HOW TO TROUBLESHOOT VCR's

34140

Radio-Electronics

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THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

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GREGORY PECK... MacARTHUR

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The C1P MF
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- **Instant program and data retrieval**

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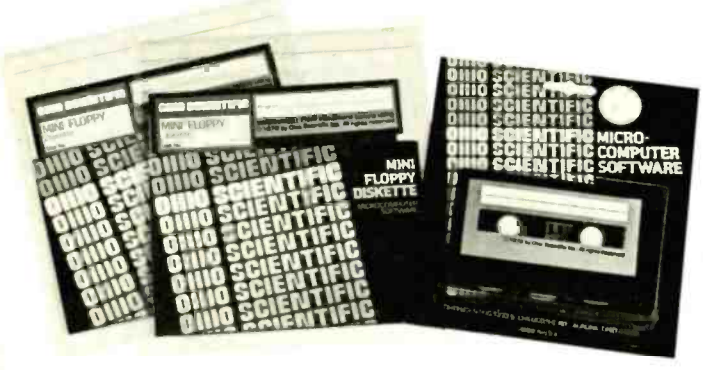

The C1P MF configuration is very powerful. However, to meet your growth needs it can be directly expanded to 32K static RAM and a second floppy by simply plugging these options in. It also suports a printer, modem, real time clock and AC remote interface as well as the OS-65D V3.0 development oriented operating system.

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*Both systems require a video monitor, modified TV or RF converter and home television for operation. Ohio Scientific offers the AC-3 combination 12" black and white TV/monitor for use with either system at $115.00 retail.

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List Price $795.00

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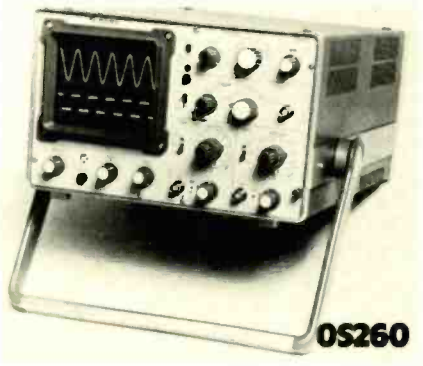
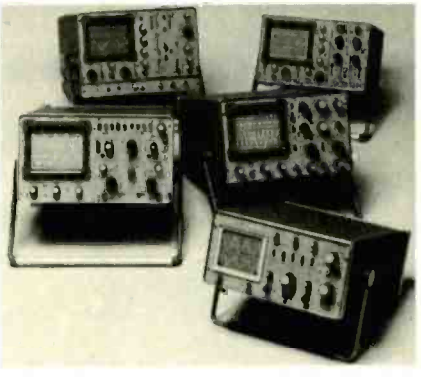


List Price $995.00

For additional information on this exciting new line of sensibly priced, professional oscilloscopes or for sales locations in your area: call toll free (800) 325-6400 Ext. 77. In Missouri call (800) 342-6600.



Gould also manufactures an additional line of general purpose oscilloscopes for industrial, scientific and laboratory applications.

GOULD

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THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

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ON THE COVER

Videodisc by Magnavox. The background is the MCA optical videodisc itself. The player is superimposed. At the top right you can see it in action. At the bottom the disc is being inserted. For more information on this system as well as the RCA system turn to page 37.
(Cover photos supplied by Magnavox)

THIS IS ONE OF THREE marvelous construction projects specially designed just for April 1, 1979. The one shown here is a one-station intercom. For full construction details along with two more turn now to page 48.

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looking ahead

New records: Official EIA figures confirm that 1978 was the best year in history for video products. A total of 10,236,000 color TV sets were sold in the United States, beating the previous record of 9,263,000 by almost a million units. Black-and-white TV sales enjoyed a renaissance, totaling 6,064,000, the highest figure since 1973. The total color-plus-monochrome figure of 16,301,000 was exceeded only once in history (in 1972). Sales of home videocassette recorders in 1978, at 402,000, almost doubled those of 1977 (estimated at about 210,000).

Take two: It's not bad enough to watch one TV show—now they're asking us to watch two or more at the same time. "Picture-in-a-picture" TV systems, the sensation of 1977 in European television (see **Radio-Electronics,** December 1977), is finally coming to the U.S. via Japan. Sharp has introduced a new 17-inch television console in which a 4-inch black-and-white picture is superimposed in one corner of the color screen, permitting the viewing of two shows at once. Either picture may be changed—or the two pictures may be interchanged—by means of a wireless remote control. By the time you read this, it should be available here for around $1,000.

An alternative to picture-in-picture is a three-screen TV, by the Taiwan manufacturer Sampo, which has one 19-inch color tube and two 5-inch black-and-white screens—separate, not superimposed—to permit you to keep up with three shows at the same time. While this approach perhaps isn't quite as ingenious as picture-in-picture, at least the little picture doesn't block your view of the big picture, the price is lower, and the small black-and-white pictures have better resolution than the superimposed picture of the picture-in-a-picture sets.

These multi-picture sets presumably have the greatest appeal to people with videocassette recorders who may be watching one show and taping another, and would like to have a little peek at the show they're taping and not watching. As an alternative to picture-in-a-picture, you could buy a small under-$100 monochrome set and put it on top of your color set. Science marches on!

RCA's videodisc system: Just one month after the Magnavision optical videodisc system went on limited sale in Atlanta, Georgia (see **Radio-Electronics,** March 1979), RCA capped more than a decade of development with a decision to go ahead with manufacture and marketing of its own videodisc system. RCA's president, Edgar Griffiths, had maintained that the see-hear disc system would get the green light only after three conditions were met: (1) A player which could retail at $400 or less. (2) A simply produced, uncoated disc which could play for two hours. (3) Enough programming to support the launch of the system. Griffiths now says all three have been met. He gave no timetable for marketing, but company sources indicated that late 1980 was a reasonable target.

The RCA system uses a grooved disc with a stylus that serves as one plate of a variable capacitor—the disc is the other, revolving at 450 rpm. Each disc is enclosed in a protective plastic caddy and is automatically removed when the caddy is inserted in the player. The player is extremely simple, has only four controls—including "live scan" (for location of a specific segment visually without loss of sync) and a feature that permits automatic repeat of a short segment of programming. The optical player, on the other hand, sells for $695, has an exact-frame-location feature, infinitely variable slow or fast motion in both reverse and forward modes, stop-motion and other deluxe features. The grooveless disc is "read" by a laser beam, so theoretically there is no record wear. The optical discs, which permit slow and fast motion as well as exact frame location, provide one hour's play time (30 minutes per side), while a long-playing optical disc (one hour per side) is designed for movies and lacks many of the special features. The optical discs sell for about $6 to $16; RCA says capacitance records will be $10 to $17. So the stage is now set for a battle between two incompatible videodisc systems, each with a different approach: The optical system (Philips and MCA) with a wearproof record and many deluxe features, vs. the capacitance (RCA) system, which aims strictly at low cost and simplicity with no special features.

NOTE: The optical system, which made its market debut in Atlanta, is spreading next to the Seattle-Tacoma market, then will gradually go nationwide, but probably won't be available everywhere until some time in 1980, maybe even 1981. Early in 1980, Pioneer is expected to begin marketing an optical disc player compatible with Magnavox's Magnavision (Philips-MCA) unit.

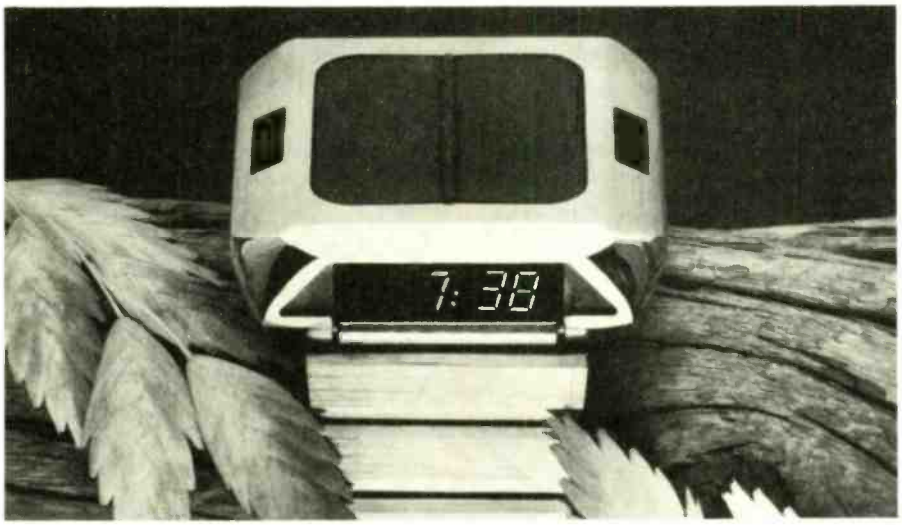
Games to computers: The so-called "home computer" was a failure—an el floppo—in 1978. The so-called personal computer did quite well, but a survey by the prestigious Arthur D. Little Co. showed that only 5 percent of the buyers of these instruments could be classified as "consumers"—that is, those who didn't have either a small-business or hobbyist interest. This failure to involve everyday folks in computers has prompted a complete change in strategy by manufacturers. The idea now is to hook 'em on fun and games,and introduce computer functions gradually. Magnavox explored this approach with its highly sophisticated *Odyssey II* with alphanumeric keyboard and plenty of game cartridges, including one entitled "Introduction to Computer Programming" (that's a game?).

Bally, which still hasn't decided whether to chuck the whole video game bit, made one last try with an add-on to its video game, including an alphanumeric keyboard and a completely new computer language called *Grafix* using simple English words. Toy manufacturer Mattel has just entered both the video game and computer field with a system called *Intellivision*, which starts as a game and ends up as a computer. Atari, has introduced two computers as an expansion of its games. After two years of unsuccessful attempts to sell computers to consumers, manufacturers this year are attempting to sugarcoat them as just slightly more sophisticated games that happen to solve household problems.

DAVE LACHENBRUCH
CONTRIBUTING EDITOR

Own the World's most perfect watch...

The only "PURE-SOLAR" timepiece in existence. Guaranteed to outperform any watch sold today...or costs you nothing!



The Sunwatch...never needs batteries...accurate to within 1 second per month...virtually indestructible, beautifully styled sport/dress watch.

An engineering/design breakthrough in space-age timekeeping technology...that now makes all other watches obsolete: ■ 100% sun-powered, no batteries that need replacing. ■ Clearly visible by day or night. ■ Unique side-window view, simplifies reading. ■ Built-in computer calendar — no need to ever re-set the watch (Not even in 31-day months and leap years!) ■ Unprecedented accuracy — you program the Sunwatch's computer to stay accurate within 1-second per month!

A "State-Of-The-Art" timepiece that combines solar age energy efficiency with a unique feeling of futuristic elegance and beauty. 10 years ago the Sunwatch was an idea, years ahead of its time, on the drawing board of Roger Riehl, a noted expert in solar energy, integrated circuitry, and computer chip technology. As a result of these years of costly and extensive research, Mr. Riehl's dream of a perfect watch has been realized, and this is now available through the Starshine Group, a California-based marketing organization specializing in unique, innovative products.

The objective in producing the Sunwatch was to put an end to all the difficulties other watches create. For instance, with the Sunwatch you will never have to worry about accuracy again. For the rest of your life, you will know you are on time — almost to the second! You will also never again stop to check the time only to find that your watch batteries are dead. The Sunwatch powered by stored light energy, never needs a battery replacement.

Another important feature is that you don't have to strain your eyes to read the numbers in bright sun or dark rooms as with other digital and conventional watches. The Sunwatch has **4 built-in varying light intensities** which automatically adjust to the immediate light conditions, making it easy to read at all times, day or night. These necessities of correct timekeeping are now possible for the first time with this remarkable achievement in watch design.

Technical Data & Special Features:

■ **Tiny silicon solar power cells** are the incredible power source; they are constantly being energized from natural sunlight or even an ordinary light bulb while you are wearing your watch. The watch operates on this stored light energy and will work even after being kept in a drawer or suitcase for several days. However, should storage in darkness for a long period result in the watch losing its charge, a few hours in the sun (or overnight under a lamp) will charge it back up to normal (Note: If this happens and the watch display loses its charge due to a long period of darkness, the internal operation continues on keeping the same accurate time. Therefore upon re-charging the watch, the display readout will show the correct, up-to-date time, just as if the watch had never lost its charge. This is because the display will automatically shut off at low charge levels, leaving enough energy to continue the internal time-keeping functions).

■ **No Resetting Needed Until 2100 A.D.!** Thanks to its own specialized **Micro-Circuit Computer,** the Sunwatch is electronically programmed to display the correct month and day with NO resetting for the next 123 years! (Of course, in 2 or 3 seconds, you can easily change the time [or any other display] at your option, should you need to change time zones, etc.)

■ **Permanently Sealed Lexan Module,** protected by U.S. and Foreign Patents until 1992, encapsulates all energy cells, solar panels, quartz crystals, Computer-On-A-Chip, Readouts, etc. This hermetically-sealed watch module is also filled with a special gelatin which absorbs tremendous shock, making the Sunwatch virtually the Most Indestructible Watch Ever.

■ **Completely Waterproof** (You can safely suspend it in boiling water for 30 minutes!) It's because of the permanent lexan seal mentioned above.

■ **Shock Resistant to 5000 G's** (You can literally crash it into a rug-surfaced brick wall at 90 M.P.H. without noticeable effect!)

Free Custom Engraving: At your request, each watch will be hand-engraved with your name (or any name you specify) to label and personalize it yours for a lifetime.

Limited Warranty is Your Protection. The Sunwatch is covered by a 2 year limited warranty issued by Riehl Time Corporation (Manufacturer of the Synchronar 2100), and included with your watch. A copy of the warranty may also be obtained free of charge by writing to Starshine Group, 924 Anacapa St., Santa Barbara, Calif. 93101. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Never Needs Batteries. Tiny silicon solar cells gather and store energy from sunlight, daylight, even an ordinary lightbulb. What a relief never to replace batteries!

No Resetting — Ever. Micro circuit computer is programmed to display the correct month and day with no resetting until 2100 A.D.

■ **Temperature and Pressure Resistant** Freeze Sunwatch in a block of ice for a year or wear in 750 feet deep without damage.)

■ **Natural Side-View Window** lets you tell the *time*, *day*, and *date* without twisting your arm into an obvious, awkward position.

■ **Continuous Seconds Display** — Useful for pulse-taking, stopwatch timing, etc.

4 Different Readout Modes: Mode #1...Displays the time in hours and minutes (as shown). **Mode #2**...Displays the month and day in numerical form (i.e., 3:13 for March 13). **Mode #3**...Displays the day of the week (alpha form) and the seconds counting off (i.e., TU: 48 for Tuesday, and 48 seconds after the minute display in Mode #1.) **Mode #4**...Displays the leap year status, and the programmable speed calibration setting that the watch is currently set at. (i.e., 23:45. The first digit "2" means that this current year is 2 years after the most recent leap year. The next 3 digits tell you that your Sunwatch is operating at a speed setting of 3:45. This setting can be changed by you in just seconds to anywhere between a range of 0:00 to 7:77. This allows you to adjust your watch speed to compensate for local climatic and magnetic conditions, etc. After a little experimentation you will soon find the proper setting to keep your Sunwatch accurate to within an unprecedented one second per month. (That's 5 times better than the latest Quartz Accutron!)

The exciting Sunwatch offers split-second accuracy based on solar energy and advanced design features, all packaged in a striking, contemporary styled timepiece that is virtually indestructible even under the most severe conditions. The Perfect Watch of a lifetime for Business People, Professionals, Teachers, Athletes, etc.

The Philosophy behind the Watch and this advertisement...Our objective is to acquaint you in a straight-forward manner, with the honest facts and features of a timepiece that we (and several thousand current Sunwatch owners) genuinely believe to be the most advanced, most practical watch in production today. We have attempted to tell you as much as possible about the Sunwatch because we know it sometimes can be difficult to make an intelligent purchasing decision of this importance, from just a few words and pictures.

Should you decide to try wearing and using one, we will engrave your name on it at no charge, and send it to you by United Parcel Service (or USPS if UPS doesn't service your area). You then have 2 weeks to literally "try it on for size" and see for yourself how incredible this watch actually is. If you decide you don't care to keep it for any reason, you can return it to us (within 2 weeks of receipt) for a prompt refund, or a credit to your charge card.

Credit Card Orders Call Toll Free 1-800-235-6945, ext. 1045. Calif. Residents Call: 805-966-7187.

Note: Thousands of earlier models of this "pure-solar" timepiece have been sold nationwide for as high as $500 or more. Recent cost reductions in certain components now make the watch much more affordable (see coupon below) and one of the best timekeeping investments you can make today.

Starshine Group.

924 Anacapa St., Dept. 738, Santa Barbara, CA 93101

☐ Please rush me _____ Sunwatch(s) in smart, slimly-styled stainless steel — for only $129.95 each. I will wear the watch for 15 days; then if not completely satisfied may return it for a full refund of purchase price (less shipping charge). Please add $3.95 per watch shipping & insurance.

☐ Please send me _____ Sunwatch(s), gold plated with matching band — only $159.95 each. If not completely satisfied, return it for a full refund of purchase price (less shipping charge). Please add $3.95 per watch shipping and insurance.

Enclosed is $_____ Check or Money Order (Calif. residents add 6% sales tax).

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☐ Master Charge ☐ Diner's Club ☐ Carte Blanche

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Microwave surveillance system may be causing health hazards

Several U.S. retail stores have been installing antishoplifting devices based on low-level microwave radiation, and their use has begun to make some individuals and governmental agencies nervous about the potential radiation hazards they pose.

The stores' antishoplifting system involves placing a tag on an item that, if not first removed by a cashier or clerk, will be detected by microwaves generated by devices positioned on either side of an exit, thus triggering an alarm bell. The radiation emitted by these detectors passes through individuals harmlessly, asserted David St. Lawrence, of Sensormatic Electronics Corporation, Deerfield, FL, which manufactures detectors.

Mr. Lawrence added that Stanford Research Institute of California conducted "a very thorough study of our systems under normal operating conditions to insure that everything we've said about our systems was absolutely true." Replying to criticism that microwave radiation could have a harmful effect on persons with implanted heart pacemakers or on pregnant women, Mr. Lawrence explained that battery-powered pacemakers were basically magnetic devices and were "not at all affected" by low-level radiation. Neither would this radiation cause harm to pregnant women or to children.

The stores in question, while declining to discuss the electronic detectors in detail, believe the systems are effective and insist that the radiation is not hazardous. The microwaves are less intense, they point out, than normal AM radio waves. However, one retail workers' union on the East Coast has resolved not to allow its members to work in stores where such systems are in effect. And the General Accounting Office, the Congressional watchdog agency, is increasingly concerned that the Federal government has not been informing the public about microwave radiation hazards. It urges that a standard be adopted to determine the permissible levels of such radiation. Presumably such guidelines would be also applied to such popular devices as microwave ovens, garage door openers, antitheft alarms, etc.

Public asked opinion on radar detectors

Two recent polls conducted by the news media in Indiana and Louisiana has shown that the public has definite opinions on the legality/illegality of radar detectors.

In answer to a proposal made by Indiana's State Police Superintendent to outlaw radar detectors, Electrolert, Inc., manufacturers of the *Fuzzbuster*, held a widely publicized news conference rebutting the superintendent's charges. Indianapolis TV viewers were polled by phone (via a local TV station) to 1) "vote" on whether radar detectors should be outlawed or not, and 2) express their views and comments on the issue. Out of a total 2560 responses, 64% were in favor of radar detectors, 36% were not.

In Baton Rouge, the city's *States-Times* newspaper also conducted a telephone survey on the issue; out of 231 residents polled, 51% opposed any anti-radar detector legislation; about 44% approved; and 5% had no opinion. The Louisiana Highway Patrol had just come out in favor of a version of the anti-radar detector legislation presently operating in the state of Virginia.

Neutrinos—new communications medium?

A group of scientists from Western Washington University have concluded an experiment which they believe demonstrates that neutrinos, nuclear particles without mass or electromagnetic quality, can be used to transmit messages through the earth. Dr. Peter Kotzer, leader of the team, asserts that the technique will eventually enable global communications even with submarines without the need for satellite relay stations, since neutrinos can pass through the earth without interference from other matter.

In fact, neutrinos not only can pass through the earth, but also the solar system and the entire universe without ever colliding with interstellar dust or other material. Because they have no mass or electric charge, the problems involved in tracing these particles are enormous. A small number of the neutrinos, however, do collide with atomic particles. This results in a secondary "shower" of particles called "mu mesons," which, in turn, combine with other matter to form tiny flashes of light called Cerenkov scintillation. These flashes are measured and a rough estimate can then be made of the total number of neutrinos that could have caused them.

Dr. Kotzer and his team were able to construct a unique "telescope" that could "see" the beam of nuclear particles emitted by an accelerator at Fermi National Laboratory in Batavia, IL. The Fermilab accelerator produces a beam of positively charged protons, which the lab uses for its own experiments. The particles then are allowed to be discharged harmlessly into a hill outside the lab. It is these particles the university scientific team was able to detect.

RCA communications satellite will provide more channels

RCA's communications satellite, Satcom I, will expand its channel availability to provide more cable TV programs nationwide. About a year ago, only four of Satcom's 18 channels were used—now all channels are spoken for, with leases running up to 10 years (at a cost of $1.3 million per year for the time used). The demand for satellite channels—known as transponders—has been so great that RCA plans to launch another communications satellite in the near future. It is predicted that all of the new satellite's 24 transponders will be claimed even before it gets off the ground.

This appears to indicate that the demand for cable TV is growing by leaps and bounds, which, in turn, means more programming will be available. The types of programs planned include news and sports channels, a full-time UPI voice-and-picture news channel, all-day nonviolent children's programming, and a channel that will provide continuous coverage of Congressional sessions. Some of the companies that will be providing the new programming are Home Box Office, Warner Communications, Reuters, Ltd., plus other networks that plan to offer various religious programs.

FCC condemns police use of jammers as radar units

The Federal Communications Commission, acting on complaints and inquiries from motorists, has warned police departments countrywide to discontinue using what the Commission terms jamming devices in their continuing war against radar detectors.

Arlan Van Doorn of the Commission's safety and special radio services bureau says that a new device purchased for traffic enforcement was being used as a radar-detector jammer, and further describes it as a transmitting unit, not a genuine radar device. The device in question was originally designed to warn highway repair crews working in areas with obstructed views (i.e., a hill or a road curve) that they must get off the road. The device is actually not a radar device, it is a transmitter that motorists have claimed is being placed on cars, or on poles—and left unattended.

Experimental light-powered telephone devised by Bell Labs

Bell Telephone Laboratories has devised an experimental telephone equipped with a photodetector that can receive and transmit light signals over one fiber lightguide. The photodetector converts more than half the light power it receives to electrical energy, which powers the phone as well as carrying a full range of telecommunications signals.

The photodetector can detect incoming light pulses at one wavelength and transmit outgoing signals on another wavelength. The actual optical-to-electrical power con-

continued on page 13

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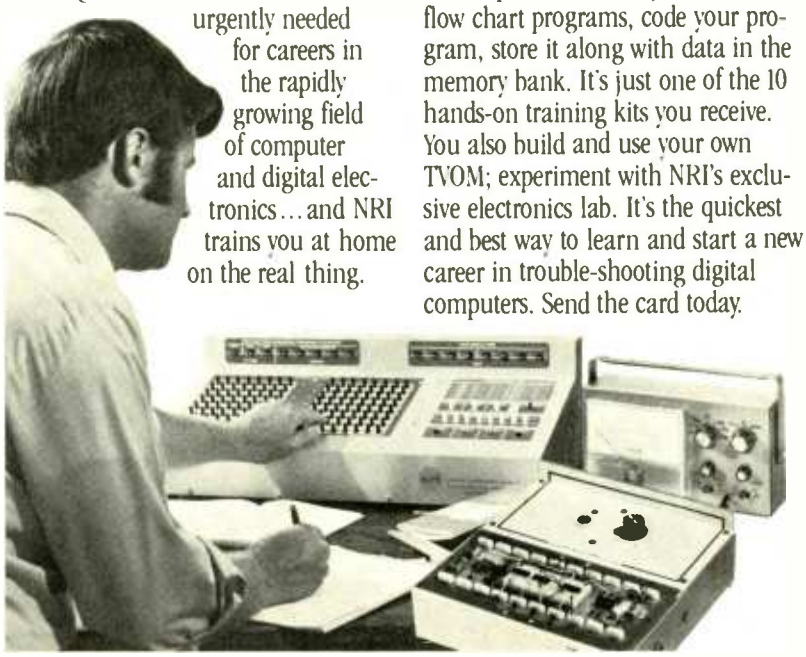

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This exclusive feature of the Model 2010A gives you a convenient means of selecting the next higher decade range. The Hi-Lo Power Ohms capability gives you three High-ohm ranges that supply enough voltage to turn on a silicon junction for diode or transistor testing. Measure in-circuit component resistance with three Low-ohm ranges.

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This quality instrument includes an ACV Frequency Response of 40 Hz to 40 kHz, automatic polarity, automatic zero, automatic decimal point, overrange indication, and overload protection on all functions and ranges. The bright LED display gives readings to ±1999 and is easy to read in dim light or bright light.

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Brief Specifications

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AC Volts: 100µV to 1000V in 5 ranges
DC Current: 0.1µA to 10 A in 6 ranges
AC Current: 0.1µA to 10 A in 6 ranges
Resistance: 0.1Ω to 20 MΩ in 6 ranges
Diode Test Current: 0.1µA, 10µA, 1mA
ACV Frequency Response: 40Hz to 40kHz
Input Impedance: 10 MΩ on ACV and DCV
Overload Protection: 1200 VDC or RMS on all voltage ranges except 250 VDC or RMS on 100mV and 1 V AC ranges. Fuse protected on ohms and mA ranges.
Power Requirement: 4.5 to 6.5 VDC (4 "C"cells) optional NiCd batteries or AC adapter/charger
Display: 0.36" (9.2mm) Digits reading to ±1999
Size: 8"W x 6.5"D x 3"H (203 x 165 x 76 mm)
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new & timely

continued from page 6

version efficiency in this exchange was determined in lab experiments to be 56% at a 0.81-μm wavelength.

Because one small semiconductor laser chip provides enough energy, not only for communications but to activate the phone's components, a light-powered phone will need no power source such as a wall outlet or self-contained battery.

The experimental phone also converts periodic laser light bursts to electrical pulses that "ring" the call alert. The "ringing" device is an electroacoustical tone containing a thin piezoelectric active element which is triggered by an alternating electrical voltage that causes it to vibrate.

Sony technical training tapes for Betamax now available

Service technicians can now learn how to operate and repair any Sony *Betamax* VTR simply by watching one of Sony's Technical Training Tapes. The full-color programs come in a series of eight videocassettes, with each tape running between 30 and 45 minutes. They contain complete operation and servicing data, including all major block diagrams, waveforms, schematics and circuit theory. Some of the topics covered include technical overview, luminance signal processing, servosystem, troubleshooting and tapehead replacement.

To obtain information on any stage of repair, etc., just select the appropriate cassette, put it into a *Betamax*, and press the PLAY pushbutton. Each taped series comes with a supplementary publication showing all the diagrams displayed on the tapes, plus some that are not contained in the service manual. The cost of each tape is $24. For further information, write Sony Corporation, Training Tape Production, 700 West Artesia Boulevard, Compton, CA 90220.

U.S. asks FCC for 200 new AM stations

In January, 1979, Henry Geller, chief of the U.S. Commerce Department's telecommunications bureau and communications policy administrator for President Carter, announced that the Administration had asked the FCC to start proceedings that would eventually create 700 new AM radio stations in addition to low-power TV stations (the latter proposal is already under FCC study). An earlier proposal by the Commission planned to create 125 additional AM stations by removing the existing 25 clear-channel 50-kilowatt stations.

Additional AM stations could be added by reducing the spacing between the present assigned frequencies from 10 kHz to 9 kHz, as is already being done in Europe and Africa. At present, in the U.S. there are 4500 AM and 4000 FM stations, with many isolated areas not receiving any facilities at all. It is felt that reduced frequency spacing would allow not only new stations to exist, but would permit special-interest groups to originate programs, encourage local station ownership and provide for uniformity of broadcast technology.

Mr. Geller added that he believes that these policies if realized, "would help create healthy competition in the broadcast media."

VICA team wins medal, honorable mentions at skills meet

The Vocational Industrial Clubs of America (VICA) recently sent a 10-member team to the International Skills Competition in Korea. The team distinguished itself by winning one bronze medal and three honorable mention awards.

The bronze medallist was David Classen, Freeport, TX (auto mechanics); the three honorable mentions went to Edgar Anna, Smithville, OH (welding); Raymond Coleman, Richmond, VA (industrial wiring); and Mark Bauer, Washington, MI (machine drafting).

The team was chosen in an earlier runoff competition from among the winners of the 1977 U.S. Skill Olympics. Among the other team members were Neal Sedell, Vancouver, WA (industrial electronics) and Richard Lomax, Camden, DE (radio and TV repair).

Compucolor Corp. forms users' group/and newsletter

A users' group and a monthly newsletter have been created by Compucolor Corporation, manufacturers of the *Compucolor II* home computer. The purpose of the group will be to exchange programs and ideas, and to assure a new *Compucolor II* owner that he is "not abandoned after he makes his purchase," according to Dave Deans, marketing vice president.

The newsletter, *ColorCue*, will serve as a sounding board for the latest information on programming and computer features. The company has also announced that it will accept for sale or trade any software contributions from members; users can then trade for other programs. For further information, contact Joy Baker, Compucolor Corporation, P.O. Box 569, Norcross, GA 30071.

ITA minimum standards report for audiocassettes now available

Copies of the recently published *Official ITA Documents for Minimum Standards of Audio Tape Products*, complete with final revision, can be obtained from International Tape Association, Inc., 10 West 66th Street, New York, NY 10023.

The ITA standards report contains specifications for 90-minute audio cassettes; standard magnetic audio cassettes and associated hardware; standard audio eight-track cartridges; and also provides duplication guidelines for eight-track cartridges and four-track cassettes.

IHF asks FCC to set date on AM stereo ruling

The Institute of High Fidelity, on behalf of its member manufacturers of hi-fi products, filed comments with the Federal Communications Commission, requesting the FCC to set an effective date for the actual implementation of AM stereo.

In its comment, the IHF stated, "an effective date for the rule would help protect the consumer from being disappointed in purchasing AM Stereo tuners and/or receiver equipment for which the ability to receive AM Stereo signals would not be realized for a lengthy period of time." It was stressed that this would in no way "limit the production and sale of AM Stereo equipment . . . but would lead to an orderly market transition for manufacturers."

It was suggested that a reasonable effective date for the rule would be six months from the time the rule is published in its final, official form.

Nonprofit videocassette club widens its membership

The American Video Tape Library (AVTL) is a nonprofit club that operates a lending library of popular films on videocassette for its membership. The club, which started on a limited basis in several western cities, is now extending its membership drive to reach owners of VCR's across the country. According to the club's managing director, Nancy B. Payne, "AVTL is the cheapest way the VTR owner can see commercially produced features rather than spending $50 to $75 to buy them." Club membership involves an initial fee of $49.95, plus $5 a month to cover mailing, tape repair and maintenance, and administrative expenses.

AVTL boasts over 100 different titles, with access to 400 others. For further information, write AVTL, 6650 South Broadway, Littleton, CO 80121, or phone toll-free 1-800-525-7487.

First TV multiplex broadcasts aired in Japan

In September, 1978, Japan's Nippon Television Network Corporation inaugurated the first TV sound multiplex broadcast in that country with a news program in both Japanese and English. This program was followed in October by similar entertainment and news programs broadcast in stereo by other Japanese stations. In both instances, the programs were aired only in the Tokyo and Osaka areas; Japanese stations look forward to nationwide multiplex broadcasts in the spring of 1980. **R-E**

editorial

Today's Greatest Bargain

Electronics . . . from the smallest diode to the largest computer system you can find . . . is the greatest price bargain you can buy today. It's also the greatest example of what technology can do.

Do you remember the first RCA black and white TV's? I do. I remember the $500 massive 10-inch RCA table model that my father brought home one summer evening. Today, for about the same kind of dollars (in number), we watch a 25-inch color set. The programs haven't gotten much better, but in 1959 dollars, the new color set costs less than $200 and that's a bargain! In the same period of time, the family car has gone from $1500 to $6000.

Or how about that fantastic stereo system you listen to? Sure, it cost you better than $1000. But that's a bargain too. The old hi-fi (low-fi?) system of the late 40's was limited to 6L6's in the output stages, had distortion levels of 3% or more and cost, in a wood cabinet console, about $700.

And what about that $2500 projection color set you bought last week? By 1982 you'll probably buy one for only $1000. The videotape player that cost $1500 last year is already selling for as little as $695. And the video disc systems that are being introduced this year for $695 will probably cost as little as $400 by 1982.

Why are electronic devices almost the only items to stand fast in the face of inflation? In one word, the answer is "*TECHNOLOGY.*"

Advances in the world of electronics are coming so fast it is almost impossible to keep up with them. And just what is lurking around the next corner is too fantastic to imagine; is so fantastic that your wildest guesses are probably not wild enough.

A few months back I asked readers what they thought the next important consumer electronics product would be. I did not get even one response that indicated some device that did not already exist. Now I'm asking again. But this time dream a little. Share with me your ideas about the products and the world of electronics. Tell me what devices you think we will have in 1990. That's only 12 years away.

Larry Steckler

LARRY STECKLER
Editor

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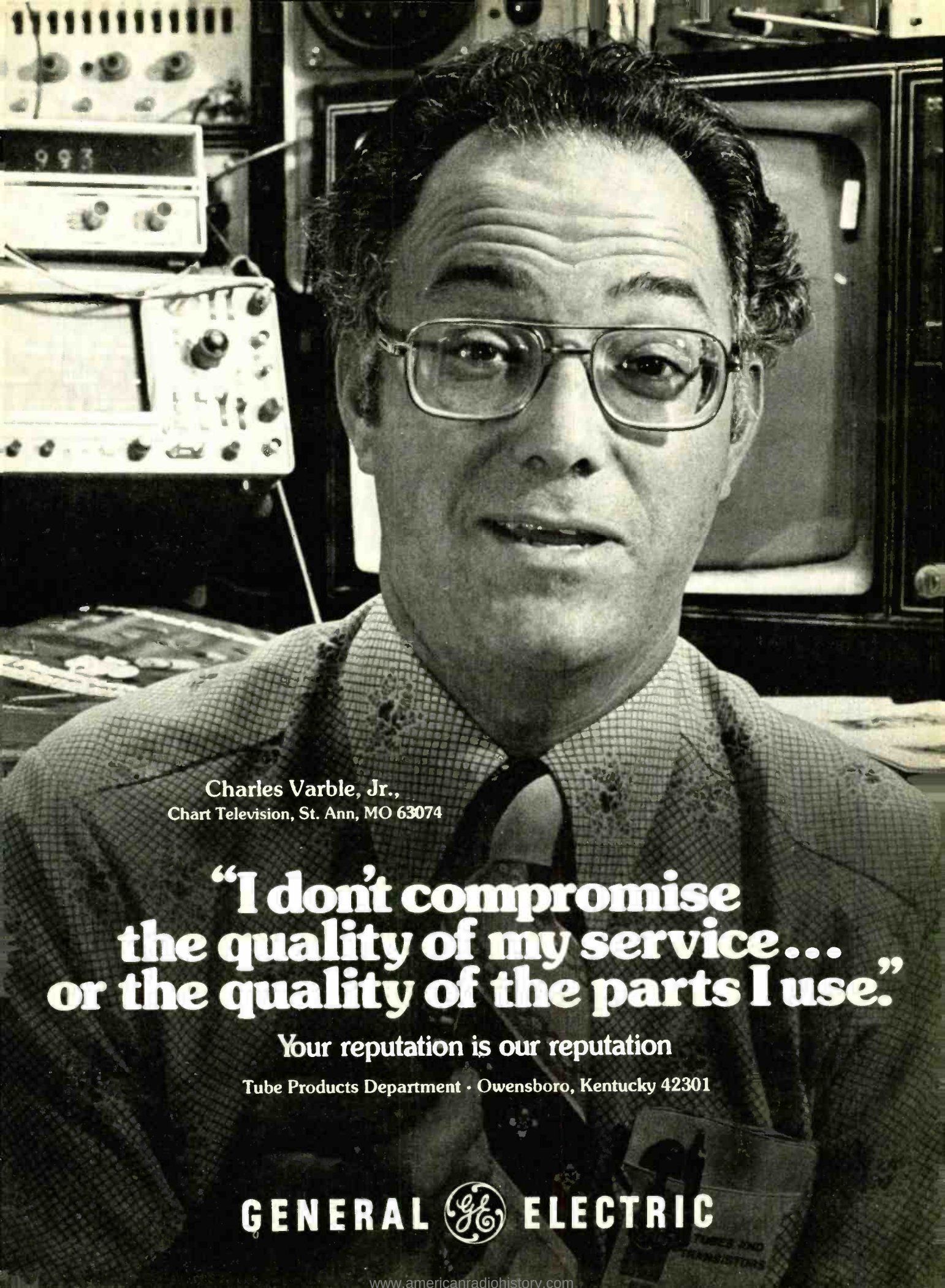

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GENERAL ELECTRIC

letters

ELECTRONIC EQUATION

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Today, with euphemisms such as superluminal velocity, we need to understand exactly what causes Doppler (d) even in a vacuum, or our road to the future will not only be long but rough.

The roots of all science (and of **Radio-Electronics**) lie in Maxwell's equation, c=wf. Assume d=wf=c, where w is the wavelength at an electromagnetic source (s), and f is the frequency at an observer (o). When s and o close, d is positive and wf is *greater* than c, or superluminal. When s and o open, d is negative. When there is no relative motion, d is zero, or back to our roots—c=wf. Thus, c (and all other forces at a distance) is a constant only to s, picks up the radial velocity of s, and can travel to any o at speeds, up to superluminal.

Note—in the past we always used the equation c=wf only at the s or only at the o, but never at both simultaneously. Thus, we always get the same value for c, but have proved nothing because we have never explained how we get Doppler even in a vacuum.

JOHN W. ECKLIN
Alexandria, VA

LONG-DURATION IC TIMERS

After several days trying to locate the XR-2250 and XR-2260 IC's referred to in the July 1978 article on IC timers by Joseph Carr, we discovered that, according to Exar sales representatives, XR-2260 had been cancelled after the poor sales showing of XR-2250 (it actually never left the drawing board), and only two XR-2250 IC's were in stock in Dallas on a replacement basis.

BOB MONAGHAN
Dallas, TX

With respect to the availability of the XR-2240, XR-2250 and XR-2260 timers mentioned in Joseph Carr's article on page 61 of the July issue, the fourth paragraph mentions that the Intersil 8240, 8250 and 8260 are equivalents. A call to Exar sales manager Brooks Hamilton revealed that the XR-2240 is available off-the-shelf, the XR-2250 was discontinued about 18 months ago, and the XR-2260 was never manufactured in production quantities.

Intersil says that the 8240, 8250 and 8260 are available; the 8240 and 8260 are immediate-delivery off-the-shelf items, and the 8250 can be shipped within three weeks of the order.

In addition, the Motorola MC14541 is equivalent to the XR-2240 and is readily available, as is the Calectro JA-1214—Editor.

IC TESTER VARIATION

The diagram shows a variation on how to build the IC tester (see "Build A Digital IC

continued on page 23

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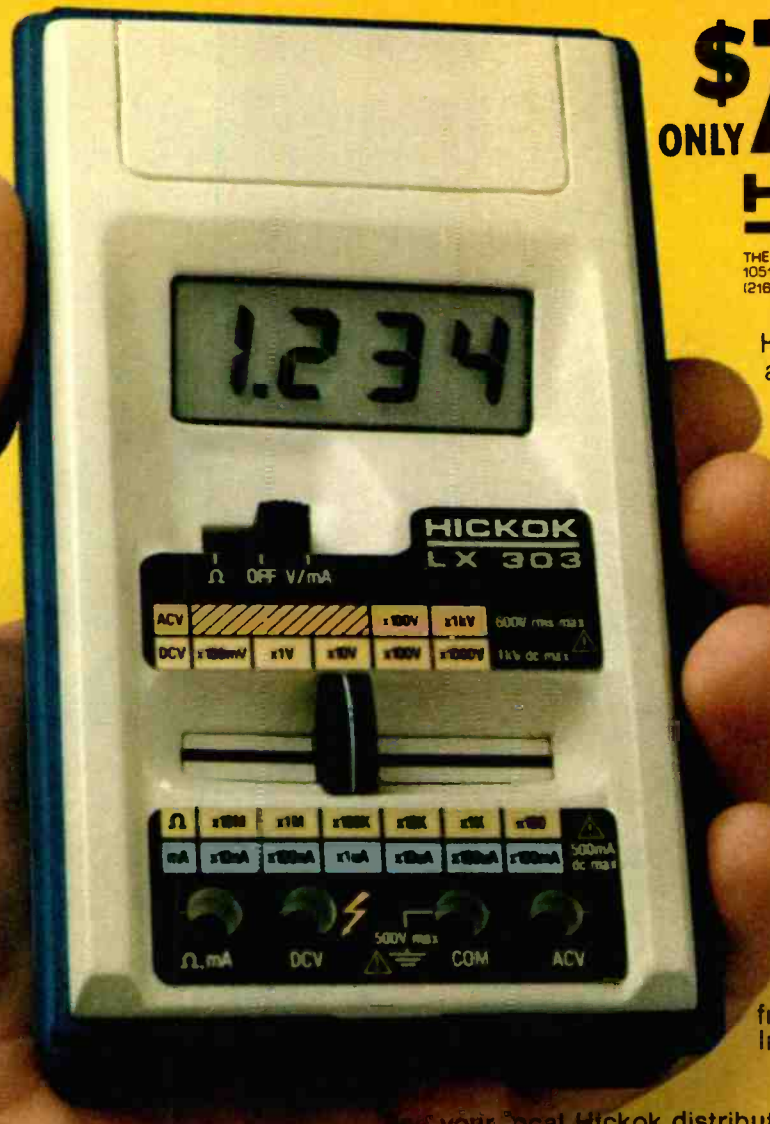

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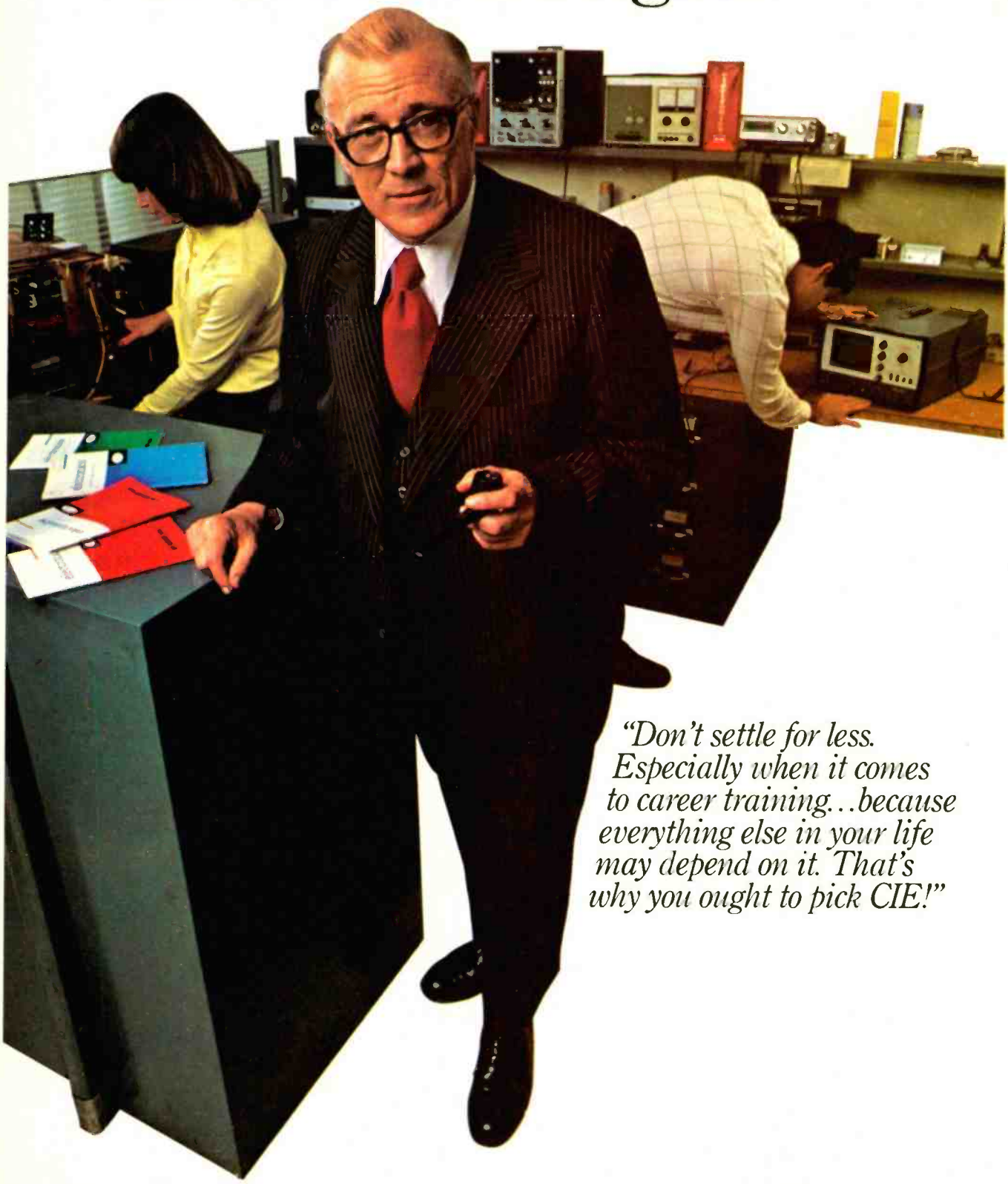

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CIRCLE 6 ON FREE INFORMATION CARD

LETTERS

continued from page 16

Identifier/Tester," June, 1977, p. 44).

I have found it to be simpler and less costly to build than the one in the article. All parts are hobby-type components that were ordered from surplus suppliers except for wire-wrap sockets SK1 through SK4 (16-pin DIP sockets). The cost of building the unit was less than $6, using new wire-wrap sockets and a Radio-Shack chassis.

The same testing procedures found in your article still apply. However, I did find that a digital frequency generator did help when testing counter IC's. Even if you do not publish the diagram, I believe it would help some people if they knew that the 75492 IC saves using 16 transistors and resistors.

JAMES W. NICKOLS III
Biloxi, MS

FUTURE ELECTRONICS IDEAS

As you requested in the September issue of **Radio-Electronics,** I am writing you some of my "visions" of future electronics.

First, a video console connected to the human brain, via a special type of "motorist helmet," that would project on a TV screen any selected "good old memories." It could even permit you to create and view your own movie as you let your imagination roam.

Second, the same "helmet" could be used with an audio console that would serve to reproduce all your thoughts and musical inspirations and record them at the same time.

This type of versatile electronics would be very welcome in any populated living room or backyard. It could serve to find out what the baby was crying for: his bottle, food, a fresh diaper, etc.

Keep up the good work and information in your magazine.

SERGE FORGET
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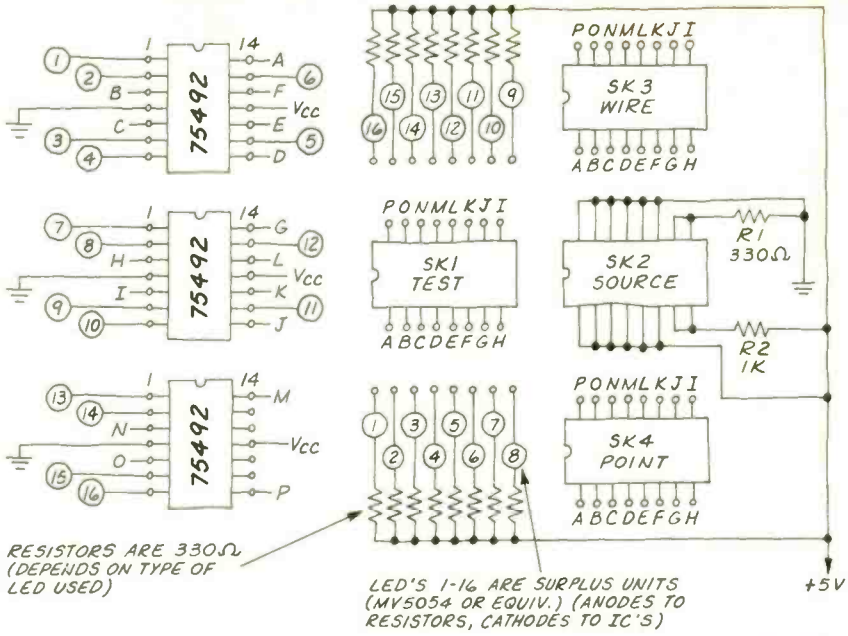

TWO USERS GROUPS FORMED

I would like to draw your readers' attention to the formation of two new Users Groups in San Antonio, TX: The Xitan Users Group and the Z Users Group. Both organizations will focus on exchange of information, services and products both produced or compatible with Xitan and the Z family microprocessors (the latter including Z-8, Z-80, Z-8000, Mostek 3880).

Each group plans to publish a newsletter

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LETTERS

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to exchange information on modifications, extensions and product evaluations; applications programs; criteria for selecting chips; proposed Z-8000 bus standards, etc.

To belong to either group costs $5 a year, and further information can be obtained from Xitan Users Group or Z Users Group, 1015 Navarro, San Antonio, TX 78205.

JON D. ROLAND
San Antonio, TX

A COMPUTER IN EVERY HOME

I'm taking issue with your statement that it is total nonsense to have a central control computer for the home.

You are losing sight of the fact that it is more important how and from where you can control than *what* you are controlling, and this is where a central unit can become cost-effective and convenient. Imagine the cost and use of your phone if you were not able to use the phone company's central units; do you realize the cost of installing 300,000,000 phone wires to each phone you had installed?

The *Ghost* system is as easy to use as a phone dial—even easier since you only dial 3 digits.

The only equipment the average user ever need see is the 16-button keypad that provides full access to all the power of the House Operating System. The Gimix Relay Driver Boards are used to control the electrical devices connected to the system, and the Gimix *Opto* board can be used to connect to sensors.

Most important is the human engineering of the House Operating System. We have put every effort into designing it so that you will find it an aid in running your house or plant, not a barrier. Commands are simple and easily remembered. You customize the system to fit your needs—not adapt to fit a rigid, predefined system. Simplicity has been a prime design goal, so that the use of the House Operating System quickly becomes automatic. Only the commands needed immediately have to be learned to run the system; no long training is necessary.

With the *Ghost* system you don't need a CRT, but can use an open TV channel—or doesn't your John Q. Public watch the tube? Floppy discs are necessary only for mass storage options such as recipe and address files, but not for control.

As far as installation is concerned, does John Q. Public install his own TV antenna? The future of the computer industry is in having service technicians do for John Q. what he can't or won't do for himself.

It was not long ago that the TV and hi-fi industries were in their infancy. Please don't turn off your readers in our industry's childhood . . . we need these future service technicians to serve John Q.

RICHARD DON
Gimix, Inc.
Chicago, IL

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equipment reports

Lab Science Model VLA-1000 Logic Analyzer

CIRCLE 143 ON FREE INFORMATION CARD

A FULL-BLOWN LOGIC ANALYZER IS A VERY expensive piece of equipment, with some name-brand models selling for $5000 or so. There are some special models that cost around $2000, and some really sophisticated ones that are close to $10,000. Lab Science sells the *model VLA-1000* logic analyzer for $595. Their design philosophy has been to eliminate the nonessential features.

Logic analyzers take a digital picture of the data presented on several parallel data-bus lines, and store it in a semiconductor memory for later analysis. When the input levels rise or fall through preset input thresholds, the data is recognized as ones or zeros and stored in memory cells. Memory contents can be accessed later and converted to oscilloscope displays for convenient analysis.

The *model VLA-1000* is a 16-channel analyzer that uses 16 data input leads plus additional clock and ground leads. The 17 active leads interface to Schmitt triggers that switch at 0.8 volt and 1.6 volts. More expensive instruments include a choice of input thresholds to interface with logic families other than TTL. Some include threshold adjustment potentiometers where individual inputs or groups of inputs can be tailored for special requirements. Lab Science has wired the input connector so that the 16 data leads can be reversed by simply turning the connector end for end. Usually it is easy to confuse the most-significant bits with the least-significant bits due both to pure error and to inconsistencies in the numbering of bit positions. To solve this problem, the *model VLA-1000* analyzer uses a 20-pin connector to interface the 18 leads so that the two end pins on each side are clock and ground.

The analyzer operates with input signals from DC through 10 MHz. It does not include an internal clock, and for those cases where you want to use the analyzer asynchronously or simply make a sampled measurement, an external clock source must be connected.

The memory itself consists of 256 bits arranged as sixteen 16-bit words. The trigger circuitry allows a selected parallel synchronization bit pattern to be recognized and recorded at the end, middle or beginning of the 16-word burst stored by the analyzer. The trigger word is selected by setting 16 switches to their zero, one or "don't-care" positions. Up to 9999 clock pulses or trigger-event intervals can be counted before storing the data. For economy, the same switches used for the sync setup are also used for the delay count. The delay is

continued on page 32

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loaded with the momentary-action delay load switch. The 16 switches are BCD-encoded to cover the 9999 count-delay range.

If you just want to observe changes in input data rather than capture a single-event sequence, the instrument has a repetitive trigger mode. At adjustable time increments, the trigger-recognition circuitry is rearmed and awaits the next trigger event.

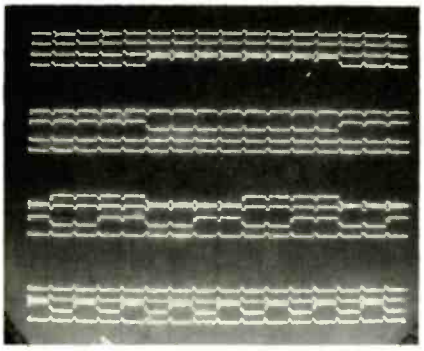

FIG. 1

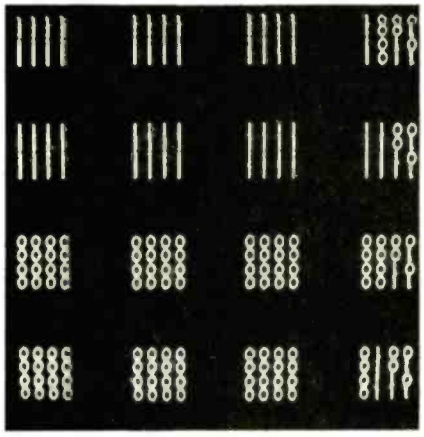

FIG. 2

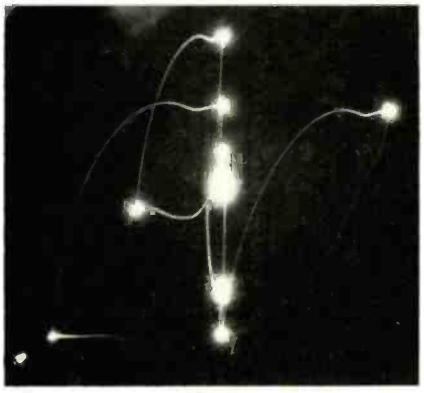

FIG. 3

Data display includes all common modes. The waveshape mode resembles a 16-channel chopped oscilloscope display (see Fig. 1). Actually, the data is read in a parallel fashion so the display does not include the irregularities of chopped or alternate displays. The traces are arranged as four groups of four horizontal traces each; they are exclusive-OR'ed with the clock transitions to display timing ticks. Designers examining microprocessor

continued on page 34

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continued from page 32

buses, or the IEEE-488 instrumentation bus, will find the data-domain mode useful. In this mode, the data is displayed as ones and zeros written numerically on the oscilloscope screen. Again, the words are formated horizontally by four groups of four words each, and further horizontal grouping by fours add clarity (see Fig. 2). The instrument does not include octal or hexadecimal readouts as many of the more elaborate units do.

The map mode displays a dot for each active 16-bit address within a 65,536-bit field (see Fig. 3). This is useful, for example, in testing digital logic systems where common faults are equated with distinctive dot patterns and can be quickly recognized subjectively.

A fourth, dual-trace D/A mode is included that requires using a dual-trace oscilloscope. The 16 bits are divided into two groups of eight, and each is converted to an analog voltage by a D/A converter. The output display consists of two traces, each with its own particular series of stepped voltages (see Fig. 4).

Unbalanced vertical and balanced horizontal outputs are used to connect the *model VLA-1000* to most oscilloscopes; blanking is not required.

The unit measures 6 × 12 × 8 inches, and although the specification sheet states it weighs 10 pounds, our test model weighed significantly less. The analyzer consists of two right-angle-mounted PC boards containing all components, and can be easily disassembled for troubleshooting.

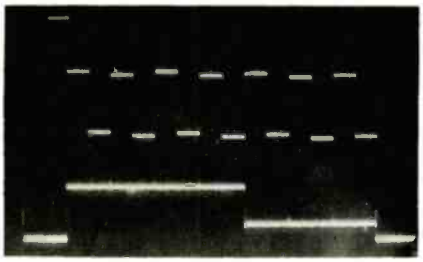


FIG. 4

If you do much digital or microprocessor work that warrants using a logic analyzer, but you cannot afford a full-featured analyzer, carefully examine the handful of limitations of this unit. If, for your requirements, the limitations of the unit are insignificant or can be easily overcome, you should seriously consider the *model VLA-1000*.

The comprehensive manual includes a complete schematic diagram, a parts list, detailed operating instructions, timing diagrams for popular microprocessors, and suggests where the synchronization clock signal should be taken. The *model VLA-1000* can be ordered from Lab Science, P.O. Box 1972, Boulder, CO 80306. **R-E**

Data Precision Model 248 DMM

CIRCLE 144 ON FREE INFORMATION CARD

DATA PRECISION CORPORATION (AUDUBON Road, Wakefield, MA 01880) manufacturer of digital multimeters, has developed the *model 248*. The company claims it is the first mini-DMM to give true RMS readings of AC voltages and currents from 30 Hz up to 20 kHz, as well as providing high accuracy and sensitivity. The DMM has a basic accuracy of ±0.05%, which makes it very useful in precision applications.

The *model 248* measures DC voltages from ±10 μV to 1000 volts in five ranges, DC current from ±10 nA (nanoamperes) up to ±2A and AC volts and current (in the same five ranges) from 10 nA to 2A. Resistance can be measured from 100 milliohms up to 20 megohms. The overload protection is amazing.

The *model 248* is a 4.5-digit instrument with large LED readouts. All ranges are set up in the standard 0–1 order, with 100% overrange capability on all but the 1000-volt range. The maximum reading on each range is 1.999, then it goes into overrange. This is indicated by the display being blanked out, except for the decimal point, and by the DC polarity indicator.

This thoroughly tested instrument comes complete with a copy of its Final Acceptance Report. Actual readings on all ranges are shown, with the accuracy as claimed. After this test, the unit is "burned in" by placing it in an 45°C oven and running it for 8 hours; the key tests on all ranges are then repeated. Note the very small variations, or none at all!

If you read the fine print on this report, it'll

scare you. The first test reads: "Pick it up and hold it 1'2 inches over a horizontal wooden surface, then drop it." The next test is worse: Set to the *100-mV* range and then apply *1000* volts to the input terminals for 5 seconds! After this, you feed in the specified test voltages and log the readings. On the unit I used, I got a reading of 100 mV on the 100-mV range, and on the 1000-volt range, the unit read 1000.1 volts.

The resistance range tests are almost as scary. First, apply 250 volts 60-Hz AC to the input on the 1000-ohm range for 2 seconds. Then check all ranges for the rated accuracy. All these tests are referenced to U.S. Bureau of Standards ratings and standards, and a Certificate of Conformance is furnished with each unit.

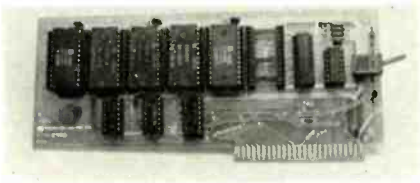
The *model 248* runs on a single NiCad battery. A plug-in charger plus test leads, complete with clips, are included. The whole unit, charger and all, can be carried in a neat zippered traveling case. The test leads plug into protected jacks on the right-hand side of the case, and the charger plugs into the back. Each unit carries a full one-year warranty against any defects.

If the decimal point blinks, this indicates there are five minutes of accurate operation left before you must recharge the battery. If the charger is left plugged in during bench operation, the battery is kept at full charge. The *model 248* will then run for 6 hours of in-spec operation before a recharge is needed. The charger recharges the unit overnight or in 12 hours.

The instruction manual contains full operating and recalibration data. All calibration adjustments are easily accessible by removing the case; the calibration points are all located in a row along the bottom of the chassis.

Zeroing and polarity indication are fully automatic. Most of the logic components are in a single LSI IC; the RMS-to-DC conversion is performed with a calculating-converter LSI module. The *model 248*'s basic design is very similar to that of its predecessor, the *model 245*. For an accurate, rugged and reliable piece of test equipment, its price is well within reason at $345. **R-E**

Apple Computer Applesoft ROM card



CIRCLE 145 ON FREE INFORMATION CARD

ONE OF THE LATEST ADDITIONS TO THE APPLE II line (Apple Computer, Inc., 10260 Bandley Drive, Cupertino, CA 95014) is the Applesoft ROM Card (part # A2B0009X). This plug-in board contains the newer version of Apple's floating-point BASIC (Applesoft II) completely in ROM. Thus, when this BASIC version is installed, it is always in the machine at power-on (no more waiting 90 seconds to load from the cassette tape), and, equally important, it cannot be wiped out inadvertently by the user's program. Of course it also frees the 10K of RAM that the cassette or disc version normally occupies, as well as 10K of

continued on page 86

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CIRCLE 34 ON FREE INFORMATION CARD

Videodisc!

Two systems have been announced—one uses an optical videodisc; the other a capacitive disc. Here's an introductory look at how they work and compare.

LARRY STECKLER
EDITOR

IT HAS BEEN A LONG TIME COMING, BUT THE FABLED VIDEODISC is finally here. The very first players using the Philips optical system, complete with built-in laser for scanning the disc, went on sale in Atlanta, Georgia on December 15, 1978. That handful of equipment sold out, at $695 each, that very same day. In February 1979 another group of videodisc players were offered for sale in Seattle, Washington—it was another sellout.

The players have been introduced by Magnavox Consumer Electronics, the United States subsidiary of the North American Philips Company. The optical videodisc system was developed by Phillips and is being marketed under the trade name of Magnavision. Program material for the new players is also ready now. MCA has a catalog of more than 200 discs including everything from cooking lessons, to sports events, to recent full-length movies. A half-hour disc costs about $5.95 and a two-hour motion picture about $15.95.

A competitive system (no equipment is yet available for sale) has been announced by RCA. This system is a capacitive disc—is not compatible with the Philips system—and the discs cannot be interchanged. There are already indications that some other manufacturers may adopt the RCA system. So far it looks like Panasonic and JVC have joined with RCA and their system. However, since the Magnavision system is already available we will talk about it first. Let's start by answering the question: What is a videodisc?

For the Philips system it is simply a prerecorded disc that looks very much like a long-playing phonograph record that delivers visual and audio signals to a standard television set. It can be replayed again and again without wear or deterioration. Some discs play up to two hours of color—or black and white—programming with stereo sound. Others can be played frame by frame for still presentations or stop action. There are two playback modes.

When the Magnavision player is operating in the standard play mode, the videodisc rotates at 1800 rpm and provides one separate image on each revolution. A disc can be played normally at 30 frames per second or in slow motion, backwards or freeze-frame mode. All frames are individually coded with index numbers and can be selected quickly by the player's random-access feature.

In the Magnavision system there are two modes for playing videodiscs. In the extended-play mode, the videodisc will play up to 60 minutes per side for a total of two hours. In the standard-play mode, the disc will play up to 30 minutes per side for a total playing time of 60 minutes.

To play the Magnavision videodisc, a compact video player is used. It is about the size of a phonograph turntable and is attached to the television set through its antenna system.

Pictures appear on the television screen with a quality claimed to be better than even a cable hook-up can provide. My viewing time was limited, so I can only say that pictures I watched were clean, clear and bright—at least equal to the very best broadcast TV. As the audio quality of the disc is much better than the audio system in the average TV set, sound fidelity can be improved by hooking up the players audio to the owner's stereo system.

A laser beam is used to scan the videodisc. As a result no stylus ever touches the disc and repeated handling or use cannot wear out or diminish videodisc quality. A thin plastic coating on the surface of the disc protects the program from fingerprints, dust or surface scratches.

Every Magnavision videodisc is composed of thousands of circular tracks that form a continuous spiral from the inside of the videodisc to the outside. These tracks are

analagous to grooves in an ordinary audio record. However, these tracks are not "grooves". Instead they consist of microscopic pits that are actually minute indentations in the videodisc material. You can see an enlarged view of this in Figure 1. Note that this diagram shows the width of a single track as well as the track pitch or space between tracks. The dimensions are given in microns. (A micron is one millionth of a meter.) The length of the pits and the spacing between them determines the intelligence on the videodisc.

The information encoded on the optical videodisc is the resultant of three FM signals. These signals are 8.1-MHz FM modulated with composite video (including chroma); 2.3-MHz FM modulated with channel 1 sound; and 2.8-MHz FM modulated with channel 2 sound. Each of the sound carriers has a maximum deviation of 100 kHz. The bandpass of the 8.1-MHz video carrier extends from down below 4 MHz to above 12 MHz so that all necessary side bands can be included. Each of the sound FM signals pulse-width modulates the 8.1-MHz video FM to create the actual resultant signals that is encoded on the videodisc.

The optical system

The heart of the Magnavision player is the laser and optical components. Figure 2 shows the path traveled by the laser light beam. The first optical element is the RASTER GRATE. This device is a piece of glass with several fine horizontal lines etched in it. It divides the main beam into three beams—one above and one below the main beam. The secondary beams are slightly smaller and dimmer than the main beam. (Actually, the RASTER GRATE creates more than three beams, but the others are so dim that they can be ignored.)

The center beam is used to read the tracks on the disc, while the two adjacent beams are used for radial tracking. The next element is the SPOT LENS. It focuses the beam to the correct size so that the beam spot on the disc will be the correct size. The FIXED ANGLE MIRRORS merely fold the beam around so the optics of the player can be kept compact.

The WOLLASTON PRISM is the next optical component in the light path. This type of prism has a special characteristic—it is designed to bend light in a direction determined by the polarity of the light beam passing through it. Thus, vertically polarized light is bent in the opposite direction of horizontally polarized light. This characteristic is important when separating the reflected beam from the transmitter beam.

As the beam leaves the left end of the prism it passes through the POLARITY CONVERTER. The main purpose of this device is to change the vertically polarized beam into a circularly polarized beam. It now reflects off the RADIAL and TANGENTIAL MIRRORS into the OBJECTIVE LENS. This lens is similar to a microscope and focuses the beam into a tiny spot on the surface of videodisc pits.

Now the beam reflects off the surface of the pits. At this point it becomes intensity modulated because the light reflected from inside a pit is less bright than the light reflected from the surface between the pits. This action occurs because the pits have a depth equal to ¼ the wavelength (90°) of the red laser light. Since the light wave takes ¼ of the wavelength going into the pit and another ¼ wavelength coming out, it is ½ wavelength (180°) out of phase with the light at the surface of the pits. A cancellation effect takes place that reduces the intensity of the beam as a pit passes through.

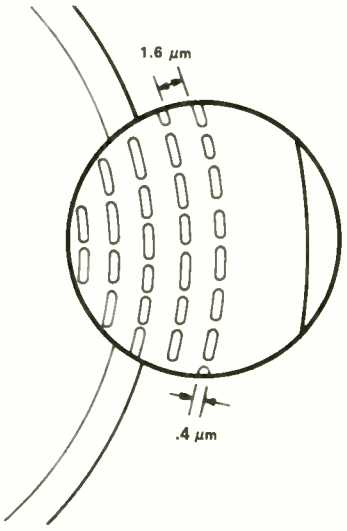


FIG. 1—MICRO PITS IN THE SURFACE of the video-disc carry the encoded video and stereo audio information.

The reflected beam follows the identical path, except in reverse, all the way back to the Wollaston prism. However, on this return trip the light wave is circularly polarized oppositely from what it was because the beam is traveling in the opposite direction. As a result, the beam is changed to horizontally polarized light as it passes back through the polarity converter. Thus, vertically polarized light comes out of the left end of the WOLLASTON PRISM, but horizontally polarized light goes into the left end of the Wollaston prism.

MAGNAVISION PLAYER WITH the lid up. The unit cannot be turned on until the lid is closed.

As a result of this polarity difference, the prism bends the reflected beam downward as it exits the right end of the prism. The incident beam and the reflected beam are now separated. The reflected beam angles around the fixed angle mirrors, passes through the cylinder lens and lands on the photo diodes.

Remember that the light bundle landing on the diodes actually contains three beams. These beams landing on the diodes generate the FM signal, the focus error voltage and the radial tracking error voltage.

The FM Signal is now fed to circuitry that translates it back into a video signal with two channels of audio. The focus error and radial tracking error signals keep the beam in the proper groove. A much more complete article will appear next month going into a more comprehensive description of how these signals are used to produce slow-motion and stop-frame action. In addition we will look at some of the actual circuitry involved.

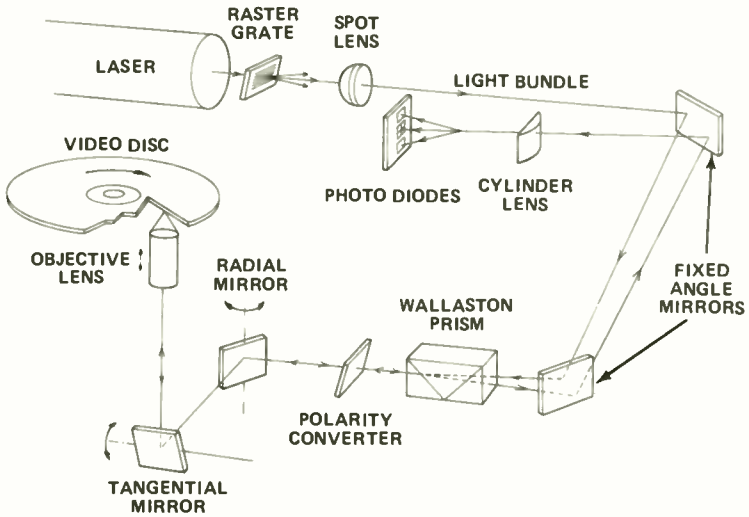


FIG. 2—OPTICAL SYSTEM USED IN MAGNAVISION disc player. The text explains how the laser beam scans the disc and is then converted into picture and sound.

EARLY RCA DISC PLAYER. The new unit may no longer look like this one, but no photos are available of the new player at this time.

RCA's capacitive disc

In a completely different way, RCA has put together its videodisc. Picture quality, as judged in a limited viewing test looks just as good as the Magnavision system. At some later date, when I've had the opportunity to have spent a lot more time watching and comparing quality in an "at home" atmosphere I'll pass along some comparative comments. But for now, the picture quality of the two systems is about the same.

The RCA videodisc can store two hours of recorded picture and stereo sound on a disc—one hour on each side of the 12-inch disc. A spiral "V"-shaped groove guides the diamond pickup stylus as the disc rotates at 450 rpm. Fig. 3 shows the grooved surface of the disc and the tip of the stylus tracking in the groove. Information representing the luminance, chroma, and audio signals is contained in transverse slots of varying width and periodicity impressed into the bottom of the groove.

The tip of a thin metallic electrode on the flat tailing edge of the stylus serves as a capacitance probe for the recovery of the signal. The conductive surface of the disc serves as the other plate of the "capacitor". As the disc rotates and the stylus tracks along the groove, the capacitance variations caused by the passing of the signal-bearing indentations under the stylus tip are sensed. These signals are converted to video and audio information and the unit plays back through a conventional TV set.

The capacitive pickup does require the use of a conductive disc. In an earlier version this was done by applying a conductive coating over the surface of the disc. In the latest version a conductive plastic is used in the manufacture of the disc and the coating is no longer needed.

A buried subcarrier encoding system is used to take best advantage of the capacitance pickup in terms of picture quality and disc playing time. It is based on the use of an FM carrier for the video information and separate FM carriers for the audio information in a single track. The buried subcarrier encoding allows the color signal to be handled in the same channel as the luminance, produces a very high quality color picture, and allows a low video carrier frequency. A direct benefit of the low carrier frequency is long playing time, since the limitation is usually the shortest reproducible wavelength.

The stylus

Since the RCA disc is a grooved disc, it is vital that the stylus track properly in the groove. The basic tracking problem in the RCA videodisc is quite similar to that encountered in audio players. The tracking forces are applied vertically, primarily by the spring metal flylead that connects to the tip of the stylus support arm.

Also, since there is a groove and a stylus the life of the stylus is important. Figure 4 shows the stylus used. Note the keel-shaped protrusion on the bottom of the V. Since the keel has relatively straight sides, its width will not increase as it wears. Therefore, its initial width can

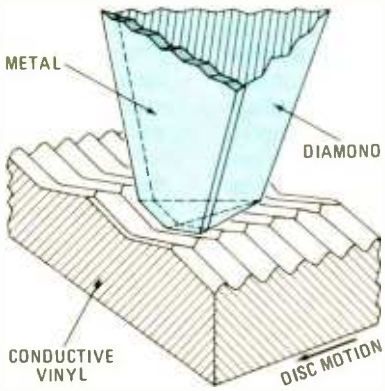


FIG. 3—CAPACITIVE STYLUS forms one half of the capacitor. The conductive disc is the other half of the system.

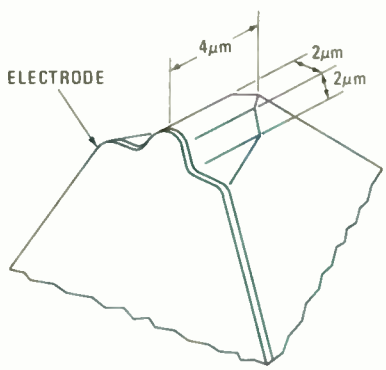


FIG. 4—STYLUS SHAPE IS CRITICAL for proper performance and life. Shown here is the optimum recommended by RCA.

be made almost equal to that of signal elements in the groove. With this kind of geometry, life is primarily a function of how high the keel can be made before it becomes fragile.

The length of the keel is also important. Here the limitation is the lift-off of the electrode when playing a warped disc as the shoe becomes too long. Many experiments have shown that the dimension shown in Fig. 4 is optimum.

The remaining key dimension is the "prow" angle. This is the angle that the leading edge of the stylus makes with the disc. If the angle is too steep the tip may become fragile. In addition, while some fine debris is pushed out of the way, some tends to wrap around the tip lifting it out of the groove. If the angle is too shallow, the tip becomes stronger and critical wrap-around is reduced, but the tip will not push as much debris out of the way and will tend to lift to ride over it causing loss of signal pickup. RCA has found that an angle of about 30° is a good compromise.

One of the problems in any videodisc is that since the rpm is constant, the performance at the inside of the disc is inferior to performance at the outside of the disc. However, the RCA system has been designed to give high quality even at the inner radius, which is reached only after 60 minutes of playing time. This means, of course, that the performance of most of the disc is better than the designated minimum.

Where do we go from here.

Naturally, the real test of the video disc is in the market place. The RCA system, which is expected to sell for $495 is $200 less expensive than the Magnavision system. But it may not be able to provide slow motion or stop motion.

The real question is whether a customer will pay $200 more for slow and stop motion. And this depends upon how the user intends to use his player. If he is going to watch motion pictures or his favorite singing star or his favorite jazz band, stop motion doesn't have very much value. But if the consumer intends to learn to tie fishing flies, or to cook quiche, the frame by frame viewing becomes vital. It's even more important for a picture by picture tour of an art museum. Both the optical and the capacitance systems appear to be functional, reliable and workable. It is my personal feeling that the availability of software, records to put on the player, will be a more important consideration to the consumer than the type of system.

Videodisc or videotape

Both videodisc and videotape have a place in the consumer market just as audio tape and audio discs coexist. If a user has no need to record, he doesn't need the added cost of a recorder. Just the same, there are bound to be many users who will have both disc and tape systems and use each one as it is best suited.

When we couple videodisc and videotape and large screen projection TV, we come up with an entertainment medium that bears only a faint resemblance to the early TV's. The new sets are coming close to matching the dreams of those early experimenters, but it's still a way to flat screens and 3-D pictures. **R-E**

Another output can be used to turn on emergency lighting in the event of a power failure. Use the interface circuit shown in Fig. 6 to turn on up to three parallel-connected, 6-volt lantern bulbs around the house. During a power failure, the alarm will also sound softly; the volume can be adjusted by R7 (Fig. 1). Or R7 and D3 can be omitted, which will result in no audio alarm signal for the power-failure condition (the audio alarm will *still sound* if a burglar *enters* during the power failure). If no power-failure indication of any sort is desired (i.e., no lantern bulbs or warning tone) just omit R8, R9, D5, Q12, Q13, and R10, in addition to R7 and D3.

The alarm system remains active even during power failures as a result of a circuit that automatically switches the unit over to an internal battery pack (use any 10- to 14-volt battery supply). If NiCad batteries are used (the system requires eight each, in series), they must be fully charged upon installation by temporarily paralleling R11 with 82 ohms (1 watt) for 10 hours, and then removing the 82 ohms across R11, allowing a steady, permanent trickle charge (of about 10 to 15 mA) to leak into the batteries. If power is interrupted for very long periods of time (more than two days), or if the alarm is being transported, the battery pack should be disconnected by removing its associated fuse. My unit uses a self-contained NiCad battery pack, but any battery can be used as long as it has the proper voltage and current capability. Remove R11 if dry cells (or lantern batteries) are used.

Mount the entire system in a safe place, where a burglar cannot easily reset the alarm or disconnect the wires to the speaker or battery.

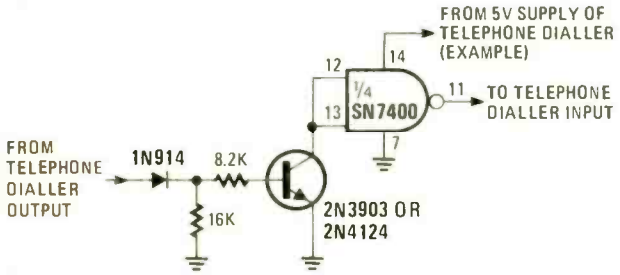


FIG. 4—INTERFACE for logic-1 dialer option.

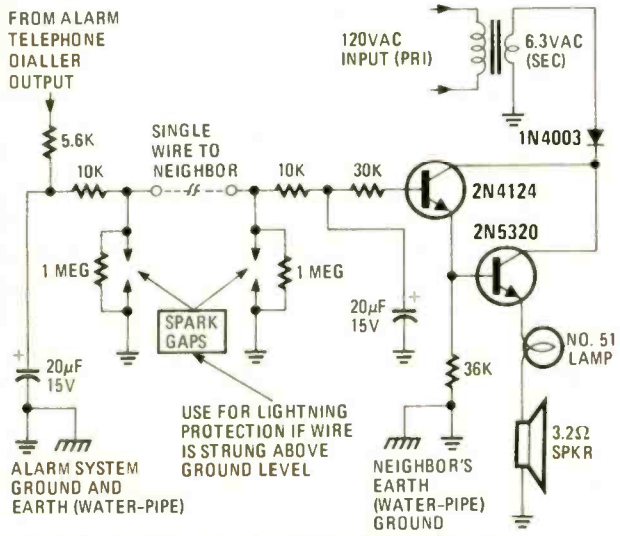


FIG. 5—REMOTE ALARM can be placed in neighbor's home.

How it works

Let's assume that all your windows are wired with foil strips, which, if broken, will open-circuit. All foil-stripped windows

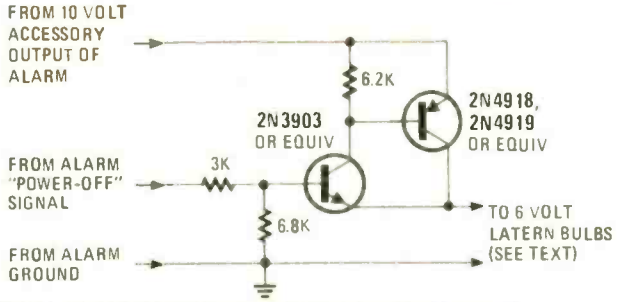


FIG. 6—EMERGENCY LIGHTING is turned on by this circuit.

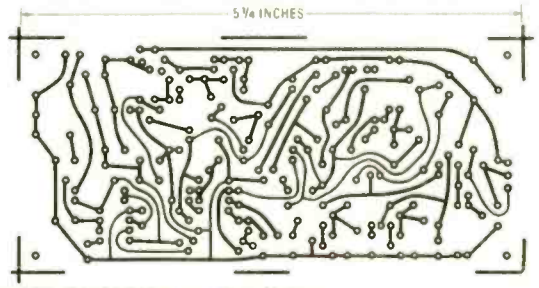
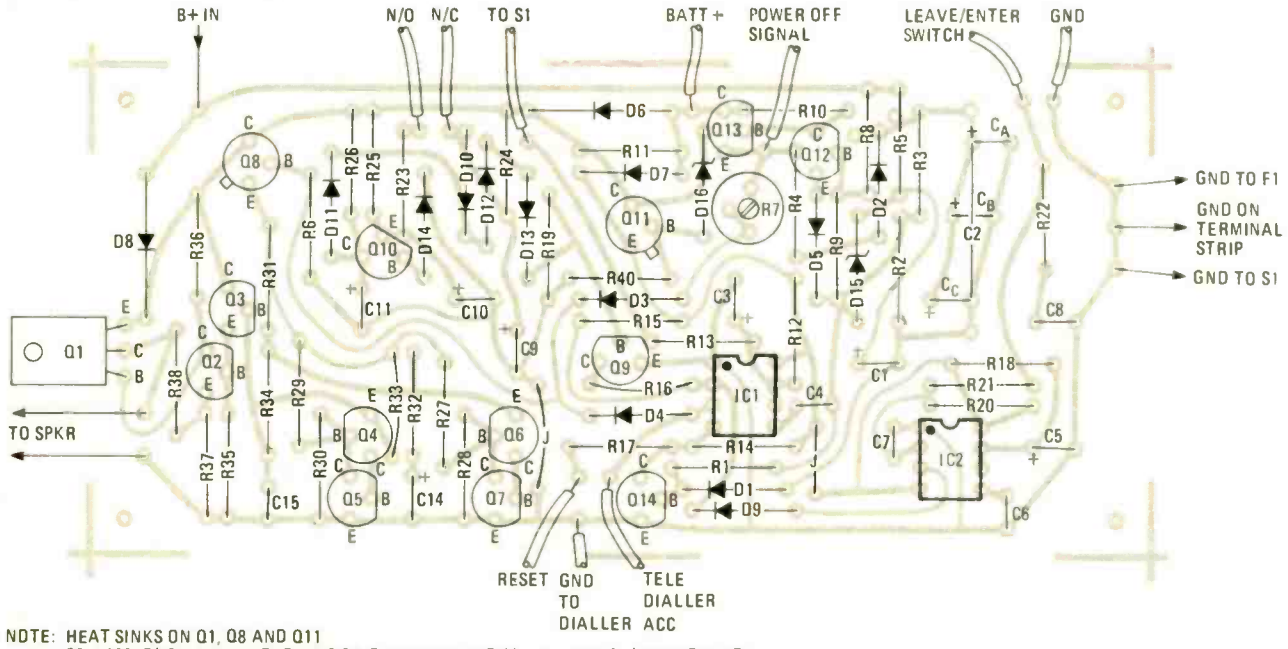


FIG. 7—FOIL PATTERN is shown half size.



NOTE: HEAT SINKS ON Q1, Q8 AND Q11
C2-1 100µF/16V AXIAL LEAD OR 3 33µF RADIAL LEAD (C_A, C_B, AND C_C) IN PARALLEL
J = JUMPER

FIG. 8—COMPONENT LAYOUT for the PC board. Parts are inexpensive and easy to obtain.

PARTS LIST

Resistors ¼ watt, 20% or better
R1, R3, R34—27,000 ohms
R2—15,000 ohms
R4, R21—1000 ohms
R5—7500 ohms
R6—30,000 ohms, see text
R7—20,000-ohm trimmer pot, ⅛ watt or higher
R8—39,000 ohms
R9—8200 ohms
R10, R13–R15, R20, R24, R26, R33, R35, R40—10,000 ohms
R11—620 ohms
R12, R18—1.2 megohms
R16—2000 ohms
R17, R38—100 ohms
R19—47,000 ohms
R22—39 ohms
R23—62 ohms
R25—20,000 ohms
R27–R30—110 ohms
R31—4700 ohms
R32—10 ohms
R36—1800 ohms
R37—33 ohms
R39—470 ohms, 2 watts, carbon

Capacitors
C1—20 μF, 10 volts, radial-lead electrolytic or tantalum
C2—100 μF, 12 volts, axial-lead electrolytic or three 33-μF tantalums in parallel
C3—47 or 50 μF, 16 volts, radial-lead electrolytic or tantalum
C4, C6, C7—.01 μF, 50 volts, ceramic disc
C5—22 μF, 16 volts, radial-lead electrolytic or tantalum
C8—4.7 μF, 16 volts, radial-lead electrolytic or tantalum
C9—4.7 μF, 6 volts, radial-lead electrolytic or tantalum
C10—6.8 μF, 6 volts, radial-lead electrolytic or tantalum
C11—47 μF, 6 volts, radial-lead electrolytic or tantalum
C12, C13—1000 μF, 25 volts, axial-lead electrolytic or one 2000-μF computer-grade electrolytic
C14—47 μF, 10 volts, radial-lead electrolytic
C15—0.1 μF, 50 volts, ceramic disc

Semiconductors
D1–D5, D9–D14—1N914 high-speed switching diode
D6, D8—silicon rectifier diode, 2 amps or higher, pigtail leads
D7—1N4001, 1N4002, 1N4003 or similar 1-amp silicon diode
D15—Zener diode, any rating between 6.0 and 8.2 volts
D16—1N5230 or similar 4.7-volt Zener diode
IC1, IC2—NE555 or LM555 timer
Q1—2N4918, 2N4919, 2N6490 or equal
Q2, Q3, Q5, Q7—2N3392, 2N3903, 2N3904 or equal
Q4, Q6—2N3905, 2N3906, 2N2907, 2N4126 or equal
Q8, Q11—2N5320 or 2N3053 NPN, 5 watts, TO-5 case
Q9, Q10, Q12–Q14—2N4124, 2N3903, 2N3904 or equal
RECT—full-wave rectifier bridge, 2 amps, 100 PIV, Varo VJ447 or similar

Miscellaneous
T1—power transformer, 12-volt 2-amp secondary, Stancor P-8130 or equal
S1—SPST miniature toggle switch
S2—SPST toggle or pushbutton switch
S3—see text
Binding-post strips, terminal lugs, screws, nuts, lockwashers, line cord, pilot lamp (optional), speaker (see text), chassis and case.

are, therefore, considered normally closed sensors and should be wired *in series* with other such sensors; and the overall series-connected arrangement must connect to the normally closed input of the alarm. (If no normally closed sensors are used, the normally closed input must be grounded to the alarm ground.) Then, IC1 will trigger, either as a one-shot (if mode switch S1 is in the MOMENTARY position) or as a bistable flip-flop (if S1 is in the STEADY position), if a normally open sensor (from, say, the front door entrance) closes (i.e., shorts). This will enable the "whoop-whoop" oscillator power source, Q8. However, if a signal of intent to enter or exit is sent to the enter-exit input (by momentarily closing S3), which triggers IC2 high, then IC1 would be prevented from triggering until IC2 "times out." The RESET switch, S2, can be either a momentary-action or positive-action switch. If a positive-action switch is used, the alarm will be inhibited as long as the switch is closed, except for the power-failure warning tone. The loudness of the power-failure warning tone is adjustable by varying resistor R7, which varies the DC voltage applied to the oscillator power lead. If a greater adjustment range for R7 is desired, lower the value of R6 to 10K. When installing the alarm system, check with local authorities. Some limit the duration of alarm signals.

When AC power is interrupted, C12 and C13 discharge rapidly through R39; this rapidly decreasing voltage is applied 19 Q12 by voltage divider R8 and R9. When the voltage at the base of Q12 is less than about 1.2 volts, Q12 comes out of conduction (turns off) and the emitter of Q13 goes high. This enables the lantern bulbs (if used) and resets IC1 through R4, D2, C2, D1 and Q14. Capacitor C2 gradually charges through R2 and R3, so that the reset condition does not become permanent, owing to current steering away from the base of Q14 after about 7 seconds. Similarly, when AC power is applied or restored, capacitor C1 resets IC1 by charging into the base of Q14 and tapering off after a few seconds due to R2. Zener diode D15 assures that power-supply ripple will not cause a false reset of IC1. Resistor R1 further enhances the noise immunity of the automatic reset circuit by keeping a low base-impedance for Q14, which also allows this transistor to have a moderate I_{CBO} leakage (this allows you to use grab bag silicon transistors). Resistor R19 serves a similar purpose for transistor Q9. Capacitors C11 and C10 enhance the power-line (60-Hz) pick-up

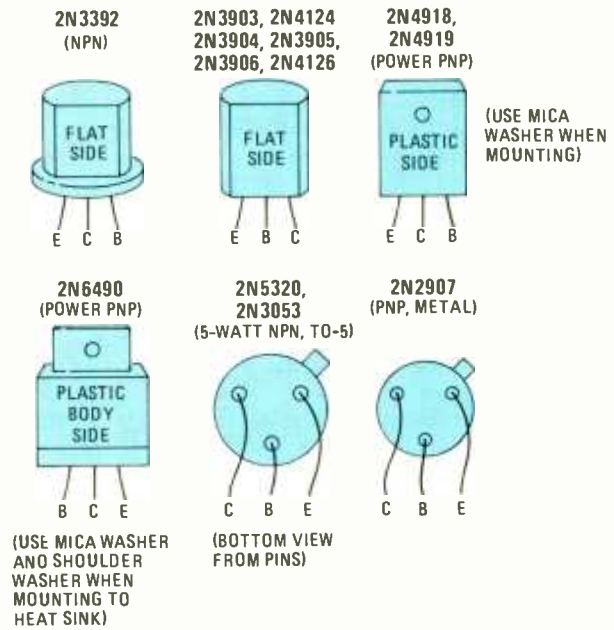


FIG. 9—PINOUTS for the optional transistors.

immunity of the sensing circuits; this allows nonshielded wire to be used for both the normally open and normally closed inputs.

The schematic in Fig. 1 and the large number of discrete semiconductors make this alarm system appear much more complex and more costly than it really is. Several transistor types are given for each application. This gives you the opportunity to use inexpensive types available from the sources advertised in the back of this issue.

The foil pattern for the relatively simple PC board is shown in Fig. 7. The components layout is shown in Fig. 8. If you cannot reproduce the foil pattern exactly, you could try making your own layout. The only really critical points are in the pin positions for IC1 and IC2. All the other components have flexible leads that can be cut and positioned as necessary. Check the transistor pinouts in Fig. 9. **R-E**

Protect Your Valuables— Light Sensitive Security Alert

Unique IC that includes a photodiode and lens makes this security alarm very sensitive to any movement in its vicinity. Movement in any direction causes diffused shadows that trigger the detector.

MELVIN WEISS

HARDLY A DAY PASSES THAT A SMALL segment of the population—complacent until now—is not made aware of the need for increased security in the home or place of business. This ever-increasing interest in security and security devices has led to the development of a number of different systems. Most of these were based on ultrasonics, interrupted light beams (visible or IR), normally open and normally closed switches, and conductive tapes. All except the simplest use one or more IC's as the alarm generator and for timing in various phases of operation.

Recently a unique type of IC motion detector was developed for use in security systems. This device is based on LSI technology and includes both linear and digital circuitry in its operation.

This motion detector operates on a *change in light level*. This is not to be confused with the system that requires a light transmitter and receiver and operates only when the light beam is completely interrupted to produce a 100% change in the level of light falling on the receiver. The light sensor used here can detect a change in light as little as ±5% and does not require a separate light source.

The advantage of this system is that triggering results when any motion in the immediate vicinity causes either the direct or reflected light to change as little as 5%. This change may be in either direction; more light or less light. The system operates in light levels varying over a range of 1000 to 1; from as low as 0.1 candlepower, quite dark, to 100 candlepower—quite bright.

The light sensor is contained in a molded clear plastic DIP housing so that light can reach an internal photodiode detector. A molded lens is mounted over the package to improve the sensitivity at low light levels.

The lens and the hole (aperture) in the side of the case are positioned so the photodiode gathers light in the shape of a cone. The lens gathers light in such a manner that the light sensor covers a 2-foot circle at a distance of around 8 feet. Figure 1 is the block diagram of the D1072 light sensor IC. Light falling on photodiode D1 causes a voltage to be developed at its output. Motion within the diode's field of view changes the light level, thus producing changes in the output voltage. Capacitor C1, connected between terminals 6 and 7, couples the voltage changes to amplifiers A2 and A3. Capacitors C1 and C3 are parts of a filter network to detect low-frequency voltage changes (motion) while C2 attenuates higher frequencies, thus making the device immune to flicker inherent in lamps operating from AC sources.

The gain of amplifiers A2 and A3 along with the log characteristic of A1 provides a signal that will trigger the internal detector when the change in light exceeds ±5%. The trigger produces a short tone burst from the internal generator. Capacitor C5 determines the frequency of the tone generated by the voltage-controlled oscillator (VCO) while C4

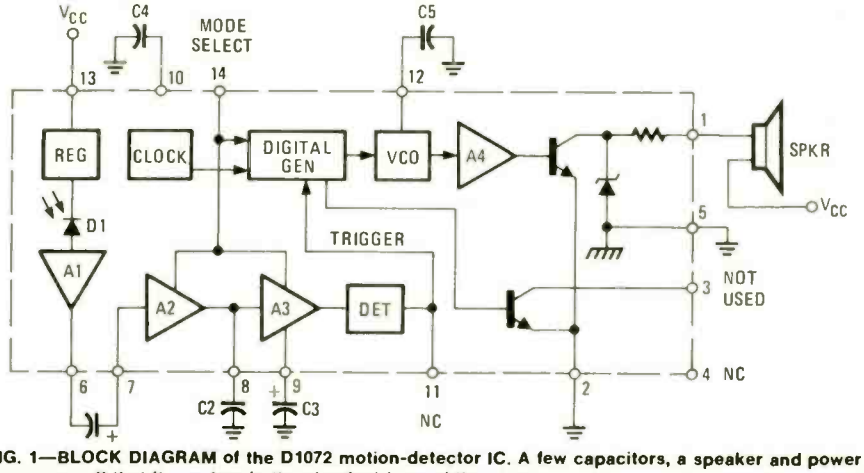


FIG. 1—BLOCK DIAGRAM of the D1072 motion-detector IC. A few capacitors, a speaker and power source are all that it requires in the simplest form of the alarm.

THREE VIEWS of the compact detector. Left-front view is at left, right-front view at right and rear interior view is above.

determines the ramp rate (rate of change) of the VCO's tone.

The alarm, when triggered, continues for around 4 to 12 seconds, depending on circuit components, and is best described as a "whoop." At the end of the alarm period, the light condition is sampled. If the light is still changing, the audible alarm continues. If the light level has stabilized—not necessarily at its previous level—the alarm stops and the circuit resets to detect the next change in light. (The D1072 operates from a *change* in light intensity and cannot operate reliably in very dark applications. For dark applications, use an invisible IR source; either LED or filtered incandescent.)

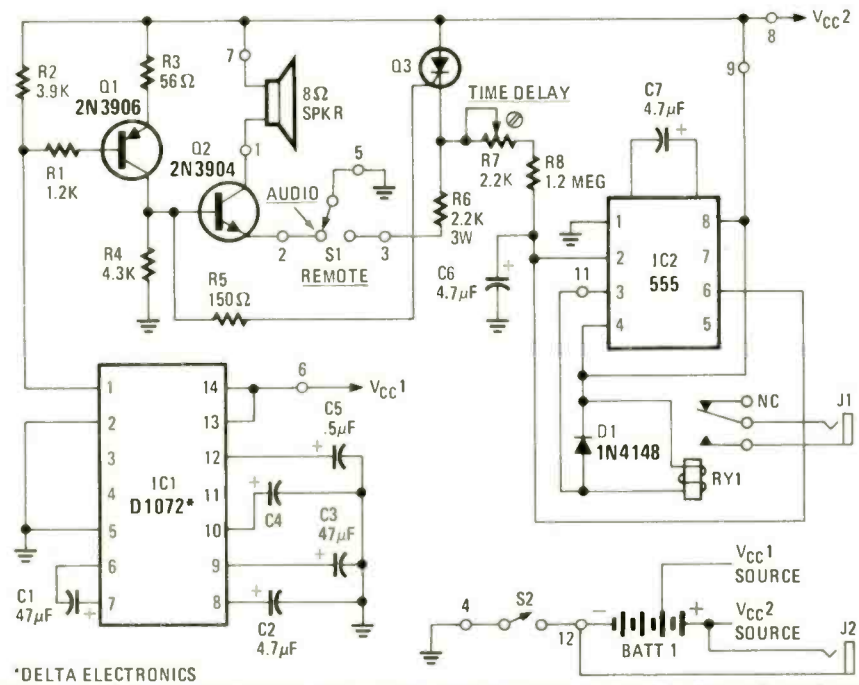
The circuit

The schematic of the complete motion detector is in Fig. 2. Transistors Q1 and Q2 form a small audio amplifier for increasing the tone burst level. Switch S1 grounds the emitter of Q2 when in the AUDIO alarm mode and the cathode of the SCR when in the REMOTE alarm mode.

In the silent remote mode, triggering is the same as in the audible mode, but instead of starting the audible alarm, a 555 timer is triggered. The timer has a range of 5 to 30 seconds and drives a relay. The relay closes and locks in at the end of the selected delay period. The closed relay contacts trigger whatever external alarm that is connected through jack J1. The external device remains active until the ON-OFF switch is turned to the OFF position. The motion detector then resets itself.

The time delay, adjustable by R7, is included so when the device is used in a security system, the operator has a chance to disable the alarm before it goes off.

The second jack is for recharging the four internal size "AA" NiCad cells. When fully charged, these cells operate the motion detector for about 48 hours. They will recharge overnight or 12 to 14 hours when completely run down. The complete device is small enough to be considered portable when operating on its internal batteries. A permanent installation may be made using the charger as a permanent power supply.



*DELTA ELECTRONICS

FIG. 2—COMPLETE SCHEMATIC of the motion-detector alarm. Features include adjustable time delay, a remote-alarm option and increased output power for the "whoop-whoop" alarm.

Construction

The motion detector is constructed on two PC boards. One PC board contains

the IC motion detector, the various external capacitors and the small AF amplifier. The foil pattern for this board is shown in Fig. 3 and the parts placement is shown in Fig. 4. Mounting the components is straightforward except for IC1, which is mounted in a wire-wrap type 16-pin socket. Mount the socket so there is a ⅜-inch space between its bottom surface and the board.

The second board contains the relay whose contacts are brought out through J1 so an external device such as a siren, tape recorder, or telephone dialer can be activated. The foil pattern for this board is shown in Fig. 5 and the parts placement is shown in Fig. 6.

The alarm is housed in a plastic instrument case 6-inches high and 3¼-inches deep. Figure 7 shows the holes on three sides of the case. The detector PC board is mounted with 6-32 × 1½-inch bolts

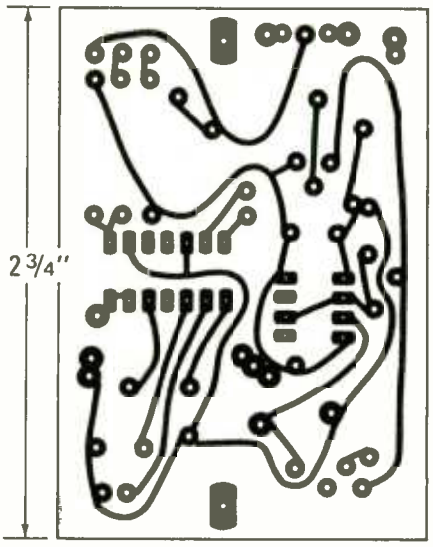


FIG. 3—FOIL PATTERN for the main PC board shown full size.

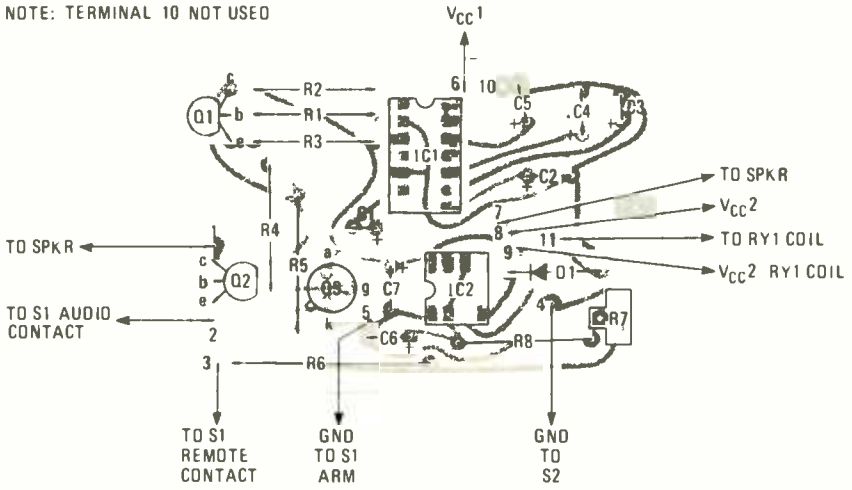


FIG. 4—COMPONENT SIDE OF THE MAIN PC BOARD. The numbered solder pads correspond to similarly numbered terminal points on Fig. 2.

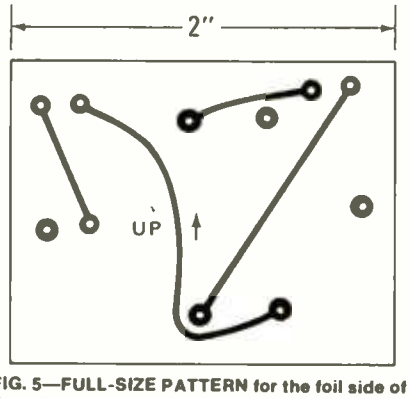
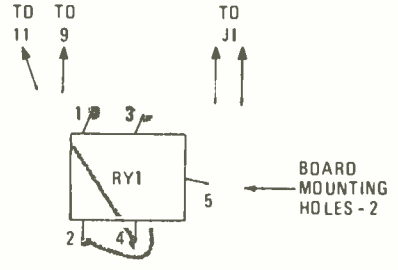


FIG. 5—FULL-SIZE PATTERN for the foil side of the relay board. Relay mounts as in Fig. 6.



NOTE. RELAY TERMINALS
1 NC CONTACT (NOT USED)
2 NO CONTACT
3 & 4 COIL
5 ARM CONTACT

FIG. 6—THE RELAY on the board with leads indicating connections to other components.

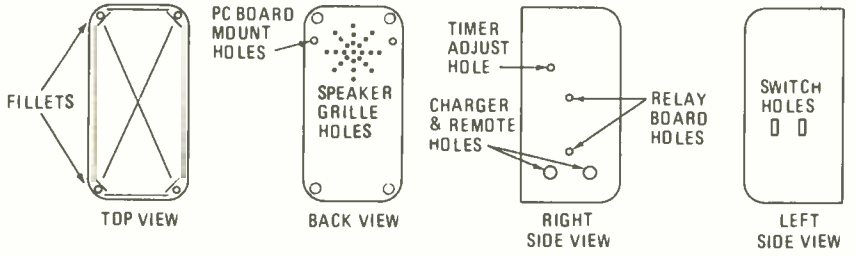


FIG. 7—VIEWS OF FOUR SURFACES of the case. Compare these with photos on preceeding page and you'll have an idea as to how it all goes together.

PARTS LIST

All resistors ¼ watt, 5% unless otherwise noted

R1—1200 ohms
R2—3900 ohms
R3—56 ohms
R4—4300 ohms
R5—150 ohms
R6—2200 ohms, 3 watts
R7—2.2 megohms, trimmer
R8—1.2 megohms
C1, C3—47 μF, 10 volts electrolytic
C2, C4, C6, C7—4.7 μF, 16 volts tantalum
C5—.5 μF
D1—1N4148
Q1—2N3906
Q2—2N3904
Q3—SCR, 50 volts PIV
IC1—D1072 motion detector (Delta Electronics, $8.95)
IC2—555 timer
S1—SPDT slide switch
S2—SPST slide switch
RY1—SPST relay, 18-ohm, 60-mA coil, (Delta Electronics 6514R, $2.75)
J1, J2—miniature open-circuit jacks
BATT1—4 NiCad "AA" cells

The following are available from Delta Electronics, PO Box 2, Amesbury, MA 01913:

Complete kit (less batteries), No. 5611W $24.95.

Completely assembled motion detector with batteries and charger, No. 5635W $69.50. Motion detector IC with data sheet, No. 1072W $8.95. Set of two etched and drilled PC boards, No. 5611W $6.50. Battery charger, No. 5636W $5.95. Relay No. 6514R $2.75.

Include $1.50 postage and handling with all orders. Massachusetts residents add state and local taxes where applicable.

and 15/16-inch spacers. The speaker is placed on the back surface so it touches the two PC board spacers. Dabs of quick-setting epoxy cement hold the speaker in place. Similarly, the two switches are epoxyed in place.

The relay board is mounted on 6-32 × ¾-inch screws held in place by a pair of threaded 7/16-inch spacers. A pair of 6-32 nuts hold the board in place. The aperture for the photodiode lens is drilled in the cover. It is a 7/16-inch-diameter hole and is 1⅜-inch in from the left side and 1⅛-inch down from the top.

The motion detector is now ready for operation. Place it in any area with an ambient light level that is within its operating range (0.1 to 100 candle power.) Turn the ON-OFF switch to ON. The alarm will sound for 4 to 12 seconds as the system adjusts for the prevailing light level. Once the sound stops, the system is in the "guard" mode and any change in light level greater than ±5% sets off the alarm. Any motion within the cone of surveillance causes the alarm to sound. This cone is a minimum of 8 feet long. At a distance of 8 feet, it is 2 feet in diameter. **R-E**

The Magnavox Comb Filter

A CLASSIC PROBLEM IN COLOR TV RECEIVER design has been the separation of luminance and chrominance signals, and the reduction of cross interference between them. Luminance and chrominance signals share the same frequency spectrum; the luminance signal energy is between DC and the 4.5-MHz sound carrier, and the chrominance signal has sidebands centered around the 3.58-MHz subcarrier. Bandpass filters are generally used to separate the peaked chroma signal, and low-pass filters separate the video signal from the composite signal. Magnavox has used a comb-filter technique in its new 25-inch *model T815*, and 19-inch *model T809 Touch-Tune* and *STAR* receivers; this technique separates the two signal components with a minimum of degradation to each.

Figure 1 shows an elemental comb filter. It consists of a time-delay element and a subtractor for combining the input

FIG. 1—ELEMENTAL COMB FILTER.

signal with the delay line output. For TV systems, the line is designed for a delay time equal to one horizontal line, or 63.6 μs (from 1 to 15,734 Hz). For any particular frequency-input sinewave, the delay line produces an output signal shifted in phase with an angle equivalent to the delay time. If the input signal is a 15,734-Hz sinewave, the delay line retards the input wave by a full cycle or 360 degrees, so that the input and output of the line look exactly the same at any time. When the two signals are subtracted as shown in Fig. 1, since both signals are equal the comb-filter output is zero. In fact, the output is zero for any frequency that is a multiple of the horizontal line rate. At twice the line frequency, for example, a 63.6-μs delay represents a delay of two complete cycles; so again the output is in phase or duplicates the input, and the comb-filter output is zero. As the input frequency changes away from multiples of the line rate, the output signal increases. The filter response therefore has peaks and nulls similar to the teeth and separations of a comb.

Figure 2 is a phasor diagram showing the comb-filter principle from a different perspective. The phasor V_{in} represents the

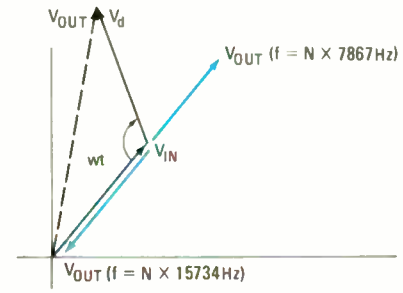


FIG. 2—COMB FILTER phasor diagram.

input signal and rotates around the origin at the input frequency. The second phasor, V_d, represents the contribution of the delay line output, which rotates along with V_{in}, maintaining a fixed angle with respect to V_{in}. When the input is a multiple of the horizontal rate, the two phasors oppose each other so that the output is at the origin or zero. As the frequency changes, the phasors unfold and the resultant phasor, V_{out}, increases in length. Note in particular that the output phasor reaches a maximum when the angle between V_{in} and V_d is 180 degrees, which happens at multiples of 7867 Hz, or one-half the line rate.

In a TV signal with little or no vertical change from field to field, picture data is concentrated in frequency bands centered around line-rate multiples, as shown in Fig. 3. It is no accident that the chroma subcarrier frequency, 3,579,485 Hz, is the 455th multiple of one-half the line

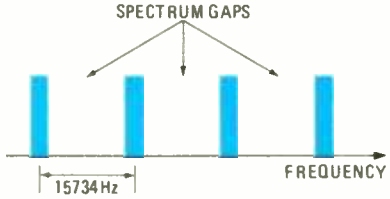


FIG. 3—CONCENTRATON OF LUMINANCE information in a vertically correlated picture.

frequency. The developers of compatible color TV recognized that there were gaps between the luminance spectrum components into which the chroma signals could be inserted without requiring additional signal bandwidth. The chroma energy is therefore contained in bands centered around the 3.58-MHz subcarrier, and separated by gaps that are equal to one-half the horizontal line rate. Figure 4 shows the combined luminance and chrominance spectrum, emphasizing these concepts.

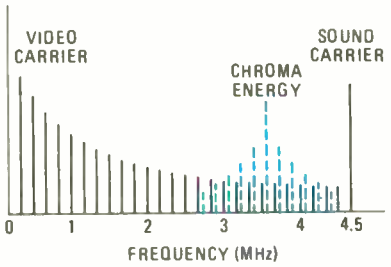


FIG. 4—CHROMA AND LUMINANCE interleaving.

In conventional TV systems that use a bandpass filter to separate the chroma from the video signals, the interspaced luminance signals remain to produce interference in the detailed picture areas. To minimize chroma in the luminance channel that can create interference patterns, the video amplifier uses a 3.58-MHz L–C trap that has the undesirable effect of limiting the high end of the video frequency band to about 3 MHz. The result is a loss of resolution and high-detail video.

Figure 5 is the block diagram of the Magnavox comb-filter system. The lower portion of the diagram that produces the chroma output is similar to that of Fig. 1, but includes the practical elements of an amplifier to compensate for the delay line loss, and an attenuator in the direct signal path equalizes signal levels at the subtraction point.

One of the unique features of the Magnavox comb-filter module is that it contains no service adjustments. The net result of this state-of-the-art filtering technique is a 25% increase in horizontal resolution from 260 to 330 lines, and the reduction of disturbing dot patterns and "barber pole" cross-color effects. **R-E**

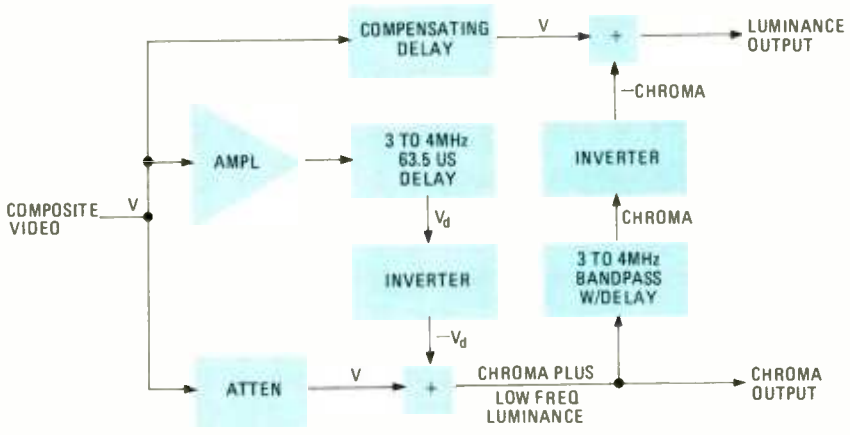


FIG. 5—COMB FILTER OPERATION.

3 Unique Projects

Looking for electronic projects to occupy a few evenings? If so, consider one or two of these unique circuits. Study the text and diagrams carefully to insure completion.

MARTIN BRADLEY WEINSTEIN
AND JOSEPH GARTMAN

ONE-STATION INTERCOM

HERE'S A DELUXE SINGLE-STATION INTERcom that incorporates many of the features usually seen only on the very most expensive commercial sets, yet its simpler single-station design enables you to build it for almost half the cost.

The unit incorporates a commercially styled telephone handset, complete with a push-to-talk button in its shank. The associated power and control junction box, connected at the other end of the commercially styled flexible retracting coiled cord, provides not only the power necessary to run the intercom, but current limiting, a PRIVACY switch, and a uniquely wired Tri-Status LED.

Looking at the circuit shown in Fig. 1, the battery provides current only when the push-to-talk bar is depressed—thus providing excellent battery life. The battery, earpiece, 1K resistor and LED comprise the complete circuit with the PRIVACY switch open (mike not connected). This assures that audio present in the room does not leak into the earpiece circuit. It also makes the 1K resistor the brightness-setting element for the LED.

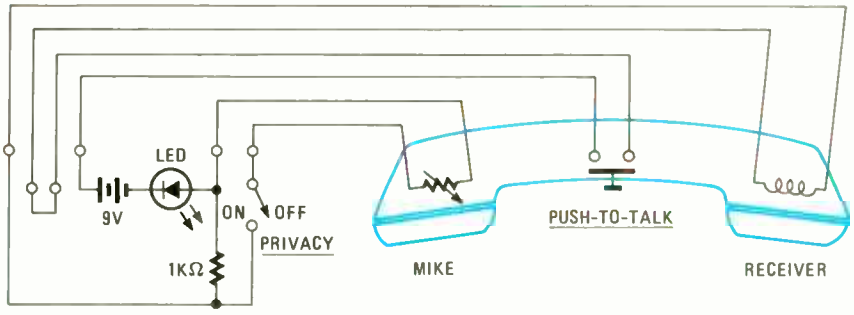


FIG. 1—ONE-STATION INTERCOM is powered by a 9-volt transistor battery and has an LED status indicator.

With the PRIVACY switch closed (in other words, in the *normal* operating mode), the microphone is connected in parallel with the 1K resistor. Since this is a carbon mike, its resistance varies in value with impressed audio. Please note that in carbon mike elements, the carbon granules can occasionally pack, thus yielding poor audio quality. A few sharp raps of the knuckles will usually clear this up.

Since the parallel combination of two resistors is always lower in resistance than the resistance of either resistor alone, closing the PRIVACY switch causes the LED to glow more brightly. So the single LED, with its off-on-bright Tri-Status modes, not only signals a push-to-talk (and confirms battery vitality), it also indicates the status of the PRIVACY switch.

PARTS LIST FOR INTERCOM

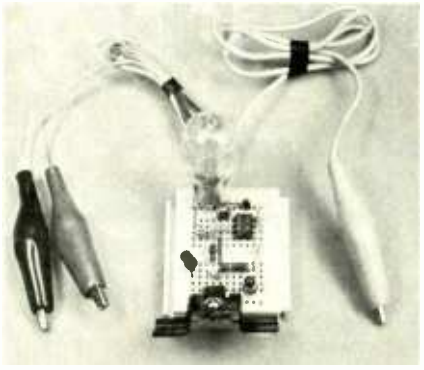
1—telephone handset with push-to-talk switch
1—SPST toggle switch
1—9-volt transistor radio battery
1—jumbo size LED, red or your favorite color
1—1000-ohm resistor, 1/2 watt to 5 watts.
Miscellaneous hookup wire, phone cradle.

The audio provided by the combination of components shown is adequate even for the moderately hard of hearing. You may want to try substituting other component values, or the battery voltage.

The One-Station Intercom is suggested for use in high security and government applications, and for people with a genuine need for a better way to talk to themselves.

The circuit we built was constructed using a set of APR-1 experimenter's tools.

SINGLE SHOT LOGIC INDICATOR WITH MEMORY



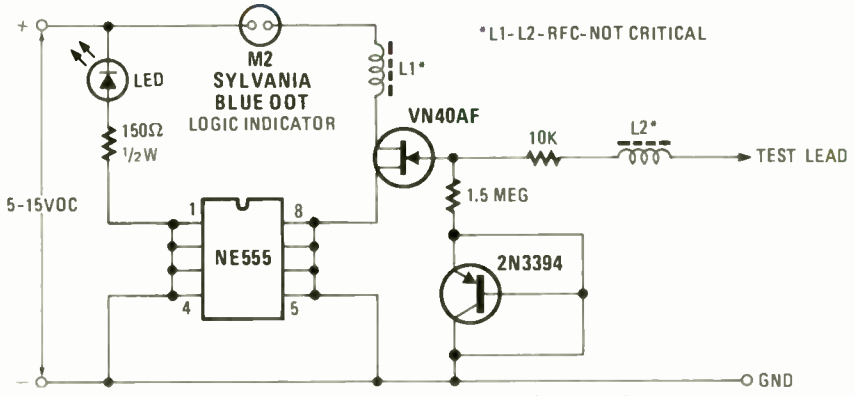


FIG. 2—LOGIC INDICATOR produces a visible indication that's hard to ignore.

HERE'S A CIRCUIT THAT COMBINES THE 555, a VMOS FET and some unusual electronics to provide a pulse indicator you can't ignore.

A careful look at the circuit shown in Fig. 2 will show that the NE555 and the 2N3394 power transistor are plugged in so as to short themselves out.

This particular circuit configuration was chosen to reduce the likelihood of static damage to these components. Inductors L1 and L2 are waveshaping components that are included because good textbook design deems their inclusion necessary. Although the circuit will function without these components, they tend to increase the likelihood of repair.

As a testimony to good circuit design, a DC supply of virtually any size will power the circuit through the alligator clip leads. The LED confirms application of power.

The actual switching function necessary to drive indicator lamp I1 is provided by the VN40AF VMOS FET. VMOS is a relatively new FET technology that cuts grooves into the semiconductor substrate to allow greatly increased output currents. Still, its input is very, very sensitive and triggers quite easily at CMOS levels.

In this circuit, of course, the shape of the pulse being awaited is inconsequential, since the VN40AF does not need to turn fully on. Also, its high (greater than 1 megohm) input impedance will allow it to trigger even from exceptionally weak pulses.

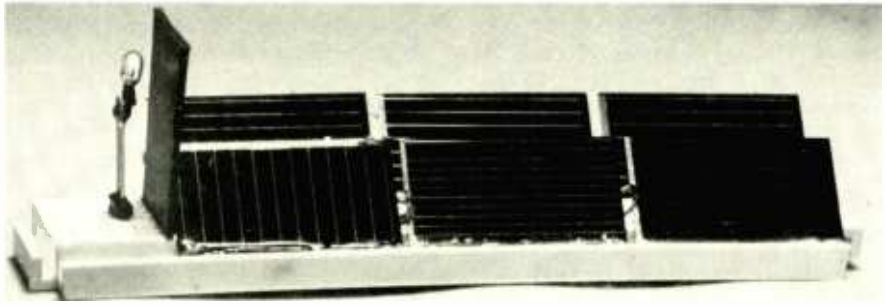
The unique output indicator lamp is a Sylvania *Blue Dot* flashbulb. It is the use of this indicator which gives the circuit both its unique one-shot characteristic and its memory capability. When triggered, the indicator (I1) will emit a brief but unforgettable stream of visible photons. After triggering, the characteristic blue dot on the bulb will no longer be blue; this is the memory indicator.

Other indications may also be apparent. The shape of the lamp's glass envelope, for example, may distort. And the clear plastic envelope surrounding the glass may become translucent, as compared to its original transparency.

PARTS LIST FOR LOGIC INDICATOR

1—LED indicator, red, green or yellow
1—resistor, 150 ohms, ½ watt,
1—resistor, 1.5 megohm, ¼ watt
1—resistor, 10,000 ohms ¼ watt
2—inductors, L1-L2, optional. 0.25 μH to 88 mH.
1—NE555 IC timer, see text
1—2N3394 PNP transistor, see text
1—VN40AF VMOS FET transistor
1—logic indicator, Sylvania M2 *Blue Dot* or equal with holder

SOLAR POWERED NIGHT LIGHT



AS ALTERNATIVE ENERGY SOURCES BE-come more and more important to our future, even the little niceties of life may have to adapt. Here is one adaptation we can try now to get us ready for tomorrow.

This simple circuit is a Solar-Powered Night Light. The six solar cells produce about ½-volt each in bright sunlight. Here, they are connected in series to provide 3 volts. The solar cells are made on very thin, very fragile glass and can break if not properly and carefully handled. A small incandescent lamp completes the circuit.

In bright sunlight, the small lamp glows quite vigorously. But since the efficiency of this circuit is low, a small black card helps make its glow visible.

Barring a nearby nova, the solar cells are not likely to stress the lamp enough to ever burn it out, so this device should continue to operate for a very, very long time without attention or maintenance.

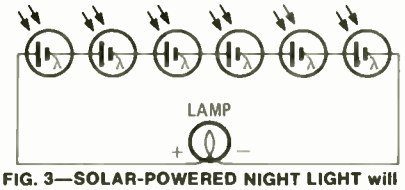


FIG. 3—SOLAR-POWERED NIGHT LIGHT will help reduce energy demands.

PARTS LIST FOR SOLAR-POWERED NIGHT LIGHT

6—0.5-volt solar cells
1—3-volt flashlight bulb

While hardly giving enough light to illuminate a room, the small lamp is actually quite adequate for many night light purposes. More pragmatically, it can be used when it is not needed as a primary source of illumination during those nights when the sun is shining bright enough to light it. **R-E**

AUDIO BREAKTHROUGH !

Magnetic Field

An entirely new concept in power amplifier design makes possible an audio amplifier that has high power, low weight and eliminates the power transformer, large capacitors and many other common components.

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

A FEW WEEKS AGO I HAD THE PLEASURE OF entertaining Robert W. Carver at my laboratory. If his name is unfamiliar to you, it was Bob Carver who started the Phase Linear Corporation and who developed the first high-powered stereo amplifier for home use that sold for (as he puts it) "less than a dollar per watt."

Recently, Mr. Carver decided to form a new company. And no sooner had the Carver Corporation been formed than we began to hear rumours about a "new" kind of audio amplifier known as a Magnetic Field Amplifier. At the time of his visit to my lab, he was still busy making sure that the new amplifier circuitry was properly protected at the U.S. Patent Office. All he would tell me then was that the amplifier would *not* require a power transformer or extensive heat-sinking. There would be no need for large-filter electrolytic capacitors. The amplifier would weigh around 12 pounds, would be highly efficient and would deliver 200 watts-per-channel at very low distortion. The projected retail price—around $300!

Had anyone else come along with this tale I would have labeled him an incurable dreamer. However, knowing Mr. Carver's earlier achievements in amplifier design, I made him promise that as soon as he was able to disclose more circuit details, he would allow me to describe the circuitry in **Radio-Electronics**. True to his word, Mr. Carver sent me a fairly complete description of how his Magnetic Field Amplifier works, and what follows is pretty much the inventor's own description of his new audio amplification technique.

Magnetic field amplifier

The concept behind the magnetic amplifier can best be understood by referring to Fig. 1. A pair of SCR's identified in Fig. 1 as the SCAN SCR and the RAMP SCR feed amplitude-modulated current into a specially constructed transformer called a magnetic cavity. The magnetic-cavity transformer is similar to an ordinary AM detector transformer found in AM radio sets. However, there are two important differences: First, the windings are arranged so that an output occurs during the *collapse* of the magnetic field instead of during its buildup. Second, it is designed as a very high-powered AM detector transformer instead of the microwatt detector generally found in radio sets. The output of the magnetic cavity is a full wave rectified by a pair of 3-amp (30-amp peak) diodes to form a conjugate pair of time-varying audio voltages. In its most simplified form, the loudspeaker is connected across the conjugate voltages and bidirectional audio current flows in the voice-coil windings.

SCR modulator operation

Figure 1 shows the main components of the SCR modulator circuitry. The action of the scan SCR, the ramp SCR, the scan diode and the commutation diode, together with L1, L2 and C1, produces an amplitude-modulated current that corresponds to the incoming audio signal in the primary winding of magnetic-cavity transformer MC1. The peak magnitude of the current depends upon the amplitude of the incoming audio voltage. This current is pumped into the primary of MC1 during a period of time called the ramp interval. Then, the energy contained in the field of MC1 is coupled to the secondary winding and onto the speaker during a period of time called the scan interval. In general, the scan interval is shorter than the ramp interval, but during full-power operation, the ramp and scan intervals are identical.

Figure 2 shows the ramp and scan periods are composed of four timing intervals. At time t_2, the magnetic field has already been established in the cavity and is beginning to collapse. The collapsing field generates a decaying current, i_1, which decays to 0 when the energy in the field associated with the primary winding is depleted at time t_3. During the scan interval prior to t_3, the scan SCR is made ready to conduct by applying a positive voltage step from the control logic. However, the scan SCR does not conduct until a forward bias is also supplied between its anode and cathode.

At time t_3, current is no longer maintained by cavity inductance since the stored energy was transferred to the secondary of MC1 and to the load. The direction of the current is then reversed and the scan diode becomes reverse-biased. At this moment, the scan SCR is forward-biased and current flows as shown in Fig. 3.

The ramp interval operates in a manner similar to that of the scan interval. Ener-

Amplifier

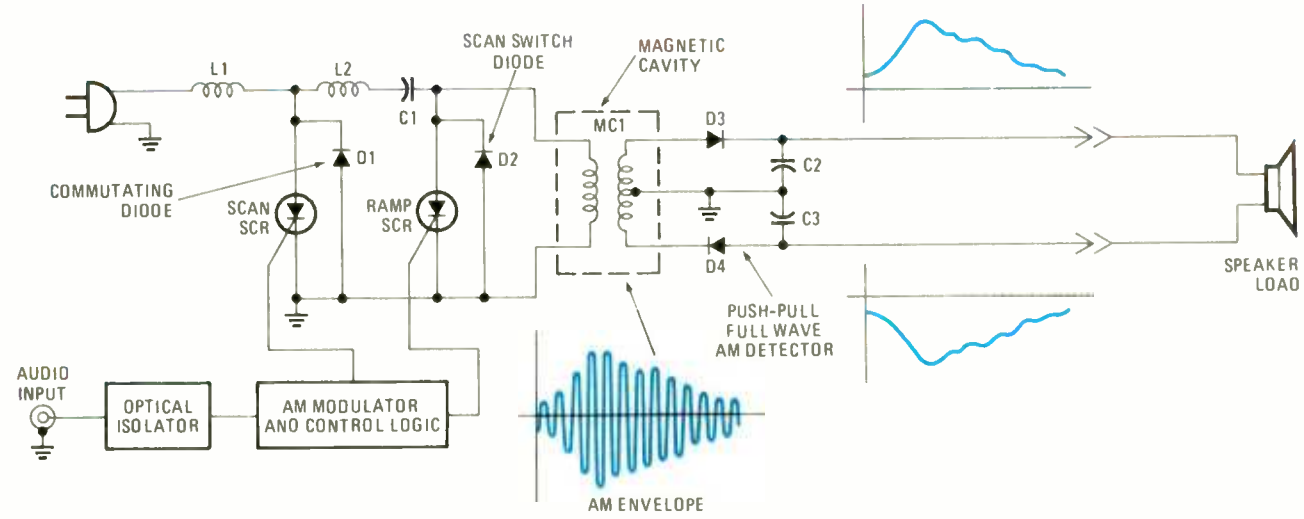


FIG. 1—THE MAGNETIC AMPLIFIER contains a magnetic cavity transformer that is driven with amplitude-modulated current. The output signal is derived from an AM detector.

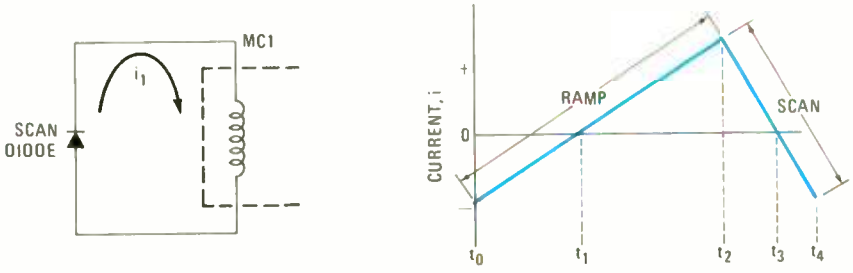


FIG. 2—DURING THE SCAN INTERVAL from t_2 to t_3, current flows through the scan diode and decays to zero.

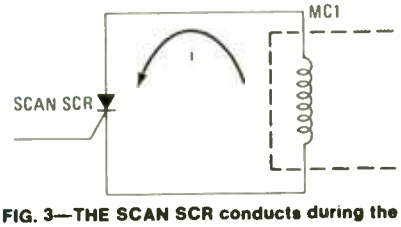


FIG. 3—THE SCAN SCR conducts during the scan interval from t_3 to t_4.

gy that is stored in the magnetic cavity is shuttled about L1, L2, C1 and the load under the control of the logic section.

The combined ramp and scan periods depend upon the amplitude and frequency of the incoming audio signal.

AM detector operation

The speaker load could simply be connected directly across the conjugate voltages at the output of the detector. However, this simple approach would yield very poor performance that would be inadequate for any high-fidelity applications. The frequency response would be poor, with high-frequency power output dropping rapidly above 6 kHz, and virtually no undistorted output power available at 10 kHz or above. In addition, excessive commutation noise at the output would impart a very high noise level to the amplifier, based upon modern high-fidelity performance standards. Finally, harmonic distortion would be about 8% at 400 Hz at all power levels. All these problems are solved by incorporating a more sophisticated AM detector that uses negative feedback to increase bandwith and lessen the noise and distortion.

Operation of the AM detector can be understood by referring to Fig. 4. The audio output is taken at the output (emitter) of Q1 for positive-going signals and at Q2 for negative-going signals. At low frequencies (e.g., 400 Hz), Q1 and Q2 essentially act as switches, except that a small voltage across the devices is developed by the combined action of the incoming audio and feedback signals applied to the input of A1. Because of the high loop gain of A1, this low voltage is just the right amount so that the output follows the input precisely. In this manner, distortion is reduced to less than 0.1%.

At high frequencies (e.g., 15 kHz), the modulator is unable to produce a varying high-frequency output. Nevertheless, it does produce a voltage with a DC component. This output voltage is filtered by C2 and C3 to form a DC voltage with a high-frequency ripple as the detector tries to follow the modulator commands.

Under these conditions, the action of Q1, Q2 and A1 resembles that of a conventional audio-output stage. In other words, the DC voltage developed across

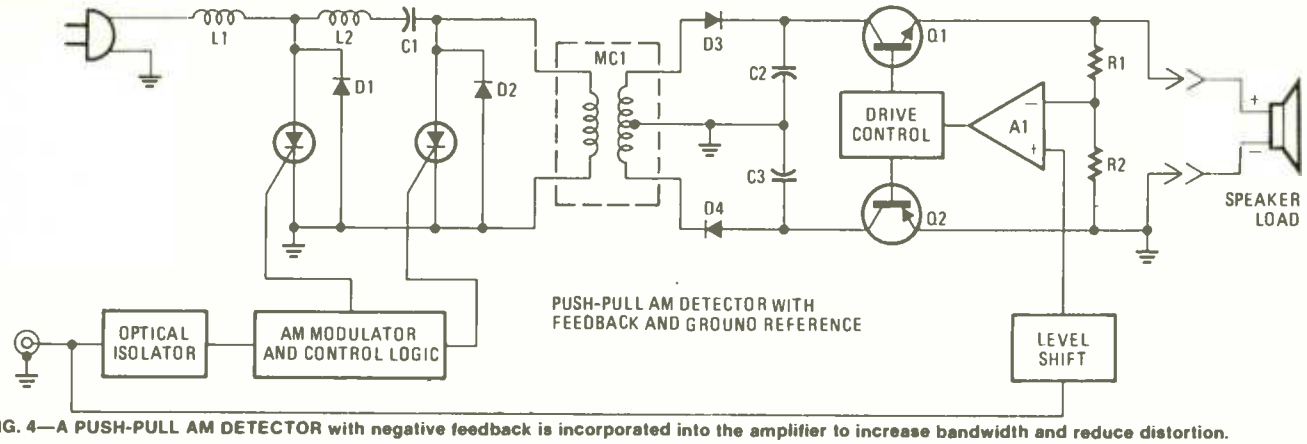


FIG. 4—A PUSH-PULL AM DETECTOR with negative feedback is incorporated into the amplifier to increase bandwidth and reduce distortion.

C2 and C3 is used to power Q1 and Q2 as a standard amplifier. Transistors Q1 and Q2 then deliver low-distortion high-frequency power to the loudspeaker load. In this mode of operation, the amplifier's efficiency is considerably reduced and, in the limiting case, is no better than that of a conventional amplifier. Mr. Carver points out, however, that the spectral-energy distribution of music signals is such that much less power is required at the high-frequency audio range than is required at mid- and low-frequencies. So, under music listening conditions, the overall efficiency of the amplifier remains very high, and it runs cool to the touch even when delivering music signals whose peaks reach the rated output level.

If a high-frequency test tone is applied to the amplifier, full power output will be delivered, but the amplifier will become quite hot to the touch. If excessive temperatures are reached, a built-in thermal-protection circuit causes shutdown to prevent any damage to the amplifier.

Since the circuit has negative feedback that forces the output to follow the input signals, it rejects the commutation noise generated in earlier parts of the circuit through the same mechanism whereby it reduces harmonic distortion.

Performance as a hi-fi amplifier

The Magnetic Field Amplifier will be small, powerful and lightweight (about 12 lb.). Mr. Carver says "it can be carried about by a human being of average physical dimensions." In conformance with Federal Trade Commission requirements, its power output rating will be 200 watts-per-channel (with both channels driven) into 8-ohm loads at any frequency from 20 Hz to 20 kHz with no more than 0.08% total harmonic distortion. The A-weighted signal-to-noise ratio claimed for the amplifier will be greater than 100 dB below its rated output, and the input sensitivity for full rated output will be 1.5 volts RMS.

The amplifier will also be equipped with an LED display having VU ballistics that will display output power-per-channel and cover a 50-dB dynamic range. It has been several weeks since I first learned of the Magnetic Field Amplifier, but in Mr. Carver's latest communication to me, he still insists that this new technology can be offered as a finished product for a suggested retail price of around $300. Even if the price does have to go up as the new amplifier enters the marketplace (and our experience has shown that the best-laid plans of audio engineers are often upset by economic realities), if the amplifier that finally emerges performs as well as promised, it could very well constitute a major breakthrough in amplifier design that could send other audio manufacturers scurrying back to their laboratories. And you can all be sure of one thing: Just as soon as I can get my hands on a test unit of the Magnetic Field Amplifier, I will put it through its paces and report the findings in a future issue of **Radio-Electronics.** **R-E**

PIONEERS IN RADIO

Edouard Branly

FRED SHUNAMAN

PROFESSOR EDOUARD BRANLY IS BEST known as the inventor of the coherer, that "tube of filings" that was for many years the only really useful detector of radio-waves. Yet it appears that, in the course of investigating his coherer, Branly set up the first organized experiment in radio transmission, some years before Popov and Marconi attempted their first transmission.

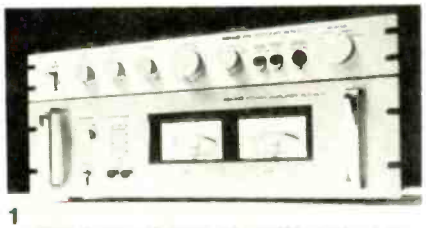
In his studies of the resistance of powdered metals, Branly noted that his results were erratic and unexplainable at times. Around 1888, he discovered the source of his trouble—nearby electrical discharges reduced the resistance of the powdered-metals. Branly then enclosed the metal powders in tubes with plugs at the ends, and tried different metals plus various degrees of compression and coarseness of grain structure. Using the combination that was the most efficient detector of electrical discharges, he arranged a semipublic demonstration on November 15, 1890.

At the time, Professor Branly was teaching in a Catholic scientific institute in Paris. The building, located at junction of the rue Vaugirard and the rue de Rennes, was L-shaped; and he arranged his experiment in two rooms of the building whose windows were in sight of each other across a courtyard. One room held his transmitter, a Leyden jar (in other experiments he used a spark coil). Branly, with his tube of filings, *(tube des limailles)* was in the other. As Branly signaled through the window, his assistant, Gendron, activated the transmitter, producing a spark. Branly immediately detected it, using a receiver containing his coherer in series with a battery and a galvanometer. Tapping the table with a small mallet, Branly "decohered" the filings. He received several signals on cue to his assistant.

Nine days after this demonstration he communicated his results to the Academy of Sciences, which then published them. They were also described in an article in two French publications, *Les Cosmos,* March 14, 1891 (in which Branly writes of using metals rods to increase the range) and *Lumiere Electrique,* May 16, 1891.

Professor Branly was certain that his experiments published in several *"revues"*, were probably read by Popov, Marconi and other experimenters. It may well be, then, that Marconi's message: "Mr. Marconi sends M. Branly his respectful compliments by wireless telegraph across the Channel, this excellent result being due in part to the remarkable works of M. Branly," then considered by Americans to refer to the only accomplishment of Branly's that they knew of, the coherer, actually referred primarily to his experiments in transmitting and receiving electrical waves. **R-E**

Radio-Electronics Audio Lab Tests



1

Nikko Beta II Preamp/ Alpha II Power Amp

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

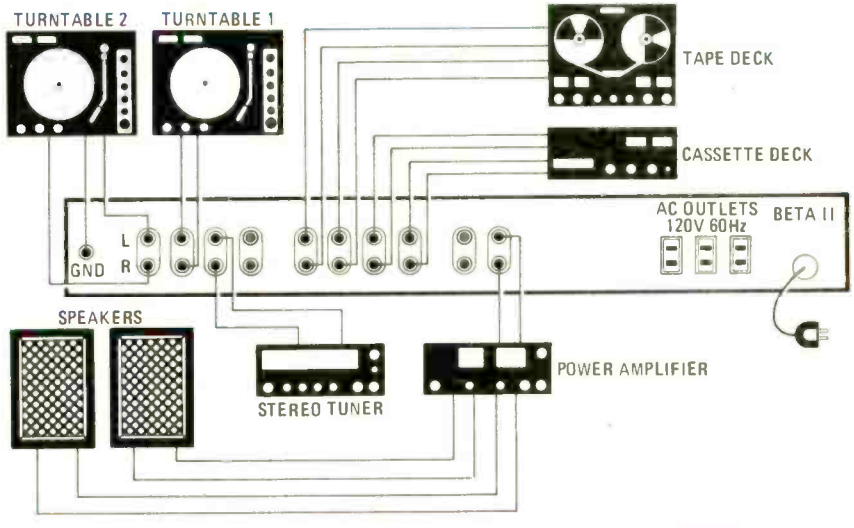
NIKKO AUDIO MAINTAINS THAT 1978 PROMISES to be the "Year of Nikko Audio," and, judging by the pair of audio components we have just finished testing, they may be right. The Nikko line has been around for several years, but, for one reason or another, has not gained the wide acceptance of other lines of audio equipment. Now, with a greatly expanded line of products, the company hopes to change all that. We chose to combine our test reports on the new *model Alpha II* power amplifier and the *model Beta II* preamplifier/control unit because these components are ideally matched for each other both in appearance and in performance level. We understand that there is (you guessed it) a *model Gamma I* stereo FM tuner that can be added to this audio pair for a complete three-piece electronic-component system. Perhaps at some future date we will have an opportunity to test that unit as well.

The *model Alpha II* and the *model Beta II* are both designed for standard 19-inch rack mounting, as shown in Fig. 1. Although the *model Alpha II* heat sinks are positioned at the rear of the amplifier (and therefore extend beyond the depth of the *model Beta II* preamp shown stacked above the amplifier), ventilating slots on the top surface of the amplifier permit any transformer heat to escape; we would therefore recommend that some nominal amount of spacing be used if you stack two units as shown. Of course, you could always position the amplifier above the preamplifier if closer spacing is required.

The *model Beta II* front panel has a power ON/OFF toggle switch on the left-hand side. Step-type BASS and TREBLE controls come next and are arranged so that when the knobs are at their mid-position, tone-control circuitry is defeated. Next comes the BALANCE control, adjacent to which is a large, 42-detent master VOLUME control accurately calibrated in dB. A tape selector switch has positions for SOURCE, monitoring of either tape-deck circuit and dubbing from either connected tape deck to the other. Pushbutton switches are provided for 20-dB audio muting and for inserting a subsonic filter. A three-position switch selects phono-input resistances of 22,000, 47,000 or 100,000 ohms, while a four-position program SELECTOR switch on the far right chooses AUX, TUNER, or either of two phono inputs.

2

The color-matched front panel of the *model Alpha II* is equipped with two large, illuminated VU output meters, calibrated both in dB and in watts across an 8-ohm load. The sensitivity of these meters can be adjusted over a wide range (from 0 dB equals 100 watts to 0 dB equals approximately 0.4 watts) by pressing two meter range pushbuttons (to the left of the meters) singly or together for a total of four ranges (0 dB, −8 dB, −12 dB and −24 dB). This arrangement permits you to gauge output levels accurately even at low listening levels, or when using high-efficiency speakers not normally requiring the high power output levels of the amplifier.



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A power ON/OFF toggle switch and a speaker selector switch are located to the right of the front panel. The speaker selector switch not only selects main, remote or both sets of connected speakers, it also has an OFF position. Since the *Model Beta II* preamplifier features twin pairs of output jacks, you can connect its signal output to a second power amplifier and

MANUFACTURER'S PUBLISHED SPECIFICATIONS:

ALPHA II:
Rated Power Output: 110 watts-per-channel, 15 Hz to 20 kHz, into 8-ohm loads, continuous power. **Harmonic Distortion:** 0.03%. **IM Distortion:** 0.03%. **Frequency Response:** 5 Hz to 100 kHz, −1 dB. **Damping Factor:** 70. **Input Sensitivity:** 1.0 volt. **S/N Ratio (IHF A-weighted):** 110 dB. **Phase Response:** ± 10 degrees from 20 Hz to 30 kHz at 1 watt. **Power Consumption:** 450 watts. **Dimensions:** 18 19/32 W × 5 7/8 H × 12 7/8-inches D. **Weight:** 29.7 lb. **Suggested Retail Price:** $420.

BETA II:
Rated Output Level: 1.0 volt. **Input Sensitivity:** phono 1 & 2, 2.5 mV; high-level inputs, 150 mV. **Frequency Response:** phono (RIAA), ±0.2 dB; high level, −1 dB, 10 Hz to 100 kHz. **S/N Ratio IHF A-Weighted:** phono, 77 dB; high level, 100 dB. **Total Harmonic Distortion (At Rated Output):** less than 0.007%. **Phono Overload:** 250 mV at 1 kHz. **Bass Control Range:** ± 10 dB at 70 Hz. **Treble Control Range:** ± 10 dB at 10 kHz. **Subsonic Filter Cutoff Frequency:** 15 Hz. **Power Requirements:** 11 watts. **Dimensions:** 18 19/32 W × 2 3/32 H × 10-Inches D. **Weight:** 9.9 lb. **Suggested Retail Price:** $210.

then turn off the speakers connected to the *model Alpha II*, if required. This feature is necessary since the *model Alpha II* possesses no input-level control of its own.

Figure 2 shows the rear panels of both units. The push-type speaker terminals and input jacks of the *model Alpha II* amplifier are flanked by identical massive heat sinks (one for each channel) onto which are mounted the power-output transistors. In addition to the required low-level and high-level input jacks, tape-in and tape-out jacks, and the two pairs of main output jacks, the rear panel of the *model Beta II* preamplifier is equipped with a chassis ground terminal and three convenience AC outlets (two switched, one unswitched). When the two units are used together, you would connect the power cord of the *model Alpha II* to one of the switched receptacles on the *model Beta II* so that turning on the preamplifier would simultaneously turn on the power amplifier. Figure 3 shows a typical system hookup using the *Beta II*. In addition to the components shown, a second pair of speakers can also be connected to the power amplifier.

Laboratory measurements

The Nikko *model Alpha II* amplifier and *model Beta II* preamplifier were tested separately in our lab. For all subsequent listening tests, they were used together, as a total-component system, to drive both the low- and high-efficiency speakers that we use as reference standards.

Table 1 contains a summary of our measured results for the *model Alpha II* amplifier. The power output for this unit far exceeded published ratings at mid-frequencies, and surpassed them by a wide margin even at the low-frequency and high-frequency extremes. The amplifier does not have an FTC power rating for 4-ohm loads, and, in fact, does not deliver much more power at that low impedance than it does with its rated 8-ohm loads. Full power output (110 watts-per-channel into 8 ohms) is obtainable over a frequency range from 12 Hz to 21 kHz for the rated distortion figure of 0.03%. Both the total harmonic distortion and IM distortion are considerably lower than the rated value at nominal full power-output levels at all frequencies within the audible bandwidth. The overall frequency response at low power-output levels, while falling short of the wideband claims, nevertheless extended from a subsonic 5 Hz all the way out to 70 kHz.

Table 2 summarizes measured results obtained for the matching *model Beta II* preamplifier. In our samples, the gain of the *model Beta II* was somewhat lower than claimed. As a result, a 4-mV input level was required to produce a rated 1.0-volt output from the main output terminals. Since the *model Alpha II*'s sensitivity (for full rated output) measured exactly 1.0 volt, that means that (in our case at least), higher-output phono cartridges would be necessary if normal master volume control settings are to be used on the preamplifier. Lower-output phono cartridges would require unusually high clockwise settings of this control. This disparity, which also showed up in the high-level inputs (a 250-mV sensitivity instead of the claimed 150 mV) will be less significant in the case of tuner or auxiliary inputs, since most tuners and auxiliary components (tape decks or TV audio) deliver more than 250 mV.

RIAA equalization was extremely accurate, as shown by the normalized sweep-response curve of Fig. 4. In this spectrum-analyzer sweep, the vertical sensitivity was set for only 2

TABLE 1

RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer: **Nikko** Model: **Alpha II**

POWER AMPLIFIER PERFORMANCE MEASUREMENTS

	R-E Measurement	R-E Evaluation
POWER OUTPUT CAPABILITY		
RMS power/channel, 8-ohms, 1 kHz (watts)	124.0	Excellent
RMS power/channel, 8-ohms, 20 Hz (watts)	118.0	Excellent
RMS power/channel, 8-ohms, 20 kHz (watts)	118.0	Very good
RMS power/channel, 4-ohms, 1 kHz (watts)	N/A	
RMS power/channel, 4-ohms, 20 Hz (watts)	N/A	
RMS power/channel, 4-ohms, 20 kHz (watts)	N/A	
Frequency limits for rated output (Hz-kHz)	12–21	Very good
DISTORTION MEASUREMENTS		
Harmonic distortion at rated output, 1 kHz (%)	0.008	Superb
Intermodulation distortion, rated output (%)	0.01	Excellent
Harmonic distortion at 1-watt output, 1 kHz (%)	0.01	Excellent
Intermodulation distortion at 1-watt output (%)	0.03	Very good
DAMPING FACTOR, AT 8 OHMS	86	Excellent
MISCELLANEOUS MEASUREMENTS		
Input sensitivity (V)	1.0	
Signal-to-noise ratio (IHF A-weighted) (dB)	110	Excellent
Frequency response (Hz to kHz, ± 1 dB)	5–70	Very good
OVERALL POWER AMPLIFIER PERFORMANCE RATING		Excellent

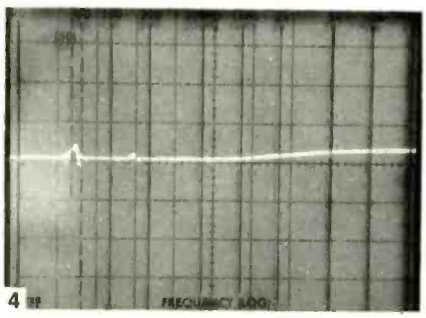
TABLE 2

RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer: **Nikko** Model: **Beta II**

PREAMPLIFIER PERFORMANCE MEASUREMENTS

	R-E Measurements	R-E Evaluation
RATED OUTPUT LEVEL REFERENCE: 1.0 volt		
PHONO PREAMPLIFIER MEASUREMENTS		
Frequency response (RIAA ± dB)	0.2	Superb
Maximum input before overload (mV)	300	Excellent
Hum/noise referred to full output (dB) (A-weighted) (at rated input sensitivity)	77	Very good
HIGH LEVEL INPUT MEASUREMENTS		
Frequency response (Hz-kHz, ± dB)	8–40, 1.0	Excellent
Hum/noise referred to full output (dB) (A-weighted)	89	Very good
Residual hum/noise (minimum volume) (dB) (A-weighted)	92	Good
TONAL COMPENSATION MEASUREMENTS		
Action of bass and treble controls	See Fig. 6	Very good
Action of secondary tone controls	N/A	N/A
		Good
Action of low frequency filter(s)	N/A	(see text)
Action of high frequency filter(s)	N/A	N/A
COMPONENT MATCHING MEASUREMENTS		
Input sensitivity, phono 1/phono 2 (mV)	4.0/4.0	
Input sensitivity, auxiliary input(s) (mV)	250	
Input sensitivity, tape input(s) (mV)	250	
Output level, tape output(s) (mV)	250	
Output level, headphone jack(s) (V or mW)	N/A	
EVALUATION OF CONTROLS, CONSTRUCTION AND DESIGN		
Adequacy of program source and monitor switching		Very good
Adequacy of input facilities		Excellent
Arrangement of controls (panel layout)		Excellent
Action of controls and switches		Very good
Design and construction		Excellent
Ease of servicing		Very good
OVERALL PREAMPLIFIER PERFORMANCE RATING		Very good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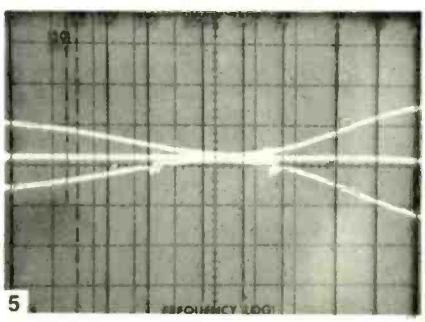
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dB-per-vertical-division. The deviation from exact RIAA response was no greater than 0.2 dB at any frequency from 20 Hz to 20 kHz. The phono signal-to-noise ratio measured 77 dB (IHF A-weighted) and phono-overload capability was a high 300 mV.

Tone-control range of the BASS and TREBLE controls is shown in the scope photo of Fig. 5, taken directly from the display on our spectrum analyzer.

Summary

Table 3 presents an overall evaluation of the *model Alpha II* and *model Beta II*, as well as our summary comments. While Nikko, like so many other hi-fi component manufacturers, tends to overuse the word "professional" in describing the *model Alpha II* and *model Beta II* (actually, professional units usually contain balanced 600-ohm inputs and outputs, XLR connectors and more, none of which are contained in these units), they offer excellent value for the *non*professional, but nevertheless serious-minded, audiophile. **R-E**

TABLE 3

Manufacturer: **Nikko** Model: **Alpha II & Beta II**

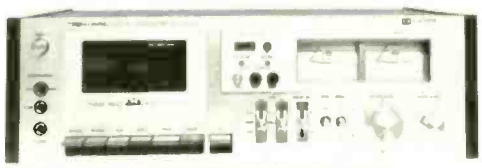
OVERALL PRODUCT ANALYSIS

Retail price	**$600 ($400 for amp, $200 for preamp)**
Price category	**Low/medium**
Price/performance ratio	**Excellent**
Styling and appearance	**Excellent**
Sound quality	**Very good**
Mechanical performance	**Very good**

Comments: This handsome pair of components puts to rest the notion that high-quality separates must necessarily be very expensive. Nikko's success with their higher-powered *model Alpha I* amplifier (with twice the power of the *model Alpha II*) and its matching *model Beta I* preamplifier (with slightly better specs and a few more control features) must have encouraged them to produce an equally good-looking pair of components that just naturally fit together. The price tag of $630 for a 110-watt-per-channel power amplifier and a companion preamplifier control chassis is quite low, especially when you consider the level of performance provided by the combination. Of course, there are a few niceties missing. For example, there is no way to listen to headphones with this combination. And, although dubbing as well as tape monitoring are provided for either of two tape decks, it is not possible to choose monitoring of *either* deck during the dubbing process. In our sample units, the preamplifier gain was a bit lower than claimed, which necessitated setting the volume control rather high when using lower-output cartridges.

As far as sound quality is concerned, the *model Alpha II/Beta II* combination is a real winner.

Radio-Electronics Audio Lab Tests Realistic SCT-30 Cassette Deck



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CIRCLE 127 ON FREE INFORMATION CARD

ONE QUICK LOOK AT THE FRONT PANEL OF the Realistic *model SCT-30* stereo cassette deck (distributed by Radio Shack outlets throughout the U.S.) tells you that the stereo cassette deck has come a long way since it was first introduced by Philips of The Netherlands nearly 15 years ago.

The front panel of this front-loading deck is equipped with just about every feature the serious recordist would want in a home cassette deck.

Figure 1 shows that the front panel has a POWER on-off pushbutton at the extreme upper left, below which are left and right microphone inputs plus a phone jack. When a single microphone is plugged into the left-channel microphone jack, a full-width monophonic track is recorded automatically. The cassette compartment door swings open gently when the EJECT pushbutton is pressed, and the cassette transport features a dual-capstan drive system as well as a three-head erase, record and playback head arrangement. The record and play heads are actually contained in a single-head package, so that no alignment is required between record and play-head gaps.

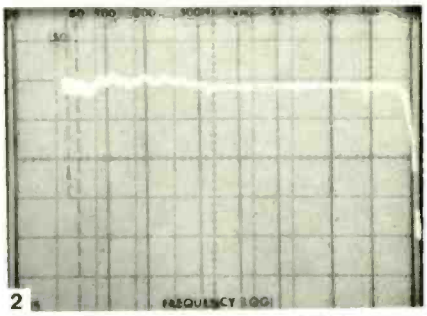
Perhaps the most important and unusual control on the entire unit is on the rear panel rather than on the front. This control is a bias FINE-TUNE adjust control that provides additional continuous variation of bias current over and above the three fixed settings of the three-position bias switch on the front panel. When making critical recordings, the bias should be adjusted specifically to suit the actual brand and type of tape used.

The owner's manual suggests a simple but effective method to make this adjustment in the absence of any test equipment. You simply record some FM interstation noise on a cassette (this type of noise is close to random white noise since it contains all audio frequencies). Then, while switching successively between source and tape (by using the front-panel source/tape switch), you adjust the vernier bias control until both source and recorded noise sound identical, or as close as possible.

Performance measurements

Since this tape deck has specific settings for three basic types of tapes, we used three types in testing, instead of our usual two. We used TDK type AD (for standard, ferric low-noise tape), TDK type SA (as a substitute for CrO_2) and 3M *Scotch* ferric-chrome tape (*Master III*). Basic frequency-response limits and other measurements are shown in Table 1, but the results require some explanation.

The fine-tune bias control arrived in our lab set to its mid-position. It was an optimum setting for the ferric-oxide TDK AD tape; the record/play response for that sample is shown in Fig. 2.



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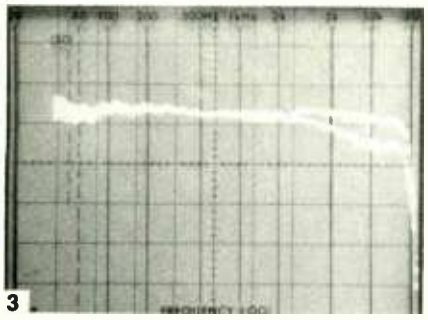
When we tried to plot the response curve for the ferric-chrome tape sample (after resetting the front panel-bias and equalization switches), we were startled to discover that response began to fall off at around 5 kHz (see the lower trace of Fig. 3). Using the rear-panel bias vernier control, we were easily able to restore a reasonably good high frequency response (see the upper trace of Fig. 3) without degrading the tape sample's distortion characteristics.

The same situation held true when we first plotted our record/play response for the TDK SA tape. The first results of this test are shown in Fig. 4; while Fig. 5 shows the response range

MANUFACTURER'S PUBLISHED SPECIFICATIONS:

Frequency Response: (standard tape), 30 Hz–15 kHz, ±3 dB; (CrO_2 tape), 30 Hz–16 kHz, ±3 dB; (ferri-chrome tape), 30 Hz–15.5 kHz, ±3 dB. **S/N Ratio** (CrO_2, with Dolby On, CCIR-Weighted): 61 dB. **Distortion at 0 VU Level:** 0.9%. **Cross-Talk:** 60 dB. **Wow and Flutter:** less than 0.06% WRMS. **Erase Ratio:** 70 dB. **Input Sensitivity:** Mike, 0.3 mV. **Line In** (Auxiliary): 80 mV. **Output Levels** (Preamplifier): 0.55 volt, adjustable. **DIN Out:** 0.25 volt maximum. **Bias Frequency:** 105 kHz. **Fast Rewind Time:** 125 seconds (for C-60 cassette). **Power Requirements:** 120 VAC, 60 Hz 15 watts. **Dimensions:** 18 W × 5 1/16 H × 10 Inches D; **Weight:** 16½ lb. **Suggested Retail Price:** $379.95.

that can be obtained by varying the vernier bias control from one extreme to the other while the front-panel bias switch is set to the Chrome tape position. When the bias control is set to obtain flat response to beyond 16 kHz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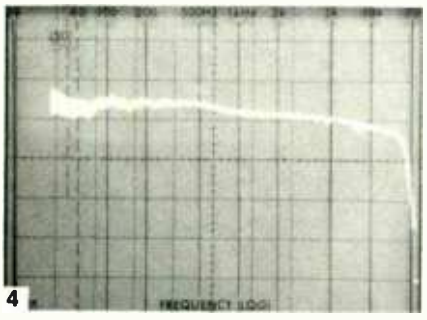
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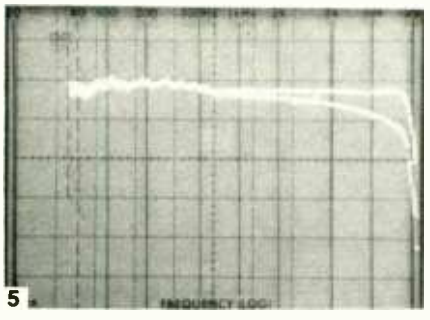
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(not the values shown in Table 1), the harmonic-distortion content of the test tape increased to 1.4% for a 0 VU record level (from the previously measured 1.1%) and to 2.3% at a ±3-dB record level (compared with the previously measured 2.0%). You therefore have the option of extending overall response slightly at the expense of harmonic distortion. This option is generally available on professional studio machines, but few home cassette recorders provide this degree of flexibility.

Signal-to-noise values shown in Table 1 (for each tape type) correspond to readings that were obtained before the bias control was reset for optimum response and therefore suffered a bit when that adjustment was made.

Wow-and-flutter measurements were about the lowest we have read for any home stereo cassette deck. Even the unweighted (RMS) wow-and-flutter value was a low 0.07%.

Summary

The overall product evaluation is found in Table 2, together with our summary comments. Generally, serious audiophiles have always eyed so-called "store brand" high-fidelity products with some suspicion. In the case of the *model SCT-30*, however, we believe it compares favorably with other top-brand stereo cassette decks in its price class and offers a better value than some. **R-E**

TABLE 1

RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer: **Realistic** Model: **SCT-30**

CASSETTE TAPE DECK MEASUREMENTS

	R-E Measurements	R-E Evaluation
FREQUENCY RESPONSE MEASUREMENTS		
Frequency response, standard tape (Hz–kHz ± dB)	20–15.7, 3.0	**Excellent**
Frequency response, CRO_2 tape (Hz–kHz ± dB)	20–14.5, 3.0	**(Good) see text**
Frequency response, other (see text) (Hz–kHz ± dB)	20–16.0, 3.0 See figs. 3,4,5,6	**See text**
DISTORTION MEASUREMENTS (RECORD/PLAY)	**AD/SA/FeCr**	
Harmonic distortion at −3 VU (1 kHz) (%)	0.9/0.7/1.2	**Excellent**
Harmonic distortion at 0 VU (1 kHz) (%)	0.9/1.1/1.5	**Very good**
Harmonic distortion at +3 VU (1 kHz) (%)	1.2/2.0/2.3	**Very good**
Level for 3% total harmonic distortion (dB)	+7/+7/+5	**Excellent**
SIGNAL-TO-NOISE RATIO MEASUREMENTS		
Standard tape, Dolby off (dB) ("A"-weighted)	58	**Excellent**
Standard tape, Dolby on (dB) ("A"-weighted)	65	**Excellent**
CRO_2 tape, Dolby off (dB) ("A"-weighted)	63	**Excellent**
CRO_2 tape, Dolby on (dB) ("A"-weighted)	69	**Excellent**
FeCr tape, Dolby off/on (dB) ("A"-weighted)	59/65	**Very good**
MECHANICAL PERFORMANCE MEASUREMENTS		
Wow and flutter (%, WRMS)	0.05	**Superb**
Fast wind and rewind time, C–60 (seconds)	100	**Fair**
COMPONENT MATCHING CHARACTERISTICS		
Microphone input sensitivity (mV)	0.3	
Line input sensitivity (mV)	75	
Line output level (mV)	480	
Phone output level (mV)	38.7 (8 ohms)	
Bias frequency (kHz)	105	
TRANSPORT MECHANISM EVALUATION		
Action of transport controls		**Very good**
Absence of mechanical noise		**Excellent**
Tape head accessibility		**Good**
Construction and internal layout		**Very good**
Evaluation of extra features, if any		**Excellent**
CONTROL EVALUATION		
Level indicator(s)		**Excellent**
Level control action		**Good**
Adequacy of controls		**Excellent**
Evaluation of extra controls		**Excellent**
OVERALL TAPE DECK PERFORMANCE RATING		**Excellent**

TABLE 2

RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer: **Realistic** Model: **SCT-30**

OVERALL PRODUCT ANALYSIS

Retail price	**$379.95**
Price category	**Medium**
Price/performance ratio	**Superb**
Styling and appearance	**Very good**
Sound quality	**Excellent**
Mechanical performance	**Excellent**

Comments: The first three-headed cassette deck that we ever tested sold for nearly $1000. Prices for such machines have now come down drastically, which proves that today's high-fidelity components offer greater value (even in the face of the shrinking dollar) than ever before. The Realistic *model SCT-30* certainly qualifies in this regard. Not only does its three-headed configuration provide continuous monitoring of recorded results (perhaps even more important in a cassette deck than in an open-reel machine, because of the former's limited dynamic range), but it allows you to adjust all critical taping parameters so that the machine is optimized for any brand or type of tape used.

The one feature this machine lacks is a line/microphone mixing capability, although the serious recordist would likely want to purchase a separate line/microphone mixer in any event. Tape wow-and-flutter was remarkably low for a machine of this type and price category, and the use of a double head (record and play) in a single tape-head package eliminates the need for any complex azimuth alignment procedures normally associated with three-headed cassette machines. It also reduces the lag-time between the actual recording and its monitored playback version. The dual capstan construction is undoubtedly responsible for the smooth tape motion we measured, but transport lever controls are also smooth-operating and extremely reliable as well as foolproof.

Since Dolby circuitry had to be incorporated in this deck in any case, Radio Shack wisely included an option that permits you to use the Dolby-decode circuitry as an adjunct to FM listening during Dolby broadcasts. All this, plus dual-Dolby calibration and vernier bias adjustment in an under-$400.00 machine makes the Realistic *model SCT-30* a real winner.

Forest Belt tells . . .

What You Need To Know About Troubleshooting Video Cassette Recorders

TO HEAR SOME MANUFACTURERS, YOU WOULD BELIEVE that home video recorders have already become a new boom product. While "boom" may be an optimistic evaluation, video cassette recorders (VCR's) have definitely captured the imagination of many consumers, who have plunked down $1000 or more for a VCR and a few blank video cassettes. With prices well below that now, and with color cameras becoming less costly, a definite market is forming.

Along with sales must come repairs and maintenance. As with color TV in the early 1950's, a major sales inducement is the knowledge that technical help can be found quickly and conveniently.

As you may know, troubleshooting a video tape recorder bears only a casual resemblance to servicing an audio recorder. There's truly a lot to learn about video cassette recorders on your way to real understanding. But, on the other hand, VCR's won't stump you. All they consist of is electronic circuits, sprinkled with a generous dash of mechanical systems.

You'll find this combination of mechanics and electronics rather elaborate. There's nothing to match it in past consumer electronics servicing. You must keep a lot of information in mind when you analyze almost any VCR operation. However, any reasonably competent technician can do it.

This Special Section brings you face to face with video cassette recorders. If you're going to sell VCR's, and service them, you'll want to know what you're getting into. What expenditures in time, effort and money will you have to make?

If your decision is "go," you have little time to waste. VCR's are already here.

What Will You Do About VCR's?

Whether you want to sell, service or simply use one, you should understand how they work, how to operate them properly and the different types that are available.

FOREST BELT

INEVITABLY THE QUESTION COMES UP: How do you plan to participate in the future market for home video recording? After all, you're in electronics, which alone means you have some of the experience required. If consumer electronics is your bag, you're already in on the ground floor.

It must be admitted, video tape recorders are not for everybody. They are a unique product, whether you want to use them, sell them, or service them. You may find (as I do) that it is an enticing challenge to learn to understand these intricate mechanisms. Rest assured that technicians who ultimately take care of VCR's will not be ordinary folk. A high degree of technology goes into video cassette recorders produced for the home market.

Moreover, there's pleasure in bringing a new and different entertainment medium to your customers, not to mention profits. Video cassette recorders for home use are comparatively expensive. Whoever sells VCR's successfully can expect satisfying financial returns.

Manufacturers of VCR's report (as is customary with new products) "not many service problems." However, they refer chiefly to in-warranty breakdowns. Outside of the warranty, the toughest problem so far is finding someone equipped and qualified to troubleshoot the VCR's. And, of course, that's where *you* come in if you're so inclined.

A video cassette recorder *does* develop troubles, and, since it costs a great deal, a customer is less likely than usual to balk at sensible (profitable) repair fees.

Beyond doubt, the most natural way to grow familiar with a VCR is to own one and use it. Put it through every pace shown in the instruction booklet. Invent some innovative uses yourself. Record some programs with a TV set as monitor, and without any monitor. Get the feel of operating a video camera.

THE MAIN VCR FORMATS

	Beta (Sony)		VHS (Matsushita)	
Companies	Aiwa Pioneer Sanyo (also V-Cord) Sears, Roebuck Sony Toshiba Zenith		Akai General Electric Hitachi JVC Magnavox Curtis Mathes MGA Montgomery Ward Panasonic J.C. Penney Quasar (also VX-2000) RCA Sharp Sylvania	
	1 Hr	**2 Hr**	**2 Hr**	**4 Hr**
Tape Speed (ips) (mm/s)	1¾ 40	7/16 20	15/16 33.35	21/32 16.67
Writing Speed (ft/s)	22.63		19	
Video head gap (microns)	Beta 1–60	Beta 2–40	VHS2 - 60	VHS4 - 39
Track overlap (microns)	none	11	none	10
Azimuth	±7°		±6°	
Cassette size (in)	3¾ × 6⅛ × 1		4 × 7½ × 1	
Tape lengths	250, 500, 750* feet		125, 250 meters	
Type loading	B (beta) by Phillips		M—by Sony	
RECORDING FREQS:				
Luminance FM	3.5 to 4.8 MHz		3.4 to 4.4 MHZ	
Chroma-under subcarrier	688.363 kHz		629.36kHz	
Audio-direct (Hz)	50–10,000	50–8,000	100–8,000	100–6,000

*New 750-ft cassette allows 1½ or 3 hr on Beta units

Learn what kind of lighting a color camera demands.

Another question is which VCR format should you choose. Of the several you may encounter, only two presently deserve close attention for home use. Three other types are already being phased out, and one or two newer formats lack serious acceptance.

Concentrate on the two standard formats: *Beta-2*, manufactured by Sony, and *VHS-4*, made by JVC (Matsushita). A large number of television manufacturers have chosen either of these formats for their own VCR products (see Table 1, which also lists characteristics of some other formats).

If you expect to go into VCR servicing in a big way, obtain one model in each format. Future articles will tell you what you must know to feel comfortable with the innards of both types. It helps to have working units at hand as you learn.

Servicing a VCR

So far, VCR sales have been limited; in 1978 fewer than a half-million units were sold. But more are being sold every month. The 1978 Christmas season saw a substantial jump in VCR sales, plus a lot of accessories.

For service during the warranty period, most manufacturers provide some backup repair. Authorized repair centers are not numerous, but they do exist around the country. Warranty

GENERAL ELECTRIC VHS VCR

service may not always be convenient except in large cities, but it is available.

Your VCR customer should rely on you for service, in or out of warranty. He'll want you to make the arrangements for service, even if you don't provide it on-premises. If you plan to charge him for handling and shipping in or out of warranty, make that clear at the time of the sale. Put it in writing, signed by you *and* the customer.

For all the above reasons, you may prefer to handle the servicing in your own shop. Training is available (see page 68). Tools and equipment require only a modest investment, if you're already providing television service. Video cassette recorders require a certain attitude and approach. The following pages take up these considerations; and may definitely influence your choice — to service or not to service.

VCR Tools And Instruments

A look at the equipment you will need to service VCR's

IF VIDEO CASSETTE RECORDERS ARE new to you, your first inclination might be to assume you can work on a VCR using the same equipment you do on TV sets. In part, that's true. Certain instruments and tools suit both types of troubleshooting. However, VCR technology places certain demands on you that you don't encounter with TV receivers.

Anyone thinking about taking on VCR servicing should expect to spend a bit of money on test instruments. How much depends on what equipment you already own. Let's take this one step at a time and discuss what you really need.

Mechanical cleaning/adjusting

Several major VCR suppliers offer a kit of tools for making mechanical adjustments. Fortunately, the circuits inside all VCR's are very similar — at least within each format. The tools for servicing an RCA VCR work equally well for a Magnavox or any other VHS machine. (RCA Part No. 199049, priced just over $500, includes test/alignment tape and all mechanical jigs and tools.) So do Zenith tools fit most Sony Beta-2 units. The differences between units are mostly in the cabinet fastenings or the like.

Certain hex-type hardware in either format is made in metric size. Plan to invest early in a set of small metric-size wrenches. Even coil slugs have metric openings, and the correct alignment tools are part of the prepackaged servicing kit for each type of VCR.

ALIGNMENT and troubleshooting that includes the video heads calls for a prerecorded cassette that manufacturers make available (at a price) to servicers.

Vital positioning fixtures for cassette holders are an absolute necessity. A tool kit for VHS recorders includes torque gauges and a tension scale, all vital for critical tape-transport adjustments. If any of these adjustments is out of tolerance, the entire machine can shut down. The Beta-format servicing package from Zenith includes a torque-measuring cassette. This cassette is a bit easier to use than torque gauges, but, of course, it doesn't fit VHS machines. A few special screwdrivers can round out your collection of nonstandard tools.

Routine maintenance of a video cassette recorder includes cleaning. Heads and tape-path components must have oxides, dust and film swabbed off every 500 hours of operation.

Cleaning kits are available. Or you can buy your own supply of long-stem cotton swabs and *Freon TF* solvent (don't use alcohol). A soft, lintless patch such as that available at some drug stores in the baby-goods department is recommended for cleaning larger sections but not the tape heads.

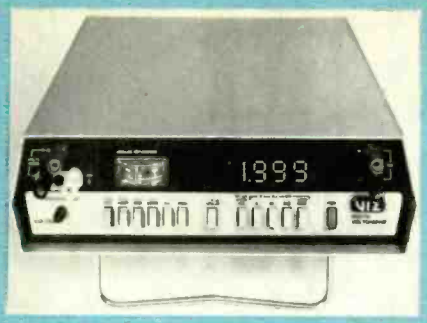
Cleaning drive parts is a must for trouble-free operation. Drive wheels, pulleys and rubber belts seem to attract grime. Even mild slippage can seriously degrade performance, or even shut the machine down. Also plan on replacing rubber belts every thousand hours or thereabouts.

Finally, most critical of all, in the mechanical portions of a machine, is lubrication. It's critical in three ways: in the lubricant you use, how much, and where you apply it. I recommend that you buy lubricant kits for both Beta-2 and VHS-4 types of VCR's. RCA sells a VHS lube kit (RCA Part No. 199050) for under $20.

Follow the VCR manufacturers' lubricating instructions carefully. If you lubricate correctly, this will avoid adding technician-induced troubles to any others.

General test equipment

The instrument used most in VCR servicing is a digital multimeter. Some service data of course calls for a VTVM



NARROW TOLERANCES of some voltages in VCR servicing recommend at least a 3½-digit multimeter.

and some for a VOM. Your own preference should really influence your choice. However, many voltage tolerances are rather close in VCR electronics. In those instances, you are best served by an accurate DMM.

You measure DC voltages mostly. The only time you might want to use an analog-type meter is when you have a zero-center adjustment to make. Even that's easy enough with a digital meter that has automatic zeroing and polarity reversal.

You need an RF-IF alignment setup about as often as you do in ordinary TV receivers, perhaps even less. Video cassette recorder tuners and IF strips are state-of-the-art designs — some tuners are the new digitally tuned type. Not much alignment will be called for. But when the VCR does need it, make sure to use *good*-quality, not inexpensive, alignment gear.

An audio signal generator comes in handy. Some Beta-format adjustments require it. It's also useful for tracing audio-track problems, whether in dubbed-over material or in the regular voice-recording channel.

In addition, there are some specific instruments you simply cannot do without. One is a really good oscilloscope. Another is a color video generator. A frequency counter is probably an instrument you've never used, at least not in TV servicing. You need one for VCR troubleshooting. Because frequency counters are so important, we'll take a look at them and their requirements separately.

NEW TO TELEVISION servicing, frequency counter occupies important place in VCR troubleshooting.

Last, although far from least, you need a test cassette for both types of VCR. The cassettes prepared by the manufacturers are expensive, but are worth every cent of their $100-or-so price. You cannot match them yourself without lab-grade signal sources.

RCA's VHS test/alignment cassette can be used on any VHS machine. Its tape contains several minutes each of carefully prescribed test signals. These signals include monochrome video patterns; EIA-type NTSC color-bar patterns; a series of multibursts at 0.5 MHz, 1 MHz, 2 MHz, 3 MHz and 4 MHz, for checking frequency response; control tracks for standard-play (SP) and long-play (LP); plus sound with some of the signal patterns.

For Beta-format machines, the Zenith test/alignment cassette contains 5 minutes of a 75% (saturation) NTSC color-bar pattern; 5 minutes of a monochrome test pattern, half of that time combined with a 333-Hz audio and the rest with a 5000-Hz tone. All this is recorded at the two-hour or LP speed. The cassette then continues (in the one-hour mode) with another 5 minutes of color bars with 3000-Hz sound; 5 minutes of monochrome with 7000-Hz sound; and, finally, a swept RF test signal for making certain video frequency-response tests.

Using an oscilloscope

Whatever your feeling about oscilloscopes for TV servicing, do not try to repair a *VCR* without a good triggered oscilloscope. If you don't use one, you will not get very far in your work. If you don't really know how to use a dual-trace triggered oscilloscope, learn how right away.

(*Editor's note:* The May 1978 issue of **Radio-Electronics** published an entire section called "What You Need To Know About Triggered Oscilloscopes." Back issues are available for $1.50 each. Request the May 1978 issue. Also you can get a *Service Training Monograph* entitled "Triggered Oscilloscopes — Four Hours to Familiarity," that teaches you how to use a basic triggered scope. You can obtain it for $12.50 postpaid from Forest Belt, Box 68120, Indianapolis, IN 46268.)

The oscilloscope you use for VCR work must be a dual-trace instrument. It should have a bandwidth capability of 15 MHz or greater; a 5-mV-per-division sensitivity (or better); and an X–Y feature that is easy to set up because you will occasionally have to arrange a vector display.

The manner in which the scope is triggered is important. You must be able to trigger it internally from either channel and, of course, externally. For some video tracing, a built-in TV integrator is a must, so you can use internal triggering for video frames. Or, if the

SENCORE INSTRUMENT has its own video and color bar patterns, plus multiburst for frequency response tests.

HF-Reject feature has a cutoff point somewhere below 12 kHz or so, you can manage all right with that.

I prefer a triggered scope that allows a manual choice between alternated-trace switching and chopped modes. Some scopes make this choice automatic, ganged with timebase switching.

Some scopes even allow you to choose triggering, during alternated-trace switching, from both channels — that is, from first one and then the other as the traces switch. This is the most versatile arrangement, since it facilitates stabilizing two waveforms that are not necessarily at the same frequency or repetition rate.

Look for lots of little factors in the scope you buy:

1. Graticule illumination.
2. A beam that's bright enough at fast sweep speeds without degrading the focus.
3. Tight round beam size for displaying the cleanest detail in complex waveforms.
4. Distinct, definite triggering control.
5. Operating controls on the front panel grouped logically instead of helter-skelter.
6. Stable warmup without position changes in the traces beyond the first two or three minutes.
7. Accurate timebase calibrations and accurate Y-axis calibrations.

DUAL-TRACE oscilloscope, with bandwidth 15 MHz or more, is needed for VCR troubleshooting and adjustments.

DELAYED TRIGGER feature in more expensive oscilloscopes enables viewing waveforms you could not otherwise display.

One feature that really helps during certain VCR servicing procedures, although you can manage without it, is the *delayed trigger*. This feature makes a scope more expensive; delayed-trigger sweep is what I would term an advanced feature. Not every technician even knows how to use it. However, delayed-trigger operation can offer distinct advantages because it lets you observe portions of a waveform that you cannot view any other way.

If you're buying a new triggered scope and can afford the extra cost, buy a scope that has delayed trigger. You won't regret it. If you don't have the extra cash, you can purchase any good dual-trace scope such as the one described. You cannot service video cassette recorders without one.

Color video generator

Most VCR makers recommend an NTSC-type color video signal for checking out their units. They generate an EIA-standard color-bar pattern.

On a TV screen, this color-bar pattern contains eight bars of color across the top half of the screen. The chroma of these eight bars is phased to create white, yellow, cyan, green, magenta, red, blue and black from left to right. Chroma saturation has been carefully set to 75%.

The bottom half of the screen displays one bar of chroma with Q-phase, one in minus-I phase, then a block of 100% white for reference (often termed a *window* or a *superpulse*), and a block of reference black. The photographs show how this signal looks on a TV screen, and how one line and one frame appear on an oscilloscope.

An advantage of the NTSC signal is that most of the VCR manufacturers have produced their service data using this kind of signal. It's what test cassettes include for the chroma-bars portion of the tape. (But *do not* depend on the test cassette for troubleshooting; the few minutes of chroma on a test tape does not last long enough for most diagnosis. Also the tape wears fast; use it only for adjustments where tape heads *and* playback system are involved.)

Generators of keyed-rainbow patterns are more numerous and generally less expensive. There's no good reason not to use one except that the service data shows NTSC patterns. However, that need not deter anyone who is familiar with keyed-rainbow patterns and phases. A keyed rainbow is actually easier to interpret in vectorscope displays. All that's missing is the stairstep luminance pattern that an NTSC generator provides. Keyed-rainbow displays impart a certain type of luminance information, but not gray-scale data.

MOST VCR DATA shows waveforms based on what's called NTSC color bar, which is actually an Electronic Industries Association standard test pattern.

A new type of video generator, the Sencore *model VA48* Video Analyzer, generates unique color and monochrome patterns for video repair, such as a multiburst, useful for response evaluation and adjustments in a VCR. You have to learn to interpret these unfamiliar patterns and waveforms, but the manuals and guides accompanying the instrument explain how.

When you can afford one, you will probably want an NTSC generator. There are only a few models presently available; but others are being readied, according to test instrument manufacturers. In the meantime, don't let the lack of one keep you from troubleshooting VCR's.

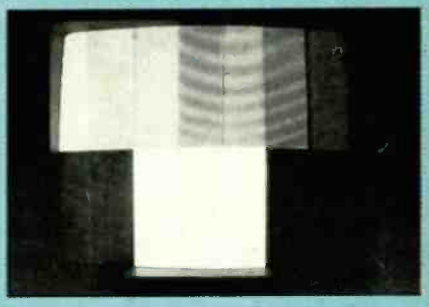
Frequency counter

Here's an instrument that may be new to you. If you have only worked on TV sets, you probably don't own a frequency counter. You may never have used one, but you need a frequency counter for certain VCR measurements and alignments.

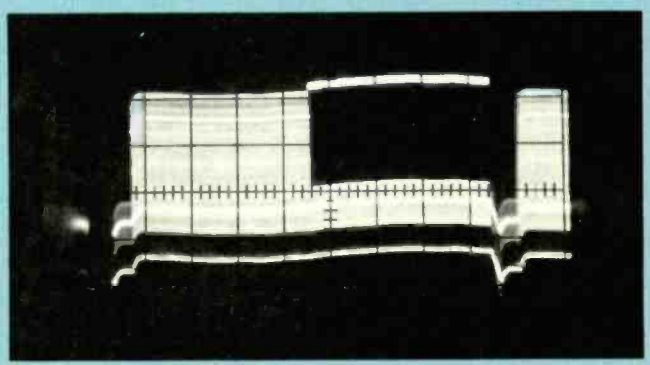
Avoid low-cost models. Accuracy and dependability are important. For VCR's, you need at least a 7-digit frequency counter. An 8-digit model would be better, but is generally more costly.

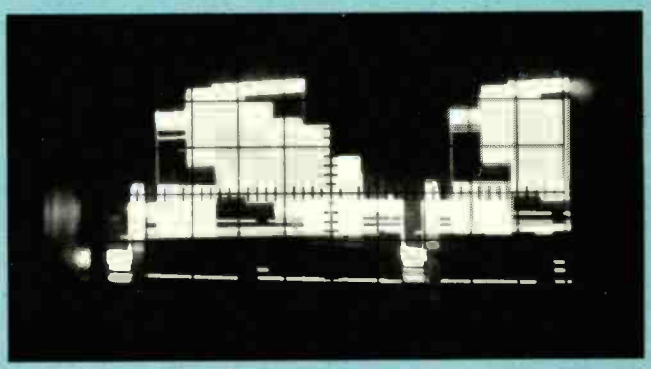
The frequency counter's sensitivity ought to lie in the vicinity of 20 mV RMS. This means a weaker signal might not give a stable count of the frequency fed in. Most signals you'll measure are stronger than 20 mV.

The counter's frequency range need not be extensive. One that extends beyond 30 MHz can be used for CB troubleshooting. A frequency counter that extends even higher can be used in checking out various FM two-way fre-



TOP ROW of bars, with chroma shut off, makes gray scale. Large white window forms reference for video peaks; black square reaches to sync tips.





WAVEFORMS generated by NTSC/EIA color bar pattern. Left pattern is triggered at frame rate. Right is triggered at horizontal line time, and shows overlapping result of lines in upper and lower portions of the test pattern.

quency bands. However, for troubleshooting VCR's, a range to 20 MHz or 30 MHz is adequate.

Next to sensitivity, the accuracy of a frequency counter is its most important characteristic. Accuracy should be no worse than 0.0005%, which is 5 PPM, plus or minus one least-significant digit (usually 1 Hz).

Check the specs of any frequency counter you're interested in. If they meet the criteria listed above, you can easily check the accuracy by comparing its count to a TV-station-controlled horizontal-sync rate. (During color programs, this rate is 15,734 Hz; it makes a good standard reference.)

Obviously VCR troubleshooting requires specific equipment. Don't fool yourself into thinking you can make do without the stipulated test equipment.

The requirements are not overwhelming. Top-notch service technicians have most of these instruments anyway. You should also, and know how to use them. If you don't it's easy to learn how. If these test instruments seem too complicated for you, then video cassette recorders will be too; but that is truly doubtful.

Servicing VCR's - a fundamental approach

5 easy steps to troubleshooting VCR's— a detailed look at each step and what is required.

THERE'S NO DOUBT ABOUT IT, VIDEO cassette recorders are complicated. But any reasonably competent technician can learn to service them. Whatever their complexities, VCR's respond readily to knowledgeable, logical troubleshooting. Two things are needed: an understanding of how a VCR operates, and a logical troubleshooting system.

Other issues of Radio-Electronics have mentioned my system of troubleshooting called Easi-Way Servicing. This planned method consists of five steps that take you smoothly to the source of trouble — the actual defective component.

Easi-Way Servicing is as much a way of thinking as a way of doing things. You can adapt this sort of reasoning to mechanical systems as easily as to electronic systems, which is necessary in VCR servicing. A VCR contains a diverse mixture of electronics, mechanics and unusual combinations of the two. So . . . let's use the Easi-Way Servicing approach to VCR troubleshooting.

Five easy steps

First, divide a piece of electronic equipment according to its various functions. A VCR, for example, has eight basic functions that take place inside the deck:

1. Power supplies.
2. Threading/unthreading the tape.
3. Tape transport — mechanical.
4. Tape transport — speed control.
5. Tape heads' speed/position control.
6. Electronic to electronic (E-E) — camera or off the air, through VCR to monitor.
7. Recording electronics — video/chroma/sound.
8. Playback electronics — video/chroma/sound.

These functions all interrelate in several ways. Nonetheless, each is a recognizably individual function in and of itself. Only a familiarity with VCR operation can prepare you to identify each function accurately. You accomplish that by understanding how each fits into the overall operation of a VCR deck.

Step One: Analyze the Inoperative Function — In this first step, you attempt to operate the machine and then analyze which functions or operations fail to perform as they should.

Right away the first complication arises. Several functions in a VCR, as in other electronic equipment, depend on other functions. For example, if any of the power supplies are inoperative, very little else can operate.

Often, finding several functions inoperative directs you to which one actually contains the fault. And very likely, it's the first function in the chain of interdependent operations. As you gain experience with how a VCR works, you'll develop a "feel" for which function is most likely at fault when several quit working.

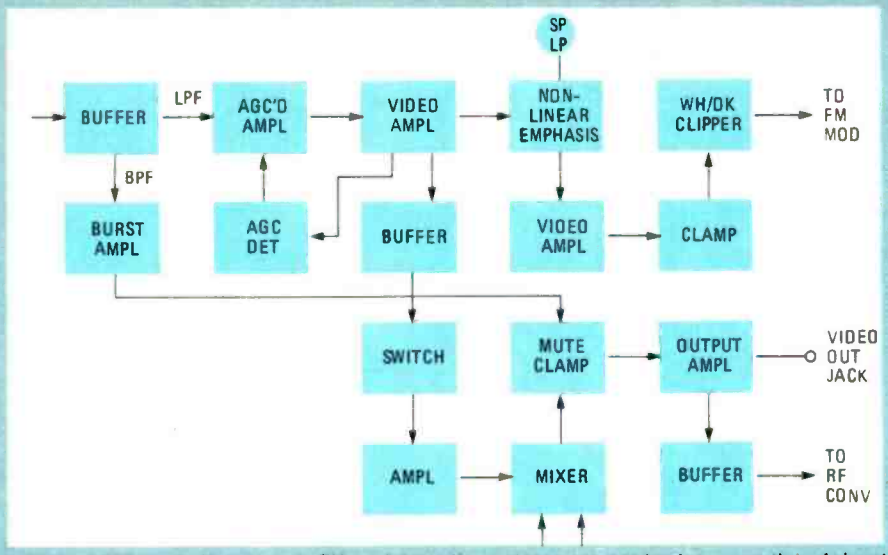
The word *analyze* simply means that you study the attempt at normal operation, noting what fails to work. Sometimes you use test instruments to verify your analysis. Again taking the power supply as an example, a digital multimeter tells quickly which voltages are alive and which are missing or incorrect. Or, suppose the tape deck plays a prerecorded tape OK, but your customer finds it difficult to make a cassette of his own. Analysis suggests there's a fault in the recording electronics. (The symptom actually tells you-even more, but we'll discuss that further along.)

The object of this preliminary analysis is to weed out and to eliminate from your troubleshooting efforts those functions that are working OK. Thus, you won't waste time searching for trouble where there is none.

Step Two: Diagnose the Affected Section — In this second step, you must recognize that each function occurs because of certain sections. In electronic functions (as I have defined them), *sections* are large blocks of circuitry that handle one or two specific signals. Mechanical functions can be broken down into *operations* instead of sections. Let's look at some examples of both.

In the playback electronics function, for instance, a section is devoted to the chroma portion of the playback signal. Another section deals with luminance signals. Still another section processes sound from the audio track of the cassette you're playing back. Another section deals with the control track. Each of these sections handles a specific signal. in a particular way.

In considering mechanical functions, various operations fall under the func-



FROM CAMERA or built-in tuner to FM modulator, these stages process luminance portion of signal for VCR, and hence is called the luminance section.

tion called *tape drive* or *tape transport*. Certain mechanisms operate only when the tape is being transported forward for *playback* or *record*. Others operate for the *rewind* function, and still another set for the *fast-forward* function. On recorders that have a *pause* feature, this function brings more mechanisms into play. Each operation can be considered separately as a "division" of the overall tape-transport function.

You can restate Step Two for mechanisms, by substituting the word *operation* for *section*. (It would then read: *Step Two: Diagnose the Affected Operation*.)

The thinking method stays the same for both cases. You simply divide the function up into its component sections or operations, and decide which is missing or failing to accomplish what is expected of it.

Step Three: Locate the Faulty Stage — When you think about troubleshooting, imagine the sections divided into stages. Your goal is to isolate the single stage that is faulty to avoid wasting time troubleshooting other stages unnecessarily.

As before, there are many interrelationships among these stages. A certain knowledge of how much (or little) one stage depends on others can lead you fairly directly to what you're looking for.

To recognize some examples of stages within a section, consider what you find in the luminance section of the record function. For Easi-Way Servicing, I define a stage as a transistor or transistors (or a tube), and the components and wiring around it; a stage processes in some way the signal(s) that dominates the section.

Figure 1 is a partial block diagram of the luminance section in the record function. Sometimes there is more than one "active" component in a stage, and in some instances there are none (unless you consider a diode, delay line, or special filter an active component).

All these stages process video signals. It is beyond the scope of this article to go into detail on how all this, or any other stage in the luminance section, works. This quick run-through aims only to give you some idea of how to think in terms of stages.

A signal from the camera, or from the tuner/IF/demodulator section of the VCR deck, feeds into a buffer-amp stage. A bandpass filter picks out chroma signals and sends them on to the chroma section.

A low-pass filter blocks the chroma and feeds video and sync signals to a group of three stages that control the video level: a video amplifier, an AGC detector and an AGC-controlled amplifier. The object of these stages of course is to stabilize the level of video (or luminance or Y-signal, whichever you prefer to call it) that is fed on to succeeding stages.

As is often the case in modern electronic equipment, several stages fit inside a single integrated circuit. This shouldn't bother your troubleshooting, but you should recognize that they *are* situated inside the IC.

After the signal leaves the video amplifier, it goes through a system of pre-emphasis. The standard-play (SP) or long-play (LP) switch is sometimes called the 2H/4H switch because in the VHS-4 format it sets the machine for either two-hour or four-hour recording. This switch determines how much pre-emphasis is applied.

The signal goes through more stages, also inside an IC. Then, the signal is clipped both in the white (video) direction and in the black (sync) direction. Finally, this pre-emphasized video signal, which is being held at a precise amplitude, goes to the FM demodulator — a different section.

Meanwhile, the video signal is also taking another path called the electronic-to-electronic (E-E) path. A buffer feeds it through a RECORD-PLAYBACK switch.

In the record function, the signal goes through an amplifier, some mixers (which happen to mix the color and sync signals back in) and an output amplifier. In between, a muting clamp stage blocks this signal path whenever a particular operating mode (such as Pause) demands it.

The restored signal goes to two outputs. One output is a video output jack on the back of the set. This allows a studio-type video monitor to be used. The other output goes to an RF modulator or converter, which lets you monitor the recording signal with an ordinary color TV receiver.

As you have probably figured out, signal tracing with an oscilloscope can locate any faulty stage in this section. A scope shows whether the AGC works properly. It lets you find a stage anywhere along the way that blocks the video or Y-signal. It can find whether the mute stage works as it should. It lets you test the clipper stages.

In other words, an oscilloscope is the best test instrument for locating a faulty stage in a section like this. Of course, other instruments and techniques may suit other sections better.

Step Four: Isolate the Troubled Circuit — Stages consist of circuits; some of them are DC circuits, and some are signal circuits. A few, in certain sections and stages, are AC power circuits.

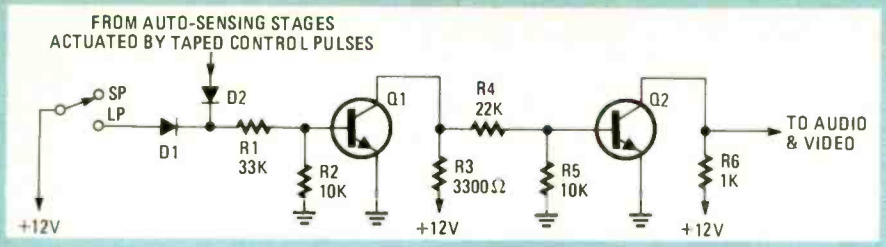
Any stage has an input and an output circuit, and it can have more than one of each. A transistor stage has DC supply circuits for the emitter, base and collector. It may be associated with tuned, R–C timing, delay or feedback circuits.

An IC, in addition to incorporating many stages and circuits, must connect to input and output circuits and at least one DC supply circuit. You will also find ground circuits, decoupling or bypass circuits, and capacitor or transformer coupling circuits. Sometimes control circuits are outside of an IC, or in conjunction with some transistor or diode.

How you isolate any troubled circuit depends greatly on what the circuit is supposed to do. Your oscilloscope is good to use for signal circuits, and it also works in AC power circuits. For DC circuits, in general, you should use a digital multimeter, using it either as a voltmeter or an ohmmeter.

In order to understand this better, take a look at the diagram in Fig. 2. At random, I have selected a transistor stage from the automatic LP/SP section of a VHS deck.

These switching stages are activated manually by the SP/LP switch. When



TWO DC-COUPLED stages for switching between long-play and standard-play show how circuits make up stages.

you turn the switch to the Long-Play mode, 12 volts DC forward-biases diode D1 and places a positive voltage at the base of Q1. This voltage forward-biases Q1 and brings its collector low. A low forward bias on Q2 has the opposite effect, making the Q2 collector go high.

This sequence reverses when you switch to the Standard-Play mode. Voltage is removed from D1, the collector of Q1 goes high, thus biasing Q2 heavily forward. The Q2 collector goes low, which signals other stages and sections in the VCR to operate in the faster-speed mode.

During playback, it doesn't matter in what position you place the LP/SP switch. A DC voltage, developed from control-track sensing stages and applied through D2, takes over control of Q1.

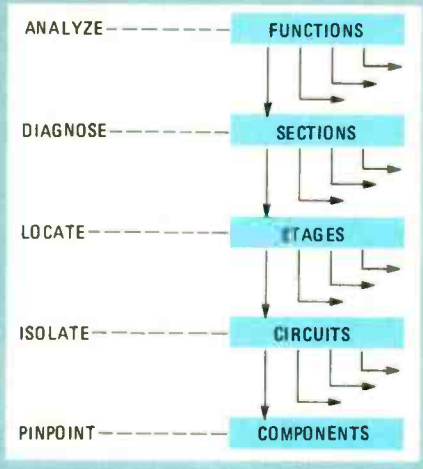
The input circuit of Q1 consists of the switch, D1 and the two resistors connected at the base. Since these stages are DC amplifiers, no signals are involved, and there is no need for capacitors or coils as input coupling devices. The output circuit of Q1 has R3 as the load, R4 as the coupling resistor and R5 as the input load resistor for Q2. The output load circuit for Q2 is R6.

Direct-current supply circuits for Q1 and Q2 are equally easy to see. Both transistors have their emitters grounded. Both are fed collector voltage through a series supply resistor (which is the load circuit when you think in input-output terms). The base bias circuit for Q1 involves R1 and R2 as well as whichever diode is operating. The base bias for Q2 is set by the divider circuit, which consists of R3, R4 and R5, with Q1 as a variable "resistor." You can also consider R2 and R5 as base-return paths or circuits.

Step Five: Pinpoint the Defective Component — When you reach this final step, your work is almost over. Once you identify the problem circuit, it is only a matter of moments to pin down the defective part — usually.

How you test components depends on your own preference. Some pinpoint faulty transistors, diodes, resistors and even leaky capacitors with DC voltage measurements. Occasionally that's not possible, but it works well in most circuits.

Others use a component substitution method. This is not practical however when the component is expensive.



For an IC, checking out a defect may seem difficult. Your best bet lies in using a four-step test procedure:

1. Check all incoming signals with your oscilloscope. If various modes of operation or functions are involved, test in each of them.
2. Test all signal outputs from the IC.
3. Measure DC voltages that should be applied to the IC. In particular, make sure the main V_{cc} voltage is applied.
4. Verify that DC output voltages or levels are correct.

From this procedure, you can be sure that if all signals and DC voltages go in OK but some don't emerge as they should, the IC or its connections are faulty.

Warning: Make sure you have traced *all* the interrelationships that occur in and around IC's. For example, one IC in the head-wheel drive section appears to be defective if certain current feedback stages don't work as they should. Certain stages in the IC are curtailed, and as a result, certain outputs and other inputs are fouled up. Because all this can become rather complex, it is important to understand what's necessary for a particular stage or IC to work properly.

Summary

This represents a definite usable technique for troubleshooting VCR's. While we have not tried to familiarize you with actual VCR systems, more specific details of important sections and functions will be discussed in future issues.

Where To

Since guidance is often necessary VCR's, its essential to know where available training. Here's a few tips

TRAINING IS A VITAL KEY, SINCE VERY few can learn how to troubleshoot a VCR without some help and guidance.

Where can you get such help? Although the VCR is a comparatively new product, there are several ways to put yourself on top of this potentially thriving service opportunity. Here are a few possibilities:

1. First, acquire a VCR of your own. Some manufacturers won't even offer training or service data until they know you own a unit. This practice is not a way to sell more VCR tape decks. It merely recognizes the fact that familiarity with the instrument is necessary. VCR's are not simple to understand, and you must see them operate.

Once you have a VCR, use it. Study all the different things it can do, and how it must be hooked up and manipulated to accomplish them. Then you will be able to recognize the customer's mistakes from the machine's faults.

Remove the top and observe what goes on in the mechanisms inside the VCR. At this early stage, don't take anything apart because putting it back together may be — and often is — critical. You will find there is no substitute for this experience.

2. One obvious way to learn is through reading magazine articles and books on VCR operation. The only trouble with this is that not many articles, and even fewer books, have been written on the subject. Two future "What You Need To Know" Sections in **Radio-Electronics** deal in detail with troubleshooting VCR decks; one will cover the VHS-4 format; the other, the Beta-2 format.

3. A recent issue of *Sencore News* (published by Sencore, the test equipment manufacturers) describes how video cassette recorders work. The articles tell how to use the Sencore *model VA48* Video Analyzer for troubleshooting VCR equipment. Sencore will provide you with a copy of the publication; just send in your name and address, and mention this article in **Radio-Electronics**.

4. Future issues of the *Service Training Monographs* will deal with video cassette recorder troubleshooting. The *Monographs* are obtained by subscription. The price of a subscription to the

Learn

n learning to troubleshoot
o go to get the best
on going about it the right way.

Modern Video Servicing category, some issues of which deal with TV troubleshooting, is $65 (for six *Monograph* issues) after January 1, 1979. Just write Box 68120, Indianapolis, IN 46268.

A few selected Forest Belt Training Programs are being put on audio cassettes, with worksheets for group training. These are called Self-Trainer Kits, write to the above address for titles and prices.

QUASAR VH5000 VCR

5. A few VCR manufacturers have training material, but, so far, it's not easy to get hold of these materials. Your best bet would be to ask a local dealer who handles the brand of VCR you're interested in. Table 00 lists some well-known brands.

RCA Selectavision

Manufacturer's service data consists mainly of schematics and diagrams, along with PC-board layouts. Key adjustments are described. The most helpful contain detailed circuit descriptions, but not many do. Unless you are a warranty service dealer, you may have to be persistent to get this data. Work through your VCR dealer whenever possible.

Independent service technicians can purchase RCA service data for the VBT200 video cassette recorder for $19.95. The address is RCA Consumer Electronics Group, Technical Publications Dept. I-450, 600 North Sherman Drive, Indianapolis, IN 46201.

Sony has prepared a set of video tapes that describe how to service their Beta-format machines. The tapes are expensive (as videotaped instruction always is) but they offer a painless way to learn. For information, write Sony Corporation, Service Dept., 47-47 Van Dam Street, Long Island City, NY 11101.

6. Howard W. Sams & Company, Inc., has a new *PhotoFact* specialized series for VCR's. There are six volumes to date:

VCR-1 Sony SL7200, A
VCR-2 RCA VBT200
VCR-3 Zenith JR9000P, W
VCR-4 Magnavox VH8200BR01
VCR-5 JVC
VCR-6 Panasonic

The best feature of this series is the easy-to-follow Sams *Standard Notation* schematics; photos that indicate parts, adjustments and circuit test points on the PC boards; and the parts substitution lists (where substitution is possible). If your dealer doesn't have them, you can order them direct. Send $17.95 per volume to Howard W. Sams & Company, Inc., Dept. FBRE. Box 558, Indianapolis, IN 46206.

MAGNAVOX VHS VCR

7. The Electronic Industries Association trained several college instructors last year how to service various VCR formats. These instructors, in turn, taught selected vocational school, high school and other college instructors.

To find out who in your region is VCR-qualified, call up your local schools. If they have no information, write EIA Consumer Electronics Group, 2001 Eye Street NW, Washington, DC 20006, to find out which university nearest you sent an instructor to the Summer 1978 Instructors Training Program. Then, write that university, care of the electronics department, and ask if any of your local schools sent instructors to their subsequent VCR training seminars. R-E

PUBLICATIONS that offer VCR servicing help. Clockwise from top left: Forest Belt's *Service Training MONOGRAPHS*; Howard W. Sams *PhotoFact* Special VCR Series; Issue of *Sencore News*.

Troubleshooting Communications Receivers

The continuation of an earlier discussion on selecting and operating RF generators and other equipment used in servicing and aligning communications receivers.

FOREST BELT

IN THE FEBRUARY 1979 ISSUE, WE DISCUSSED how to use signal generators in troubleshooting a communications receiver and looked specifically at the FM detector and limiter circuits. This month we continue the discussion with RF and IF troubleshooting, RF alignment and the oscillator stages.

RF and IF troubleshooting

When you get around to checking the RF and high-IF circuits of a communications receiver, you can manage most of the troubleshooting using a highly accurate and stable signal generator. If your generator's accuracy is not digital-close, add a frequency counter. You'll see why, shortly.

In troubleshooting, check the high-IF stages first. Figure 1 shows the block diagram of these stages in a double-conversion receiver. The procedure is simple.

First, make sure the discriminator is calibrated (see the February 1979 issue). Now meter the discriminator. Set your accurate signal generator precisely for the high IF; and feed the signal into the base or input circuit of the first mixer.

Next, find the frequency adjustment for the *second* oscillator, if there is one. It is usually a small trimmer capacitor. Using discriminator metering as your indicator, adjust the crystal of the second oscillator for a precise zero-center reading. Caution—this is correct only if your signal generator is producing an extremely accurate high-IF signal.

With a less costly signal generator, proceed in a different manner. Forget about discriminator metering; just connect your frequency counter to the output of the second oscillator. Then, adjust the crystal trimmer for a frequency count that is precisely correct to produce the low IF when mixed with the high IF.

If this frequency is not listed with the crystal, you can find out what it is by subtracting the low IF value from the high IF value. For example, with a high IF of 10.7 MHz and a low IF of 455 kHz, subtract 455 from 10,700 (both in kilohertz). The crystal should hold the second oscillator percisely at 10.245 MHz. A 7-digit counter reads 1024500 when you have the trimmer exactly right.

Once the second oscillator is correct, you can depend on a zero discriminator reading to verify the accuracy of your signal generator setting.

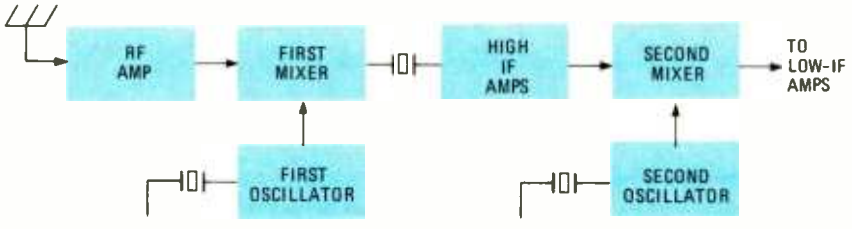


FIG.1—ORDINARY DUAL-CONVERSION RECEIVER lends itself readily to RF and IF troubleshooting by alignment.

Shift your metering now to the limiter. Reduce the signal level enough to keep the limiter reading somewhat less than maximum. But use sufficient input signal to produce some quieting and a noticeable limiter reading. Now, adjust your high-IF coils for a maximum reading at the limiter test point. Reduce signal as needed to avoid a flattening out of the meter reading.

Once the IF coils are peaked, use the filter-checking procedure described earlier to check high-IF crystal filters. If your generator has decade frequency controls, flip the switch for 2 kHz above and 2 kHz below the center frequency (10.7 MHz in this example). Note the noise level increase on both sides of center frequency; they should be about equal.

This noise level balance is the best way to assess filter action, short of running a sweep-response curve. A defective crystal or ceramic filter often has a response that is extremely tilted at its center frequency. Otherwise, a filter shows up bad simply by not passing along any signal at all. This is easy to determine by using your signal generator to inject a signal before and after the filter.

If convenient, observe the limiter meter reading as you flip the frequency 2 kHz above and below the center frequency. Both the noise level and the limiter reading can help you discern whether or not the filters are "centered" as they should be.

RF alignment/troubleshooting

Servicing the RF section in a dual-conversion receiver is much the same as for the high-IF section. You set the first

oscillator, peak the multipliers (if there are any) and finally adjust the RF stages. As usual, any discrepancy detected in making these adjustments provides the quickest clue to the source of trouble.

Figure 2 shows the schematic of the RF and high-IF stages. The coils and trimmers indicate how many adjustments a receiver may require.

Adjustment 1: Set the second oscillator frequency if the crystal has a trimmer. If not, just use a frequency counter to check that this frequency is nearly correct; in this case, within 0.001%.

Suppose the high IF is 5.5 MHz. Subtract 455 kHz. The second oscillator must run at 5045 kHz. At a tolerance of 0.001%, your frequency counter should measure an oscillator frequency somewhere between 5044.949 kHz and 5045.050 kHz. Adjustments 2 and 3 are for high-IF peaking, using the limiter as an indicator.

For the RF section, use the same procedure as before, depending on whether your generator is highly accurate or just an ordinary model. However, the unit must be very stable, or you will waste time trying to keep the frequency close enough for accurate adjustments. Feed the RF signal into the antenna jack.

The Fig. 2 receiver is a multiple-frequency unit, with four first-oscillator adjustments: adjustments 4 through 7. If your generator is not highly accurate, use your frequency counter to adjust the crystal frequency. The service manual should show each crystal frequency.

If you don't happen to know the frequencies, you can figure them out if you know the frequency to be received and the multiplier factor if there is a multiplier stage. The procedure goes like this:

Subtract the high IF (in MHz) from the frequency to be received, which should also be in MHz carried at least to three decimal places. Then, divide that mixer-injection frequency by the multiplier factor. This gives you the actual frequency the oscillator must generate.

Using an example from the Fig. 2 receiver, figure out the crystal frequency for receiving 155.370 MHz. The intermediate frequency is 5.500 MHz. Subtract that value from 155.370 MHz. The injection frequency for the mixer, therefore, is 149.870 MHz. Multipliers in this particular receiver work at ×4 and ×3. So, divide the injection frequency by 12. The oscillator must run at a frequency just barely above 12.489 MHz.

In fact, it is important that the oscillator be even more accurate than that, since you have calculated the frequency only to within kHz (12.489 MHz is 12,489 kHz). Your frequency counter should deliver even better resolution. Therefore, carry the division result to six decimal places; or all the way down to within one Hertz of exact oscillator frequency. If carried to that precision, the oscillator should run at 12.489166 MHz. A 7-digit frequency counter will read 12.48916 MHz or 12.48917 MHz.

Setting the oscillator by this method produces reasonably accurate results. Later, you will learn how to "net" the receiver into the system where it is operated to refine the accuracy even further.

A highly accurate, digitally locked signal generator lets you set the first oscillator in the receiver using the previously calibrated discriminator as an indicator.

For the example given above, simply feed in a highly accurate 155.370-MHz signal. Adjust the first-oscillator frequency trimmer in the receiver for a precise zero reading at the discriminator. Use a strong signal, so that the receiver limiters are driven to full limiting. If you've performed your earlier adjustments correctly, this brings the receiver close to its final frequency. Using any method, set the oscillator on each frequency to be received.

Next, reduce the RF input level from the generator enough that the limiters no longer limit fully. You can always tell when this happens because a bit of receiver-circuit noise becomes audible, and the limiter reading drops below maximum.

Connect your meter to the limiter test point. Set the receiver frequency selector to whatever frequency is closest to the midway point between the highest and lowest frequency. Set the generator for that frequency.

Adjust the oscillator-output coils (none are shown in Fig. 2) for a maximum limiter reading; and make this adjustment for all the multiplier coils. In Fig. 2, this is shown as adjustments 8, 9, 10 and 11. Peaking the coils sends more signal to the first mixer, and ultimately also to the low-IF section. This is why the limiter reading can be used as an alignment indicator for these multipliers.

Incidentally, note that the second multiplier "stage" evolves around a diode. This is simply a nonlinear device to clip the RF cycles and create harmonics. The tuned circuits you adjust (9, 10 and 11 in Fig. 2) peak the third harmonic. The first multiplier and coil (adjustment 8) build up the fourth harmonic of the oscillator signal. Together, they form a ×12 multiplier.

As always, during these adjustments, reduce the signal-generator output level to the point where you can keep working with a less-than-maximum limiter read-

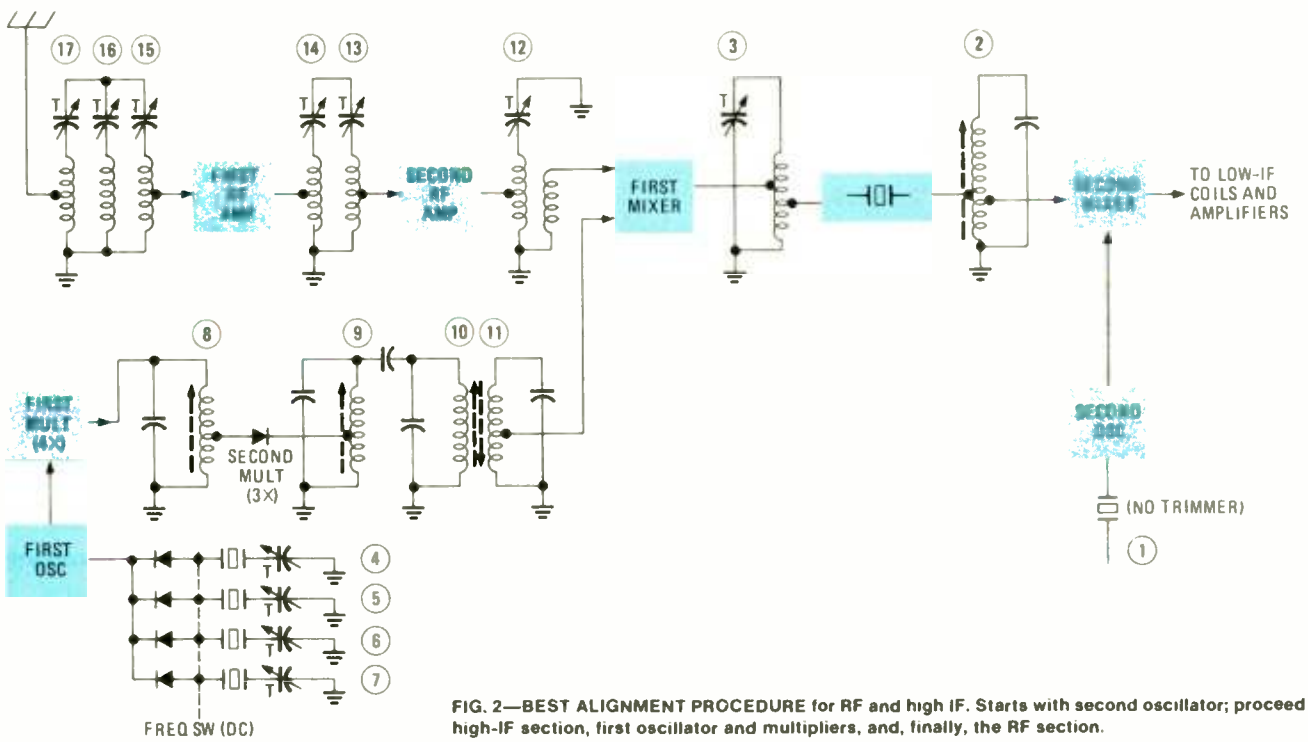


FIG. 2—BEST ALIGNMENT PROCEDURE for RF and high IF. Starts with second oscillator; proceed to high-IF section, first oscillator and multipliers, and, finally, the RF section.

ing. That way, adjustments won't be so broad. If an adjustment doesn't show sharp "peaking," look for trouble thereabouts. The cause of mistuning or lack of tuning could be a defective coil, a faulty decoupling capacitor - or even a leaky transistor in some instances.

Don't worry about any slight pulling effect the oscillator-output coils may have on frequency. This effect is very minor, and it will be corrected during final adjustments later on.

Finally, peak all the RF coils, working backward from the mixer. The generator and the receiver frequency should still be set for the frequency nearest the center of those the receiver will handle. The limiter metering point is your indicator, and the generator's output level should be kept low enough to show up as distinct peaks on the meter.

Oscillator hints

Some have trouble diagnosing faults in oscillator stages. Here are a few hints that may speed up your repairs on a defective oscillator.

Only rarely does a faulty crystal *kill* an oscillator; usually, a crystal slides off-frequency.

A dead oscillator, or one that drops out intermittently—especially on low or high voltages—can usually be traced to a transistor with too much collector-base leakage. If you feel insecure in your ability to analyze transistor voltages, use a transistor checker. Or substitute a transistor you know has high forward-reverse ratios between collector-base and emitter-base. For oscillators at VHF frequencies, you cannot allow much transistor leakage to occur.

WAVETEK MODEL 3002

If you are not sure the oscillator is at fault, there are two good places for injection troubleshooting.

First, you can set your signal generator to the injection frequency for the first mixer. The injection frequency is found by subtracting the high IF from the frequency you expect to receive. Keep your injection signal unmodulated, of course.

If mixer injection brings the receiver to life, lower the generator frequency to whatever the oscillator should emit. Feed that signal to the input side of the multipliers. Multiplication should raise the frequency to the right injection frequency for the first mixer. That, too, should bring the receiver to life—if the multipliers are OK.

If the oscillator is really dead, check the transistor as described earlier. You can use a transistor checker or substitute a known good transistor.

If you believe the transistor is all right, measure to make sure it has somewhere near its proper DC collector voltage; measure again for its proper base voltage and emitter voltage.

Make sure that the crystal is sitting correctly in its socket. If you suspect the crystal is faulty, try another one (any frequency) to see if the oscillator starts up.

Identify the oscillator feedback path, (if this is not done via internal-transistor capacitance) and determine that this path is OK.

Here's how: Disconnect the feedback capacitor. Feed a correct signal from your

CUSHMAN MODEL CE-4B

generator to the base of the oscillator transistor. Then, using a frequency counter or wideband oscilloscope, verify that the transistor at least can amplify a signal. If it does, the feedback capacitor should couple the signal to the frequency counter or oscilloscope. If that occurs normally, the trouble probably lies elsewhere.

As a last resort, substitute new feedback capacitors. If the capacitors were to change value severely, it would upset the feedback ratio, and either prevent oscillation or make oscillation erratic.

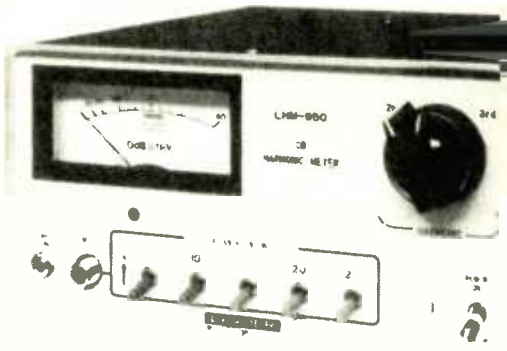
Tuning up system receivers

Once every six months or once a year, or on whatever cycle you perform preventive maintenance, you should tune up *all* system receivers. This is performed using the base transmitter as a signal source. You should also net-in every receiver after repairing it for the best possible system performance.

Always use the main base transmitter as the signal source. Make certain it has been frequency-checked and set with a frequency meter or counter that was recently calibrated against WWV standards.

Meter the discriminator or demodulator of each receiver. While the base signal is being transmitted, precisely adjust the receiver's first oscillator trimmer for an exact zero-center demodulator reading. Zeroing all the receivers this way, using the same transmitter, allows them to deliver highest clarity and sensitivity.

Follow this procedure for each frequency a receiver handles. If a system has base-to-mobile and mobile-to-mobile frequencies, select one mobile transmitter as the signal source for all the others, and for the base receiver. Make sure the transmitter is frequency-checked and set precisely. Then, adjust all the other receivers in the system for zero discriminator at that frequency.



LEADER LHM-950

Note: When you perform this procedure periodically, look out for any receiver that indicates a discriminator reading that is seriously off-zero. Ordinarily, over a year's duration, drift should be insignificant. A really noticeable shift indicates that a crystal is beginning to drift in the first or second oscillator, or that the discriminator itself is developing trouble. Pull that particular receiver in for a thorough going-over.

This kind of thoughtful preventive care heads off many serious problems. You will often find a problem before it shows up. **R-E**

Ben's Hardware didn't have a 20-foot ladder. Want me to try Teely's Hardware?

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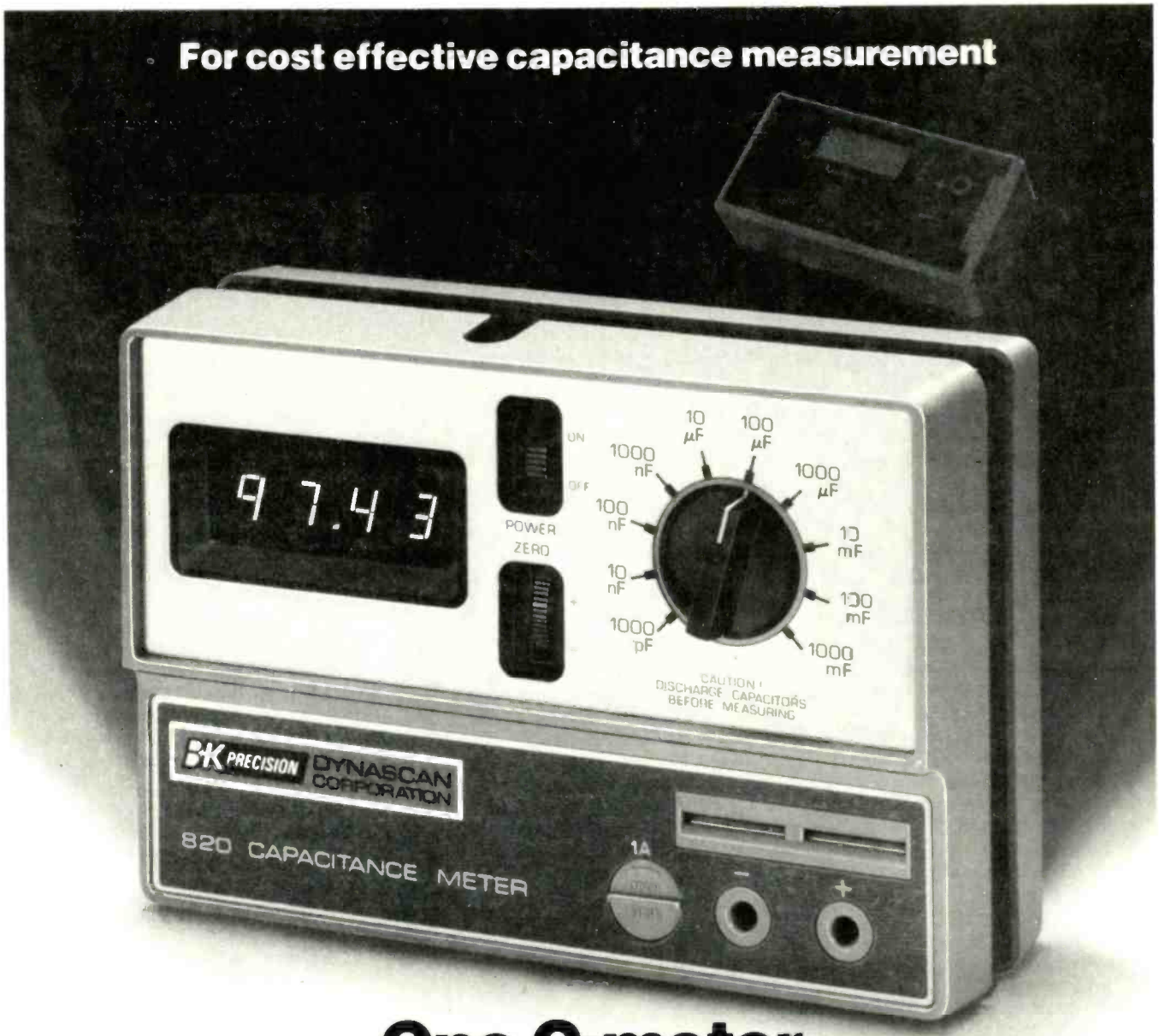

One C-meter stands out of the darkness— the $130 B&K-PRECISION 820

For about one-third the cost of the most popular digital capacitance meter, you can own five times more measurement capability. The new B&K-PRECISION 820 reads all the way to 1 Farad, in ten ranges. With 0.5% accuracy, the 820 resolves to 0.1pF for a maximum count of 9999.

The 820 keeps on going in freezing cold to blistering 100 degree heat, making it ideal for field use. The bright LED display is easily readable under all lighting conditions. It has the versatility needed for any application and the durability to stay on the job. The 820 can be powered by disposable batteries or optional rechargeable batteries.

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CIRCLE 45 ON FREE INFORMATION CARD

HOBBY CORNER

How to determine the voltage and current rating of unmarked transformers.

EARL "DOC" SAVAGE, K4SDS, HOBBY EDITOR

HAVE YOU EVER REACHED INTO YOUR "junkbox" and found a power transformer with the tag missing? You probably have a marking system something like mine. When transformers are new or when I salvage them from old equipment, I identify the leads with tags, or write on the transformer with a waterproof marker. But tags come off, and some markers are more "waterproof" than others.

Whether because of missing tags or markings, or because the transformer was borrowed from someone who neglected to mark it, I usually end up with unmarked transformers. You have probably discovered that slapping 120 VAC on just any old leads can cause real fireworks. Don't do that, but don't throw the transformers out either. You can figure out which lead is which by applying a little logic.

The great majority of power transformers are low-voltage types for solid-state power supplies. We'll concentrate on these in this article, but you can use the same principles to identify high-voltage transformers as well.

First, you may find some numbers printed on the transformer. Unfortunately, these are seldom manufacturers' identification numbers. More often than not, they are "house numbers" placed there for the benefit of the bulk purchaser who was putting them into equipment. You might get lucky and match your numbers to those listed in a catalog, but the chances are slim and I wouldn't waste any time trying.

Second, you could check the *color* of the insulation on the lead wires (if any). If there are colors and you can decide what they are, you may be able to match them up with the old color code given in most electronics data books and handbooks. However, I have found the wrong colors are used so frequently that I don't trust them any more.

My approach is to disregard numbers, colors, and even wire size, and proceed right to the identification process. Here's how I do it, step by step:

The first task is to mark each lead with a temporary number since it is easy to lose track of which leads you just tried. I use a small piece of masking tape with a number written on it.

Second, you should find out which leads are connected to each other through the same windings. You can use an ohmmeter or just a battery and flashlight bulb to check this. Touch the leads in various combinations until each lead has been identified as being connected to at least one other lead. Of course, since there are no "one-lead windings," if you find such a situation, this tells you that there is a burned or broken winding in there.

Make sure to write down what leads are connected to each other as you go along. Unless you make notes, it is hard to keep track of more than four leads. For example, you might find something like this: leads 1 and 6; 2 and 3; and 4, 5 and 7. After you have this information, draw out the transformer windings and label the leads according to your findings.

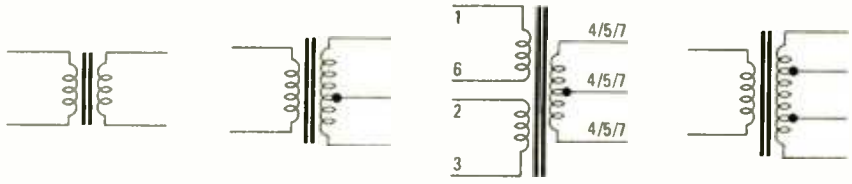

FIG. 1

Some of the more common types are shown in Fig. 1. The transformer shown in Fig. 1-c is labeled for the example given in the above paragraph. Note that at this stage, we don't know which winding is the primary (120 VAC), or which number belongs to each lead of the tapped winding. We can figure that the winding with the center tap is a secondary winding because that is almost always the case.

The next identification step is not really necessary. It may make you feel a little more comfortable but don't worry about omitting it. This optional step is to measure the resistance of the windings you have identified. With an ohmmeter as found in the typical VOM, you won't learn much because the lowest meter scale is far too large, but perhaps a hunch will help.

A primary winding usually shows a DC resistance in tens of ohms—say, 15 or 20 ohms and maybe up to 90 or 100 ohms. A low-voltage secondary shows a lower resistance—from less than 1 up to several ohms. To add to the confusion, the primary of one transformer can be less than the secondary of another. In spite of the fact that you can *almost* count on the primary having a higher resistance than the secondary, I recommend making one more test before throwing 120 volts on any winding. Incidentally, if your measurements are very different from the ones described here, be careful because you may have some other kind of transformer—an interstage or an audio transformer, etc.

The next identification step makes use of the following fact: The *ratio* of voltages on the various windings of a transformer will be almost the same regardless of the absolute value applied to one winding. Knowing this, I apply a *low* voltage to what I *think* is a secondary winding of the unknown transformer. Usually, I use approximately 3 VAC from one-half of a 6.3-VAC center-tapped transformer. Note that this is *AC* voltage because transformers don't work on DC.

With 3 VAC applied to a probable secondary, measure the output of the other winding or windings. If one or more of these measurements is extremely small—much less than 1 volt—you are using the primary winding or another high-voltage winding. In this case, switch to another pair of wires so that the voltages are large enough to measure. Make a chart of the wire numbers and your measurements. In the case of our sample transformer, the chart would look like the one shown in Table 1.

Now, figuring that the highest voltage is on the primary, let's call leads 2 and 3 the leads to the 120-volt winding and write that data on the chart. (Note that the identification information shown in parenthesis in the chart was added after all measurements were made.) Call 55 volts one-half of 120 volts—at this point,

don't worry about a few volts one way or the other because there are several areas where inaccuracies can creep in.

TABLE 1

Leads	Reading	Identification
1&6	3V	test input (6V)
2&3	55V	(primary, 120V)
4&5	6V	(4&5 = 12V)
4&7	3V	(7 = CT)
7&5	3V	

Since the 55- to 120-volt relationship is 1:2, so are all the others. Thus, we multiply the readings by 2 and write 6 volts in for leads 1 and 6, and 12 volts for leads 4 and 5. Because lead 7 is obviously in the middle of (and connected to) leads 4 and 5, it must be the center tap of the 12-volt winding.

Of course, there are many other possible combinations of measurements on any given transformer. All you have to do is to follow the same procedure. To help you further, Table 2 shows some common readings when applying 3 volts.

You will notice that accumulated errors of measurement and approximations can mask the differences in 10-volt and 12-volt windings, for example. This should be of no concern because you have identified the 120-VAC primary.

At this point you are ready to apply 120 VAC to the primary winding. **Exercise extreme caution**—these voltages and currents can kill! Do *not* depend upon a steady hand or upon insulation alone. *Always* disconnect a power circuit *before* touching it.

(EXTREME CAUTION IS THE WORD when applying voltage to the windings of an unknown transformer. Add another dose of caution if the transformer being tested has long wire leads that may accidentally touch each other, or a metal tool or surface of the workbench. And, no matter how tempted you are to clip the test leads on to a "secondary" winding before applying the AC power to the "primary," **DON'T DO IT!** When voltage is first applied, transient voltages high enough to burn out the meter movement, blow multiplier resistors and fuse switch contacts, can develop across an unloaded "secondary."

Set your meter to its highest AC range, then apply AC to your "primary." Now, touch the test prods to the leads of the winding being metered. Reduce the meter voltage range step-by-step until you get a voltage reading in the upper one-third section of the scale. — *Editor*)

The 120 VAC applied to the primary should come through an isolation transformer (two 120-volt windings). If you don't have an isolation transformer, you can make one by putting two filament or low-power transformers back-to-back (see the August 1978 "Hobby Corner" for details). In any case, the 120 volts should come through a fuse—a ¼-amp or so will do. With the primary fully powered, it is then a simple matter to measure the actual output voltage(s).

TABLE 2

Primary Reads	Multiply By	To Get Primary	Applied Winding Is	Multiply all windings by same number
240V	½	120V	1.5V	
120V	1	120V	3V	
60V	2	120V	6.3V	
30V	4	120V	12.6V	
20V	6	120V	18V	
15V	8	120V	24V	

All computations approximate

The only remaining question about your unknown transformer is its power-handling capacity or current (ampere) rating. Unfortunately, there is no way that you can readily determine this accurately, but there are some guidelines that can help you figure out the rating.

The best way to obtain a close approximation of the rating is to put the transformer in a power-supply circuit and actually measure the current output. Keep your finger on the transformer case to judge its temperature. If it feels warm, this is normal—you are not drawing too much current and, perhaps, you can draw even more. If the transformer begins to get uncomfortably hot you have reached or exceeded its current rating.

You could rig up a variable load and increase it slowly as you measure the current and judge the temperature. If you do, increase the current *very* slowly to give the temperature a chance to reach the outside of the transformer case and to stabilize at each increase. It is best to start at a conservative rating based upon transformer size. It is quite possible to overload the transformer and burn up a winding before the excessive temperature can reach the outside where you can feel it.

Well, there you have the basic info on low-voltage power transformers. Now you can get those unknowns out of your junkbox and use them to build some useful power supplies. If you need help in choosing the other components for your supplies, you can refer to the September 1978 "Hobby Corner." **R-E**

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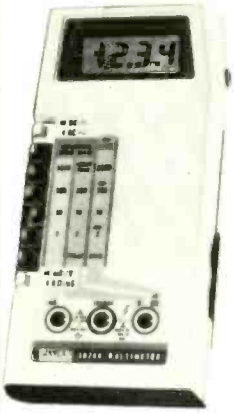

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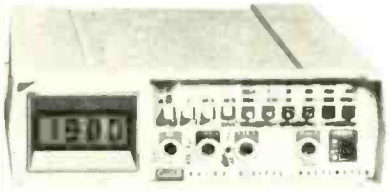

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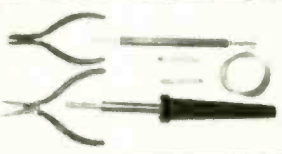

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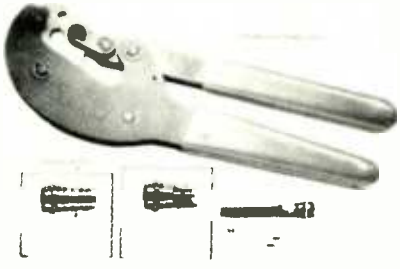

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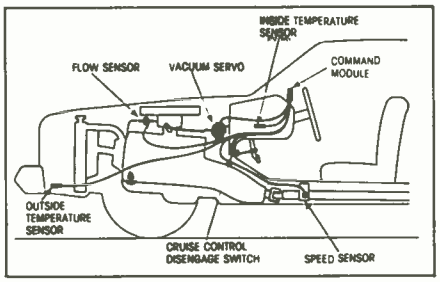

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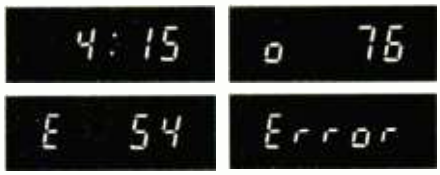

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Tuners that use solid-state bandswitches are easy to repair if you know how.

JACK DARR, SERVICE EDITOR

ALL-ELECTRONIC TV TUNERS ARE SHOWing up in more and more sets. One of the things the manufacturers needed to make these work was some kind of a "switch that wasn't a switch." Many switches are needed, and, for obvious reasons, manufacturers didn't want to use the mechanical types. Anyone who has ever cleaned a TV tuner can easily see why. So, they found a new use for diodes. By this time, everyone must have realized the analogy—a diode in full conduction is a closed switch, and a cut-off diode is an open switch. It works.

One popular use for these diodes is in bandswitches, as shown in Fig. 1 (courtesy of Quasar's *Technical Training Manual* for the *Compumatic model TS-961/962*). The oscillator coil is tapped. The entire coil tunes over the low-VHF TV channels, and the top half only will cover the high-frequency (VHF) channels. A varactor diode does the actual tuning.

For low-band operation, with the diode as shown in Fig. 1, a negative voltage is applied to the anode. The diode is cut off, creating an open circuit. To switch to the high-frequency band, a positive voltage is applied to the anode. The diode conducts, and shunts the capacitor from the tap of the coil to ground. This makes the tap a good ground for high-frequency RF, and the bottom half of the coil is shorted out.

To change from VHF to UHF, more switching diodes can be used to turn the B+ voltage off on the low-band oscillator (leaving the RF and mixer stages to act as amplifiers), and to turn the UHF tuner on. There are also logic IC's that are used for this purpose.

Several tuning voltages may be needed for the different frequency bands. Generally, one tuning voltage is used for low-band VHF, another for high-band VHF, and one more for the UHF band. For example, let's say the low-band tuning voltage is 0–10, the high-band is 10–20 volts, and UHF is a higher voltage. These values serve only as illustration. You should check the schematic for the actual voltages used in any particular set. These values are critical.

So, all this leads us to make some nice simple tests when there is trouble in the tuner. For example, if the set receives low-band but no high-band stations, check the switching voltage on the diode to make sure it is correct, and that it changes in polarity when a high-band station is selected. If the voltage is correct, the diode is open. If only high-band VHF is being received, the diode may be shorted. Either problem could also be due to incorrect switching voltages. Go back to the source of this voltage and check. This will usually be a separate regulator module, etc.

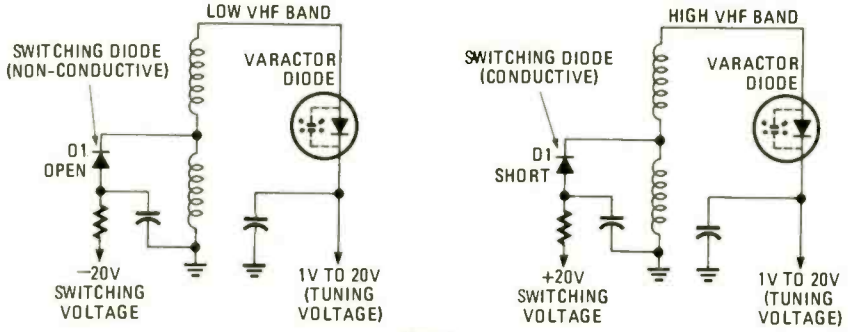

FIG. 1

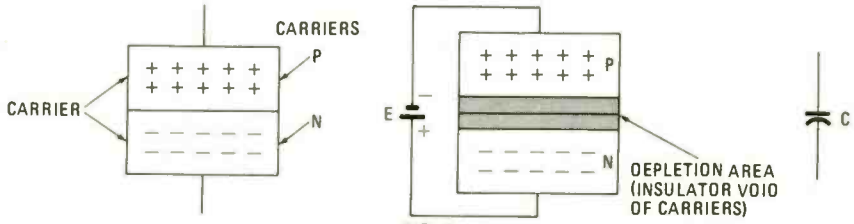

FIG. 2

The tuning varactor is a special type of diode. With zero voltage across the junction, each side of the junction acts as one plate of a capacitor. Applying a *reverse* bias to the varactor cuts it off more tightly, and creates an area in which there are no current carriers of any kind; this area is an *insulator* and becomes the dielectric of the capacitor. With the plates farther apart, the capacitance is less, and the frequency is higher. The greater the reverse bias, the farther apart the plates are (see Fig. 2).

To repeat, the first test should be to read the tuning voltage. No, correction! The first step should be to read the *schematic* and determine what the tuning-voltage limits must be. Many service manuals show the normal voltage range for given frequency bands, sometimes for each channel. If the receiver is obviously on the wrong channel but will tune to different channels, the tuning voltage is off-value. As with most DC voltages in solid-state sets, these voltages are tightly regulated. Check the voltage regulator to see where the problem is. Incidentally, don't overlook the possibility of a poor contact between the regulator module and the DC voltage supply. This can cause a complex problem, but one with a simple solution!

Several sets now do not have the familiar off-on switch. A triac may be taking its place; this device is basically two SCR's back-to-back with a common gate. If AC is applied to the anodes, along with a gate voltage, both sides will conduct on alternate halves of the input AC voltage. In this condition, the triac is a closed switch. The gate voltage needed is quite small, and is provided in many different ways. One set (Quasar) uses an optical coupler driven by the control IC's. Other sets use IC's to switch a low voltage to the triac gate.

Testing is simple: If the set stays on all the time, check to see if the triac is shorted and if there is proper gate voltage. If the gate voltage is on all the time, this

continued on page 78

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continued from page 76

means there's a fault in the control circuitry. If the set won't turn on at all, check for proper gate voltage. If this reads OK, the triac may be open. Both conditions cause the same problem.

The Quasar manual mentioned earlier shows that a microprocessor is used to control bandswitching, channel tuning, on-off and other functions.

The bandswitching and VHF/UHF switching is handled by driver transistors controlled by the microprocessor. With some added circuitry (including a PLL) the microprocessor controls the tuner frequency by reading the frequency of the desired channel and then developing a DC tuning voltage that will place the set exactly on-channel. If there is a bandswitching problem, check the driver transistors to make sure they have the correct DC voltages and react normally. The manual describes the whole process completely, which makes for fascinating reading!

Keep the tests simple and functional, and you won't have any serious problems with these electronic tuners. Just make sure that all the DC voltage values are right on the button because they are extremely critical. **R-E**

service questions

SYNC PROBLEMS

I had a horizontal-sync problem in this model XAM 9T75, which developed two or three pictures on the screen at once. I changed the diode AFC unit; no help. I checked the capacitors; same result. I finally bridged the same size capacitor across C3 between the sync separator and the AFC diodes. Now the set works perfectly! I didn't take the original capacitor out. Can you explain what happened?—L. P., Potomac, MD.

The original C3 was completely open and out of the circuit. However, this is just a sync coupler and very small. By bridging it you were able to get the horizontal sync through to the AFC.

BLOWN DIODES

This Sylvania model CX5160W-1 came in with diode SC530 shorted and resistor R532 burned. I replaced the diode with ECG-116, and the resistor too. The set played for five minutes then went off. Replacing the diode with a higher-rated one blew the new one and R532 again! I need help!—W. S., Lewistown, PA.

This sounds like *such* a familiar problem! The schematic shows this diode is used on the flyback as a low-voltage DC power supply. You CAN'T use stock sili-

continued on page 80

con diodes for this kind of service. You must use a fast-recovery type—RCA SK-3175, ECG-519 or ECG-525. Any time you see a circuit fed from a flyback pulse, use this type of diode and it will work.

SPEAKER HOOKUPS

Can you please tell me how to hook up two or three 8-ohm speakers so that the 8-ohm impedance can be kept?—G. G., Worthington, PA.

There is no way you can combine two or three 8-ohm speakers and come out with an 8-ohm impedance.

However, if you add one more 8-ohm speaker (to make four speakers) you can. Tie each pair in series; then each one will have a 16-ohm impedance. Now, tie your two series in parallel, and there you are—8 ohms again! (Plus you add another tweeter, etc.)

ODD VERTICAL SWEEP

This Catalina black-and-white model 122-3030 has a really odd problem. The picture appears only on the bottom third of the screen, and is upside down and backwards! I can't figure this. Help!—J. N., Houston, TX.

The crystal ball says you have probably got *massive foldover*; this does cause the bottom part of the picture to appear upside down, etc.

In your letter you say the yoke checks out. However, look closely: the vertical yoke is connected in parallel, which is unusual for a vertical yoke! If one-half is open, you would still get continuity but a very odd vertical scan. Trace the vertical yoke connections, and take one loose so that each winding can be checked separately.

AGC PROBLEM

I've got an AGC problem in this TV. There's −26 volts on the 4HS8 AGC plate that seems to be killing the IF. This should read +30 volts. Other DC voltages seem to be close. When I scope the AGC plate, a high waveform with a peculiar shape appears at vertical frequency. If I ground the AGC plate and place +30 volts on the AGC, I get a picture. What is this?—R. C., Corona CA.

(He sent me a partial copy of the schematic but forgot to inform me what make TV set it was!)

If you can override the AGC and get a picture this proves this is undoubtedly AGC trouble. You do seem to have the keying pulse on the AGC plate, judging from the amplitude of that waveform. (Scope this plate at *horizontal* frequency!)

Check the 3.9-megohm resistor on the AGC line that goes from there to the B+280-volt line. This is to keep the AGC line from being driven too far negative. I think you'll find this is open. **R-E**

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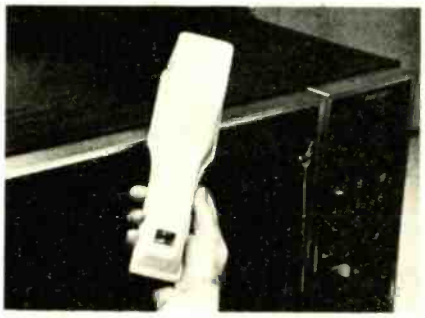

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stove; if meter pointer moves to red portion of scale this indicates excessive leakage. Unit comes with instructions and costs $19.95 (plus state and local taxes as applicable).—**Tanray Associates, Inc.,** Box 99, Elberon, NJ 07740.

TOOL SETS. One *Super 3* set contains one each of A316-4, A416-4 and P2 screwdrivers (3/16-inch, 1/4-inch and No. 2 Phillips); the other *Super 3* set holds one each of S8, S10 and S11 nutdrivers

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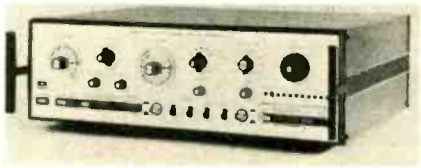
(1/4-inch, 5/16-inch and 11/32-inch, respectively). Both come carded for display, and are available from distributors.—**Vaco Products Co.,** 1510 Skokie Blvd., Northbrook, IL 60062.

SWEEP-FUNCTION GENERATOR, *model 737,* produces triangle, sine and squarewaves and pulses over a 0.0001-Hz–30-MHz frequency range; provides minimum pulse widths of 17 ns, 15 volts P-P into 50 ohms and risetimes less than 10 ns. Unit's two trigger modes can be used to produce signal pulses or bursts. Three trigger modes can be selected; manual, external or an internal ramp/step generator. The frequency range can be varied over a 1000:1 ratio by varying the input voltage to an internal summing amplifier; this voltage can be supplied via the



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external VCF input or the internal ramp/step generator.

The *model 737* contains start and stop frequency dials, each containing inner and outer dials—the outer single-turn dial has a linear/log scale that can vary the frequency over a three decade range; the inner dial is a 12-position switch used to select the frequency range and either the linear or the log mode for the outer dial. LED's indicate the frequency mode selected. The ramp/step generator pushbuttons are used to sweep and step frequencies, and create pulse or burst waveforms. The ramp/step generator operates over a 1-μs to 1000-second range. Additional front-panel controls handle variable symmetry, sync output selection and the trigger level. The *model 737* sells for $1295 FOB.—**Exact Electronics, Inc.,** 455 S. E. 2nd Ave., Hillsboro, OR 97123.

ELECTRONIC BLOCK KITS, *EX-Kit models EX-60, EX-100, EX-150,* use snap-together blocks to create up to 150 different projects, including an AM radio, amplifier, Morse code oscillator circuit, sound-lever meter and basic computer circuits. Easy-to-assemble kits include building blocks, crystal earphone, accessory wires and manual. No soldering, wiring or mechanical connections required. Components are identified by electrical symbol and value. Power is supplied by 6-volt

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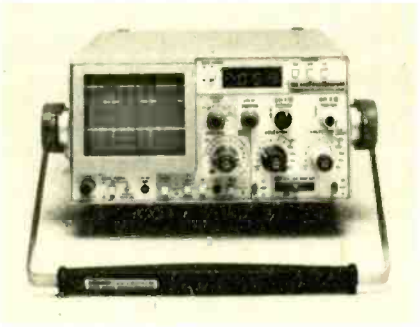
batteries, and each kit comes in a rugged plastic case with handle. Suggested retail prices: *model EX-60,* $44.95; *model EX-100,* $46.95; *model EX-150,* $69.95.—**Distributors, Takahashi International,** 1426-B Richey, Santa Ana, CA 92705.

DUAL-TRACE OSCILLOSCOPE/DMM, *model 305,* is a portable dual-function instrument. The oscilloscope offers a sensitivity of 5 mV-per-division and a 5-MHz bandwidth with a sweep speed range from 1 μs-per-division to 50 ms-per-division. Other oscilloscope features include front-panel X-Y operation; Channel 1 and Channel 2 alternate, chop and add modes; Channel 1 and Channel 2 triggered with polarity inversion; and ×10 magnification.



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The autoranging DMM measures voltages in 4 ranges from 2 volts to 1000 VDC (700 VAC), and resistance from 2000 ohms to 2 megohms (±0.6% accuracy).

The *model 305* operates on AC, DC or built-in battery pack. It comes with probes and carrying case; measures 4.4 × 9.3 × 14.2 inches; weighs 10 lb.; and is priced at $1725.—**Tektronix, Inc.,** P.O. Box 500, Beaverton, OR 97077.

520-MHz FREQUENCY COUNTER, *model PM6664-01,* offers 8-digit LED display and full operation to 80 MHz with 1-Hz resolution. Features automatic continuously variable input sensitivity from 20 mV (100 Hz–520 MHz) to 1 volt.

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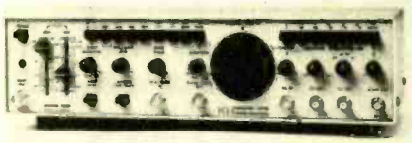
Resolution is 1 Hz up to 80 MHz and 10 Hz above 80 MHz. The unit weighs 3.2 lb and measures 5.75 × 1.75 × 8.7 inches, and sells for $545.—**Philips Test and Measuring Instruments, Inc.,** 85 McKee Dr., Mahwah, NJ 07403.

3-MHZ LINEAR/LOG SWEEP FUNCTION GENERATOR, *model 1600,* provides linear or log sweeps with separate start-stop controls. The generator operates over a frequency range of 0.2 Hz to 3 MHz, and generates sinewaves, squarewaves, triangle waves, ramps and pulse strings. Among the 14 operational modes are included



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continuous, gated, triggered, pulsed, swept, triggered-sweep, gated-sweep, hold-sweep-hold, sweep-hold burst and external voltage control. The main output is adjustable from less than 5 mV to 20 volts P-P, with a 50-ohm output impedance. The variable DC offset is from −10 volts to +10 volts. Suggested retail price: $695.—**Krohn-Hite Corp.,** Avon Industrial Park, Avon, MA 02322.

PROJECTION TV KIT, *model Q-12,* comes complete with a 12-inch *Quasar* color TV set. Also provided are an adjustable two-element F1.3 lens system and lens-hood assembly. Adjustable

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stand with wheels only needs 4 mounting screws; complete kit sells for $425. High-efficiency viewing screens are also available.—**Miami Flock Equipment Co., Inc.,** Optical Div., 304 N.E. 79th St., Miami, FL 33138.

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STAR SHIP SIMULATION, by Roger Garrett. dilithium Press, 30 N.W. 23rd Pl., Portland, OR 97210. 122 pp. 5¼ × 8½ in. Softcover $6.95.

Simulation, the representation of physical systems and phenomena by computers, models or other equipment, can be performed on a small computer. This book describes the design and implementation of a software simulation; each design step is carefully defined, then the program structure is outlined. Chapter 3 deals with the Star Ship simulation project itself; Chapter 4 discusses the implementation of the program. A simple glossary of terms is in the back.

UNDERSTANDING CALCULATOR MATH, Texas Instruments Learning Center. Texas Instruments, Inc., Box 3640, M.S. 84, Dallas, TX 75285. 225 pp. 5¼ × 8¼ pp. Softcover $3.95.

This book covers the basic data, formulas, facts and mathematical tools needed to use a calculator more effectively. It is written in simple, nontechnical language and provides a "keystroke by keystroke" explanation of all the functions on a handheld calculator with their home/office applications. There's a section on puzzles and games, and several tables and a bibliography appear in the back of the book.

RADIO ANGELS, by Paul Jerome Stack. The Ham Radio Publishing Group, Greenville, NH 03048. 172 pp. 5½ × 8¼ in. Softcover $3.95.

Many times during the course of a disaster (or near-disaster) the ham operator is the only link to the outside world. Whether during an earthquake in Nicaragua or an epidemic in Africa, the heroic efforts of amateur radio operators have resulted in many lives being saved. This book tells their stories. Chapter 7 describes a proposal for a ham radio jump team for rescue operations; and there is a glossary of radio terms in the back of the book.

HOW TO MODIFY OLD TELEPHONES. A. M. Gray, Inc., 11004 E. 40 Highway, Box 9710, Kansas City, MO 64137. 26 pp. 8½ × 11 in. Softcover $6.95, plus 50¢ postage.

This book shows you how to convert your antique telephone into a working instrument that is compatible with modern telephone systems. It is written in layman's terms, and gives complete easy-to-follow directions on how to convert two main types of antique phones: the wooden magneto wall phone of the late 1800's and the brass "candlestick" type of the 20's. The text is accompanied by simple illustrations; names and addresses of necessary components are listed in the back.

TRIGGERED OSCILLOSCOPES—FOUR HOURS TO FAMILIARITY, by Forest Belt. Forest Belt's Service Training Monographs, P.O.Box 68120, Indianapolis, IN 46268. 8½ × 11 in. 33 pp. Softcover $12.50 ppd.

This Service Training Monograph is a series of actual training sessions that aid in understanding how to operate an oscilloscope. It is the first of a group of such sessions designed specifically for video, communications and industrial technicians. Explanations, illustrations, examples and exercises have been grouped logically to proceed smoothly to a thorough comprehension of oscilloscopes, using the *Easi-Way* method that lets you view scope displays and manipulate the controls yourself.

THE BUGBOOK VII, by Jonathan A. Titus, Christopher A. Titus, Peter R. Rony and David G. Larsen. E&L Instruments, Inc., 61 First St., Derby, CT 06418. 284 pp. 6 × 9 in. Softcover $8.50.

This seventh in the *Bugbook* series provides an in-depth look at how 8080-based computers are interfaced to real-world analog devices. It contains practical hardware and software analog conversion techniques; nine experiments in waveform generation, data acquisition and CRT display control are included in the back. Chapter 1 deals with interfacing to D/A converters; other chapters compare software interrupts and real-time clocks in data acquisitions; sample-and-hold circuits and multiplexer devices; and miscellaneous conversion techniques.

THE SEMICONDUCTOR MEMORY BOOK, by Intel Marketing Communications. Wiley-Interscience, Div. John Wiley & Sons, Inc., 1 Wiley Drive, Somerset, NJ 08873. 524 pp. 8¼ × 11 in. Softcover $14.95.

State-of-the-art semiconductor memories are lower in cost, higher in density, have a faster access and cycle time, greater reliability and more modular than core memories. This book examines in great detail the three main categories of MOS-technology semiconductor memories—RAM, ROM and serial—and discusses design, configuration and environmental applicability for each type. The text is accompanied by many graphs and tables and schematic diagrams, and an index appears in the back of the book. **R-E**

EQUIPMENT REPORTS

continued from page 35

space on each disc. In addition, the board has hardware and software selection capability between Integer BASIC and Applesoft II.

A small toggle switch protrudes from the board and is accessible from the rear of the Apple II without having to remove its cover. This switch selects the BASIC that is initiated by the normal control-B command. However, this selection can be overridden by software addressing of two locations. Thus, for example, when retrieving an Applesoft program from the disc, the DOS automatically selects the Applesoft ROM Card before loading the program. As with the original on-board ROM in the Apple II computer, the Applesoft firmware board contains an extra (empty) socket for future ROM expansion.

Applesoft II is a fairly comprehensive BASIC interpreter written by Microsoft. It includes extensive graphic commands to match the Apple II's 16-color low-resolution and four-color high-resolution graphic capabilities. Also included are such additional commands as HOME (cursor), INVERSE, FLASH, SPEED, and ON ERR GO TO. Data matrices can now also be STORE'd and RECALL'ed from the cassette.

If the firmware board is installed in an Apple II system with a disc, it offers one more convenience: FP and INT commands to switch between floating-point Applesoft II and Integer BASIC. The Applesoft ROM board makes an excellent addition to the Apple II computer. It costs $200; a bit expensive but worth it if you take into account the RAM savings it affords. **R-E**

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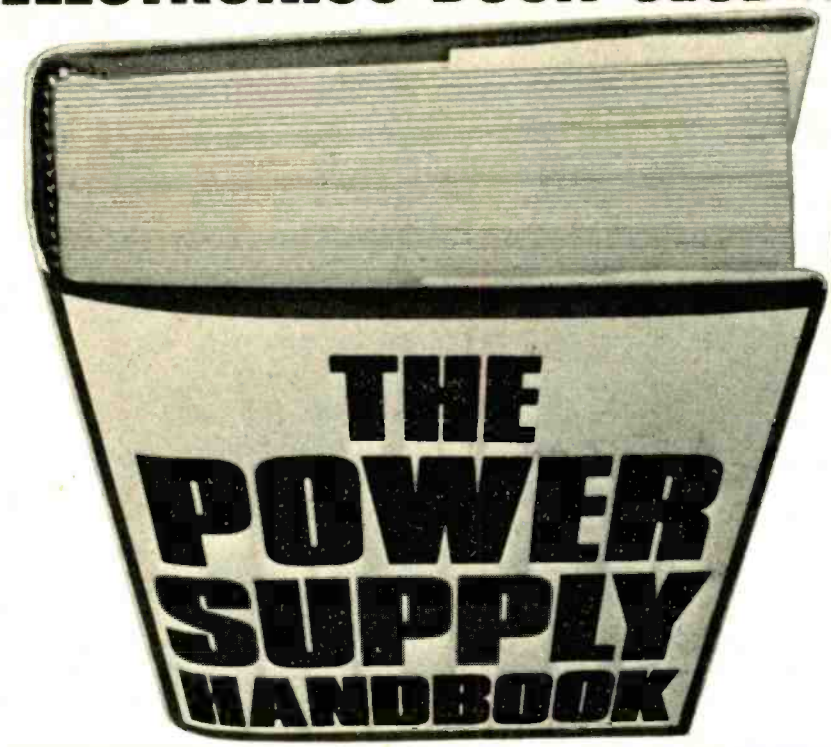

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A broad, rich, and varied collection of ready-to-build power sources for electronics technicians, hams, engineers, and hobbyists!

This is THE complete power supply book...the all-in-one Answerbook with ALL the data you need to build, design, test, and customize virtually any power supply system you want—from AC-to-DC converters to linear amplifier filament transformers, from simple dual-voltage systems to hefty 3000V DC powerhouses, from low-voltage units to precision 10.000V DC references, from sine wave inverters to failsafe superchargers! It contains 420 pages of solid how-to info, stripped clean of irrelevancies, packed with practical instructions on how to create just the unit you need for that special application. You get a brief course in power supply theory, some basic schooling in testing, a thorough guide to power supply design, and section after section of pretested power supply circuits you can build and modify. Projects like 13V mobile systems, 12V 20A brute supplies, voltage sextuplers for SSB, 115V 60 Hz sine wave inverters, regulated nicad chargers, precision 10.000V DC references, adjustable low-voltage regulated supplies, 117V AC to 24V DC converters, and lots of special-purpose AC supplies. And precisely because this manual is so comprehensive, you'll be able to build PS systems that are as good as any you can buy, systems that meet your specifications.

Probably the most remarkable thing about this volume is the sheer variety and quality of the projects it offers...each one is reliable, pretested, easy to build, and you can construct most of them from inexpensive salvaged or surplus parts. It would have to be a very unusual PS indeed not to be covered in this manual, for here you'll find everything from simple get-the-job-done units to highly refined adjustable supplies. Step-by-step instructions tell you how to put together voltage doublers for MOS LSI, super low-voltage supplies, 78MG voltage regulators, 13V supplies for mobile equipment, 110V 600 Hz inverters, polarity changers, 12V to 300V converters, solid-state car alternator/regulators, silver-zinc cell battery chargers, zero to 30V lab supplies, simple four-voltage bench supplies, and many more. The projects come with all the data you need to insure flawless no-hitch construction—concise analyses of special circuits, easy-to-follow directions, detailed schematic diagrams, complete parts lists, and special discussions of construction safety precautions.

The scope of this handbook is broad—broad enough to include construction info on tested circuits that'll help you make the most of any power supply you put together—circuits that'll allow you to interface, modify, and test your own PS designs. The authors show you how to construct voltage splitters, IC protection circuits, smoke testers, two-terminal current limiters, voltage limit sensors, active voltage dividers, microfarad multipliers, capacitor rejuvenator-leakage testers, and many, many others. 420 pps., 292 illus. Hardbound. List $12.95.

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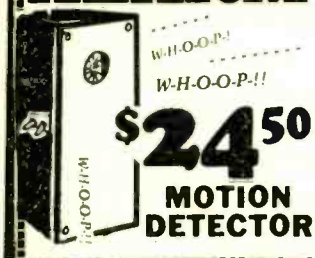

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- 24 hour alarm
- Chronograph counts up to 12 hrs., 59 mins. 59.9 sec.
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- Dual time zone for any two cities of the world at your own choice.
- With light switch to allow you to see the time in the dark!

$65.50

ONE YEAR FULL WARRANTY!

JUMBO 1" LED ALARM CLOCK MODULE

Assembled – not a kit!

Features:
- 1" 4 digits red LED display
- 12 hours real time format
- 24 hours alarm audio output (just add speaker)
- Power failure indicator
- Count down timer 59 mins.
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$8.50 EACH

PPCM 701

Transformer **$1.75**

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 red). 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 $17.50

ELECTRONIC DUAL SPEAKER PROTECTOR

Cut off when circuit is shorted or overload to protect your amplifier as well as your speakers. A must for OCL circuits.

KIT FORM
$8.75 EA.

FM WIRELESS MIC KIT

It is not a pack of cigarettes. It is a new FM wireless mic kit! New design PC board fits into a plastic cigarette box, (case included) Uses a condensor microphone to allow you to have a better response in sound pick-up. Transmits up to 350 ft! With an LED indicator to signal the unit is on.

KIT FORM
$7.95

PPMM2

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All boxes are made of aluminum. Top is anodized black. Bottom is silver and comes with 4 rubber pedestals.

Part No.	Sizes	Price
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FTA 452	4" (W) x 2" (H) x 5" (D)	3.50 ea.
FTA 572	5 3/8" (W) x 2 3/4" (H) x 7" (D)	4.95 ea.

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This is an advance unit using CMOS I.C. and digital parts. You simply mount the unit on the door and the magnetic switch will turn the unit on to make a charming "Ding-Dong" sound when someone comes in. A presetable 3-digit digital security system circuit allows you to set the unit on "guard" when an unexpected person opens the door. The siren alarm will sound and cannot turn off without the correct 3-digit combination. Uses 9V battery (included). Completed unit, not a kit.

$29.50

TIMATRON RACK MOUNT TYPE CABINETS!

All are of aluminum and machine made to very high-precision quality with sleek, black anodized finish. Front panels come blank and undrilled to allow you to make panels of your own design. For large quantity orders Formula International will silkscreen print and drill panel holes at a minimal extra charge.

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16" (W) x 4" (H) x 8" (D)	33.45
9½" (W) x 2¼" (H) x 12" (D)	33.45
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9½" (W) x 4" (H) x 8" (D)	30.25

9 STEPS LED LEVEL INDICATOR KIT

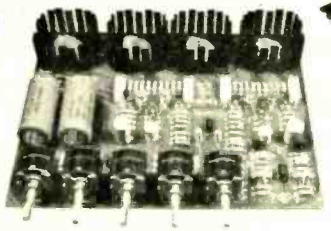
for most stereo amplifiers

This new project works as a pair of VU meter to indicate the output level of your amplifier from -20dB to +3dB. Kit includes all LED, transistors, electronic components, P.C. Board and instructions.

Easy to build and fun to see.

ONLY $12.50 EA.

60W + 60W STEREO AMPLIFIER



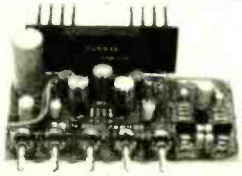
COMPLETED UNIT—NOT A KIT!

OCL pre amp. & power stereo amp. with bass, middle, treble 3-way tone control. Fully assembled and tested, ready to work. Total harmonic distortion less than 0.5% at full power. Output maximum is 60 watts per channel at 8Ω . Power supply is 24 - 36V AC or DC. Complete unit

*Kit form $37.50 — Assembled $49.50 ea.

Power transformer $ 8.50 ea.

22W + 22W STEREO HYBRID AMPLIFIER KIT



POWER TRANSFORMER $6.50 EACH

It Works in 12V D.C. As Well! Kit includes 1 PC SANYO STK-024 stereo power amp. IC LM 1458 as pre amp, all other electronic parts, PC Board, all control pots and special heat sink for hybrid. Power transformer not included. It produces ultra hi-fi output up to 44 watts (22 watts per channel) yet gives out less than 0.1% total harmonic distortion between 100Mz and 10KHz.

$32.50 PER KIT

A NEW 80W + 80W COMPLETE STEREO AMPLIFIER

With all tone control and a new design. Bi-Fet Front Amp will be selling next month at **$72.50 ea.**

Completed Unit, Not a Kit! Order Now.

SANYO HYBRID

Audio power amplifiers I.C. Max. hi-fi output power, minimum ext. components needed.

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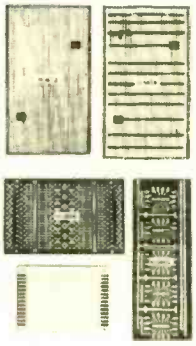
50 Watts	STK-050	$26.50
10W + 10W (stereo)	STK-040	$14.50
15W + 15W (stereo)	STK-041	$25.50
20W + 20W (stereo)	STK-043	$31.50

*data sheet comes with purchase

UNIVERSAL PROTOBOARDS "CIRCUIT FIT"



All Boards are made of High Quality G10 Fiberglass and Phenolic. Pre-drilled in .042" diameter holes on 0.1" centers with tin plated copper eyelet and finger edge connectors (single sided) to allow any kind of standard components to fit board.

Part No.	Size	Holes	Price Fiberglass	Price Phenolic
U.S.P. 723	2" x 2.8"	529	$ 1.27	$ .50
U.S.P. 724	2.8" x 3.7"	750	2.42	.80
U.S.P. 725	3.7" x 5.5"	1500	4.89	1.38
U.S.P. 728	7" x 9.6"	6240	19.50	10.40
H-5612	3½" x 6"			1.70
H-5616	3½" x 6"			1.70
H-5606	3½" x 5"			1.50
H-5602	2½" x 6½"			1.50

ELECTRONIC WHEEL OF FORTUNE KIT

With 10 numbers split into black and white on dial. The LED turns when you hit the play switch, then it slows down and stops on one number. It sounds like a motor inside, but there is none. Lots of fun and easy to build. Kit comes with nice looking case, all electronic parts, P.C. Board and LEDs. Battery not included.

$12.50

CIRCLE 4 ON FREE INFORMATION CARD

SUPER 15 WATT AUDIO AMP KIT

ONLY $23.50 each

Uses STK-015 Hybrid Power Amp

Kit includes: STK-015 Hybrid IC, power supply with power transformer, front Amp with tone control, all electronic parts as well as PC Board. Less than 0.5% harmonic distortion at full power ½dB response from 20—100,000 Hz. This amplifier has QUASI—Complimentary class B output. Output max is watt (10 watt RMS) at 4Ω .

MINI ELECTRONIC ORGAN KIT

PET-102 (25 KEYS)

The kit contains all electronic and mechanical parts, key boards, speaker, switches and PC Board as well as the wooden cabinet. Ideal for school project or gift to children interested in electronics. Uses 6V C size x 4 battery (not included).

$38.50

MANY SOUND DECISIONS!

$3.60 EACH

Solid state sound indicator operating voltage 6V DC 30μA. Small size approximately ¾" X 1¾".

Model EB2116 (Continuous)
Model EB2126 (Slow Pulse)
Model EB2136 (Fast Pulse)

1Watt AUDIO AMP

All parts are pre assembled on a mini PC Board
Supply Voltage 6 ~ 9V D.C.
SPECIAL PRICE $1.95 ea.

"FISHER" 30 WATT STEREO AMP

MAIN AMP (15W X 2)

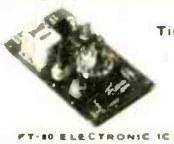
Kit includes 2 pcs. Fisher PA 301 Hybrid IC all electronic parts with PC Board. Power supply ± 16V DC (not included). Power band with (KF 1% ± 3dB). Voltage gain 33dB. 20Hz ~ 20KHz.

Super Buy Only $18.50

5W AUDIO AMP KIT

2 LM 380 with Volume Control
Power Supply 6 ~ 18V DC
only $5.00 ea.

TIMER KIT



Time Controlled from 1-100sec. Ideal to be used as timer delay unit for burglar alarm, photo service, and other purposes. Max. loading 110V, 2 AMP. Supply voltage 12-18V DC.

PT-80 ELECTRONIC IC TIMER

$11.50 each

ELECTRONIC ALARM SIREN

COMPLETE UNIT

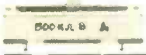
Ideal for use as an Alarm Unit or hookup to your car back up to make a reverse indicator. Light Output up to 130dB Voltage Supply 6 ~ 12V $7.50

AU—999

SOUND ACTIVATED SWITCH

All parts completed on a PC Board
SCR will turn on relay, buzzer or trigger other circuit for 2 ~ 10 sec. (adjustable)
Ideal for use as door alarm, sound controlled toys and many other projects.
Supply voltage 4.5V ~ 9V D.C
$1.75 ea./2 for $3.00

LINEAR SLIDE POT



500KΩ SINGLE
Metal Case 3" Long
2 FOR $1.20

DIGITAL ELECTRONIC LOCK KIT

$6.50 ea. IN CIRCUIT

for auto ignition, entry door, burglar alarm, etc. 4 Digits Programmable to Any Combination

CMOS I.C.

400Ω RELAY AND KEY PAD NOT INCLUDED

BATTERY POWERED FLUORESCENT LANTERN

$10.50 EACH
MODEL 888 B

FEATURES

- Circuitry designed for operation by high efficient, high power silicon transistor which enable illumination maintain in a standard level even the battery supply drops to a certain low voltage.
- 9" 6W cool/daylight miniature flourescent tube.
- 8 x 1.5V UM-1 (size D) dry cell battery.
- Easy sliding door for changing batteries.
- Stainless reflector with wide angle increasing luminsation of the lantern.

PROFESSIONAL CASE

for our 0-30V Power Supply. It is a nice looking metal cast case with giant 4" volt/amp meter; output blinding post and fuse holder, on/off switch and line cord! ONLY $21.50 EA.

CASE 030

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.

0-30 POWER SUPPLY

$10.50 each

Transformer for Power Supply, 2AMP 24V x 2 $8.50

12V DC MINI RELAY

6V	SPDT	2AMP	1.30
12V	SPDT	3AMP	1.60
12V	DPDT	2AMP	2.50
12V	4PDT	3AMP	3.50

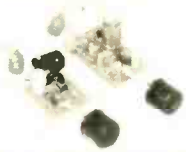
ELECTRONIC SWITCH KIT

CONDENSER TYPE

Touch On Touch Off uses 7473 I.C. and 12V relay

$5.50 each

ULTRA SONIC SWITCH KIT

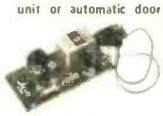


Kit includes the Ultra Sonic Transducers, 2 PC Boards for transmitter and receiver. All electronic parts and instructions. Easy to build and a lot of uses such as remote control for TV, garage door, alarm system or counter. Unit operated by 9—12 DC.

$15.50

CDS LIGHT CONTROL SWITCH KIT

High Sensitivity Darlington Circuit, operated with a 9V D.C. supply to control lights or use it for burglar alarm, shooting game, visitor buzzer, product counting, flash-light slave unit or automatic door opener and many more. The potentiometer is to adjust the sensitivity and the relay in the circuit can handle up to 200 watts.



$4.50 ea. kit

TEXTOOL 40 PINS D.I.P. ZERO INSERTION TEST SOCKET

It is perfectly suited for both hand test and burn in requirements. All brand new parts. $8.75 ea.

I.C. TEST CLIPS

Same as the E Z clips With 20" Long Leads In Black and Red Colors

$2.75 per pair

5 AMP 5VDC

3 Terminals Positive Voltage Regulator Hard to find! Fairchild 78HO5To-3 Package, Input 8.5 - 20V DC Output +5V DC 5AMP Load Regulation 1%.

Only $8.75 ea

EECO THUMBWHEEL SWITCHES

BCO OUTPUT 0—9

10 positions 3 digits with end and each digit section is detatchable.

3 Digits only $5.00

Sub Mini Size PANEL METER

500 UA
ONLY $1.20 ea

PANEL METER (D.C. Type)

$8.50 ea.

Size 60MM X 66MM
White Face Type

0-50 UA	0-30V
0-1MA	0-50V
0-5MA	0-100V
0-100MA	

TRANSFORMERS

ALL 117 VOLT INPUT

30V	4AMP	$7.50 EA.
36V CT	3AMP	$8.50 EA.
48V CT	3AMP	$8.50 EA.
24V CT	3AMP	$8.50 EA.
24V CT	0.8AMP	$1.80 EA.
12V CT	0.5AMP	$1.80 EA.
12V CT	120MA	$1.25 EA.

AC POWER SUPPLY

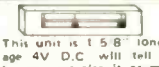
Wall Type Transformer

12V AC	Output	200MA $2.75 EA.
16V CT AC	Output	100MA $2.10 EA.
6V DC	Output	120MA $1.90 EA.
12V DC	Output	100MA $1.90 EA.

WIDE ANGLE PANEL METER

1⅜" x ⅜"
1MA Full Scale
(scale marks 0-100)
$1.50 each

HOUR INDICATOR



This unit is 1 5/8" long operating voltage 4V D.C will tell you how many hours your circuit or machine has been in service up to 100 hours.

Limited Quantity ONLY $1.75 ea.

FM WIRELESS MIC KIT

$6.95 EACH KIT

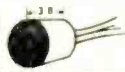
This new model FM wireless MIC kit uses 3 high freq. transistors, works in the FM range (88-108 MHz). It transmits the sound wave fidelity clearly over long distances (up to 250 ft.). Kit comes with all electronic parts, P.C. Board and mini microphone!

WE FOUND THE CASE FOR THE FM MIC!

Small nice looking aluminum case size like a Pack of cigarettes. It is an intercom. Audio amp inside with a mic jack, a mini toggle sw on top, can be used for many projects. We give you the circuit data as well.

VERY SPECIAL PRICE 2 for $4.99

Sub-Mini Size CONDENSER MICROPHONE



$2.50 each
FET Transistor Built-In

FLUORESCENT LIGHT DRIVER KIT

12V DC POWERED
Lights up 8 ~ 15 Watt Fluorescent Light Tubes
Ideal for camper, outdoor Auto or Boat

Kit Includes high voltage coil, power transistor, heat sink, all other electronic parts and PC Board, light tube not included!

WITH CASE ONLY $6.50 PER KIT

HEAVY DUTY CLIP LEADS

10 pairs — 5 colors
Alligator clips on a 22" long lead. Ideal for any testing.

$2.20/pack

MINI-SIZED I.C. AM RADIO

Size smaller than a box of matches!
Receives all AM stations
Batteries and ear phone included

Only $10.50

MINI-MINI TOGGLE SWITCH

Half size of submini toggle switch rated 3 amp 125V AC contact

			1-9	10-99
MS 244	SPDT		1.00	0.90
MS 245	DPDT		1.20	1.10

LARGE QUANTITY AVAILABLE FOR OEM

SUBMINIATURES TOGGLE SWITCHES

SPDT	On-Off	$1.30 ea
DPDT	On-Off	$1.50 ea
3PDT	On-Off	$1.75 ea

Mini size Rocker Type
Also available at the same price

MINI SIZE REED RELAY

Approx. 1" square
SPST Normal Open
Contact rated 1AMP
Coil 6 ~ 12V DC
All brand new by AMF
3 for $2.00

PUSH-BUTTON SWITCH

N/Open Contact
Color: Red, White, Blue, Green, Black. 3/$1.00
N/Close also
Available 50¢ ea.
LARGE QTY. AVAILABLE

SOLID STATE ELECTRONIC BUZZER

Mini size 1" x ⅝" x ⅜"
Supply voltage 1.5V 12V
Ideal for Alarm or Tone Indicator
$1.50 each

MINIMUM ORDER $10.00. California residents add 6% sales tax and 10% shipping.
Out of state add 15% of total purchase for shipping charges, out of USA and Overseas add 25% of total purchase.
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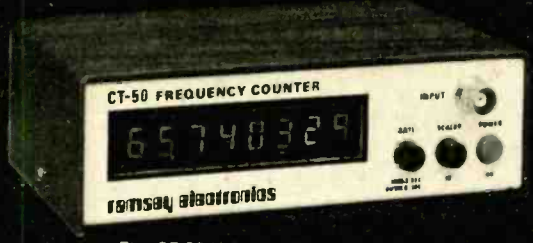
CIRCLE 5 ON FREE INFORMATION CARD

FREQUENCY COUNTER KIT

Outstanding Performance

Incredible Price $89.95

CT-50



The CT-50 is a versatile and precision frequency counter which will measure frequencies to 60 mHz and up to 600 mHz with the CT-600 option. Large Scale Integration, CMOS circuitry and solid state display technology have enabled this counter to match performance found in units selling for over three times as much. Low power consumption (typically 300-400 ma) makes the CT-50 ideal for portable battery operation. Features of the CT-50 include: large 8 digit LED display, RF shielded all metal case, easy pushbutton operation, automatic decimal point, fully socketed IC chips and input protection to 50 volts to insure against accidental burnout or overload. And, the best feature of all is the easy assembly. Clear, step by step instructions guide you to a finished unit you can rely on.

Order your today!

CT-50, 60 mHz counter kit	$89.95
CT-50WT, 60 mHz counter wired and tested	159.95
CT-600, 600 mHz scaler option, add	29.95

SPECIFICATIONS:

- Frequency range: 6 Hz to 65 mHz; 600 mHz with CT-600
- Resolution: 10 Hz @ 0.1 sec gate; 1 Hz @ 1 sec gate
- Readout: 8 digit, 0.4" high LED, direct readout in mHz
- Accuracy: adjustable to 0.5 ppm
- Stability: 2.0 ppm over 10° to 40° C. temperature compensated
- Input: BNC, 1 megohm, 20 pf direct, 50 ohm with CT-600
- Overload: 50VAC maximum, all modes
- Sensitivity: less than 25 mv to 65 mHz, 50-150 mv to 600 mHz
- Power: 110 VAC, 5 Watts or 12 VDC @ 400 ma
- Size: 6" x 4" x 2", high quality aluminum case, 2 lbs
- IC's: 13 units, all socketed

CB-1 Color TV calibrator stabilizer	$14.95
DP-1 DC probe, general purpose probe	12.95
HP-1 High impedance probe, current-loading	15.95

CAR CLOCK

The UN-KIT, only 5 solder connections

Here's a super looking, rugged and accurate auto clock which is a snap to build and install. Clock movement is completely assembled—you only solder 3 wires and 2 switches, takes about 15 minutes! Display is bright green with automatic brightness control photocell—assures you of a highly readable display, day or night. Comes in a satin finish anodized aluminum case which can be attached 5 different ways using 2 sided tape. Choice of silver, black or gold case (specify).

DC-3 kit, 12 hour format	$22.95
DC-3 wired and tested	$29.95
110V AC adapter	$5.95

Under dash car clock

12/24 hour clock in a beautiful plastic case features: 6 jumbo RED LEDS, high accuracy (1min/mo.), easy 3 wire hookup, display blanks with ignition, and super instructions. Optional dimmer automatically adjusts display to ambient light level.

DC-11 clock with mtg. bracket	$27.95
DM-1 dimmer adapter	2.50

PRESCALER

Extend the range of your counter to 600 mHz. Works with any counter. Includes 2 transistor pre-amp to give super sens. typically 20 mv at 150 mHz. Specify ÷10 or ÷100 ratio.

PS-1B, 600 mHz prescaler	$59.95
PS-1BK, 600 mHz prescaler kit	49.95

OP-AMP SPECIAL

741 mini dip	12/$2.00
B1-FET, mini dip, 741 type	10/$2.00

VIDEO TERMINAL

A completely self-contained, stand alone video terminal card. Requires only an ASCII keyboard and TV set to become a complete terminal unit. Two units available, common features are: single 5V supply, XTAL controlled sync and baud rates (to 9600), complete computer and keyboard control of cursor. Parity error control and display. Accepts and generates serial ASCII plus parallel keyboard input. The 3216 is 32 char. by 16 lines, 2 pages with memory dump feature. The 6416 is 64 char. by 16 lines, with scrolling, upper and lower case (optional) and has RS-232 and 20ma loop interfaces on board. Kits include sockets and complete documentation.

RE 3216, terminal card	$149.95
RE 6416, terminal card	189.95
Lower Case option, 6416 only	13.95
Power Supply Kit	14.95
Video/RF Modulator, VD-1	6.95
Assembled, tested units, add	60.00

CALENDAR ALARM CLOCK

The clock that's got it all: 6-.5" LEDs, 12/24 hour, snooze, 24 hour alarm, 4 year calendar, battery backup, and lots more. The super 7001 chip is used. Size: 5x4x2 inches.

Complete kit, less case (not available)

DC-9	$34.95

30 Watt 2 mtr PWR AMP

Simple Class C power amp features 8 times power gain. 1 W in for 8 out, 2 In for 15 out, 4 W in for 30 out. Max. output of 35 W. Incredible value, complete with all parts, less case and T-R relay.

PA-1, 30 W pwr amp kit	$22.95
TR-1, RF sensed T-R relay kit	6.95

FM MINI MIKE KIT

A super high performance FM wireless mike kit! Transmits a stable signal up to 300 yards with exceptional audio quality by means of its built in electret mike. Kit includes case, mike, on-off switch, antenna, battery and super instructions. This is the finest unit available.

FM-3 kit	$12.95
FM-3 wired and tested	16.95

CLOCK KITS

our Best Seller your Best Deal

Try your hand at building the finest looking clock on the market. Its satin finish anodized aluminum case looks great anywhere, while six .4" LED digits provide a highly readable display. This is a complete kit, no extras needed, and it only takes 1-2 hours to assemble. Your choice of case colors, silver, gold, bronze, black, blue (specify).

Clock kit, 12/24 hour, DC-5	$22.95
Clock with 10 min. ID timer, 12/24 hour, DC-10	27.95
Alarm clock, 12 hour only, DC-8	24.95
12V DC car clock, DC-7	27.95

For wired and tested clocks add $10.00 to kit price.

Hard to find PARTS

LINEAR ICs		REGULATORS	
301	$ .35	78MG	$1.25
324	1.50	723	.50
380	1.25	309K	.85
380-8	.75	7805	.85
555	.45	78L05	.25
556	.85	7905	1.25
565	1.15	7812	.85
567	1.25	7912	1.25
1458	.50	7815	.85
3900	.50		
CMOS ICs		**TTL ICs**	
4011	.20	4500	.35
4013	.35	447	.65
4046	1.85	475	.50
4049	.40	490	.50
4518	1.25	4196T1	1.35
5369	1.75	**SPECIAL ICs**	
TRANSISTORS		1090	13.50
2N3904 type	10/1.00	0116	1.25
2N3906 type	10/1.00	4511	2.00
NPN 30W Pwr	3/1.00	5314	2.95
PNP 30W Pwr	3/1.00	5375AB	2.95
2N3055	.60	7001	6.50
J-FT 2N2646 type	3/2.00	4059 - N	9.00
FET MPF102 type	3/2.00	7208	17.95
JMF 2N5179 type	3/2.00	**LEDs**	
MRF-238 RF	11.95	Jumbo red	8/1.00
SOCKETS		Jumbo green	6/1.00
8 pin	10/2.00	Jumbo yellow	6/1.00
14 pin	10/2.00	Mini red	8/1.00
16 pin	10/2.00	Micro red	8/1.00
24 pin	4/2.00	Bi-Polar	.75
28 pin	4/2.00	**FERRITE BEADS**	
40 pin	3/2.00	With info. specs	.15/1.00
		4 hole balun	5/1.00

Ramsey's famous MINI-KITS

FM WIRELESS MIKE KIT

Transmits up to 300' to any FM broadcast radio, uses any type of mike. Runs on 3 to 9V. Type FM-2 has added sensitive mike preamp stage.

FM-1 kit $2.95 FM-2 kit $4.95

COLOR ORGAN/MUSIC LIGHTS

See music come alive! 3 different lights flicker with music. One light for lows, one for the mid-range and one for the highs. Each channel individually adjustable, and drives up to 300W. Great for parties, band music, nite clubs and more.

Complete kit, ML-1 $7.95

LED BLINKY KIT

A great attention getter which alternately flashes 2 jumbo LEDs. Use for name badges, buttons, warning panel lights, anything! Runs on 3 to 15 volts.

Complete kit, BL-1 $2.95

VIDEO MODULATOR KIT

Converts any TV to video monitor. Super stable, tunable over ch. 4-6. Runs on 5-15V, accepts std. video signal. Best unit on the market!

Complete kit, VD-1 $6.95

TONE DECODER

A complete tone decoder on a single PC board. Features: 400-5000 Hz adjustable range via 20 turn pot, voltage regulation, 567 IC. Useful for touch-tone decoding, tone burst detection, FSK, etc. Can also be used as a stable tone encoder. Runs on 5 to 12 volts.

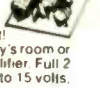
Complete kit, TD-1 $5.95

WHISPER LIGHT KIT

An interesting kit, small mike picks up sounds and converts them to light. The louder the sound, the brighter the light. Completely self-contained, includes mike, runs on 110VAC, controls up to 300 watts.

Complete kit, WL-1 $6.95

SUPER SLEUTH



A super sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as general purpose amplifier. Full 2 W rms output, runs on 6 to 15 volts, uses 8-45 ohm speaker.

Complete kit, BN-9 $5.95

POWER SUPPLY KIT

Complete triple regulated power supply provides variable 6 to 18 volts at 200 ma and + 5V at 1 Amp. Excellent load regulation, good filtering and small size. Less transformers, requires 6.3V @ 1 A and 24 VCT.

Complete kit, PS-3LT $6.95

SIREN KIT

Produces upward and downward wail characteristic of a police siren. 5 W peak audio output, runs on 3-15 volts, uses 3-45 ohm speaker.

Complete kit, SM-3 $2.95

ramsey electronics

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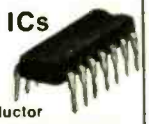
CIRCLE 36 ON FREE INFORMATION CARD

Radio Shack: No. 1 Parts Place
Low Prices and New Items Everyday!

Top-quality devices, fully functional, carefully inspected. Guaranteed to meet all specifications, both electrically and mechanically. All are made by well-known American manufacturers, and all have to pass manufacturer's quality control procedures. These are not rejects, not fallouts, not seconds. In fact, there are none better on the market! Always count on Radio Shack for the finest quality electronic parts!

TTL and CMOS Logic ICs



Full-Spec Devices Direct from Motorola and National Semiconductor

Type	Cat. No.	ONLY
7400	276-1801	35¢
7402	276-1811	39¢
7404	276-1802	35¢
7406	276-1821	49¢
7410	276-1807	39¢
7413	276-1815	79¢
7420	276-1809	39¢
7427	276-1823	49¢
7432	276-1824	49¢
7441	276-1804	99¢
7447	276-1805	99¢
7448	276-1816	99¢
7451	276-1825	39¢
7473	276-1803	49¢
7474	276-1818	49¢
7475	276-1806	79¢
7476	276-1813	59¢
7485	276-1826	1.19
7486	276-1827	49¢
7490	276-1808	79¢
7492	276-1819	69¢
74123	276-1817	99¢
74145	276-1828	1.19
74150	276-1829	1.39
74154	276-1834	1.29
74192	276-1831	1.19
74193	276-1820	1.19
74194	276-1832	1.19
74196	276-1833	1.29
4001	276-2401	49¢
4011	276-2411	49¢
4012	276-2412	69¢
4013	276-2413	89¢
4017	276-2417	1.49
4020	276-2420	1.49
4021	276-2421	1.49
4023	276-2423	69¢
4027	276-2427	89¢
4028	276-2428	1.29
4046	276-2446	1.69
4049	276-2449	89¢
4050	276-2450	69¢
4051	276-2451	1.49
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Creates almost any type of sound — music to "gunshots!" Built-in audio amp. Includes 2 VCO's, LF osc., noise gen., filter, 2 mixers, envelope modulator, logic circuit. 28-pin DIP. With data/applications circuits. **276-1765** 2.99

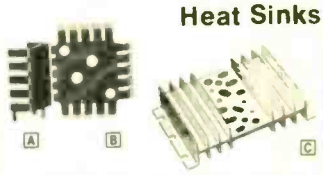
Analog Audio Delay IC MN 3002

10.95

For Phase-Shifter, Reverb & Delay Circuits

"Bucket Brigade" device uses 512 shift registers to provide a continuously variable electronic delay for complex audio signals. Includes data sheet and applications circuits. **276-1760** 10.95

Heat Sinks



[A] **TO-220.** For PC board-mounted power semiconductors in TO-220 cases. Anodized aluminum.
276-1363 ..... 79¢

[B] **TO-3 Sink.** For PC or chassis mtg.
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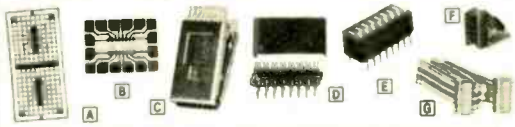
[C] **Universal.** Mounts 2 devices, accepts 9 case styles. **276-1361** 2.69

Top-Quality IC and PCB Accessories



[A] **PC Board.** Mounts two 14 or 16-pin ICs or sockets for bread boarding. Copper clad. 2⅜x5x1/16". **276-151** 2.99

[B] **PC Board.** Mounts single 14 or 16-pin IC or socket. **276-024** ..... Pkg. of 2/99¢

[C] **18-Pin IC Test Clip.** **276-1951** 3.99

[D] **16-Pin DIP Header.** With snap-on cover. **276-1980** 1.29

[E] **8-Rocker 16-Pin DIP Switch.** **276-1301** 1.99

[F] **Vertical 16-pin Socket.** For LED displays. **276-1986** 1.49

[G] **16-Pin DIP Jumper Cable.** 18" long. **276-1976** 3.99

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Miniature Hobby Motors

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273-210 ..... 69¢

[B] **6-9VDC.** 500mA. 1⅝x¾".
273-209 ..... Pkg. of 2/99¢

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PC Potentiometers

[A] Vertical [B] Horizontal

Ohms	¼ W. (Fig. A) Cat No	Ea.	½ W. (Fig. B) Cat No	Ea.
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1k	271-227	49¢	271-333	39¢
5k	271-217	49¢	—	—
10k	271-218	49¢	271-335	39¢
25k	—	—	271-336	39¢
50k	271-219	49¢	—	—
100k	271-220	49¢	271-338	39¢
500k	271-221	49¢	—	—
1 Meg	271-229	49¢	—	—

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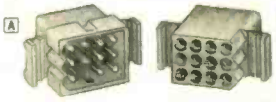
Everything you need for making high-quality custom PC boards.
276-1576 ..... 7.95
Extra Resist Pen. 276-1530 ..... 1.29
Extra Etching Solution. 276-1535 ..... 2.19

Molded Connectors



Molded nylon body. Each circuit rated 8A @ 250V. Standard .093" pin diameter.

[A] **4-Pin Male. 274-224** ..... 99¢
6-Pin Male. 274-226 ..... 1.19
9-Pin Male. 274-229 ..... 1.39
12-Pin Male. 274-232 ..... 1.49

[B] **4-Pin Female. 274-234** ..... 99¢
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8224 Clock and Generator Driver. **276-2524** 3.95

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8251 Programmable Communication Interface. 276-2551 ..... 9.95

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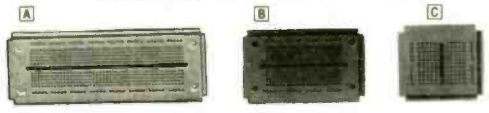
IC Breadboard Sockets



Modular boards snap together and feature standard 0.3" center. Accept 22 through 30-gauge solid hookup wire.

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[A] **Intel® 8080/8085 Programming Manual.** Handy reference for programming with Intel's assembly language. **62-1377** 3.95

[B] **Intel Memory Design Handbook.** Explains use of Intel's memory components and support circuits in systems. **62-1378** 3.95

[C] **Intel Data Catalog.** 928 pages of specifications on most of Intel's standard microcomputer-related products. **62-1379** 4.95

[D] **Semiconductor Reference and Application Handbook.** Complete specs and applications for popular IC transistors, diodes. **276-4002** 1.95

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74LS09	.29
74LS10	.23
74LS11	.60
74LS13	.49
74LS14	.99
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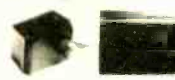

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XC22G	green	4/$1
XC22Y	yellow	4/$1
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XC209Y	yellow	4/$1
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XC526C	clear	4/$1
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MAN 2	5 x 7 Dot Matrix-red	.300	4.95	MAN 6740	Common Cathode-red-D D	.560	.99
MAN 3	Common Cathode-red	.125	.25	MAN 6750	Common Cathode-red ± 1	.560	.99
MAN 4	Common Cathode-red	.187	1.95	MAN 6760	Common Anode-red	.560	.99
MAN 7G	Common Anode-green	.300	1.25	MAN 6780	Common Cathode-red	.560	.99
MAN 7Y	Common Anode-yellow	.300	.99	DL701	Common Anode-red ± 1	.300	.99
MAN 72	Common Anode-red	.300	.99	DL704	Common Cathode-red	.300	.99
MAN 74	Common Cathode-red	.300	1.25	DL707	Common Anode-red	.300	.99
MAN 82	Common Anode-yellow	.300	.99	DL728	Common Cathode-red	.500	1.49
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MAN 3620	Common Anode-orange	.300	.99	DL746	Common Anode-red ± 1	.630	1.49
MAN 3630	Common Anode-orange ± 1	.300	.99	DL747	Common Anode-red	.600	1.49
MAN 3640	Common Cathode-orange	.300	.99	DL749	Common Cathode-red ± 1	.630	1.49
MAN 4610	Common Anode-orange	.300	.99	DL750	Common Cathode-red	.600	1.49
MAN 4640	Common Cathode-orange	.400	.99	DL338	Common Cathode-red	.110	.35
MAN 4710	Common Anode-red	.400	.99	FND70	Common Cathode	.250	.69
MAN 4730	Common Anode-red ± 1	.400	.99	FND358	Common Cathode ± 1	.357	.99
MAN 4740	Common Cathode-red	.400	.99	FND359	Common Cathode	.357	.75
MAN 4810	Common Anode-yellow	.400	.99	FND503	Common Cathode(FND500)	.500	.99
MAN 4840	Common Cathode-yellow	.400	.99	FND507	Common Anode (FND510)	.500	.99
MAN 6610	Common Anode-orange-D.D	.560	.99	5082-7730	Common Anode-red	.300	1.30
MAN 6630	Common Anode-orange ± 1	.560	.99	HDSP-3400	Common Anode-red	.800	2.10
MAN 6640	Common Cathode-orange-D D	.560	.99	HDSP-3403	Common Cathode red	.800	2.10
MAN 6650	Common Cathode-orange ± 1	.560	.99	5082-7300	4 x 7 sgl Digit-RHDP	.600	19.95
MAN 6660	Common Anode-orange	.560	.99	5082-7302	4 x 7 Sgl Digit-LHDP	.600	19.95
MAN 6680	Common Cathode-orange	.560	.99	5082-7304	Overrange character (±1)	.600	15.00
MAN 6710	Common Anode-red-D D	.560	.99	5082-7340	4 x 7 Sgl Digit-Hexadecimal	.600	22.50

RCA LINEAR

Part	Price	Part	Price
CA3013T	2.15	CA3082N	2.00
CA2023T	2.56	CA3083N	1.60
CA3035T	2.48	CA3086N	.85
CA3039T	1.35	CA3089N	3.75
CA3046N	1.30	CA3130T	1.39
CA3059N	3.25	CA3140T	1.25
CA3060N	3.25	CA3160T	1.25
CA3080T	.85	CA3401N	.49
CA3081N	2.00	CA3600N	3.50

CALCULATOR CHIPS/DRIVERS

Part	Price
MM5725	$2.95
MM5738	2.95
DM8864	2.00
DM8865	1.00
DM8887	.75
DM8889	.75
9374 7 seg C.A. LED driver	

CLOCK CHIPS

Part	Price
MM5309	$4.95
MM5311	4.95
MM5312	4.95
MM5314	4.95
MM5316	6.95
MM5318	9.95
MM5369	2.95
MM5387/1998A	4.95
MM5841	9.95

MOTOROLA

Part	Price
MC1408L7	$4.95
MC1408L8	5.75
MC1439L	2.95
MC3022P	2.95
MC3061P	3.50
MC4016(74416)	7.50
MC4024P	3.95
MC4040P	6.95
MC4044P	4.50

IC SOLDERTAIL — 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 STANDARD (GOLD)


	1-24	25-49	50-100
8 pin SG	$.30	.27	.24
14 pin SG	.35	.32	.29
16 pin SG	.38	.35	.32
18 pin SG	.52	.47	.43
24 pin SG	$.70	.63	.57
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	$.39	.38	.31
10 pin WW	.45	.41	.37
14 pin WW	.39	.38	.37
16 pin WW	.43	.42	.41
18 pin WW	.75	.68	.62
22 pin WW	$.95	.85	.75
24 pin WW	1.05	.95	.85
28 pin WW	1.40	1.25	1.10
36 pin WW	1.59	1.45	1.30
40 pin WW	1.75	1.55	1.40

1/4 WATT RESISTOR ASSORTMENTS – 5%

ASST. 1	5 ea	10 OHM, 27 OHM	12 OHM, 33 OHM	15 OHM, 39 OHM	18 OHM, 47 OHM	22 OHM, 56 OHM	50 PCS	$1.75
ASST. 2	5 ea	68 OHM, 180 OHM	82 OHM, 220 OHM	100 OHM, 270 OHM	120 OHM, 330 OHM	150 OHM, 390 OHM	50 PCS	1.75
ASST. 3	5 ea	470 OHM, 1.2K	560 OHM, 1.5K	680 OHM, 1.8K	820 OHM, 2.2K	1K, 2.7K	50 PCS	1.75
ASST. 4	5 ea	3.3K, 8.2K	3.9K, 10K	4.7K, 12K	5.6K, 15K	6.8K, 18K	50 PCS	1.75
ASST. 5	5 ea	22K, 56K	27K, 68K	33K, 82K	39K, 100K	47K, 120K	50 PCS	1.75
ASST. 6	5 ea	150K, 390K	180K, 470K	220K, 560K	270K, 680K	330K, 820K	50 PCS	1.75
ASST. 7	5 ea	1M, 2.7M	1.2M, 3.3M	1.5M, 3.9M	1.8M, 4.7M	2.2M, 5.6M	50 PCS	1.75

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) $9.95 ea.

$10.00 Minimum Order — U.S. Funds Only · Spec Sheets — 25¢
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NEW 1979 Catalog

Jameco ELECTRONICS

PHONE ORDERS WELCOME (415) 592-8097

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1021 HOWARD AVENUE, SAN CARLOS, CA 94070
ADVERTISED PRICES GOOD THRU APRIL

TELEPHONE/KEYBOARD CHIPS

AY-5-9100	Push Button Telephone Dialler	$14.95
AY-5-9200	Repertory Dialler	14.95
AY-5-9500	CMOS Clock Generator	4.95
AY-5-2376	Keyboard Encoder (88 keys)	14.95
HD0165	Keyboard Encoder (16 keys)	7.95
74C922	Keyboard Encoder (16 keys)	5.95

ICM CHIPS

ICM7045	CMOS Precision Timer	24.95
ICM7205	CMOS LED Stopwatch/Timer	19.95
ICM7207	Oscillator Controller	7.50
ICM7208	Seven Decade Counter	19.95
ICM7209	Clock Generator	6.95

NMOS READ ONLY MEMORIES

MCM6571	128 X 9 X 7 ASCII Shifted with Greek	13.50
MCM6574	128 X 9 X 7 Math Symbol & Pictures	13.50
MCM6575	128 X 9 X 7 Alphanumeric Control Character Generator	13.50

MISCELLANEOUS

TL074CN	Quad Low Noise bi-fet Op Amp	2.49
TL494CN	Switching Regulator	4.49
TL496CP	Single Switching Regulator	1.75
11C90	Divide 10/11 Prescaler	19.95
95H90	Hi-Speed Divide 10/11 Prescaler	11.95
4N33	Photo-Darlington Opto-Isolator	3.95
MK50240	Top Octave Freq. Generator	17.50
DS0026CH	5Mhz 2-phase MOS clock driver	3.75
TIL308	.27" red num. display w/integ. logic chip	10.50
MM5320	TV Camera Sync. Generator	14.95
MM5330	4½ Digit DPM Logic Block	5.95
LD110/111	3½ Digit A/D Converter Set	25.00/set

LITRONIX ISO-LIT 1
Photo Transistor Opto Isolator
(Same as MCT 2 or 4N25)
2/99¢

SN 76477
SOUND GENERATOR
Generates Complex Sounds
Low Power — Programmable
3.95 each

TV GAME CHIP AND CRYSTAL
AY-3-8500-1 and 2.01 MHZ Crystal (Chip & Crystal includes score display, 6 games and select angles, etc. **7.95/set**

EXAR

Part	Price
XR205	$8.40
XR210	4.40
XR215	4.40
XR320	1.55
XR-L555	1.50
XR555	.39
XR556	.99
XR567CP	.99
XR567CT	1.25
XR1310P	1.30
XR1468CN	3.85
XR1488	1.39
XR1489	1.39
JE2206KA	14.95
JE2206KB	19.95
XR1800	3.20
XR2206	4.40
XR2207	3.85
XR2208	5.20
XR2209	1.75
XR2211	5.25
XR2212	4.35
XR2240	3.45
XR2242CP	1.50
XR2264	4.25
XR2556	3.20
XR2567	2.99
XR3403	1.25
XR4136	1.25
XR4151	2.85
XR4194	4.95
XR4202	3.60
XR4212	2.05
XR4558	.75
XR4739	1.15
XR4741	1.47

DIODES

TYPE	VOLTS	W	PRICE
1N746	3.3	400m	4/1.00
1N751	5.1	400m	4/1.00
1N752	5.6	400m	4/1.00
1N753	6.2	400m	4/1.00
1N754	6.8	400m	4/1.00
1N757	9.0	400m	4/1.00
1N759	12.0	400m	4/1.00
1N959	8.2	400m	4/1.00
1N965	15	400m	4/1.00
1N5232	5.6	500m	.28
1N5234	6.2	500m	.28
1N5235	6.8	500m	.28
1N5236	7.5	500m	.28
1N5242	12	500m	.28
1N5245	15	500m	.28
1N456	25	40m	6/1.00
1N458	150	7m	6/1.00
1N485A	180	10m	5/1.00
1N4001	50 PIV 1 AMP		12/1.00

TYPE	VOLTS	W	PRICE
1N4002	100 PIV 1 AMP		12/1.00
1N4003	200 PIV 1 AMP		12/1.00
1N4004	400 PIV 1 AMP		12/1.00
1N4005	600 PIV 1 AMP		10/1.00
1N4006	800 PIV 1 AMP		10/1.00
1N4007	1000 PIV 1 AMP		10/1.00
1N3600	50	200m	6/1.00
1N4148	75	10m	15/1.00
1N4154	35	10m	12/1.00
1N4305	75	25m	15/1.00
1N4734	5.6	1w	.28
1N4735	6.2	1w	.28
1N4736	6.8	1w	.28
1N4738	8.2	1w	.28
1N4742	12	1w	.28
1N4744	15	1w	.28
1N1183	50 PIV 35 AMP		1.60
1N1184	100 PIV 35 AMP		1.70
1N1185	150 PIV 35 AMP		1.70
1N1186	200 PIV 35 AMP		1.80
1N1188	400 PIV 35 AMP		3.00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR(2N1849)	$1.95
C38M	35A @ 600V	SCR	1.95
2N2328	1.6A @ 300V	SCR	.50
MDA 980-1	12A @ 50V	FW BRIDGE REC	1.95
MDA 980-3	12A @ 200V	FW BRIDGE REC	1.95

TRANSISTORS

Part	Price
C106B1	.50
MPSA05	.30
MPSA06	5/1.00
TIS97	6/1.00
TIS98	6/1.00
40409	1.75
40410	1.75
40673	1.75
2N918	4/1.00
2N2219A	2/1.00
2N2221A	4/1.00
2N2222A	5/1.00
PN2222 Plastic	7/1.00
2N2369	5/1.00
2N2369A	4/1.00
MPS2369	5/1.00
2N2484	4/1.00
2N2906	4/1.00
2N2907	5/1.00
PN2907 Plastic	7/1.00
2N2925	5/1.00
MJE2955	1.25
2N3053	2/1.00
2N3055	.89
MJE3055	1.00
2N3392	5/1.00
2N3398	5/1.00
PN3567	3/1.00
PN3568	4/1.00
PN3569	4/1.00
MPS3638A	5/1.00
MPS3702	5/1.00
2N3704	5/1.00
MPS3704	5/1.00
2N3705	5/1.00
MPS3705	5/1.00
2N3706	5/1.00
MPS3706	5/1.00
2N3707	5/1.00
2N3711	5/1.00
2N3724A	.65
2N3725A	1.00
2N3772	2.25
2N3823	1.00
2N3903	5/1.00
2N3904	4/1.00
2N3905	4/1.00
2N3906	4/1.00
2N4013	3/1.00
2N4123	6/1.00
PN4249	4/1.00
PN4250	4/1.00
2N4400	4/1.00
2N4401	4/1.00
2N4402	4/1.00
2N4403	4/1.00
2N4409	5/1.00
2N5086	4/1.00
2N5087	4/1.00
2N5088	4/1.00
2N5089	4/1.00
2N5129	5/1.00
PN5134	5/1.00
PN5138	5/1.00
2N5139	5/1.00
2N5210	5/1.00
2N5449	3/1.00
2N5951	3/1.00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-99	100		1-9	10-99	100
10 pf	.05	.04	.03	.001µF	.05	.04	.035
22 pf	.05	.04	.03	.0047µF	.05	.04	.035
47 pf	.05	.04	.03	.01µF	.05	.04	.035
100 pf	.05	.04	.03	.022µF	.06	.05	.04
220 pf	.05	.04	.03	.047µF	.06	.05	.04
470 pf	.05	.04	.035	.1µF	.12	.09	.075
100 VOLT MYLAR FILM CAPACITORS							
.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022	.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	.28	.23	.17	1.5/35V	.30	.26	.21
.15/35V	.28	.23	.17	2.2/25V	.31	.27	.22
.22/35V	.28	.23	.17	3.3/25V	.31	.27	.22
.33/35V	.28	.23	.17	4.7/25V	.32	.28	.23
.47/35V	.28	.23	.17	6.8/25V	.36	.31	.25
.68/35V	.28	.23	.17	10/25V	.40	.35	.29
1.0/35V	.28	.23	.17	15/25V	.63	.50	.40
MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS							
Axial Lead				Radial Lead			
.47/50V	.15	.13	.10	.47/25V	.15	.13	.10
1.0/50V	.16	.14	.11	.47/50V	.16	.14	.11
3.3/50V	.14	.12	.09	1.0/16V	.15	.13	.10
4.7/25V	.15	.13	.10	1.0/25V	.16	.14	.11
10/25V	.15	.13	.10	1.0/50V	.16	.14	.11
10/50V	.16	.14	.12	4.7/16V	.15	.13	.10
22/25V	.17	.15	.12	4.7/25V	.15	.13	.10
22/50V	.24	.20	.18	4.7/50V	.16	.14	.11
47/25V	.19	.17	.15	10/16V	.14	.12	.09
47/50V	.25	.21	.19	10/25V	.15	.13	.10
100/25V	.24	.20	.18	10/50V	.16	.14	.12
100/50V	.35	.30	.28	47/50V	.24	.21	.19
220/25V	.32	.28	.25	100/16V	.19	.15	.14
220/50V	.45	.41	.38	100/25V	.24	.20	.18
470/25V	.33	.29	.27	100/50V	.35	.30	.28
1000/16V	.55	.50	.45	220/16V	.23	.17	.16
2200/16V	.70	.62	.55	470/25V	.31	.28	[illegible]

CIRCLE 17 ON FREE INFORMATION CARD

Transistor Checker

— Completely Assembled —
— Battery Operated —

The ASI Transistor Checker is capable of checking a wide range of transistor types, either "in circuit" or out of circuit. To operate, simply plug the transistor to be checked into the front panel socket, or connect it with the alligator clip test leads provided. The unit safely and automatically identifies low, medium and high power PNP and NPN transistors. Size: 3¾" x 6¼" x 2"
"C" cell battery not included.

Trans-Check $29.95 ea.

Custom Cables & Jumpers

DB 25 Series Cables

Part No.	Cable Length	Connectors	Price
DB25P-4-P	4 Ft	2-DP25P	$15 95 ea.
DB25P-4-S	4 Ft	1-DP25P 1-25S	$16 95 ea.
DB25S-4-S	4 Ft	2-DP25S	$17.95 ea.

Dip Jumpers

DJ14-1	1 ft	1-14 Pin	$1 59 ea
DJ16-1	1 ft	1-16 Pin	1 79 ea
DJ24-1	1 ft	1-24 Pin	2 79 ea
DJ14-1-14	1 ft	2-14 Pin	2 79 ea
DJ16-1-16	1 ft	2-16 Pin	3 19 ea.
DJ24-1-24	1 ft	2-24 Pin	4 95 ea

For Custom Cables & Jumpers, See JAMECO 1979 Catalog for Pricing

CONNECTORS

25 Pin-D Subminiature

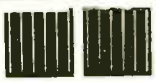
DB25P (as pictured)	PLUG (Meets RS232)	$2.95
DB25S	SOCKET (Meets RS232)	$3.50
DB51226-1	Cable Cover for DB25P or DB25S	$1.75

PRINTED CIRCUIT EDGE-CARD

156 Spacing-Tin-Double Read Out — Bifurcated Contacts — Fits .054 to .070 P C Cards

15/30	PINS (Solder Eyelet)	$1.95
18/36	PINS (Solder Eyelet)	$2.49
22/44	PINS (Solder Eyelet)	$2.95
50/100 (.100 Spacing)	PINS (Wire Wrap)	$6.95
50/100 (.125 Spacing)	PINS (Wire Wrap) R681-1	$6.95

Solar Cells 2x2cm

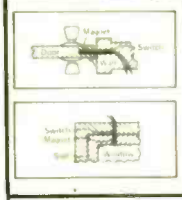


- 0.4 volts
- 100mA
- 41 MW

Can be added in series for higher voltage or parallel for higher current.

#SC 2x2 $1.95 ea. or 3/$5.00

Magnetically Activated Switch



The 9250 0002 is a single pole normally closed switch. When the magnet is engaged, the circuit is open. This switch is only suitable for use in non-magnetic doors and windows

#9250-0002 2/$1.00

AC Wall Transformer

Ideal for use with clocks, power supplies or any other type of AC application.

Part No.	Input	Output	Price
AC 250	117V/60Hz	12 VAC 250mA	$3.95
AC 500	117V/60Hz	12 VAC 500mA	$4.95

REMOTE CONTROL TRANSMITTER & RECEIVER

$19.95

INSTRUMENT/CLOCK CASE

This case is an injection molded unit that is ideal for uses such as DVM, COUNTER, or CLOCK cases. It has dimensions of 4½" in length by 4" in width by 1-9/16" in height. It comes complete with a red bezel.

PART NO: IN-CC $3.49 each

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES

8080A	CPU	$ 9 95
8212	8-Bit Input/Output	3 25
8214	Priority Interrupt Control	5 95
8216	Bi-Directional Bus Driver	3 49
8224	Clock Generator Driver	3 95
8226	Bus Driver	3 49
8228	System Controller/Bus Driver	5 95
8238	System Controller	5 95
8251	Prog. Comm. I/O (USART)	7 95
8253	Prog. Interval Timer	14 95
8255	Prog. Periph. I/O (PPI)	9 95
8257	Prog. DMA Control	19 95
8259	Prog. Interrupt Control	19 95

6800/6800 SUPPORT DEVICES

MC6800	MPU	$14 95
MC6802CP	MPU with Clock and Ram	24.95
MC6810API	128X8 Static Ram	5 95
MC6821	Periph. Inter. Adapt (MC6820)	7 49
MC6828	Priority Interrupt Controller	12.95
MC6830L8	1024X8 Bit ROM (MC68A30-8)	14 95
MC6850	Asynchronous Comm. Adapter	7 95
MC6852	Synchronous Serial Data Adapt	9 95
MC6860	0-600 bps Digital MODEM	12 95
MC6862	2400 bps Modulator	14 95
MC6880A	Quad 3-State Bus Trans. (MC8126)	2 25

MICROPROCESSOR CHIPS—MISCELLANEOUS

Z80(780C)	CPU	$19 95
Z80A(780-1)	CPU	24 95
CDP1802	CPU	19 95
2650	MPU	19 95
8035	8-Bit MPU w clock, RAM, I/O lines	19 95
P8085	CPU	19 95
TMS9900JL	16-Bit MPU w hardware multiply & divide	49 95

SHIFT REGISTERS

MM500H	Dual 25 Bit Dynamic	$ 50
MM503H	Dual 50 Bit Dynamic	50
MM504H	Dual 16 Bit Static	50
MM506H	Dual 100 Bit Static	50
MM510H	Dual 64 Bit Accumulator	50
MM5016H	500/512 Bit Dynamic	89
2504T	1024 Dynamic	3 95
2518	Hex 32 Bit Static	4 95
2522	Dual 132 Bit Static	2 95
2524	512 Static	99
2525	1024 Dynamic	2 95
2527	Dual 256 Bit Static	2 95
2528	Dual 250 Static	4 00
2529	Dual 240 Bit Static	4 00
2532	Quad 80 Bit Static	2 95
2533	1024 Static	2 95
3341	Fifo	6 95
74LS670	4X4 Register File (TriState)	1 95

UART'S

A-Y-5-1013	30K BAUD	5.95

MICROPROCESSOR MANUALS

M-Z80	User Manual	$7 50
M-CDP1802	User Manual	7 50
M-2650	User Manual	5 00

ROM'S

2513(2140)	Character Generator(upper case)	$9 95
2513(3021)	Character Generator(lower case)	9 95
2516	Character Generator	10 95
MM5230N	2048-Bit Read Only Memory	1 95

RAM'S

1101	256X1	Static	$1 49
1103	1024X1	Dynamic	99
2101(8101)	256X4	Static	3 95
2102	1024X1	Static	1 75
21L02	1024X1	Static	1 95
2111(8111)	256X4	Static	3 95
2112	256X4	Static MOS	4 95
2114	1024X4	Static 450ns	9 95
2114L	1024X4	Static 450ns low power	10 95
2114-3	1024X4	Static 300ns	10 95
2114L-3	1024X4	Static 300ns low power	11 95
5101	256X4	Static	7 95
5280/2107	4096X1	Dynamic	4 95
7489	16X4	Static	1 75
74S200	256X1	Static Tristate	3 95
93421	256X1	Static	2 95
UPD414 (MK4027)	4K	Dynamic 16 pin	8 95
UPD416 (MK4116)	16K	Dynamic 16 pin	14 95
TMS4044-45NL	4K	Static	14 95
TMS4045	1024X4	Static	14 95
2117	16,384X1	Dynamic 350ns (house marked)	9 95
MM5262	2KX1	Dynamic	4 1 00

PROM'S

1702A	2048	FAMOS	$5 95
TMS2516 (2716)	16K*	EPROM(Intel 2716) *Requires single +5V power supply	49 95
TMS2532	4KX8	EPROM	89 95
2708	8K	EPROM	10 95
2716 (1)	16K**	EPROM **Requires 3 voltages —5V, +5V, +12V	29 95
5203	2048	FAMOS	14 95
6301-1(7611)	1024	Tristate Bipolar	3 49
6330-1(7602)	256	Open C Bipolar	2 95
82S23	32X8	Open Collector	3 95
82S115	4096	Bipolar	19 95
82S123	32X8	Tristate	3 95
74186	512	TTL Open Collector	9 95
74188	256	TTL Open Collector	3 95
74S287	1024	Static	7 95

CSC CONTINENTAL SPECIALTIES PROTO BOARDS

Proto Board 203

A total ready to use power breadboard assembly complete with a built-in regulated, short proof power supply. Just plug in and start building! 2 extra floating 5 volt binding posts for external signals. Self contained with power switch, indicator lamp and power fuse. 14 pin DIP capacity. All machine tool sockets. All machine tool construction. 5¼" L x 6¾" W x 2¼" H. Shipping weight 3 lbs.

PB 203 $75.00

Model Number	L x W x H (Inches)	Price
PB-6	6.0 x 4.5 x 1.4	$15.95
PB-100	6.0 x 4.5 x 1.4	$19.95
PB-101	6.0 x 4.5 x 1.4	$22.95

Proto Board 203A

All the features of the PB 203 plus additional power supply flexibility provides 5% Regulated VDC supply fused separately +15VDC and -15 VDC, 0.5A supplies, each with intensity and independently adjustable output voltage. Ripple and noise of +5 and -15V supplies 10mV at 0.25A

PB 203A $124.95

Model Number	L x W x H (Inches)	Price
PB-102	7.0 x 4.5 x 1.4	$26.95
PB-103	9.0 x 6.0 x 1.4	$44.95
PB-104	9.8 x 8.0 x 1.4	$54.95

BK PRECISION 3½-Digit Portable DMM

- Overload Protected
- ½" high LED Display
- Battery or AC operation
- Auto Zeroing
- 1m, 1Va, 0.1 ohm resolution
- Overange reading
- 10 meg input impedance
- DC Accuracy 1% typical

Ranges: DC Voltage 0-1000V
AC Voltage 0-1000V
Freq. Response 50-400 HZ
DC/AC Current 0-100mA
Resistance 0-10 meg ohm
Size 6.3 x 4.4 x 2

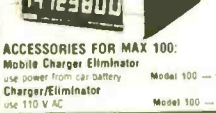
Model 2800 $99.95

Comes with test leads, operating manual and spare fuse

Accessories:

AC Adapter BC-28	$9.00
Rechargeable Batteries BP-26	20.00
Carrying Case LC-28	7.50

CSC 100 MHz 8-Digit Counter



- 20 HZ-100 MHz Range
- 6 LED Display
- Crystal-controlled timebase
- Fully Automatic
- Portable — completely self-contained
- Size — 1.75 x 7.38 x 5.63
- Four Power sources: i.e. batteries 110 or 220V with charger 12V with auto lighter adapter and external 7.2-10V power supply

MAX-100 $134.95

ACCESSORIES FOR MAX 100:

Mobile Charger Eliminator use power from car battery Model 100 — CLA $3.95

Charger/Eliminator use 110 V AC Model 100 — CAI $8.95

New CSC Mini-Max 6 Digit 50MHz Frequency Counter

- Guaranteed frequency range of 100 Hz to 50 MHz
- Full 6 digit display with antiglare window
- Fully automatic-range, polarity, slope, trigger. Input level switching not required.
- Lead-zero blanking—All zeros to the left of the first non-zero digit are blanked. Kilo Hertz and Mega Hertz decimal points automatically light up when the unit is turned on.
- Built in input overvoltage protection.
- Use 9V Battery or 110/220V power
- Complete with mini antenna.
- Lightweight — Only 8oz

MINI-MAX $89.95

Accessories For Mini-Max

Part No.	Description	Price
MM-A4	Antenna	$ 3.95
MM-C5	Carrying case	5.95
MM-IPC	Input cable with clip leads	3.95
MM-AC2	110V adapter	9.95
MM-AC3	220V adapter	9.95

$10.00 Minimum Order — U.S. Funds Only
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The Incredible "Pennywhistle 103"

$139.95 Kit Only

The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modem and terminal for telephone hamming and communications. In addition, it is free of critical adjustments and is built with non-precision, readily available parts.

Data Transmission Method	Frequency-Shift Keying, full-Duplex (half duplex selectable)
Maximum Data Rate	300 Baud
Data Format	Asynchronous Serial (return to mark level required between each character)
Receive Channel Frequencies	.2025 Hz for space .2225 Hz for mark
Transmit Channel Frequencies	Switch selectable Low (normal) = 1070 space 1270 mark High = 025 space, 2225 mark
Receive Sensitivity	46 dbm accoustically coupled
Transmit Level	15 dbm nominal Adjustable from 6 dbm to 20 dbm
Receive Frequency Tolerance	Frequency reference automatically adjusts to allow for operation between 1800 Hz and 2400 Hz
Digital Data Interface	EIA RS-232C or 20 mA current loop (receiver is optoisolated and non-polar)
Power Requirements	120 VAC, single phase 10 Watts
Physical	All components mount on a single 5" by 9" printed circuit board. All components included. Requires a VOM, Audio Oscillator, Frequency Counter and/or Oscilloscope to align

TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K. Kit comes complete with:

- 8 each UPD416 (16K Dynamic Rams)
- Documentation for conversion

TRS-16K $115.00

Special Offer - Order both your TRS-16K and the Sup'R' MOD II Interface kit together (retail value $144.95) for only $139.95

COMPUTER CASSETTES

- 6 EACH 15 MINUTE HIGH QUALITY C-15 CASSETTES
- PLASTIC CASE INCLUDED 12 CASSETTE CAPACITY
- ADDITIONAL CASSETTES AVAILABLE #C-15-S2.50 ea

CAS-6 $14.95

(Case and 6 Cassettes)

SUP 'R' MOD II

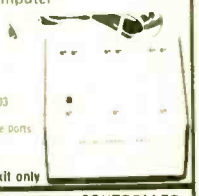
UHF Channel 33 TV Interface Unit Kit

- Wide Band B/W or Color System
- Converts TV to Video Display for home computers. CCTV camera, Apple II, works with Cromeco Dazzler, SOL-20, IRS-80, Challenger, etc.
- MOD II is pretuned to Channel 33 (UHF)
- Includes coaxial cable and antenna transformer.

MOD II $29.95 Kit

RS-232 CONTROL CENTER

Plug in your modem, computer prom programmer, terminal, printer, etc. and selectively control data flow.



- Same Contour as Pennywhistle 103
- Totally self-contained
- Includes 2 master ports and 3 slave ports

PART NO. RS-232CC $89.95 kit only

CASSETTE CONTROLLER

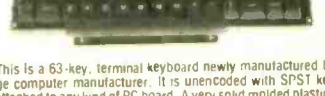
Ideal for use with the TRS 80 and others.

"Plug/Jack interface to any computer system requiring remote control of cassette functions"

The CC100 controls cassette motor functions, monitors tape location with its internal speaker and requires no power. Eliminates the plugging and unplugging of cables during computer loading operation from cassette.

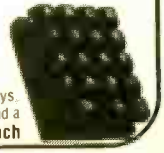
#CC-100 $29.50

63-Key Unencoded Keyboard



This is a 63-key, terminal keyboard newly manufactured by a large computer manufacturer. It is unencoded with SPST keys, unattached to any kind of PC board. A very solid molded plastic 13 x 4" base suits most application. IN STOCK $29.95/each

Hexadecimal Unencoded Keypad



19-key pad includes 1-10 keys, ABCDEF and 2 optional keys and a shift key. $10.95/each

CIRCLE 18 ON FREE INFORMATION CARD

CIRCLE 46 ON FREE INFORMATION CARD

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* of the same cat. no.

A PENNY MORE GETS YOU TWO

☐ SKINNY TRIM POTS, PRECISION, asst. styles, values 50% yield (3389)	1.29	12 for	1.30
60pc PRECUT, PRETINNED WIRE, various lengths and colors (1971)	1.29	120 for	1.30
60-MINI RESISTORS, for PC appl., vert. 1/8W, color coded (2235)	1.29	120 for	1.30
8 TRANSISTOR RADIO EARPHONES, 8 ohms imped (2946)	1.29	16 for	1.30
10-5K POTS, audio taper, plastic snap-in mounting (5124)	1.29	20 for	1.30
10-1&2 MEG DUAL POTS, audio taper, "snap-in" mnt (5125)	1.29	20 for	1.30
50-1 AMP ZENERS, wide asst. of values, untested (1964)	1.29	100 for	1.30
12-SCR'S & TRIACS, 10 AMP, asst. values, untested (2087)	1.29	24 for	1.30
3-QUADRACS, 10 AMP, 100% prime, 50-100 200 V, TO-220 (5048)	1.29	6 for	1.30
20-MINI RECTIFIERS, 1½ AMPS, 25V, epoxy, axial (5374)	1.29	40 for	1.30
10-1N4007 1000V MINI RECTIFIER, epoxy case, axial leads (2383)	1.29	20 for	1.30
75 MOLEX CONNECTOR Type M1938-4, makes 14 to 40 pin sockets (1609)	1.29	150 for	1.30
50 IF TRANSFORMERS, asst sizes (3549)	1.29	100 for	1.30
10 T.V. CHEATER CORD JACKS, (5519)	1.29	20 for	1.30
10-1 AMP 200V MINI RECTIFIER, IN4003, epoxy, axial (2379)	1.29	20 for	1.30
4-1.5V SILVER OXIDE WATCH BATTERIES, (5063)	1.29	8 for	1.30
3-LCD WATCH READOUTS, 3½" digits, 7 seg, dim 1½ x 1" (5066)	1.29	6 for	1.30
20-IC DICE CHIP, complete circuitry, asst. sizes (5065)	1.29	40 for	1.30
2-100KHz MARKER CRYSTALS, specify 104.067, 104.092, or 114.00 KHz (3896)	1.29	4 for	1.30
12-1.5V LAMP AND SOCKET SET, 200ma, T2 style (3956)	1.29	24 for	1.30
10-RCA PHONO JACKS, chassis mount, teflon base (5119)	1.29	20 for	1.30
10 COAXIAL PIN HEAD LEDS, RED (5617)	1.29	20 for	1.30
4-5 DIGIT 7-SEGMENT READOUTS, in flat pak case (5616)	1.29	8 for	1.30
4-¼" BLOCK TRIM POTS, 5K (2536)	1.29	8 for	1.30
1-"FOTO FET" N CHANNEL Crystalonics, J Sealed Effect Transistors (1169)	1.29	2 for	1.30
1 VOLTAGE REGULATOR, TO202 case, 12V 600MA (1900)	1.29	2 for	1.30
1-3 DIGITS ON A DIP, LED, red, DL 33 (1887)	1.29	2 for	1.30
3-MMS262 2K DYNAMIC RAM, specify type (3459)	1.29	6 for	1.30
10-2N711 HIGH SPEED SWITCHING TRANSISTORS, TO18, npn (3374)	1.29	20 for	1.30
2-15W HI POWER TRANSISTORS, 220V, npn, TO66 (2797)	1.29	4 for	1.30
3-24 PIN IC SOCKETS (2168)	1.29	6 for	1.30
1-MMS312 DIGITAL CLOCK CHIP, 100% (1525)	1.29	2 for	1.30
2-MMS7254 FUNCTION CALCULATOR CHIP, 100% (2036)	1.29	4 for	1.30
1-MMS202 ERASABLE PROM, 100% (3459)	1.29	2 for	1.30
3-10 AMP 25V BRIDGE RECT, comb style (2447)	1.29	6 for	1.30
10-2N3565 RF TRANSISTORS, TO106, 2N5133 (3372)	1.29	20 for	1.30
6 LINEAR SWITCHING TRANSISTORS, 2N2905, pnp, TO5 (3375)	1.29	12 for	1.30
50-2 AMP CTL'INORICAL RECT, up to 1K, u-test (4006)	1.29	100 for	1.30
6-OPEN FACE READOUTS, LED, red, some segs missing mostly duals (3952)	1.29	12 for	1.30
10-2N2222 or equiv. TO 18 metal case (1992)	1.29	20 for	1.30
10-OAT 8 ENTRY SWITCHES, SPST, 1 amp, norm open 125V (=5321)	1.29	20 for	1.30
8-TRANSISTOR RADIO EARPHONES, 8 ohms imped (2946)	1.29	16 for	1.30
18 FLUORESCENT OVERFLOW READOUT TUBES, w/leads (3288)	1.29	30 for	1.30
10-2N3704 TO92 TRANSISTORS (3490)	1.29	20 for	1.30
1-2N5001 80V TRANSISTORS STUD (2800)	1.29	2 for	1.30
☐ 3 MICROPROCESSOR/SUPPORT CHIPS, asst. MMS780 90 series, 24-28 pin (=5639A)	1.29	6 for	1.30
☐ 6 CLOCK/CALCULATOR CHIPS, asst. MMS378, 75, 5737 etc. (=5638A)	1.29	12 for	1.30
☐ 25 DTL FAIRCHILD IC's, gates and flip flops, Dip, 100% (=3709)	1.29	50 for	1.30
☐ 1-24 VOLT 50 MIL, TRANSFORMER, 115 V input, open frame, 1" x 1" x 3/4" (=5631)	1.29	2 for	1.30
☐ 10-2N3704 TRANSISTORS, silicon, TO-92 case, hfe-300, 100% (=5625)	1.29	20 for	1.30
☐ 10-2N3705 TRANSISTORS, silicon, TO-92 case, hfe-150, 100% (=5626)	1.29	20 for	1.30
☐ 10 D33021 TRANSISTORS, low power, silicon, hfe-60, TO-92 (=5627)	1.29	20 for	1.30
☐ 1 ALLEN BRADLEY POT, 10K, 2-1 4 watts, type-J, 2" x ¼" shaft (1748)	1.29	2 for	1.30
☐ 50 ASST. RED LEDS, 20% or better, various styles and types (=5624)	1.29	100 for	1.30
☐ 10 G.E. POWER TAB TRANSISTORS, D40N1, N2, some N5, TO-220 (=5629)	1.29	20 for	1.30
☐ 2-¼" BLOCK TRIM POTS, 200K (2535)	1.29	4 for	1.30
☐ 1-12VDC 5MIL REED RELAY, spst, N.O. 2200 ohms, 7/8" x 5/16" x 5/16" (=5515)	1.29	2 for	1.30
☐ 50 TEMP. COEFFICIENT VOLTAGE REF. DIODES, asst. volt, +50% (=5647)	1.29	100 for	1.30
☐ 10 LM-380 IC's, 2 watts, dip, 50%+ yield, U-test (=1975)	1.29	20 for	1.30
☐ 50 RED BLOCK DISC CAPS, assorted values, 50% material (=1698)	1.29	100 for	1.30
☐ 50 SHOCKLEY DIODES, most popular switching diode, hobby & untested (=1072A)	1.29	100 for	1.30
☐ 6 OPTO-COUPLER, 1500V isolation, hobby material, U-test (=2629A)	1.29	12 for	1.30
☐ 4 CHERRY MICRO SWITCH, 125 VAC, 15A, N.C. type E-13, screw terminals (=5525)	1.29	8 for	1.30
☐ 5 SPST PUSHBUTTON MOMENTARIES, rt. angle, pc mt, on-on (=5635)	1.29	10 for	1.30
☐ 25 TTL's, with 7400's, U-test, dips (=2415A)	1.29	50 for	1.30

☐ 30 RADIO AND TV KNOBS, asst styles, sizes (B217)	1.29	60 for	1.30
☐ 60 TUBULAR CAPACITORS, asst volts and sizes (B219)	1.29	120 for	1.30
☐ 55 LOW NOISE RESISTORS ¼, ½W, HiFi, etc (220)	1.29	110 for	1.30
☐ 50 POWER RESISTORS, 3,5,7 w. asst, pop sizes (B220)	1.29	100 for	1.30
☐ $25 SURPRISE, all kinds of parts in e pak (B294)	1.29	2 for	1.30
☐ 12 PANEL SWITCHES, rotary, slide, toggle, etc (B295)	1.29	24 for	1.30
☐ 60 COILS AND CHOKES, rf, parasitic, lf, etc (B287)	1.29	120 for	1.30
☐ 60 TERMINAL STRIPS, up to 4 solder lugs (B334)	1.29	120 for	1.30
☐ 60 PRECISION RESISTORS, ½W, 1% axial (=B363)	1.29	120 for	1.30
☐ 50 MICA CAPACITORS, asst values (B373)	1.29	100 for	1.30
☐ 10 SETS RCA PLUGS AND JACKS, phono (B402)	1.29	20 for	1.30
☐ 60 DISC CAPACITORS, asst values long leads (B437)	1.29	120 for	1.30
☐ 20 TRANSISTOR ELECTRO'S, asst up and ax (=B453)	1.29	40 for	1.30
☐ 75 HALF WATTERS, resisters, color codad, asst (B454)	1.29	150 for	1.30
☐ 35 SILVER MICAS, red backs, axial, asst. (B455)	1.29	70 for	1.30
☐ 6-50 AMP RECT, asst volts up to 25, stud (L717)	1.29	12 for	1.30
☐ 100 GERMANIUM DIODES, axial leads, u test (L642)	1.29	200 for	1.30
☐ 100-STABISTORS, Regulator, sensing and computer, Axial, excellent yield (=3140)	1.29	200 for	1.30
☐ 100 PRINTED CIRCUIT ½ WATT RESISTORS, asst (U1060)	1.29	200 for	1.30
☐ 12 TRANSISTOR SOCKETS, asst npn and pnp types (U651)	1.29	24 for	1.30
☐ 50-3 AMP SILICON RECTIFIERS, axial, asst V (=U865)	1.29	100 for	1.30
☐ 50 POLYSTYRENE CAPS, plastic coated, prec. (U1052)	1.29	100 for	1.30
☐ 10 ME-2 bulbs, for 110vac projects, hobby, etc (U1222)	1.29	20 for	1.30
☐ 10 PROXIMITY REED SWITCHES, (U1258)	1.29	20 for	1.30
☐ 6 2N915 UMF TO 18 TRANSISTORS (U1423)	1.29	12 for	1.30
☐ 30 MOLEX CONNECTORS, nylon, asst. sizes (5642)	1.29	60 for	1.30
☐ 50-MINI BLOCK CAPACITORS, Erie, red square discs, Asst. values (=1698)	1.29	100 for	1.30
☐ 6 CALCULATOR AC ADAPTOR JACK, standard threads 3 terminals (2316)	1.29	12 for	1.30
☐ 50 ONE AMP ZENER DIODES, asst, axial, u test (U1964)	1.29	100 for	1.30
☐ 5-PA-263 THREE WATT PC BOARDS, for amps (U2013)	1.29	10 for	1.30
☐ 5 MINI MOTORS, 1½ Vdc, for many hobby proj (U2551)	1.29	10 for	1.30
☐ 50 IN4000 RECTIFIERS, asst to 800V, u test (U2594)	1.29	100 for	1.30
☐ 15 PRINTED CIRCUIT BOARDS, asst sizes, hobby (U2010)	1.29	30 for	1.30
☐ 2 MERCURY SWITCHES, silent touch, SPST (U2823)	1.29	4 for	1.30
☐ 6 ITS A SNAP, 9 VDC BAT-clip, red n black lead (U2852)	1.29	12 for	1.30
☐ 8 1400 VOLT "RED BALL" RECTIFIERS, axial 1 AMP (U2590)	1.29	16 for	1.30
☐ 20 1N4148 SWITCHING DIODES, 4 nsec, axial (U3000)	1.29	40 for	1.30
☐ 3-10 AMP QUADRACS, w/trigger diode up 600V (U3620)	1.29	6 for	1.30
☐ 5 MICRO SWITCHES, push, asst types (U3011)	1.29	10 for	1.30
☐ 40 SQUARE DISC STYLE CHOKES, color coded (U3203)	1.29	80 for	1.30
☐ 30 TRANSISTORS TO92 2N4400 series, u test (U3291)	1.29	60 for	1.30
☐ 6-TRANSISTORS TRANSFORMERS, audio, inter, etc mini (U3295)	1.29	12 for	1.30
☐ 15 PRINTED CKT TRIMMER POTS, asst values, etc (U3346)	1.29	30 for	1.30
☐ 20 M CABLE, 1 cond shielded, 1-24, for phono (U3653)	1.29	40 M	1.30
☐ 10-PNP 30 WATT TO-3 TRANSISTORS, hobby (U3772)	1.29	20 for	1.30
☐ 50 TUBE SOCKETS, 4,5,6,7 pin tubes, asst (U3835)	1.29	100 for	1.30
☐ 1-10 AMP POWER TAB QUADRAC, 200 PRV, TO220, Z/trigger (1590)	1.29	2 for	1.30
☐ 10-BULLET RECTIFIERS, 1.5 amp, 200V, axial (84)	1.29	20 for	1.30
☐ 6 READOUTS, MAN 3, common cath, LED, the claw, RED (3338)	1.29	12 for	1.30
☐ 8-LEDS, asst. sizes and shapes, red, green, yellow, amber (3869)	1.29	16 for	1.30
PHOTO FLASH ELECTRO. CAP, 600 MF 360 V (3897)	1.29	2 for	1.30
☐ 2-CIRCUIT BREAKERS, glass sealed, axial, rotad 1 amp (3905)	1.29	4 for	1.30
MICRO MINI TOGGLE, SPST, 2 pos, on-off, 125V 3 amps (3936)	1.29	2 for	1.30
☐ 5-CB CRYSTALS, orig. used w/synthesizer, asst. freq, NC-18/U holder (5051)	1.29	10 for	1.30
☐ 4-PUSH BUTTON, SPST, PANEL, N.C. 125V 1A (5285)	1.29	8 for	1.30
☐ 10-INSTRUMENT KNOBS, asst. styles and colors, ¼" shaft (5121)	1.29	20 for	1.30
☐ 4-TAPE HEADS, Mini types (5182)	1.29	8 for	1.30
☐ 5-TANTALUM ELECTROS, TEARDROP style, 2.2uf 25V (5205)	1.29	10 for	1.30
☐ 2-INLINE FUSE HOLDERS, complete w/5 amp fuse (5213)	1.29	4 for	1.30
☐ 30-4" CABLE TIES, non-slip white plastic (5217)	1.29	60 for	1.30
☐ 30pc HEAT SHRINK, asst. sizes, 50% shrinkage (5248)	1.29	60 for	1.30
☐ 20 TOROIDS, some with coils (5431)	1.29	40 for	1.30
☐ 10 1.5V ZENERS, 400mw, axial, glass case (5404)	1.29	20 for	1.30
☐ 2-ALUMINUM HEAT SINKS, for TO-220 (5338)	1.29	4 for	1.30
☐ 2-5.1V. 5%, 10W, STUD ZENER, DO-4 case (5287)	1.29	4 for	1.30

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Type	SALE	2 FOR
☐ SN7401	$.18	$.19
☐ SN7402	.18	.19
☐ SN7403	.18	.19
☐ SN7405	.21	.22
☐ SN7406	.29	.30
☐ SN7407	.29	.30
☐ SN7409	.21	.22
☐ SN7410	.18	.19
☐ SN7411	.25	.26
☐ SN7413	.40	.41
☐ SN7416	.25	.26
☐ SN7420	.19	.20
☐ SN7423	.29	.30
☐ SN7426	.29	.30
☐ SN7427	.29	.30
☐ SN7437	.25	.26
☐ SN7438	.25	.26
☐ SN7440	.19	.20
☐ SN7443	.69	.70

Type	SALE	2 FOR
☐ SN7444	.59	.60
☐ SN7450	.20	.21
☐ SN7451	.20	.21
☐ SN7453	.20	.21
☐ SN7454	.21	.22
☐ SN7455	.19	.20
☐ SN7460	.21	.22
☐ SN7464	.19	.20
☐ SN7465	.19	.20
☐ SN7470	.30	.31
☐ SN7491	.59	.60
☐ SN7494	.69	.70
☐ SN7495	.69	.70
☐ SN7496	.65	.66
☐ SN7498	.19	.20
☐ SN74107	.33	.34
☐ SN74109	.49	.50
☐ SN74114	.25	.26
☐ SN74121	.35	.36
☐ SN74123	.59	.60

Type	SALE	2 for
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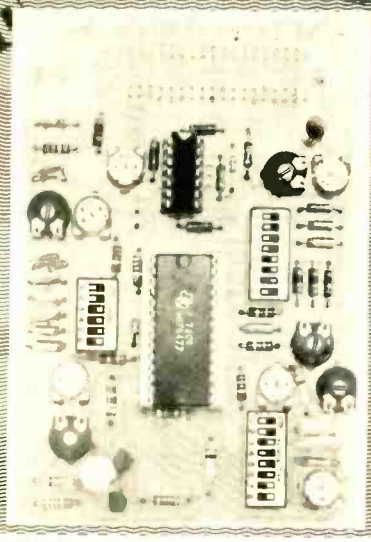

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UPC575C2	1.25	1.40	1.55
UPC576H	1.85	2.05	2.35
UPC592H2	.65	.75	.85
UPC1001H2	1.85	2.05	2.35
UPC1008C	4.10	4.30	4.80
UPC1020H	1.85	2.05	2.35
UPC1025H	1.85	2.05	2.35
UPC1028H	1.40	1.62	1.80
UPC1031H	2.52	2.74	2.96
UPC1152H	2.90	3.10	3.30
UPC1156H	1.85	2.05	2.35
UPD277C	8.70	8.90	9.10

	25-UP	10-24	1-9
UPD857C	7.90	8.30	9.40
UPD858C	5.90	6.20	6.90
UPD861C	7.80	8.20	9.30
2SA102	.20	.25	.30
2SA473	.45	.55	.60
2SA484	1.20	1.40	1.60
2SA495	.25	.30	.35
2SA509	.30	.35	.40
2SA562	.25	.30	.35
2SA564	.25	.30	.35
2SA634	.35	.40	.45
2SA636	.75	.95	1.15
2SA643	.30	.35	.40
2SA673	.30	.35	.40
2SA678	.30	.35	.40
2SA683	.30	.35	.40
2SA684	.35	.40	.45
2SA695	.35	.40	.55
2SA699A	.40	.50	.60
2SA706	.80	.95	1.05
2SA720	.25	.30	.35
2SA745R	3.60	3.80	4.20
2SB22	.25	.30	.35
2SB54	.20	.27	.30
2SB77	.30	.40	.45
2SB175	.20	.27	.30
2SB186	.20	.27	.30
2SB187	.20	.27	.30
2SB324	.25	.30	.35
2SB367	.85	.95	1.10
2SB405	.25	.30	.35
2SB407	.65	.80	.90
2SB463	.80	1.00	1.10
2SB474	.60	.70	.80
2SB507	.70	.80	.90
2SB511	.60	.70	.85
2SB557	1.60	1.85	2.30
2SC183	.30	.40	.50
2SC184	.30	.40	.50
2SC372	.18	.25	.28
2SC373	.20	.25	.30
2SC380	.18	.25	.28
2SC382	.30	.35	.40
2SC387A	.27	.35	.40
2SC394	.18	.23	.27

	25-UP	10-24	1-9
2SC458	.18	.23	.27
2SC460	.30	.35	.40
2SC481	.90	1.10	.125
2SC482	.80	.95	1.10
2SC485	.95	1.15	1.30
2SC495	.30	.40	.50
2SC509	.25	.30	.35
2SC517	1.80	2.00	2.40
2SC535	.25	.30	.35
2SC620	.25	.35	.40
2SC632A	.30	.35	.40
2SC634A	.30	.35	.40
2SC697A	2.65	2.95	3.20
2SC710	.18	.25	.27
2SC711	.18	.25	.27
2SC712	.18	.25	.27
2SC717	.30	.35	.40
2SC730	2.80	3.00	3.20
2SC732	.20	.25	.30
2SC733	.20	.25	.30
2SC734	.20	.25	.30
2SC735	.20	.25	.30
2SC756A	1.30	1.60	1.80
2SC761	.30	.32	.35
2SC778	2.70	3.00	3.20
2SC781	1.85	2.05	2.35
2SC784	.25	.30	.35
2SC789	.75	.85	.95
2SC793	1.90	2.10	2.40
2SC799	1.95	2.15	2.45
2SC828	.20	.25	.30
2SC829	.20	.25	.30
2SC839	.25	.30	.35
2SC867A	3.10	3.30	3.60
2SC900	.20	.25	.30
2SC930	.20	.25	.30
2SC945	.20	.25	.30
2SC1000BL	.30	.40	.45
2SC1013	.50	.60	.65
2SC1014	.45	.60	.65
2SC1018	.50	.60	.70
2SC1030	1.70	2.00	2.30
2SC1056	4.30	4.50	4.70
2SC1060	.65	.75	.85
2SC1061	.65	.75	.85

	25-UP	10-24	1-9
2SC1096	.40	.50	.55
2SC1114	3.30	3.50	3.70
2SC1116A	3.30	3.45	3.80
2SC1124	.75	.85	.95
2SC1127	.75	.85	.95
2SC1162	.60	.70	.80
2SC1166	.20	.25	.30
2SC1172B	3.00	3.50	3.85
2SC1173	.45	.50	.55
2SC1177	10.80	12.30	13.70
2SC1209	.25	.30	.35
2SC1222	.20	.25	.30
2SC1226A	.50	.55	.60
2SC1237	1.60	1.80	2.05
2SC1239	2.00	2.55	2.75
2SC1306	1.30	1.45	1.60
2SC1307	1.85	2.05	2.35
2SC1318	.30	.35	.40
2SC1364	.25	.35	.40
2SC1383	.25	.30	.35
2SC1384	.25	.30	.35
2SC1424	2.60	2.70	2.80
2SC1448A	.60	.70	.80
2SC1475	.60	.70	.80
2SC1509	.40	.45	.50
2SC1567	.50	.60	.70
2SC1675	.20	.25	.30
2SC1678	1.00	1.15	1.30
2SC1687	.35	.40	.45
2SC1727	1.55	1.65	1.75
2SC1728	.60	.70	.80
2SC1760	.65	.75	.85
2SC1775	.30	.35	.40
2SC1816	1.35	1.60	1.80
2SC1908	.25	.35	.40
2SC1909	1.60	1.80	2.10
2SC1945	4.30	4.80	5.20
2SC1957	.50	.60	.70
2SC1969	3.40	3.80	4.20
2SC1973	.60	.65	.70
2SC1974	1.20	1.60	1.80
2SC1975	1.20	1.60	1.80
2SC2009	.70	.75	.80
2SC2021	.50	.55	.60
2SC2028	.45	.50	.55

	25-UP	10-24	1-9
2SC2029	1.45	1.75	1.95
2SC2072	3.50	3.70	3.90
2SC2076	.40	.55	.60
2SC2091	.80	1.00	1.10
2SC2092	1.70	1.90	2.10
2SC2098	2.90	3.10	3.35
2SD72	.45	.60	.65
2SD91	1.25	1.40	1.55
2SD92	1.25	1.35	1.45
2SC178	.85	.90	1.05
2SD187	.30	.40	.45
2SD216	2.40	2.60	2.90
2SD234	.55	.65	.75
2SD235	.55	.65	.75
2SD261	.30	.35	.40
2SD287	2.45	2.65	2.85
2SD291	2.05	2.45	2.75
2SD313	.55	.65	.70
2SD315	.55	.65	.70
2SD325	.55	.65	.70
2SD330	.55	.65	.70
2SD356	.65	.75	.85
2SD358	.65	.75	.85
2SD359	.75	.85	.95
2SD427	1.75	1.95	2.20
2SD525	.70	1.00	1.10
2SD526	.55	.65	.75
2SK19	.45	.50	.55
2SK23A	.65	.75	.85
2SK30A	.40	.45	.50
2SK33	.55	.65	.75
2SK34	.45	.55	.60
2SK41	.50	.55	.60
2SK55	.60	.65	.75
3SK22Y	1.35	1.55	1.75
3SK35	1.20	1.30	1.50
3SK37	1.70	2.00	2.30
3SK40	.85	1.05	1.15
3SK41	1.25	1.40	1.55
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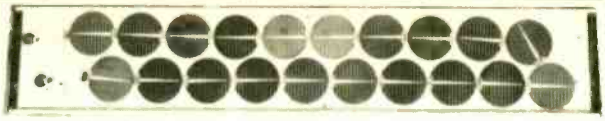

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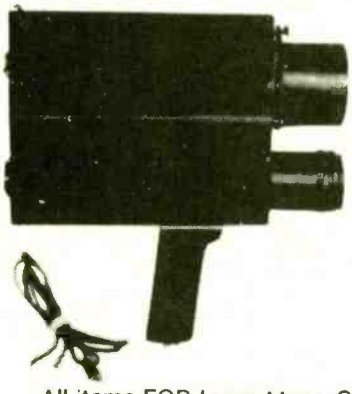

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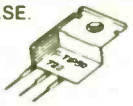

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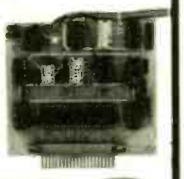
E.S. TRS-80 SERIAL I/O

• RS-232 compatible • Can be used with or without the expansion bus • On board switch selectable baud rates of 110, 150, 300, 600, 1200, 2400, parity or no parity odd or even, 5 to 8 data bits, and 1 or 2 stop bits. D.T.R. line. Board only $19.95 Part No. 8010, with parts $59.95 Part No. 8010A, assembled $79.95 Part No. 8010C. No connectors provided, see below.

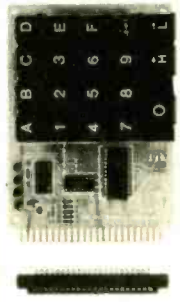


EIA/RS-232 connector Part No. DB25P $6.00, with 9', 8 conductor cable $10.95 Part No. DB25P9

3" ribbon cable with attached connectors to fit TRS-80 and our serial board $19.95 Part No. 3CAB40

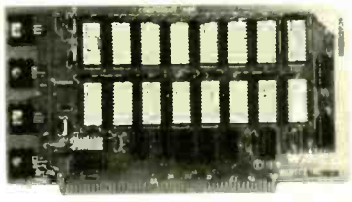
HEX ENCODED KEYBOARD E.S.

This HEX keyboard has 19 keys, 16 encoded with 3 user definable. The encoded TTL outputs, 8-4-2-1 and STROBE are debounced and available in true and complement form. Four onboard LEDs indicate the HEX code generated for each key depression. The board requires a single +5 volt supply. Board only $15.00 Part No. HEX-3, with parts $49.95 Part No. HEX-3A. 44 pin edge connector $4.00 Part No. 44P.



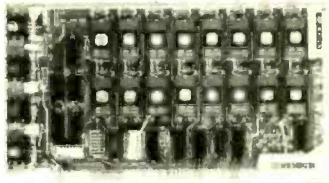
4K EPROM wmc ine.

This board is designed to operate with any speed or power 1702A. Addressable in 4K byte increments and can be configured to occupy either 2K or 4K segments. It can be populated one memory chip at a time. Bare board $30, board with parts $200, assembled $230. Part No. EPM-1



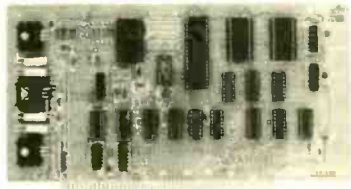
16K OR 32K EPROM wmc ine.

Designed to operate with any speed or power 2708 or single voltage (+5V) 2716. Addressable in 4K increments and can occupy multiples of 4K. It can be populated one memory chip at a time. Has bank addressing and Phantom Disable. The board comes with an exclusive software program that can be placed in a 2708 or 2716 that will, when used in conjunction with a RAM memory board, check out every line on the EPM-2. Bare board $30, board with parts with 2708 $455, assembled $485. Board with parts with 2716 $1,225, assembled $1,255. Part No. EPM-2



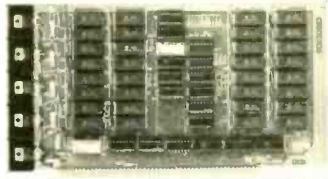
8080A CPU (With Eight Level Victor Interrupt Capability) wmc ine.

Uses the 8080A and the 8224 clock chip. The crystal frequency used is 18 MHz and the vector interrupt chip is the 8214. The board will function normally without the interrupt circuitry. When the interrupt circuitry is built up, the board will respond to eight levels of interrupts. Designed to be a plug-in replacement for the IMSAI CPU board and will work in other computers with the appropriate modifications made to the ribbon cable connector pin out from the front panel. The board will work in systems without a front panel if the system has a PROM board that simulates the functions of the front panel. Bare board $30, with parts $185, assembled $220. Part No. CPU-1



16K STATIC RAM wmc ine.

Operates with any speed or power 2114. All input and output lines are fully buffered. Addressable in 4K byte increments. If the system has a front panel, the board will allow itself to be protected. If there is no front panel, the board will not allow itself to be protected. The board has Bank Address capability, Phantom Disable, MWRITE, and selectable wait states. Bare board $30, board with parts $665. Part No. MEM2



S-100 BUS ACTIVE TERMINATOR *

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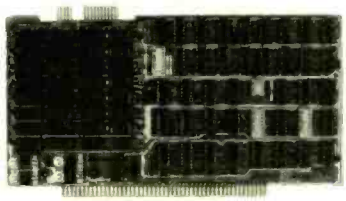
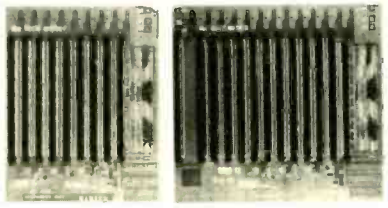
Main memory for microcomputers, intelligent terminals, business systems, medical systems, and OEM systems. • High density random access memory 48K bytes or 64K bytes • Fully buffered • S-100 bus compatible • Low power (dynamic memory) • Transparent refresh • Digital delay line techniques for reliable operation • Multiple boards allowed using hardware or software controlled bank select • "Phantom" signal for RAM/ROM overlap • All boards are fully tested prior to shipment. Operating System test and extensive bit pattern testing. • Works directly in 8080A processors or Z-80 environment at 2MHz • Currently used by industry • 1 year warranty. Only available assembled and tested with 48K $1,250 Part No. 48K, or with 65K $1,475 Part No. 65K



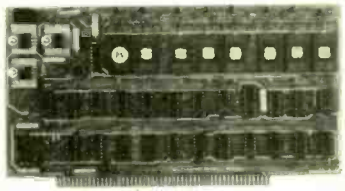
9 AND 13 SLOT MOTHER BOARDS wmc ine.

All traces are reflow solder covered and both sides are solder masked. The connectors used on these boards are the IMSAI™ type (.125" between pins, .250" between rows). Spacing between connectors is .750". All lines, except power and ground, have a passive RC network termination available. There is a kluge area available that will accept two 40 pin sockets and one 36 pin socket. The circuitry for supplying three separate regulated voltages to the kluge area is contained on the board. Part No. QMB-12 $40 bare, $105 kit, $120 assembled. Part No. QMB-9 $35 bare, $90 kit, $105 assembled.



8K EPROM PIICEON

Saves programs on PROM permanently (until erased via UV light) up to 8K bytes. Programs may be directly run from the program saver such as fixed routines or assemblers. • S-100 bus compatible • Room for 8K bytes of EPROM non-volatile memory (2708's). • On-board PROM programming • Address relocation of each 4K or memory to any 4K boundary within 64K • Power on jump and reset jump option for "turnkey" systems and computers without a front panel • Program saver software available • Solder mask both sides • Full silkscreen for easy assembly. Program saver software in 1 2708 EPROM $25. Bare board $35 including custom coil, board with parts but no EPROMS $139, with 4 EPROMS $179, with 8 EPROMS $219.



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7405	.18	7475	.48	74161	.88
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7408	.18	7483	.65	74170	1.68
7409	.18	7485	.87	74173	1.20
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7411	.18	7489	1.35	74175	.85
7412	.18	7490	.45	74178	.75
7413	.38	7491	.58	74177	.75
7414	.60	7492	.43	74180	.65
7416	.22	7493	.43	74181	1.80
7417	.25	7494	.60	74190	1.00
7420	.18	7495	.65	74191	.85
7425	.30	7498	.65	74192	.78
7426	.22	7497	.90	74193	.78
7427	.28	74107	.28	74194	.80
7430	.18	74121	.38	74195	.50
7432	.32	74122	.40	74196	.88
7433	.32	74123	.65	74197	.60
7438	.22	74125	.60	74298	.58
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2.2UF 20V	5/$1.00	30UF 6V	5/$1.00
3.3UF 20V	4/$1.00	33UF 20V	$ .40
4.7UF 15V	5/$1.00	47UF 20V	$ .35
		68UF 15V	$ .50

74LS SERIES

74LS00	.31	74LS138	.94		
74LS02	.31	74LS139	.94		
74LS03	.31	74LS151	.88		
74LS04	.38	74LS153	.88		
74LS05	.34	74LS155	.82		
74LS08	.34	74LS156	.82		
74LS09	.34	74LS157	.82		
74LS10	.31	74LS160	1.21		
74LS11	.31	74LS161	1.21		
74LS13	.59	74LS162	1.21		
74LS14	1.08	74LS163	1.21		
74LS15	.31	74LS164	1.34		
74LS20	.31	74LS168	1.42		
74LS21	.31	74LS169	1.42		
74LS27	.33	74LS170	2.89		
74LS28	.39	74LS173	1.63		
74LS27	.39	74LS174	1.35		
74LS30	.39	74LS175	1.35		
74LS32	.39	74LS181	2.63		
74LS33	.39	74LS180	1.48		
74LS37	.37	74LS191	1.44		
74LS38	.37	74LS192	1.19		
74LS40	.31	74LS193	1.48		
74LS42	.88	74LS194	1.08		
74LS47	.98	74LS196	1.08		
74LS51	.34	74LS197	1.08		
74LS54	.34	74LS241	2.37		
74LS73	.47	74LS257	1.16		
74LS75	.67	74LS258	1.19		
74LS76	.47	74LS259	2.63		
74LS86	.47	74LS266	.40		
74LS90	.67	74LS279	.63		
74LS92	.67	74LS279	.94		
74LS93	.67	74LS280	.81		
74LS107	.47	74LS283	.78		
74LS112	.47	74LS365	.81		
74LS113	.47	74LS366	.81		
74LS114	.47	74LS368	.81		
74LS124	1.28	74LS375	.86		
74LS126	.81	74LS386	.47		
74LS132	.94	74LS670	2.70		

LINEAR CIRCUITS

LM 101	.75
LM 301/748	.25
LM307	.30
LM 308	.75
LM 311	.75
LM 318	1.20
LM 324	.70
LM 339	1.10
LM 358	.70
LM 370	1.15
LM 377	1.60
LM 380	.95
LM 382	1.25
LM386	.80
LM 387	1.25
LM 537	2.50
LM 583	2.50
LM 555	.39
LM 556	.85
NE540L	2.75
560	2.00
565	.95
566	1.10
567	1.10
703	.90
733M	.75
5837M	.95
709	.25
710	.35
741C or V	.25
747	.50
LM 1310	2.50
1456	.95
1458	.50
3900	.40
8038CC	3.90
7911	1.95
LF356H	1.20

TRIACS

PRV	1A	10A	25A
100	.40	.70	1.30
200	.70	1.10	1.75
400	1.10	1.60	2.60
600	1.70	2.30	3.60

SCR'S

PRV	1.5A	6A 35A
100	.40	.50 1.20
200	.60	.70 1.60
400	1.00	1.20 2.20
600	1.50	3.00

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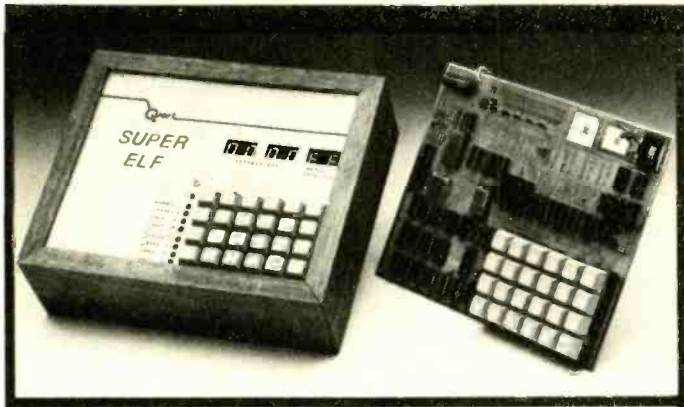

RCA Cosmac Super Elf Computer $106.95

Compare features before you decide to buy any other computer. There is no other computer on the market today that has all the desirable benefits of the **Super Elf** for so little money. The Super Elf is a small single board computer that does many **big** things. It is an excellent computer for training and for learning programming with its machine language and yet it is easily **expanded** with **additional memory, Tiny Basic, ASCII Keyboards, video character generation, etc.**

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during** and **after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on nine LED indicator lamps.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.
A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step**. Large, on board displays provide output and optional **high and low address**. There is a 44 pin standard connector for PC cards and a 50 pin connector for the **Quest Super Expansion Board**. Power supply and sockets for **all** IC's are included in the price plus a detailed 90 page instruction manual.

Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and research and development.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95, Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95. NiCad Battery Memory Saver Kit $6.95.** All kits and options also come completely assembled and tested. **Questdata**, a 12 page monthly software publication for 1802 computer users is available by subscription for $12.00 per year.

Tiny Basic for ANY 1802 System

Cassette **$10.00. On ROM $38.00.** Super Elf owners, 30% off. **Object code listing with manual-$5.00. Object list, manual and paper tape $10.00. Original ELF Kit Board $14.95.**

Super Expansion Board with Cassette Interface $89.95

This is truly an astounding value! This board has been designed to allow **you** to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface**. Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf**. The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed.** EPROM can be used for the monitor and Tiny Basic or other purposes.

A 1K Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software. (relocatible cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. The Super Monitor is written with subroutines allowing users to take advantage of monitor functions simply by calling them up.

Improvements and revisions are easily done with the monitor. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports** with **full handshake**. They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. A Godbout 8K RAM board is available for $135.00. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50. A 50 pin connector set** with ribbon cable is available at $12.50 for easy connection between the **Super Elf** and the **Super Expansion Board.**

The **Power Supply Kit** for the Super Expansion Board is a 5 amp supply with multiple positive and negative voltages $29.95. Add $4.00 for shipping. Prepunched frame $5.00. Case $10.00. Add $1.50 for shipping.

INTEGRATED CIRCUITS

7400TTL

7400N	17	
7402N	17	
7404N	19	
7409N	23	
7410N	17	
7414N	63	
7420N	17	
7422N	1.39	
7430N	20	
7442N	.50	
7445N	69	
7447N	69	
7448N	69	
7450N	17	
7474N	29	
7475N	49	
7485N	.88	
7489N	2.00	
7490N	43	
7492N	43	
7493N	69	
7495N	90	
74100N	29	
74107N	34	
74121N	.59	
74123N	39	
74125N	.69	
74145N	.95	
74150N	.89	
74151N	1.00	
74154N	.87	
74157N	.87	
74161N	.87	
74162N	.87	
74163N	.96	
74174N	.90	
74175N	1.15	
74190N	.87	
74192N	.91	
74193N	1.55	
74221N	1.65	
74288N	.66	
74365N	.66	
74366N	.66	
74367N		

74LS00 TTL

74LS00N	.25
74LS02N	.25
74LS04N	.25
74LS05N	.25
74LS08N	.25
74LS10N	.25
74LS13N	.40
74LS14N	.90
74LS20N	.25
74LS22N	.25
74LS27N	.41
74LS30N	.25
74LS33N	.39
74LS38N	.30
74LS74N	.35
74LS75N	.47
74LS90N	.51
74LS93N	.51
74LS95N	1.89
74LS107N	.35
74LS112N	.35
74LS113N	.35
74LS132N	.72
74LS136N	.35
74LS151N	.67
74LS155N	.67
74LS157N	.67
74LS162N	.91
74LS163N	.91
74LS174N	.95
74LS190N	1.06
74LS221N	1.95
74LS258N	.67
74LS367N	.89

LINEAR

CA3045	.90
CA3046	.67
CA3081	1.80
CA3082	1.90
CA3089	2.95
LM301AN-AH	.35
LM305H	.87
LM307N	.35
LM308N	.89
LM309H	1.15
LM309K	.95
LM311N-N	.90
LM377N	2.92
LM318	1.35
LM320K-5	1.20
LM323K-5	6.95
LM320K-12	1.35
LM320K-15	1.35
LM320T-5	1.60
LM320T-8	1.60
LM320T-12	1.50
LM320T-15	1.60
LM324N	1.15
LM339N	1.55
LM340K-5	1.35
LM340K-8	1.35
LM340K-12	1.35
LM340K-15	1.35
LM340K-24	1.35
LM340T-5	1.25
LM340T-8	1.25
LM340T-12	1.25
LM340T-15	1.25
LM340T-18	1.25
LM340T-24	1.25
LM343H	4.50
LM350	7.50

CD4553	3.50
CD4566	2.25
CD4583	1.50
CD4585	1.10
CD40192	3.00
74C00	.28
74C04	.33
74C10	.28
74C14	2.10
74C20	.28
74C30	.28
74C48	1.95
74C74	.75
74C76	1.40
74C90	1.15
74C93	1.40
74C154	3.00
74C160	1.44
74C175	1.35
74C192	1.65
74C221	2.00
74C905	3.00
74C906	.75
74C911	1.95
74C922	5.50
74C923	5.50
74C925	6.95
74C926	6.95
74C927	6.95

INTERFACE

8095	.65
8096	.65
8097	.65
8098	.65
BT09	1.25
BT10	4.50
BT13	3.00
BT20	5.50
BT23	3.10
BT24	3.50
BT25	3.20
BT26	1.69
BT28	2.75
BT97	1.69
BT98	1.69

A to D CONVERTER

80368	4.50
8700CJ	13.95
8701CN	22.00
8750CJ	13.95
LD130	9.95
3400CJ/F	7.40
KD7103	9.50
KD7107	14.25

CMOS

CD34001 Fair	.50
CD4000	.16
CD4001	.21
CD4002	.21
CD4006	1.10
CD4007	.21
CD4008	.71
CD4009	.39
CD4010	.39
CD4011	.21
CD4012	.21
CD4013	.36
CD4014	.86
CD4015	.86
CD4016	.36
CD4017	.94
CD4018	.94
CD4019	.21
CD4020	1.02
CD4021	1.02
CD4022	.86
CD4023	.21
CD4024	.75
CD4025	.21
CD4026	1.51
CD4027	.36
CD4028	.79
CD4029	1.02
CD4030	.21
CD4035	1.02
CD4040	1.02
CD4042	.71
CD4043	.53
CD4044	.63
CD4046	1.67
CD4049	.36
CD4050	.36
CD4051	1.13
CD4060	1.42
CD4066	.71
CD4068	.40
CD4069	.40
CD4070	.40
CD4071	.21
CD4072	.21
CD4073	.21
CD4075	.21
CD4076	1.75
CD4078	.40
CD4081	.21
CD4082	.21
CD4116	.47
CD4490	5.50
CD4507	1.00
CD4508	4.25
CD4510	1.02
CD4511	.94
CD4515	2.52
CD4516	1.10
CD4518	1.02
CD4520	1.02
CD4527	1.51
CD4528	.79

MOS/MEMORY RAM

2101-1	3.95
2102-1	.95
2102AL-4	1.60
2102Q	1.75
2104A-4	4.95
21078	4.95
2111-1	3.75
2112-2	3.95
2114	8.50
4116	12.95
2513B	6.30
2LD2-1	1.29
MM5262	.40
MM5280	3.00
MM5320	9.95
MM5330	5.94
PD411D-3	4.00
PD411D-4	5.00
P5101L	13.95
4200A	9.95
82S25	2.90
91L02A	1.50
HD0165-5	6.95
MM5700	4.50
GIAY38500-1	9.95
MCM6571A	9.95
9368	3.50
410D	10.00
416	16.00

CLOCKS

MM5309	3.00
MM5311	3.60
MM5312	4.80
MM5313	3.60
MM5314	3.90
MM5315	5.00
MM5316	5.00
MM5318	3.60
MM5369	2.10
MM5841	14.45
MM5865	7.95
CT7001	5.80
CT7002	8.95
CT7010	9.95
CT7015	7.25
MM5375AA/N	3.90
MM5375AB/N	4.90
7205	16.50
7207	7.50
7208	15.95
7209	4.95
DS0026CN	3.75
DS0036CN	3.75
MM53104	2.50

MICROPROCESSOR

6800	17.50
6802	24.95
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8085	27.00
Z80A	19.75
8212	2.90
8214	8.00
8216	2.90
8224	2.90
8228	5.35
8251	8.50
8253	10.00
8255	9.25
8257	19.50
8259	19.50
COP1802CD	19.95
CDP1802D	25.00
CDP1861	12.95
6820	9.95
6850	12.95
6502	12.50

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PIN	1 UP	PIN	1UP
8	15	22	30
14	18	24	35
16	20	28	42
18	27	36	58
20	29	40	57

3 level wire wrap gold
14 pin .75
2 level 14 pin ea. .20

WIRE WRAP LEVEL 3

PIN		PIN	
14	25	24	86
16	33	28	1.00
18	57	40	1.23

UART FIFO

AY5-1013	5.50
AY5-1014	7.50
3341	6.95

PROM

1702A	3.95
N82S23	2.95
N82S123	3.50
N82S126	3.75
N82S129	3.75
N82S131	3.75
N82S136	8.75
N82S137	8.75
2708	10.50
DM8577	2.90
8223	2.90
2716T1	29.50
2716 Intel	48.00

CRYSTALS

1 MHz	4.50
2 MHz	4.50
4 MHz	4.25
5 MHz	4.25
10 MHz	4.25
18 MHz	3.90
20 MHz	3.90
32 MHz	3.90
32768 MHz	4.00
1.8432 MHz	4.50
3.5795 MHz	1.20
2.0100 MHz	1.95
2.097152 MHz	4.50
2.4576 MHz	4.50
3.2768 MHz	4.50
5.0688 MHz	4.50
5.185 MHz	4.50
5.7143 MHz	4.50
6.5536 MHz	4.50
14.31818 MHz	4.25
18.432 MHz	4.50
22.1184 MHz	4.50

CONNECTORS

44 pin edge	2.75
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100 pin edge WW	5.25

KEYBOARD ENCODERS

AY5-2376	$12.50
AY5-3600	13.50
74C922	5.50
74C923	5.50
HD0165-5	6.95

IC Test Clips

	1	10
Red	55	47
Black	55	47

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comp. w/speC/sock

TRANSISTORS

2N1893	.40
2N2222A	.18
2N2369	.30
2N2904A	.20
2N2907A	.25
2N3053	.40
2N3638	.25
2N3643	.25
2N3904	.18
2N3906	.18
2N3055	.69
2N4400	.25
2N4401	.25
2N4402	.20
TIP31	.60
TIP33A	1.00

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DB25S	3.95
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DE9P	1.50
DE9S	1.95
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Fully assembled 77.50
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6V 300 ma	3.25
12 Volt 300 ma transformer	1.25
12.6 V CT 600 ma	3.75
12V 250 ma wall plug	2.95
12V CT 250 ma wall plug	3.50
24V CT 400 ma	3.95
10V 1.2 amp wall plug	4.85
12V 6 amp	12.95

DISPLAY LEDS

MAN1	CA	270	2.90
MAN3	CC	125	.39
MAN72/74	CA/CA	300	1.00
DL704	CC	300	1.25
DL707/DL707R	CA	300	1.00
DL727/728	CA CC	500	1.90
DL747/750	CA CC	600	1.95
DL750	CC	600	1.95
FND359	CC	357	.70
FND500-507	CC/CA	500	1.35
FND503-510	CC/CA	500	.90
FND800-807	CC/CA	800	2.20
3 digit Bubble			.60
4 digit Bubble			.80
DG8 Fluorescent			1.75
DG10 Fluorescent			1.75
5 digit 14 pin display			1.00
NSN69 9 digit display			8.00
7520 Claires photocells			.39
TIL311 Hex			9.50

COMPUTER GRADE CAPS

1600	mfd	200V	4.50
2000	mfd	45V	2.50
3200		50V	2.50
5500		25V	2.50
5800		40V	3.00
6100		40V	3.00
6100		50V	3.00
7700		50V	2.50
8000		50V	3.50
9400		65V	3.00
10000		20V	2.50
12000		30V	3.50
35000		25V	5.00
55000		25V	5.00
82000		15V	6.00
50000		10V	6.00

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DC clock with 4-.50" displays. Uses National MA-1012 module with alarm option. Includes light dimmer, crystal timebase PC boards. Fully regulated, comp. instructs. Add $3.95 for beautiful dark gray case. Best value anywhere.

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Will erase 25 PROMs in 15 minutes. Ultraviolet, assembled **$34.50**

Rockwell AIM 65 Computer

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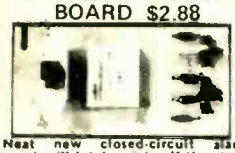

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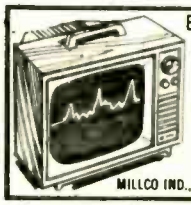

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60	Fordham Radio Supply	102
—	Forest Belt's Training Workshop	81
4 & 5	Formula International	92 & 93
—	Fuji-Svea	109
—	G E - General Electric	15
53	Godbout Electronics	100
—	Gold Edge	90
—	Golden Enterprises	108
11	Gould	2
56	Grantham College of Engineering	74
95 & 100	Heath	7 & 33
48	Hickok Electrical Instruments	17
57	Hobby World	106
58	I. E. Intergrated	106
—	Information Unlimited	89
67	International Crystal Mfg. Co.	84
17 & 18	Jameco Electronics	96 & 97
9	Jim-Pak	79
22	Kester Solder	83
—	Lakeside Industries	110
49	Lampkin Labs	23
42	Meshna	104
30	Micro Mart	104
—	Millco Industries	108
21	Morrow's Micro Stuff	71
13	National Camera Supply	83
—	National Radio Institute (NRI) Div. of McGraw Hill	8-11
—	National Technical Schools	28-31
44	Netronics	24
39	New-Tone Electronics International	103
10	Ohio Scientific	1
43	O. K. Machine & Tool	Cov. 3
6	Optoelectronics	22
31	P A I A	78
59	Panavise	78
54	Platt Luggage	16
26	Poly Paks	99
34	Pomona Electronics	36
66	P T S Electronics	85
7	Quest	107
16	Quimtronix	100
—	Radio Shack	95
36	Ramsey Electronics	94
27	Rye Industries	16
—	Sabtronics	12
—	H. W. Sams	77
37	Schober Organ	26
63	Soar	80
2	Solid State Sales	106
61	Southwest Technical Products	80
—	Speakerlab, Inc.	90
33	Sprague Products Co.	34
—	Starshine	5
68	Tek-El Corp.	103
14	Tri-Star	108
—	Tri-Tek	90
—	Trumbull	90
29	Tuner Service	25
—	VIZ Mfg.	86
23	Wersi Electronics	100
52	Zemco	75

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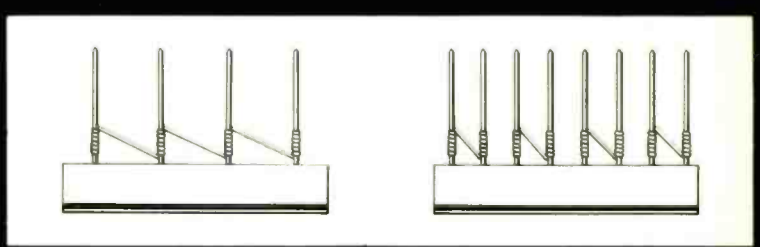

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