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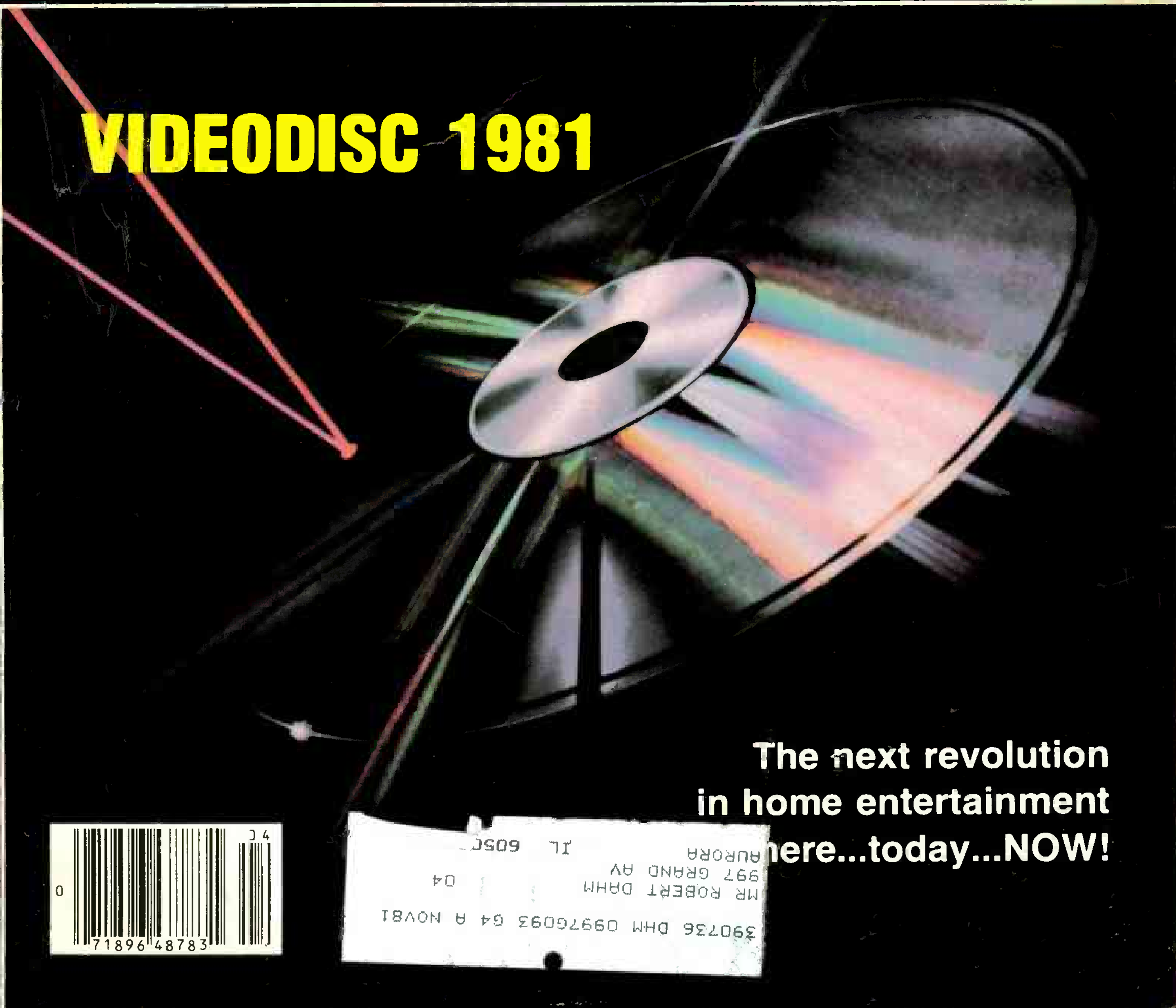

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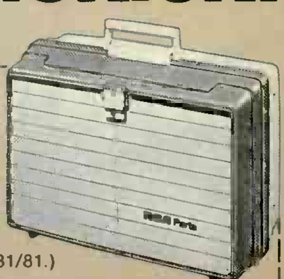

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Now, a mini-scope with the features most wanted by field engineers!

B&K-PRECISION'S new Model 1420 is a good example of what can materialize when a company listens well. This new 15MHz dual-trace mini-scope was designed by B&K-PRECISION engineers from a clean sheet of paper to respond to the special needs of field engineers . . . a *mini-scope* with *lab-scope* features.

So small in size (4.5″x8.5″x12″), the 1420 easily fits into a standard attache case with plenty of additional storage room for a DMM, tools and accessories. For use in any environment, the 1420 can be powered from an AC line, 10 to 16VDC or an optional internal battery pack. Unlike some competitive mini-scopes, adding a battery pack will not add to the size of the slim 1420.

The rugged 1420 features dual-trace operation and an honest 15MHz response. In addition, its smooth roll-off provides useful response to 20MHz.

An efficient rectangular CRT displays waveforms with high brightness for good readability under all field service conditions.

Too many field-service mini-scopes sacrifice features and performance for compact size, handicapping the field engineer. The new generation 1420 has overcome these problems. In spite of its small size, the 1420 has eighteen sweep ranges that span from 1 μS/div. to 0.5S/div. in a 1-2-5 sequence; variable between ranges. Sweep magnification is X10, extending the maximum sweep rate to 100nS/div. For use with computer terminals or video circuits, a video sync separator is built in. For added ease of use, automatic selection of chop and alternate sweep modes is provided, as is front-panel X-Y operation.

The new 1420 mini-scope comes complete with two 10:1/probes and is available *now* from your local B&K-PRECISION distributor. Available options include carrying case and probe pouch.

To receive a free 16-page color brochure describing the 1420 and the complete B&K-PRECISION oscilloscope line, call toll-free,
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Model 1420 $825

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APRIL 1981 Vol. 52 No. 4

ON THE COVER

Within a few months, three different videodisc systems will be competing in the marketplace. Each has its own advantages...and drawbacks. Find out how the systems compare with one another beginning on page 47.

INTERFACING AN IBM *SELECTRIC* mechanism to your computer doesn't have to be complicated. A four-IC solution begins on page 52.

ELECTRONIC SERVICING is entering a new era. Discover how a small shop can provide the services of a large organization. Story starts on page 79.

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looking ahead

VIDEO IN 1980

A final surge in the last two months of the year pushed 1980 home-VCR sales to 804,663 units, up 69.3% from the 475,396 sold in 1979. Color-TV sales chalked up their second-best performance in history, totaling 10,162,276; that's less than 1% behind 1978's record 10,236,319. Even black-and-white sets shared in the upturn, turning in their best sales since 1973.

AUTOFOCUS

Autofocus obviously is going to be the magic word for home color-video cameras this year, and the feature is expected to sweep the video business within the next 12 months. Three brands have already been announced and should be available by the time you read this. Probably the most interesting is a compact unit from Akai that weighs only about five pounds, yet includes a two-speed 6:1 power-zoom lens, automatic fade of both picture and sound, electronic viewfinder and a positive-negative reversal feature making it possible to make tapes from film negatives or produce special effects. With an $f1.3$ lens, it requires only five foot-candles of light and is list-priced at $1,150. Hitachi's autofocus model, which lists at $1,000, also has all deluxe features, as does Toshiba's self-focuser at $1,395.

NEW IN VCR's

The first combination PCM digital audio recorder and VCR is Hitachi's VHS unit, scheduled for marketing late this year. It will be priced at about $3,000, about the same as previously introduced PCM converters that require the addition of a VCR. The lightest portable VCR that uses a standard cassette (VHS) is expected to be shown this May by RCA. The unit is made by Hitachi, and weighs less than 11 pounds. It's the lightest we know about to date but Sony and Zenith will show Betas that may also break the 11-pound barrier.

Speaking of lightweight VCR's, Technicolor has introduced a one-hour mini-cassette for its seven-pound non-standard recorder (see **Radio-Electronics,** November 1980 issue). The previous cassettes recorded for only 30 minutes. Technicolor also added a tuner-timer accessory (so that its little portable can record broadcast material) and a version of its recorder with a built-in 7½-inch color TV set (total weight 21 pounds). Look for more stripped-down VCR's to be marketed at low prices to compete with videodiscs. Sanyo's $695-list unit (which sells for as low as $499 in some places) was first, followed by somewhat more expensive units from Magnavox, Panasonic, and Quasar. The Sanyo is a single-speed unit, while the latter three are three-speed recorders but lack such features as sound dubbing.

DISC JOCKEYING

"We can do anything better than you," said Hitachi, Sanyo, and Toshiba to RCA at the recent Consumer Electronics Show in Las Vegas. The three companies introduced their own versions of the RCA-developed CED player (all to be priced at the same $499.95 as RCA's), but all claimed their own to be more compact and generally better than the RCA brand. Both Hitachi and Sanyo have two-speed forward and reverse visual scan where RCA has a single speed. Toshiba has fingertip solenoid switches and says it soon will add motorized disc insertion and reject. Hitachi has a stereo-sound output jack on the back, to accommodate a black box as soon as RCA finalizes the parameters for its stereo soundtrack. All three newcomers have audio and video outputs, that RCA's player lacks. For technical details of the RCA system see the article in this issue.

CES saw previews of more new video equipment. Fisher was the first to show a video component system in the United States (although Sony is selling one in Japan.) Fisher's unit contained modules with a 26-inch color monitor, another with a TV tuner and optional optical videodisc player and Beta VCR, with plenty of space for audio components. Two floor-standing speakers complete the ensemble. Sansui demonstrated its version of the Japanese-developed VHD disc system, but said that it might introduce the RCA-type CED here instead. Advent proclaimed it would have a Pioneer-made LaserVision optical videodisc player and a special Sony-built Beta VCR with Dolby noise reduction and stereo sound. Korea's Samsung and Gold Star both showed prototype optical disc players. Sharp showed a VHD player but word from Japan indicates it will market CED here.

MORE PROJECTORS

The same show saw some new projection-TV debuts. Advent demonstrated a one-piece system designed to overcome the problem of what to do with projection television when you're not watching it—the screen folds across the top of the projector to make a good-looking walnut-finish table. Fisher demonstrated a 46-inch rear-projection set, while Fisher's parent, Sanyo, showed a one-piece front-projection 50-inch unit. NEC entered the projection-TV market under its own name with a 60-inch one-piece unit using Novabeam tubes made in Japan under license from Kloss Video. Mitsubishi showed a high-brightness version of its single-piece set.

DAVID LACHENBRUCH
CONTRIBUTING EDITOR

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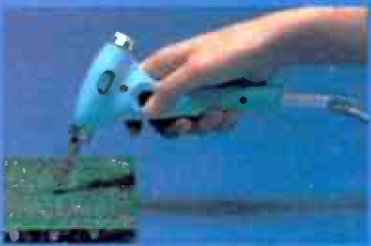

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CIRCLE 48 ON FREE INFORMATION CARD

what's news

Computers to work with light beams?

Ohio State University reports progress on a computer that uses light beams to carry and process data. The project is being funded by NASA's Lewis Research Center, and involves scientists from Denver University as well as Ohio State.

The light computer will theoretically move information much faster than is possible with present-day techology. But the new computer will not be able to dispense with IC's altogether—they will still have a place within its complex configurations.

Latest predictions are that the new computer may be ready for mass production in about five years.

New thermographic system has color video display

An improved thermal imaging system extends the capabilities of the Hughes Probeye infrared viewer to include a color video display of the heat picture being viewed.

The thermograph, now familiar to many because of the heat pictures of Mt. St. Helens published in many magazines, is a photograph-like image of an object taken by heat waves instead of light. Thus the hottest part of the picture shows up lightest (or darkest) and the shadings fall off (or get lighter) over the cooler portions of the object thermographed.

In the new Hughes *TIP-1400*, the video display is presented in 16 colors, each indicating a particular temperature range. The system can also display an isothermal area (a region of uniform temperature) showing one temperature level only, while cancelling out all the others.

The system is designed for use in such applications as temperature monitoring in glass, metal and ceramic production, for heat checks on heavy machinery, and to help spot insulation leaks in heating and air-conditioning systems.

Including a Probeye viewer, an image-conversion unit and the color video display, the Hughes *TP-1400* thermographic system sells "for under $30,000."

Radar-gun accuracy

Jon Svensson, of Normal, IL, found guilty of speeding on the evidence of a K-15 radar gun, insists that had he been allowed to introduce expert witness he could have shown that a radar gun might give a wrong reading in the circumstances under which he was arrested. The judge ruled that the testimony would have been prejudicial to the jury because it was not relevant to the case.

The expert, Jay Schreiber, stated that because of the angle between Svensson's car and the police vehicle, the radar gun should have read a little less than 20 miles per hour for the 28-mph speed at which Svensson claimed he was traveling. But, said Schreiber, the gun does not read speeds of less than 20 mph, and the result was a double-bounce effect that caused the gun to read 39 miles per hour instead of a little more than 19.

Even without the technical testimony, the jury deliberated three hours before reaching a verdict of guilty.

New echo canceller eases satellite communications

Echo, or reflection due to impedance mismatch on wire lines, has long been a problem in telecommunications. Now, with the great distances of satellite communications, it becomes a tricky problem in radio transmission.

The echo problem has been attacked with echo suppressors—sophisticated electronic switches that compare the signals in the two directions of a transmission, decide which is the main signal, then place a high loss in the path of the reflected one. Unfortunately, when simultaneous conversion is involved, speech is often blocked or "chopped," annoying the listener or even damaging intelligibility.

The new echo canceller—developed by RCA American Communications in cooperation with COMSAT and others—inserts a reverse replica of the original echo signal into the circuit instead of a loss, thus effectively annihilating the echo while allowing the speech to pass undisturbed. Results so far have been so successful that RCA Americom plans to install echo cancellers on all private line circuits as a matter of course.

DuPont and Philips join in audio, video fields

The DuPont Co. and N.V. Philips have announced a joint venture in the manufacture and worldwide sale of magnetic tape and cassette products. The new product is called PD Magnetics. DuPont is bringing its experience in magnetic and chemical technology, and Philips is contributing its skills in engineering and marketing consumer electronic and magnetic tape products to the new company.

The parent companies believe that combining their skills and expertise will make PD Magnetics an organization that can become a leading supplier of audio and video products—a market that may reach $4 to $5 billion by 1985.

Production of PD Magnetics tape products is slated for early 1981 in Oosterhout, Netherlands. **R-E**

HUGHES TIP-1400 THERMAL VIDEO SYSTEM displays a color "heat picture" of the object being viewed, in 16 colors. Each color represents a temperature range. The "picture" can be zoomed up to four times original size, or one frame can be frozen and displayed for any desired length of time.

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We've got great news for people who've been holding out for a high quality, high performance DMM at a moderate price: Fluke's new nine-function model D 804 is now available at select electronics supply stores.

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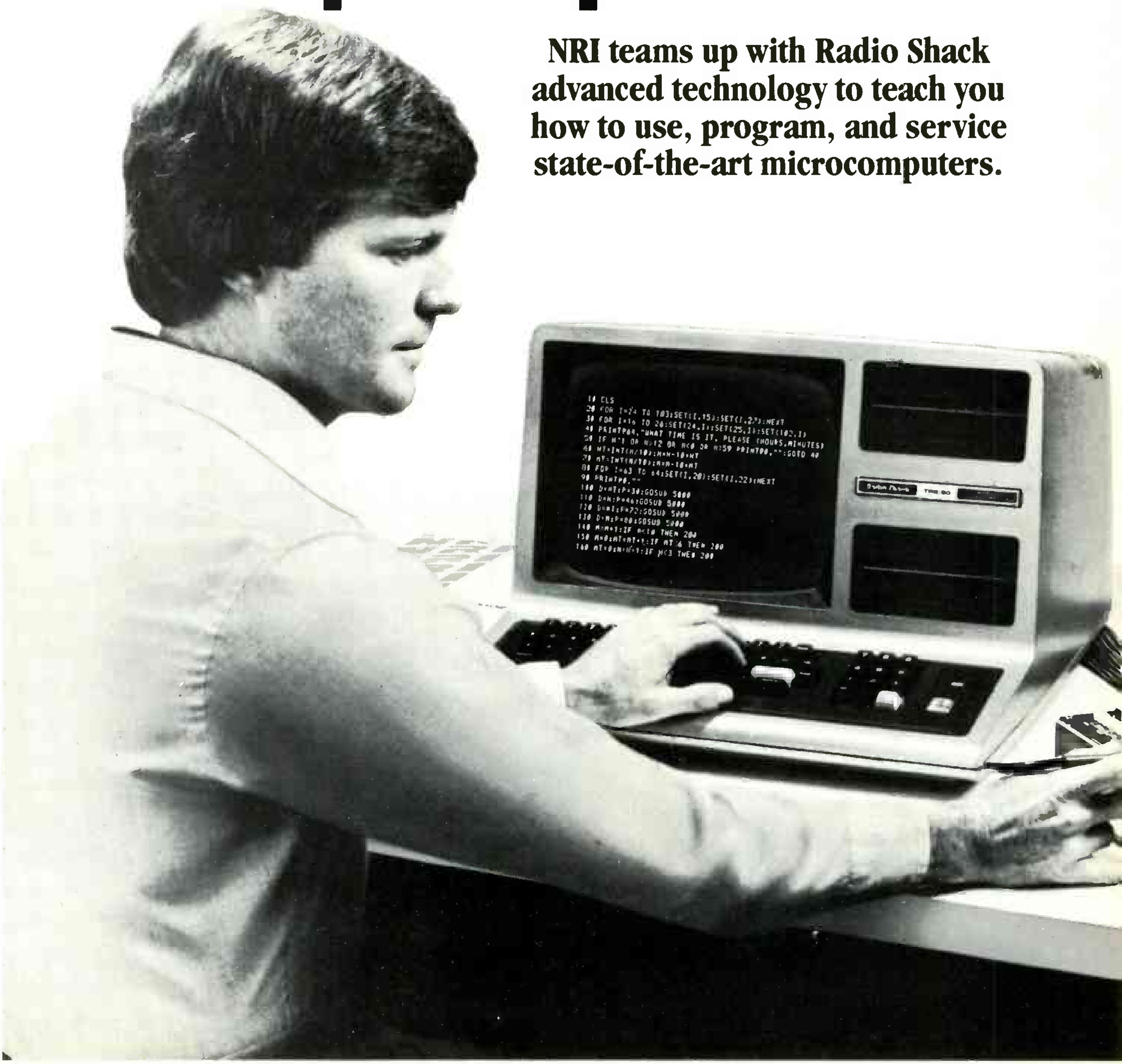

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satellite tv news

SATELLITES GO TO THE MOVIES

Hollywood movie studios, perhaps in a spinoff of their pay-TV satellite enthusiasm, are renewing their consideration of satellite technology to send movies directly into neighborhood theaters around the country. It may be years—or decades—before such a set-up could be established, and an executive of one of the top studios admitted that the current research is just "scratching the surface." Such a move to satellite delivery would have to be accompanied by the installation of giant-screen video projectors in theaters. Nonetheless, the escalating price of movie distribution makes such alternatives appealing; studios now spend $1 million per film just to make prints, with the cost of freight raising that expense considerably.

The idea of satellite feeds to movie theaters, of course, is not new. British theaters have experimented with such a system and several efforts have been launched here in the past. Those were mostly for special events, such as fights or concerts. Many experts predict that there will be an increasing use of satellite-to-theater technology for such activities.

MORE BIRDS:

America's newest communications satellite lifted off on schedule in mid-November of 1980—the first satellite in the advanced communications system being established by Satellite Business Systems. SBS-1, located at 106° west longitude, has 10 transponders and operates in the 14/12 GHz band—and transmits all-digital data, voice, and video service. It is intended mainly to beam business communications (especially computer communications and private-line telephone calls) between branch offices of companies—but there will also be substantial video teleconferencing among the customers. The 550-kilogram satellite has a relatively high power output—20 watts per transponder—and a net usable bandwidth of 43 MHz. In conjunction with SBS's time-division multiple access and demand-assignment techniques, each transponder will relay up to 48 million bits per second of information. SBS-1 is the first U.S. domestic satellite to use the Ku-band. The company (a partnership of IBM, Comsat General, and Aetna insurance) plans to launch its next satellites in April 1981 and November 1982. All the birds are built by Hughes Aircraft.

In addition, Western Union has confirmed plans to build its Westar V satellite, scheduled for launch in August 1982. The advanced satellite—with more capacity and higher power than the current Westar birds—will be located at 75° west longitude.

And the Canadian government will extend its use of Anik B for another 19 months. The 14/12 GHz-capacity bird will now offer more education, health-care services, broadcasting (including DBS), and other services well into 1982. The DBS services on Anik B are run presently by TV Ontario from Toronto and by the Canadian Broadcasting Corp. and Canadian TV from British Columbia.

The Russians have also launched a new satellite, "Stasionat 3," now orbiting at 85° east longitude. The bird, latest in the Raduga telecommunications satellite series, is believed to have about seven transponders, operating in both the 6/4 and 8/7 GHz bands. Although most of its services are telephone and business-related operations (including some military services, most likely), the bird also is said to transmit national TV programs to the nation's network of earth stations, which is called "Orbits."

TELE-CONFERENCING

Satellite hobbyists may find themselves peeking in on more and more curious daytime events—and there's every indication that there's still more to come from the world of "talking heads" and sales charts. Officially it's called video teleconferencing, and it is attracting immense attention from business and government executives nationwide, who are finding it ever more difficult to afford the time and money to travel to meetings. Thanks to satellites, inexpensive downlinks, and other factors, it is becoming easier to hold meetings in various cities simultaneously. People in far-flung locations can look in on the main proceedings via a video-satellite hookup.

To help such people along, there are several organizations which coordinate teleconferences. Company names like VideoNet, VideoStar, Media Sense, and others will soon become familiar network names—as they put together the one-shot satellite networks for organizations which want to get together via satellite. Many hotel chains (especially Holiday Inns and Ramada Inns) are installing earth stations to pick up the video conferences. Thus people gather for luncheons and a meeting in the hotels' conference rooms to look in on sessions taking place elsewhere in the country. It should be noted, however, that many of the companies are becoming sensitive to outsiders peeking in on their meetings—so there is a move afoot to encode satellite signals, thus making it harder for unauthorized locations to pick up the sessions.

GARY H. ARLEN
CONTRIBUTING EDITOR

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Sinclair's 4K integer BASIC has performance features you'd expect only on much larger and more expensive computers.

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The ZX80 is available only by mail from Sinclair, a leading manufacturer of consumer electronics worldwide.

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Price includes TV and cassette connectors, AC adaptor, and 128-page manual.

All you need to use your ZX80 is a standard TV (color or black and white). The ZX80 comes complete with connectors that easily hook up to the antenna terminals of your TV. Also included is a connector for a portable cassette recorder, if you choose to store programs. (You use an ordinary blank cassette.)

The ZX80 is a family learning aid. Children 10 and above will quickly understand the principles of computing—and have fun learning.

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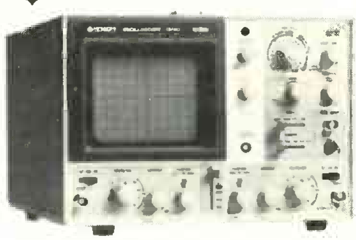

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editorial

Non-Standard Standards

There are two videodisc systems currently being sold, and a third system is not far behind. RCA and Magnavox/Pioneer are battling it out for acceptance in retail stores across the country, while JVC has not yet released their VHD system. Unfortunately, those three systems are totally incompatible. You cannot play an RCA-format videodisc on a Magnavision player, and vice-versa. Likewise, a JVC VHD videodisc cannot be played on either of the other two players. The situation becomes worse when you realize that it is economically unfeasible to build a single player that would play all three videodisc formats.

The battleground is not limited to just three manufacturers. Many corporate giants are lining up to sign licensing agreements to produce one of the three players. The industry is bracing itself for an all-out war. It is a winner-take-all situation, with the big losers being consumers.

It is not the first time that consumers have been faced with this kind of situation. Remember audio cassettes before the Philips audio cassette became the industry standard? There are several incompatible audio-cassette formats, of varied shapes and sizes, that were being touted at retail stores. One of those formats would have rendered stereo recordings incompatible with monaural players. Eventually, those formats fell by the wayside in favor of the Philips cassette format. The manufacturers of those other formats lost money, but they knowingly took a risk and lost. What about all those consumers that purchased players and prerecorded software for those formats that ceased production? They were unknowingly pawns in a war and they lost, too.

More recently, we had 4-channel sound. Here, so many different formats were brought to the marketplace that consumers threw their hands up and refused to purchase any of the systems. 4-channel sound died a sudden death. All the manufacturers lost that war; but before they did, many 4-channel hi-fi systems and prerecorded discs were sold. If you bought a 4-channel system, you also lost. You probably still have the system but cannot buy any new software. The competing systems only accelerated the decline into none.

It is time that our industry matured. Behind the slick state-of-the-technology hardware there should be some thought for the future. No one benefits when the public is "conned" into buying equipment that may soon become worthless. Investing several hundreds of dollars in a videodisc system and discovering a year or so later that videodiscs were no longer being produced for that system could hurt. It would become a long-remembered loss to the consumer. It restricts the sale of new equipment: The consumer who isn't sure he's making the right choice, makes no choice and buys nothing.

It would be of benefit to all, manufacturers and end users alike, if somewhere along the line, manufacturers could agree on a standard. We did it, eventually, for audio cassette tape. We did it, eventually, for FM stereo. We will do it, eventually, with videodisc systems. But most important of all, maybe the next time, we'll do it before the customer spends any more of his money on a loser.

Art Kleiman

ART KLEIMAN
Managing Editor

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letters

THE DIGITAL SLOT MACHINE

I read the article, "Build the Digital Slot Machine" by Fred Blechman and David McDonald in the January 1980 **Radio-Electronics** with great interest. I built the circuit out of my junk-box parts, and it was, indeed, fun to play with—but the silence was deafening. I decided to add a sound system, and it may be of interest to any readers who constructed the circuit.

There is no change in the original circuit, and with only three more IC's, a quaint sound system is produced. The WIN logic is the same up to pin 6 of IC12-d. The circuit around IC11 is modified and IC14, IC15, and IC16 are added to the original circuit.

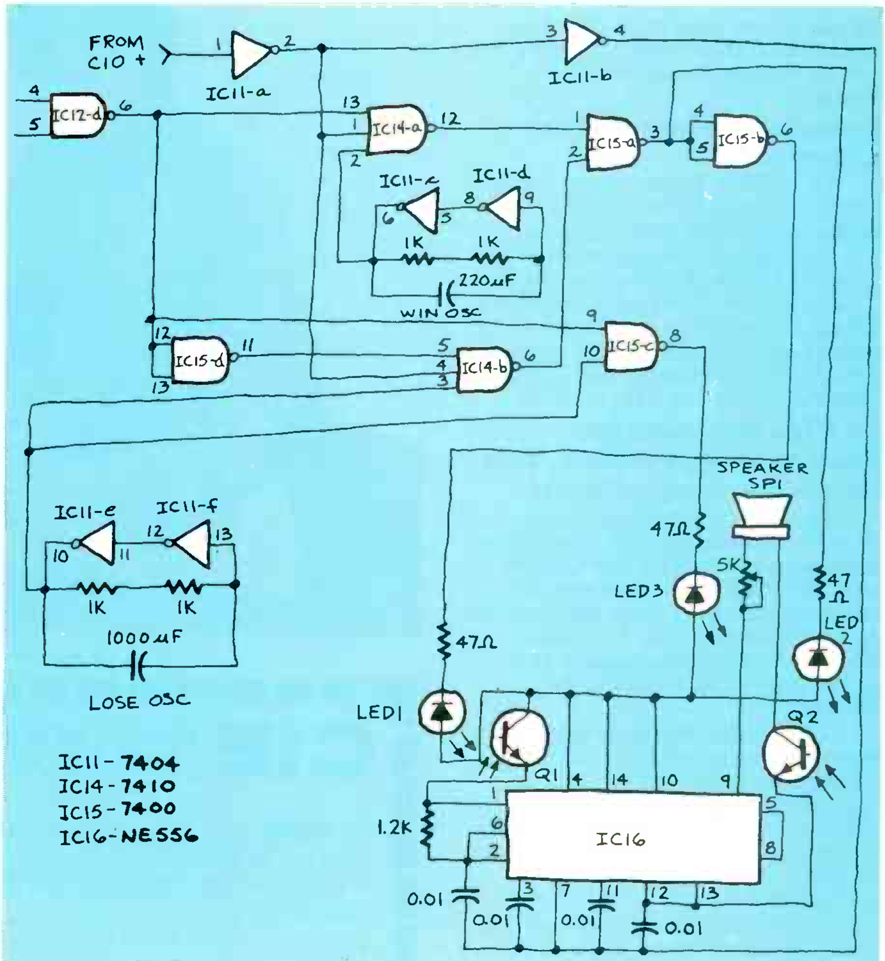

FIG. 1

The circuit is shown in Fig. 1. IC11-a serves the same function as in the original circuit: to inhibit the win or lose logic during roll. IC11-c and IC11-d form a WIN oscillator and IC11-e and IC11-f form a LOSE oscillator. The LOSE oscillator is at a lower frequency and pulse than the WIN oscillator. IC14 forms gates for the WIN or LOSE oscillators. When a roll is complete, the output of IC11-a is high, producing one of the enables for gates IC14-a and IC14-b.

When the output of WIN gate IC12-d is high, pin 6 is high, enabling gate IC14-a and inhibiting IC14-b. The WIN oscillator is gated through IC15-a, because LOSE gate IC14-b output is high. Gates IC15-a and IC15-b drive LED1 and LED2, and turn them off and on at the WIN oscillator frequency. When LED2 is on, LED1 is off; and when LED1 is on, LED2 is off. Light from LED1 and LED2 illuminates phototransistors Q1 and Q2. The WIN logic also activates LED3. During WIN, IC12-d is high and enables IC15-c; thus LED3 is driven at the LOSE oscillator frequency. The off-and-on action of LED1 and LED2, plus the slower off-and-on action of LED3, produce four different tones at a rather rapid rate.

During LOSE, IC12-d is low, activating IC14-b through IC15-d and inhibiting IC14-a. Thus, LED1 and LED2 are driven by

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LETTERS

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IC15-a and IC15-b, and turn off and on at the LOSE oscillator frequency. During LOSE, LED3 is not lit. The low-frequency, low-pulsed rate of turning LED1 and LED2 off and on produces a "Hummmm Phttt, Hummmm Phttt" sound.

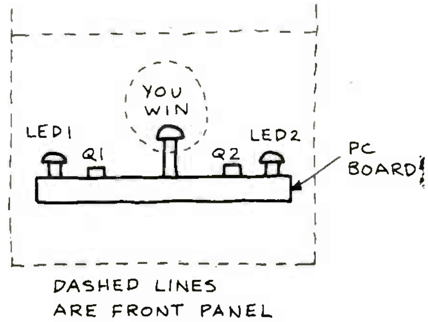

FIG. 2

A dual 555 IC (IC 16) is the sound-system oscillator, and the frequencies are controlled by illumination of the phototransistors Q1 and Q2. The dark resistance is higher than the light resistance, and the changing resistance produces the various sounds. Many different sounds may be obtained by moving the position of LED1 and LED2 around the phototransistors. Place LED3 so that it is an equal distance from phototransistors Q1 and Q2. Place Q1, Q2, LED1, LED2, and LED3 near the front panel and drill a hole in that front panel near LED3. Label the hole YOU WIN, which is flashed when the WIN logic is high. Shield LED1 and LED2 to prevent their illumination getting through the YOU WIN hole during LOSE. Figure 2 shows the suggested placement for the phototransistor and lamp.

GEORGE C. GOODER
APO S.F. 96224

HISTORY OF TELEVISION

The article, "History of Television," in the June 1980 issue brought back many memories.

In 1950, the June 11th issue of "La Patrie" (a Montreal newspaper) devoted their whole front page (and a long continuation inside) to a writeup on my success in receiving TV pictures from stations in the USA (see the August 1950 **Radio-Electronics**).

Six years later (1956), I was able to receive good color pictures using my old 630TS (build from a kit), a color wheel, and an NTSC decoder. I was even obtaining a 60-inch picture using a Norelco projector, 1949-1950 vintage. That color-TV receiver and projector are still in working condition, though seldom used.

Keep up your good magazine. I especially enjoy reading Jack Darr's "Service Clinic" every month.

MAURICE DUBREUIL
Lavaltrie, Quebec

REVERSED LED

I noticed an error in the schematic of the circuit shown in the "New Ideas!" department in the January 1981 issue. The "water needed" LED ("W") is reversed.

STEVEN M. CASH
Houston, TX R-E

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equipment reports

Keithley Model 130 DMM

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PERHAPS THE HANDIEST PIECE OF TEST EQUIPment introduced in recent times is the digital multimeter. A few years ago they were bulky and expensive, but now you can own a hand-held unit for a fraction of what those early units cost.

One of the slickest portable DMM's to have hit the marketplace is the *model 130* manufactured by Keithley Instruments, Inc., 28775 Aurora Rd., Cleveland, Ohio 44139. When one considers such factors as accuracy, portability, and ease of operation, any money spent on the *model 130* will be returned with interest in a very short time. Housed in an attractive, but rugged plastic case, the unit measures 7.1×3.1×1.5 inches and weighs 10 ounces. An 0.6-inch high, 3½-digit, LCD readout is used for long battery life.

In use, the *model 130* can be held in one hand conveniently, with the range selection and function switches rotated by the thumb. Five standard banana jacks are used for the test-lead connections to the front panel. Those are the common, the mA, and the volts/ohms, jacks. The remaining two jacks are used for the 10-amp current range and are connected directly to an internal 0.01-ohm resistor, across which the voltage drop is measured by the circuitry and displayed on the LCD readout. The use of standard jacks allows your existing test leads, and/or any special test setups you may already have in your shop, to be used with the *model 130*.

According to the instructions provided with the test model, it is anticipated that battery life will be about 100 hours with a standard 9-volt carbon-zinc battery, or 200 hours with an alkaline battery. There is a low-battery indicator that will appear when 90% of the battery life has been expended. The battery is accessible through a small slide-out panel on the rear of the cabinet. A similar compartment at the rear provides access to a two-amp fuse that protects the current ranges. The fuse can be tested from the front panel.

With all test equipment, it is advisable that the owner read the operating instructions before use. The manual provided with the *model 130* is thorough though small. The disassembly instructions contain an exploded view of the three major sections of the unit. The manual also contains a pictorial of the printed-circuit board with all parts identified by their reference number, the schematic diagram, calibration procedures, specifications, and a list of available accessories.

DC voltage is measured on five ranges from 200 mV to 1,000 volts full-scale. Resolution varies from 100 μV to 1 volt depending upon the range in use with an accuracy of $\pm 0.5\%$ of

continued on page 32

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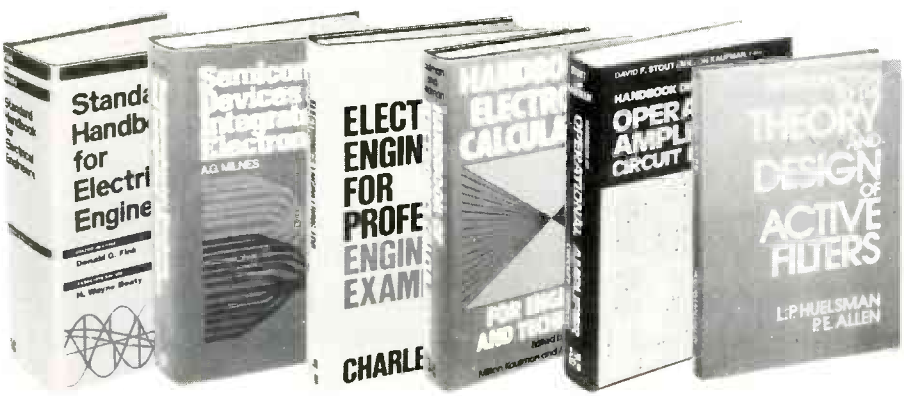

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DIGITAL HARDWARE DESIGN By J. B. Peatman. *428 pp., over 400 illus.* Taking you beyond the microcomputer, this guide reexamines traditional techniques and focuses maintainability as a key goal, on the design of circuitry too fast for the microcomputer alone, and on designing for usefulness. It covers everything from algorithmic state machines to separately clocked circuits—with scores of examples.
491/321 Pub. Pr., $26.95 Club Pr., $20.00

EQUIPMENT REPORTS

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reading ±1 digit. DC current is measured on five ranges from 2 mA to 10 amps full-scale with an accuracy of ±1% of reading ± 1 digit on the three lowest ranges. The 2-amp and 10-amp ranges have an accuracy of ± 2% of reading ± 1 digit.

AC voltages are also read on five ranges from 200 mV to 750 volts full-scale. Resolution varies from 100 μV to 1 volt with an accuracy of ± 1% of reading ±5 digits. The AC current ranges are the same as for DC current except for the accuracy, which varies from ± 2% of reading ±5 digits to ±3% of reading ± 5 digits depending on the range selected.

The resistance ranges are: 200 ohms full-scale with an accuracy of ±0.5% ±4 digits; 2000, 20 K, and 200 K ohms full-scale with an accuracy of ±0.5% ±1 digit; and 20 megohms full-scale with an accuracy of ±2% ± 1 digit. The maximum open-circuit voltage is 1.5 volts and the input can be subjected to 300 volts DC or RMS (maximum).

The test unit supplied included the accessory *model 1304* Soft Carrying Case and Stand. The case is simulated leather with an attached belt loop and a built-in pocket for the mini-manual and test leads. The DMM can be fastened into the carrying case with a large-headed screw that threads into the bottom of the *model 130* through an access hole in the carrying case. That precludes the possibility that the instrument might fall out of the case if the zipper fastener should become unzipped. The belt loop allows you to fasten the case to your belt, leaving both hands free for other chores until a measurement is required. The stand elevates the *model 130* to an angle that makes the readings easier to see when used on a bench, and it can be used with or without the case.

Other accessory items are available including a high-voltage probe, a 50-amp shunt, an RF Probe, and a clamp-on current probe. There is even a spare-parts kit available, as well as various test-lead sets.

If you are in the market for your first DMM, getting ready to update your workbench or tool caddy, or are just in need of one or two additional meters, it will be to your advantage to investigate the Keithley *model 130* Digital Multimeter. The *model 130* has a suggested retail price of $115 and the accessory *model 1304* carrying case and stand has a suggested retail price of $10. Both are available from your local electronics distributor. **R-E**

A P Products Powerace 103

CIRCLE 102 ON FREE INFORMATION CARD

SOLDERLESS BREADBOARDS HAVE BEEN around for quite a while now, and they keep getting better. Modularization and simplification are done with style in this new offering, a sleek breadboarding package that includes three power supplies.

The *Powerace 103* (AP products, 72 Corwin Drive, Painesville, OH 44077) includes a 6½ × 4½-inch solderless breadboarding area; well-regulated +5 volts DC at 750 mA, +15 volts DC at 250 mA, and −15 volts DC at 250 mA power supplies; a zero-center (15-0-15 volts DC) edge-reading panel meter; two Darlington-driven, high-logic indicating LED's; two debounced momentary switches providing both true and complement 5-volt logic-level outputs; and two more slide switches that provide 5-volt logic-compatible high or low levels. The six separate logic outputs, two logic-indicator inputs, three power-supply outputs, and meter input are all available at panel-mounted solderless tie-point blocks.

The *Powerace 103's* features make it especially appropriate for those circuits that combine some analog and some digital elements, and of course it's appropriate for use with a circuit that is exclusively either type. The power supplies have proved to be adequate without exception in this reviewer's experiments to date. And they are very clean. Ripple and noise are less than 10 millivolts at full load for all outputs, line and load regulation is better than 1%. Also, through the use of a 5554 regulator and associated pass transistors, the ±15 volt-DC power-supply-outputs track, maintaining the necessary supply balance for critical amplifier and converter design.

The momentary switches with both true and

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EQUIPMENT REPORTS

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complement logic outputs are called "logic switches" by the manufacturer. Switch positions S3 and S4 (both the switches and their tie-points) are each labeled with Q and $\overline{Q}$ designations. Those are actually SPDT switches that switch a ground to either the $\overline{\text{set}}$ or $\overline{\text{reset}}$ input of an R/S flip-flop made from a pair of two-input NAND gates. Since the first low will trigger the change of state, that essentially debounces the switching. Also, that configuration makes both the true and complement outputs available. Each can source 5 mA or sink 15 mA.

Switches S1 and S2 are not debounced. Those are small SPDT slide switches that connect the tie point block to either +5 volts DC through a 470 ohm resistor providing a 10 mA sourcing capability, or to ground with unlimited sinking capability.

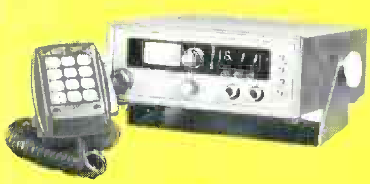
A P Products has tied together the power supply grounds, meter ground, logic ground, front panel, and the aluminum baseplate on which the solderless breadboards are mounted. That provides an ample ground plane for a prototype circuit, a definite aid when working with high-frequency, high-speed, or noise-critical circuits.

The solderless breadboards themselves are two of the company's *Super-Strips* that can accommodate not only DIP IC's, but most active or passive, discrete or integrated components available. That is because they use industry-standard 0.1-inch contact spacing. The 1,680 solderless tie points are arranged in 16 distribution buses of 25 tie points each, and two pairs of twin-rows of terminals. Each terminal has 5 tie-points. There is a 0.3-inch channel between the terminals of each pair or rows. There are 64 terminals in each row. If that arrangement seems confusing, rest assured that it is easy to understand and work with. The breadboard is well described in the application manual that accompanies the *Powerace 103*.

Here is a product where the whole is greater than the sum of its parts. Its styling is attractive and practical. The *Powerace 103* is designed with the user in mind. Components mounted on the breadboard and instrumentation on the panel are easy to see, easy to reach, and easy to work with. Even so, the *Powerace 103* takes up just a $7\frac{1}{4} \times 11\frac{1}{2}$-inch area on your bench.

The *Powerace 103* sells for $149.95. **R-E**

Heath Model VF-7401 Scanning Transceiver



CIRCLE 50 ON FREE INFORMATION CARD

THE HEATH COMPANY HAS RECENTLY ANnounced the addition of the *model VF-7401* Two-Meter Digital Scanning Transceiver to the company's ever-popular ham radio line. Its features include the ability to scan automatically any 1-MHz portion of the two-meter band selected by the operator. There is also a priority channel activated each time the transceiver is turned on. That frequency is hardwired into the logic at the time of assembly and may be altered at any time the operator desires. The unit measures just $2\frac{3}{4} \times 7\frac{1}{4} \times 10\frac{1}{4}$ inches and weighs five pounds.

In spite of the complexity and small size of the *model VF-7401*, assembly is straightforward, if one takes one's time and carefully studies the instructions provided by Heath. Assembly of the model *VF-7401* should, however, only be attempted by someone with more than a minimal amount of kit-building experience. As is the case with most other kits, sometimes the steps outlined by the booklet may seem to be out of order to the builder who has considerable experience. However, the constructor is most likely to find out later on that there were very good reasons for that particular sequence of assembly.

Probably the first thing that comes to mind as you look over the parts provided will be that there appear to be too many PC boards to fit into the small cabinet. There are six PC boards in all: The readout and VCO boards, both quite small, and the synthesizer and receiver boards, both somewhat larger, all mount on the upper part of the transceiver chassis assembly. The transmitter board is mounted on the underside of the chassis and the power amplifier is mounted to the heat sink at the very rear of the cabinet. When the package is all assembled, you may wonder how it can be serviced if it fails to operate. As it turns out the boards can be "lifted" enough to allow access to the undersides without too much trouble. The only problem we had, in spite of all the warnings and the thorough inspections with a magnifying glass, was a solder bridge on the receiver's oscillator injection from the synthesizer board. Otherwise, the rig operated without a hitch after it was aligned.

Speaking of aligning and tuning, Heathkit provides at least two methods of aligning the receiver and transmitter sections. One thing that should not be overlooked is to preset the coil slugs as specified by the instructions. It is amazing how close the alignment of the receiver will be at that time. Heath's instructions state that the setting will be within two turns of the correct position. You can count on that fact. We attempted to align the receiver using instruments and found that it took considerably longer than the preset slug method. On the negative side of the instructions, we did find a few steps where the arrow indicating the operation was omitted or some other error was discovered. However, since our unit was probably an early model run, it is possible that those problems have been found and already corrected. Even so, it took very little effort to figure out exactly what was meant. As always, Heathkit has provided an excellent assembly manual.

Frequency selection is accomplished with three push-buttons located under the 7-segment LED readouts on the front panel. The buttons (1 MHz, 100 kHz, and 10 kHz) advance the frequency of the transceiver at the scan rate. If, for example, you wished to operate at 146.940 MHz, you would first place the *model VF-7401* into the manual mode with the manual/scan button. You then advance the frequency by pressing the 1-MHz button until the first position of the three-digit display reads 6, the 100-kHz button until the second position of the display reads 9, and the 10-kHz button until the last position of the display reads 4. You would then be operating on the desired frequency. The unit would remain on that frequency as long as it is in the manual mode. There is an offset switch that will add a + 5-kHz offset to the transmit and receive frequencies. If you switch into the scan mode, the transceiver will scan from 146.000 to 146.990 continuously. For repeater operation, transmit offsets of +600 kHz, −600 kHz, or 1 MHz are available, in addition to simplex. If you use a repeater requiring a sub-audible tone, there are three user-selectable frequencies for that purpose.

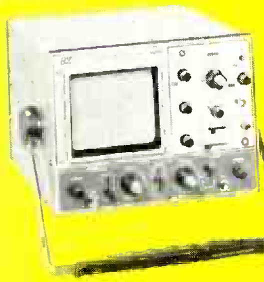
The transmitter is rated at 15 watts output (at 13.8 volts DC input) and is adjustable over a range from 10 to 15 watts by a rear-panel control. The unit assembled and tested for this article attained a solid 14 watts at 12.8 volts DC on the lab's power meter. Modulation is adjustable from 0—7 kHz deviation. Spurious and harmonic output is −60 dB.

Receiver specifications include a sensitivity of 0.5 μV for 12 dB SINAD (or 15 dB of quieting). Image and spurious rejection is −50 dB or greater. IF rejection is greater than −80 dB. The squelch threshold is 0.3 μV or less. In lab checks we found that the receiver will respond to a 0.1 μV signal but that for reliable squelch operation, a signal between 0.2 μV and 0.3 μV is needed. That agrees with the published specs. On-the-air tests indicate that several stations can be heard weakly once the squelch has been opened. Audio output is 1.5 watts with less than 10% THD (2 watts maximum.)

Other features include a front-panel combination relative signal strength/output power meter and a 4-pin DIN microphone connector. The unit tested came with a standard microphone. However, a *Micoder* (auto-patch encoder) unit can be wired for use with the *model VF-7401* that will allow the transceiver to be used for auto-patch operation. Power for the *Micoder* is drawn directly from the transceiver's power supply rather than from its own internal battery.

All in all, we found the Heathkit *model VF-7401* Two-Meter Digital Scanning Transceiver to be enjoyable to assemble and even more fun to operate. The *model VF-7401* Two-Meter Digital Scanning Transceiver sells for $339.95 and is available from The Heath Company, Benton Harbor, MI 49022. **R-E**

B&K Precision Model 1520 20 MHz oscilloscope



CIRCLE 103 ON FREE INFORMATION CARD

MOST TECHNICIANS WILL TESTIFY THAT AN oscilliscope is among their most valuable

EQUIPMENT REPORTS

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pieces of test equipment. Now there is a new breed of those instruments featuring triggered sweep. Even kit companies now produce triggered-sweep oscilloscopes rather than the old continuous-sweep devices. The main advantages of those new scopes are better definition and higher frequency response. The B&K Precision *model 1520* is an excellent example of that new technology.

The *model 1520*'s circuitry is built around a circular CRT that uses a brilliant blue P31 phosphor. An 8 × 10 centimeter graticule comes with the scope, and a replaceable vectorscope graticule is included for TV work.

The *model 1520* is very compact (approximately 10 × 7½ × 14 inches), and weighs 20 pounds. Its aluminum cabinet is finished in brown and beige, with a brushed aluminum panel. An adjustable carrying handle doubles as a tilt stand. Two probes are included, each in its own zipper pouch. The probes are low-capacitance types, permitting high-frequency use with minimum circuit loading. Switches allow you to select direct reading or 10:1 attenuation of test point signals.

The oscilloscope features high sensitivity (5 millivolts per division), with calibrated sweep ranges from .5 microsecond to .5 second per division. Vertical-input impedance is 1 megohm shunted by 27 pF.

Sweep response offers high resolution from DC to beyond 20 MHz. In our tests, we were able to maintain high definition through 40 MHz before distortion became apparent. Overshoot is less than 3% (100 kHz squarewave). A built-in ×10 magnifier switch stretches the horizontal sweep, permitting you to extend the upper-frequency limit. The magnifier also lets you examine a detailed portion of the waveform. A .1-volt (P-P) squarewave calibrator is built in. That calibrator provides a convenient setup for making waveform measurements.

Synchronization is very stable, locking on to input waveforms and maintaining its hold through the upper limits of its frequency range. A minor touchup of the triggering vernier is necessary if the input waveform is changed considerably in frequency. In our test, triggering became a little touchy at the highest frequency input but it was always rock steady after adjustment. Internal or external triggering is available. A 17.5-nanosecond risetime assures a distortion-free display at high frequencies over the full viewing area of the screen.

In the dual-trace mode, the traces may be individually adjusted. Alternate sweep or 200-kHz chop modes can be selected for the dual-sweep display. Twelve calibrated voltage scales (5 millivolts to 20 volts per division) provide accurate measurements on both channels. Switch-selectable synchronization sources are channel A, channel B, line, internal, or external. Additionally, each sync source may have positive or negative polarity.

The two channels may be integrated algebraically, letting you display a single trace that is the sum of the two inputs. That capability is excellent for displaying differential voltages or distortion. The two channels may also be displayed at right angles (X-Y) for the purpose of graphic displays.

A Z-axis input (intensity modulation) is provided for time and frequency markers. Trace rotation may be done electrically by adjusting a front-panel control.

There are many uses for an oscilloscope as versatile as the *model 1520*. Digital-logic applications allow you to design, analyze, and troubleshoot both professional and home-entertainment microprocessor and computer circuitry. For video applications, the *model 1520* is useful in aligning and setting up CATV/MATV installations and television receivers. In addition, a built-in sync separator circuit is included for analyzing composite video signals.

Citizen's Band and low-band communications equipment may be analyzed directly with the *model 1520*. Modulation patterns, RF peaking, and IF alignment are greatly simplified with this instrument. Digital-data transmissions and single-sideband exciter alignment are made much easier with a laboratory-quality oscilloscope such as the *model 1520*.

The accompanying manual is well written and will greatly assist both the beginner and the veteran service technician. The manual contains many illustrations.

We were very impressed by the quality of construction and thoughtful design of the new *model 1520* oscilloscope from B&K Precision. We think you will be too. The model 1520 is not inexpensive, but it offers the user quite a bit for his money. If you are in the market for a quality top-of-the-line oscilloscope, it would be worth your while to take a careful look at this one.

The *model 1520* oscilloscope sells for $840 and is available from your local electronics distributor. For further information, write B&K Precision Dynascan Corporation, 6460 West Cortland Street, Chicago, IL 60635. **R-E**

Wilson WV-1A Four-Band Vertical Antenna

CIRCLE 104 ON FREE INFORMATION CARD

SOME HAMS LIKE VERTICAL ANTENNAS. SOME don't. The argument is not clear cut, as there are many variables in operation when compared to horizontally-polarized antennas. Verticals do have a lower angle of radiation (good for ground wave and DX), and they take up less room, generally requiring only one support point.

Arguments against them include their vulnerability to electrical noise (which is often vertically polarized), and their lack of directivity making them susceptible to QRM (interference from other stations) from every direction. They are certainly more expensive, as they must be solidly built for self support. They also require an elaborate ground system for efficient operation.

But we were not interested in the pro or con argument when we ordered Wilson's new *WV-1A* for evaluation. We were interested in how the new product would compare to similar antennas from competitors like Hy-Gain, Hustler, and Mosley.

Assembly

The *WV-1A* is securely shipped in a heavy-duty cardboard box and packed in styrofoam. Unpacking the unit, we were pleased to discover that the antenna is made of high quality taper-swaged seamless aluminum tubing of heavy enough gauge to be self-supporting without guying. The heavy-duty bracket is also as sturdy as any we have seen for a moderately priced antenna system. A SO-239 female coaxial connector (included) allows for convenient connect-disconnect to the transmission line.

All assembly hardware is packaged in a plastic bag. A parts list is provided with a check-off procedure to verify correct factory parts count. Part numbers, quantities, measurements, and descriptions are all provided so that no mistake is made while reviewing the hardware provided, or when ordering replacement parts.

To aid in assembly, detailed illustrations are included in the assembly manual. Spacings, identification details, and assembly procedures are thoughtfully illustrated.

As with all other aluminum antenna elements, we would recommend application of anti-corrosive paste at all aluminum fittings and joints to preserve continuity. Normal weathering encourages electrolytic corrosion of most metals, especially aluminum. If you live anywhere near the ocean, that protection is especially important. Unfortunately, antenna manufacturers no longer supply a complimentary package of that protective paste with their products. The paste will have to be ordered separately from other sources.

Although it is theoretically possible to mount a vertical antenna against an actual ground (the earth), a perfect ground counterpoise is rarely (if ever) found in nature. An artificial ground plane consisting of radials is always recommended. To test that, we decided to mount the *WV-1A* on a ten-foot ground pipe driven into rocky, wet soil. No ground radials were used.

Since the *WV-1A* is made of thick-walled aluminum tubing, no additional guying was necessary. The trap-loading coils are high-Q, providing sharp resonance near the band centers. Naturally, with tuned traps, bandswitching is automatic. When properly tuned, the *WV-1A* needs no further adjustment for four-band operation.

The antenna is designed to properly match a 50-ohm transmission line, standard for all communications equipment. Since the antenna is fed at a low impedance point, high voltage arc over is not a consideration. Conductor sizes are more than adequate for full legal power limit—2 kilowatts PEP in the amateur service. When ideally mounted and adjusted, it is possible to get a 1.1:1 VSWR on all bands. Actually, that low reflected power will only occur at one frequency. The high-Q coils allow the VSWR to increase to about 2:1 at the band edges on 40 through 15 meters, and it is significantly higher on 10 meters.

Without radials, sharp resonance is not easi-

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

EQUIPMENT REPORTS

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ly obtained, and actual SWR values are not predictable. As previously mentioned, we mounted the *WV-1A* on a 10-foot ground pipe. As expected, VSWR was high, and the antenna would not perform well.

It if is not possible to provide an effective ground plane using either a large conductive mesh or radials, the antenna should be isolated as high above ground as possible. Wilson has an optional radial kit available that consists of heavy-gauge, twisted wire with porcelain egg insulators. Cutting instructions and mounting techniques are well described in the accompanying literature. With rooftop mounting, and a carefully designed radial counterpoise, a vertical antenna gives a good accounting of itself.

We found the adage about vertically-polarized electrical interference to be a myth at our location. Our noise is mostly horizontally polarized, and the vertical was far less susceptible to electrical interference than was our horizontal dipole.

Caveat for SWL's

The *WV-1A* is not a general-coverage antenna. Although it is capable of excellent performance (transmitting and receiving) on the 7, 14, 21, and 28-MHz amateur bands, it will not work on frequencies between those ranges. The high-Q coils present high impedance paths at frequencies far removed from the design center frequencies. Shortwave listeners will get better results from a 20-to 50-foot random length of wire on the non-amateur frequencies.

We field-tested the *WV-1A* for about two months, observing its electrical and physical reaction to wind and rain. Overall, it has held up well. Wilson offers a one-year warranty covering performance and workmanship. The *WV-1A* seems to be honestly priced, and competitive with other similar vertical trap antennas available for amateur radio applications.

The *WV-1A* sells for $59.95 and is available from Wilson Systems Inc., 4286 South Polaris Ave., Las Vegas, NV 89103. **R-E**

Non-Linear Systems Model MLB-1 Logic Probe

CIRCLE 105 ON FREE INFORMATION CARD

SERVICING MODERN ELECTRONIC PRODUCTS is much easier when you have the latest troubleshooting methods at your disposal. Most modern equipment has some digital circuitry, and in the future there will be much more of it. Because of that, there is a growing need for special test equipment designed to test digital circuitry. One such item is a logic probe that makes digital servicing a lot easier than analog circuit tracing.

The Non-Linear Systems *model MLB-1* Logic Probe is a specialized unit used in testing all types of digital circuits. It draws power from the equipment under test and will accept power supplies of up to 30 volts (maximum). The unit contains reverse-polarity protection. The input is switch-selectable and will accept DTL/TTL (5 volts V_{CC}) or CMOS/MOS (HTL at 15 volts V_{CC}) logic up to a maximum frequency of 10 MHz. Three LED indicators on the *model MLB-1* will tell at a glance the logic state of the device being tested.

In normal use the *model MLB-1* is first connected to the power supply of the unit under test with the alligator-clip-terminated leads attached to the logic probe. In most applications all that's required to check the device will be to touch the built-in probe to a pin of the gate (or other logic device) under test. The logic state at that pin will be shown on the LED's on the top of the *model MLB-1*. For instance, if a pulse appears at that particular pin, the LED marked PULSE will flash and the LED that indicates the nature of the pulse will also be lit (or will be going on and off indicating that the logic level at that point is changing from a "high" to a "low".

The *model MLB-1* can also be used to deter-

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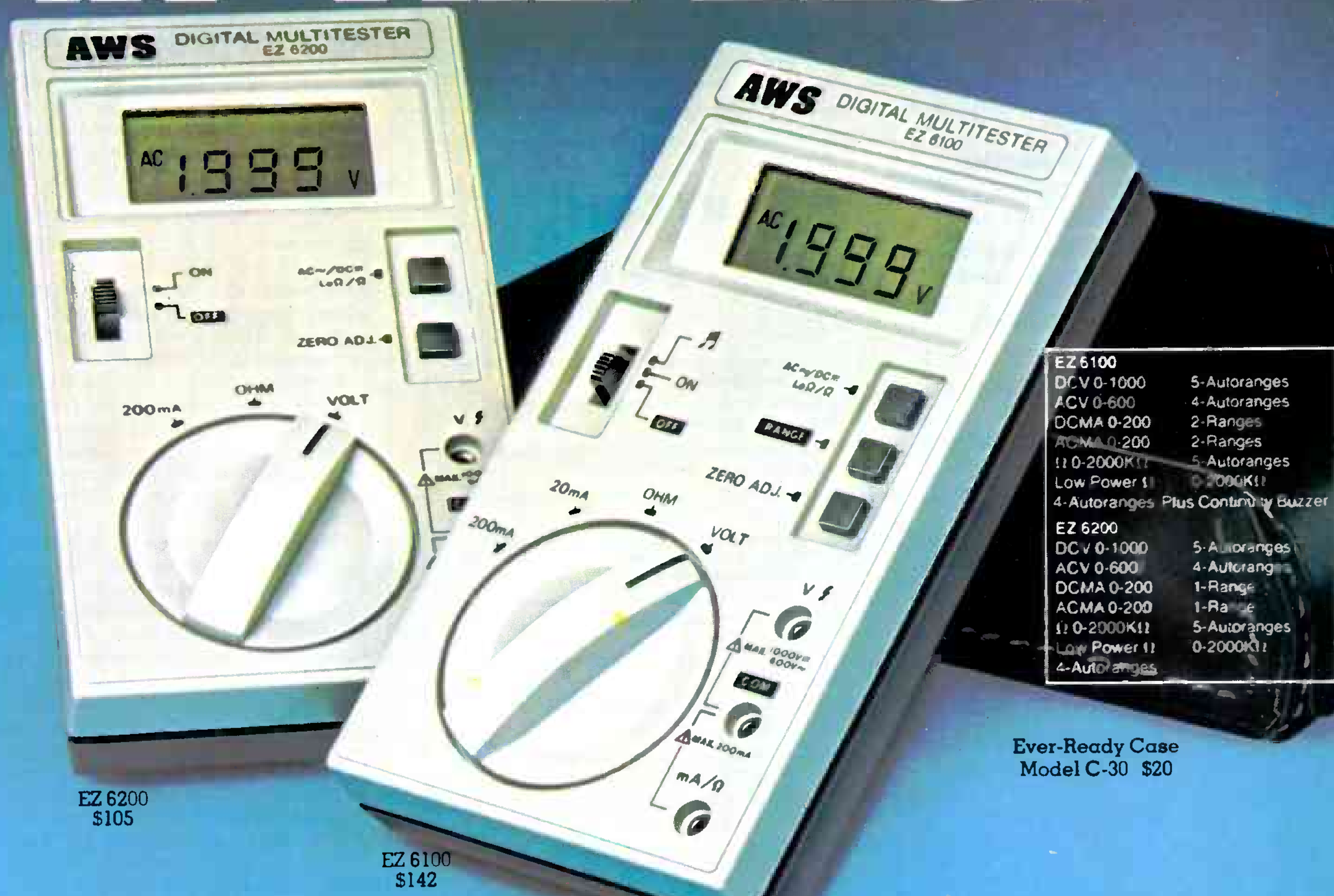
YOU'VE SEEN THE REST...

NOW LOOK AT THE BEST!



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EQUIPMENT REPORTS

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mine if a random pulse is activating some piece of equipment when it should not be doing that. When you place the memory/pulse switch on the side of the probe in the MEM position, the LED will remain on after the first pulse. That lets you connect the device to a circuit you suspect is generating a random pulse. You can do other things and need only to check the *model MLB-1* to see if indeed a random pulse was generated. The *model MLB-1* can similarly be used to see if an inactive circuit becomes active. Those examples are just a few applications for a digital logic probe.

The *model MLB-1* is very convenient to use. Its small size (1⅛ × 5¾ inches) makes it easy to hold and the 1½-inch, partially insulated, needle probe lets you reach test points on a crowded PC board. For high-frequency use, the *model MLB-1* comes with a six-inch ground lead (with an alligator clip) that may be plugged into the tip of the tester (near the probe) and connected to a ground (or common) point near the device under test.

For those of you who like to know how something is built, the *model MLB-1* tested is built on two tiny epoxy-glass PC boards. Construction is excellent and the device should withstand hard use. The instruction sheet supplied (both sides of a single sheet) contained a great deal of information although there was no schematic or servicing data.

If you often, or even occasionally, service digital equipment you owe it to yourself to check into the *model MLB-1*. The *model MLB-1* Logic Probe sells for $44.95. From Non-Linear Systems, Inc., Box N Del Mar, CA 92014. **R-E**

Drake R7 General Coverage Receiver

CIRCLE 106 ON FREE INFORMATION CARD

RECENTLY, THERE HAVE BEEN MANY NEW ENtries into the general-coverage shortwave receiver market. That is certainly good news for the hobbyist because many of those receivers reflect the sophisticated technology that was developed during the CB boom.

While the majority of those new receivers are imported, one noteable exception is the *model R7* from Drake. It features a six-digit LED readout with the sixth digit allowing frequency accuracy to the nearest tenth of a kilohertz (100 Hz). A 25-kHz crystal calibrator is also included in the *model R7*.

A variety of selectivity options are available from the manufacturer. Those include 4.0-, 1.8-, 0.5-, and 0.3-kHz filters that sell for $55 each. A 2.3-kHz filter is supplied with the receiver. All filters are 8-pole crystal devices. Image and IF rejection are at least 80 dB down.

One feature that added to the popularity of Collins Radio equipment years ago was passband tuning. That technique allowed the user to slightly vary the IF of his receiver to remove an adjacent interfering signal. The *model R7* has passband tuning and it works well. A tunable IF notch filter lets you attenuate the annoying heterodyne (whistle) from a nearby station without interfering with the desired signal.

The sensitivity of the *model R7* is 0.5 microvolts in the SSB/CW mode on shortwave, and 2.0-microvolts AM. At lower frequencies, sensitivity drops off somewhat: 1.0 microvolt-SSB/CW and 4.0-microvolts AM below 1.5 MHz. Frequency coverage is 10 kHz to 30 MHz, continuous tuning.

The sensitivity may be improved somewhat by using the built-in preamplifier. Although the preamp is capable of 10-dB gain, additional circuit noise restricts the useable gain to about 5 or 6 dB.

The *model R7* is a triple-conversion superheterodyne receiver, upconverting to its first IF at 48.05 MHz. A second IF of 5.645 MHz and a third IF of 50 kHz both help provide an ultimate selectivity of at least 100 dB.

While it is relatively simple to build a high-sensitivity receiver using modern IC's, stability is another matter. A receiver may drift off frequency as its components change temperature. Mechanical deformation of the chassis caused by bumping can also cause dramatic shifts in frequency. The *model R7* displayed neither of those shortcomings, staying right on frequency from warmup, even with the BFO turned on, and did not shift in frequency when slapped on the sides and top of its cabinet.

The RIT (*R*eceiver *I*ncremental *T*uning) feature is not of particular value when the receiver is used alone but, when used with a

continued on page 104

Video Review knows a bright idea when it sees one.

Simulated TV picture. Simulated wood cabinet.

Video Review magazine tests a lot of sophisticated video products.

They get to see virtually every make and type of color TV receiver.

Which makes their selection of Magnavox as their standard TV receiver pretty impressive.

"We thought the Magnavox picture quality and resolution were superb."

"Ever since *Video Review* began testing products," says the magazine, "we've been looking for a top quality, 19-inch TV set that might serve as a standard of reference for all of the other products we test...video cameras, video cassette recorders, video cassettes.

"We thought the Magnavox picture quality and resolution were superb, and that off-the-air sensitivity was also extremely good.

"Major VHF channels were received with uniformly accurate color fidelity. This receiver produced superior color pictures even when using its own indoor VHF and UHF antennas."

"The special tuning features and remote control capabilities of the Magnavox receiver are awesome."

"The tuning system is purely electronic and totally digital," they continue. "There is a fine tune switch and a memory lock button. If any channel is received mistuned, the user simply fine tunes up or down in frequency by holding the button, and when perfect tuning has been achieved, the button is released and the memory lock button is depressed once.

"Nearby is Magnavox's Videomatic feature. Depressing this button activates the electronic eye for automatic brightness adjustment, color adjustment circuits and automatic fine tune."

"...unusually good for any receiver."

Overall, *Video Review* rated the Magnavox 9.5 or better (out of a possible 10.0) on Video Quality, Reception Sensitivity, Color Fidelity, and Video Resolution and Fidelity. As they put it, "...unusually good for any receiver."

We can only add that once you see a Magnavox color TV at your Magnavox dealer, we think you'll agree.

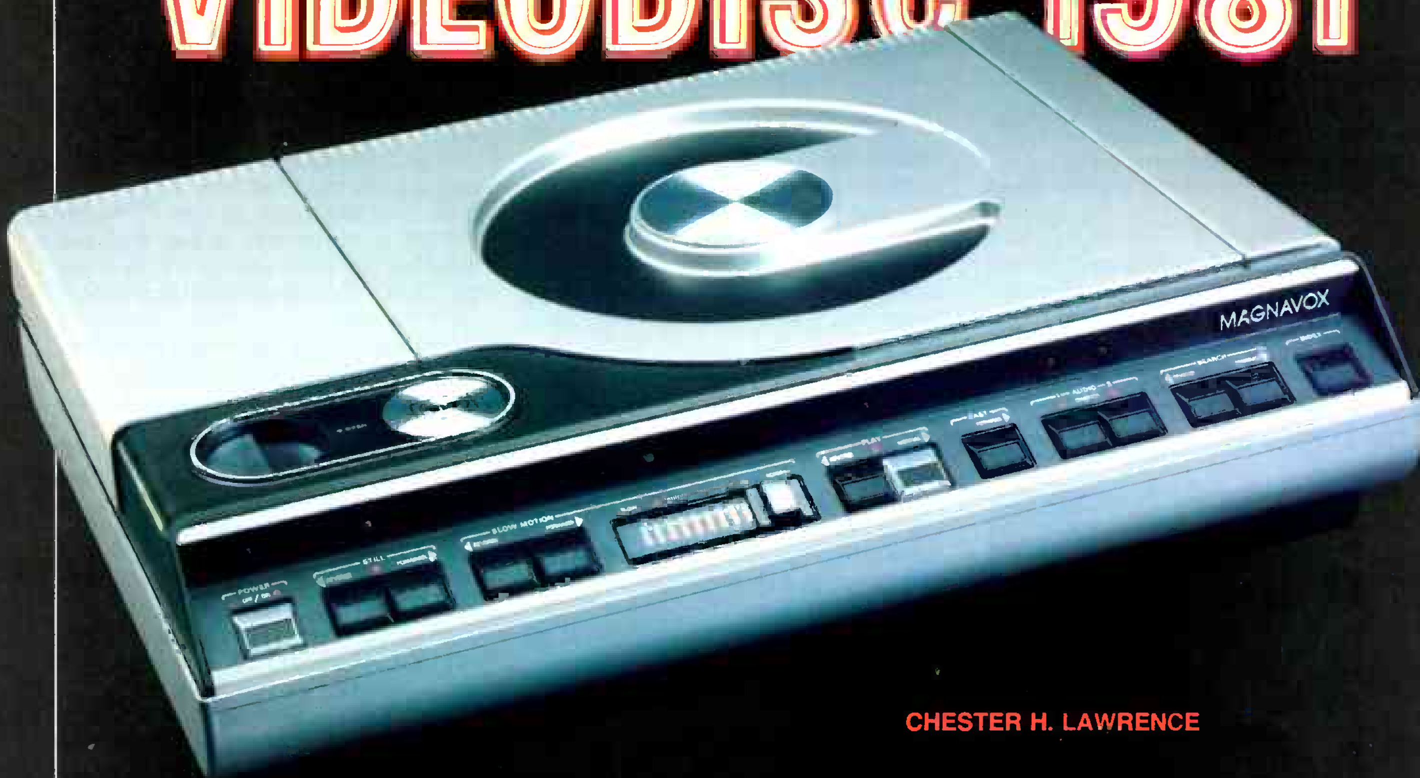
For Magnavox color TV specifications, write Magnavox Consumer Electronics Company, Dept. 700, P.O. Box 6950, Knoxville, Tennessee 37914.

MAGNAVOX

The brightest ideas in the world are here to play.

CIRCLE 61 ON FREE INFORMATION CARD

VIDEODISC 1981



CHESTER H. LAWRENCE

Three ways to go...Which path is best? There are enough facts here to help you make that decision.

AFTER A LONG WAIT AND SEVERAL FALSE STARTS IT LOOKS like 1981 will really be the year of the videodisc. Back in April 1979 **Radio-Electronics** published the first articles that showed how the Magnavox and RCA videodisc systems really worked. At that time the Magnavox system was the only videodisc that anyone could buy. Today, it's a different story. Right now, while you are reading this article, you should be able to go out and buy a Magnavox player for optical videodiscs or a Pioneer player for those same optical videodiscs or an RCA player for their capacitance videodiscs.

By the end of this year substantial quantities of all three will be readily available and software—movies, performers, cooking lessons and a lot more will be rolling off the production lines. The revolution in home entertainment has finally arrived. Along with it arrives a mass of confusions and questions. I've tackled those in this article.

Who's confused—and why? You, the customer. There are, right now, two non-compatible systems that you can buy and a third one on the way from JVC. It's your money, and you have to decide which of these three systems is the one that's right for you. Yet none of them is compatible with any other.

MAGNAVOX OPTICAL VIDEODISC

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

IT'S TWO YEARS OLD NOW. This player was first introduced to the public in Atlanta, Georgia on December 15, 1978. On that same day the handful of available equipment sold out. Today, improved versions of the player are available along with a wide range of records (videodiscs) to play on the machine. The current price is under $700 and reasonable numbers of these players are available now.

The disc itself looks very much like a conventional long-playing phonograph record. It's different in that it delivers video and audio signals to a standard color TV set. Since only a beam of light from a low-power solid-state laser touches the disc, it can be played again and again without wear or deterioration. A single side of one disc can deliver up to 1 hour of viewing, in color, with stereo sound. Others play for only 30 minutes on a side, but can be played frame by frame for still presentations or stop action.

The disc itself rotates at 1800 RPM and each frame (1 or 2 to a rotation) is individually coded with normally invisible index numbers and can be selected quickly when used in players that have a random-access feature.

Right now both Magnavox and Pioneer offer optical videodiscs for sale in the US. At the winter CES Show in Las Vegas Gold Star and Kenwood both announced and demonstrated optical videodisc players.

I've had the opportunity to actually spend a lot of time with both Magnavox and Pioneer videodisc players. I can assure you that they work, work well, and are easy to use. They do deliver pictures and sound that are superior to what you currently view on "live" TV broadcasts and videotape players.

I've also found that right now (end of January 1981) discs for this system

RCA CAPACITANCE VIDEODISC

RCA VIDEODISC PLAYER. Disc is inserted, in its case, into the player. Your hand never touches it.

JUST APPEARING ON THE MARKET is the RCA videodisc player. They have dubbed it a CED (*Capacitance Electronic Disc*) system. RCA tells me that this system was selected for development after carefully researching alternative approaches. It is less expensive than the optical videodisc players at its announced, under $500, price.

The CED system which will also be offered by Zenith in about six months, followed by Hitachi, Radio-Shack, Sony and others, uses plastic discs with spiral grooves. A pickup stylus rides the disc grooves, thus reducing the complexity of the mechanics that control stylus movement. Features such as Visual Search and Rapid Access, both in the forward and reverse directions are available on all RCA CED discs and players. High-quality picture performance, up to two hours of playing time (one hour per side) are system features.

I have not yet had the opportunity to test, in my home, the RCA player. My only personal contact with it to date has been at press conferences and the Winter Consumer Electronics Show, this past January. What I have seen indicates the capability of delivering a better than broadcast-quality picture. However, the players demonstrated at the CES show all evidenced a background hash in the picture. It was not visible at normal viewing distances, but when you got up close to the screen it was there.

Remember, these may not have been production units and a show atmosphere can create interference conditions that would not occur in your home. When I have had the opportunity to check out the player in an at home environment, I'll present a more complete report.

JVC CAPACITANCE VIDEODISC

JVC-TYPE PLAYER MADE BY Panasonic is not yet available to the consumer.

NOT YET ON THE MARKET, the JVC VHD system offers a capacitance-type videodisc that does not have a groove. So far, in addition to JVC, General Electric, Matsushita Electric (Panasonic), Thorn EMI, Sansui, Hitachi and others have said that they also will produce the unit.

The player reproduces full-color video programs with two-channel stereo sound. The player rotates the disc at 900 RPM and is capable of visual forward and reverse slow motion, forward and reverse fast motion, search or stop-action mode. Like the RCA unit it offers front loading and your hands never touch the disc.

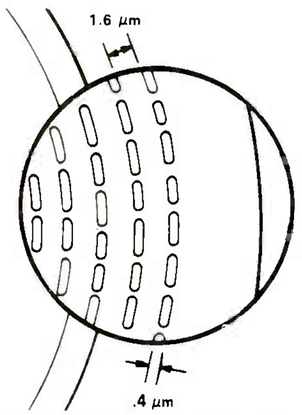
VHD stands for *Video High Density*, and it offers two optical features the others systems do not. The first is a random access capability that will permit the viewer to program more than 10 separate segments for playback, in order, and at the particular speed selected for each segment. The second is a digital audio processor that when added to the basic player provides 4-channel PCM (*Pulse Code Modulated*) stereo sound for audio enthusiasts.

While the VHD system uses a capacitance playback system, there is no groove to guide the stylus around the disc. Instead the diamond stylus follows invisible spiral tracks consisting of micro-pits in which both pilot and main signals are recorded and used.

The playback stylus has an electrode that detects capacitance variations between the disc and the stylus.

The VHD disc is slightly smaller than that used by the other systems. It is only 10 inches in diameter and provides the same 2-hour maximum playing time.

Disc and stylus are both subject to wear. As a result they do have to be replaced periodically. However the wear is much less than that of the



MICRO PITS IN THE SURFACE of the videodisc carry the encoded video and audio information.

are still relatively hard to come by. However, that problem seems to be easing. In fact I just received the first in a new series of "Interactive Videodiscs." The one I have lets you watch a football game and simultaneously listen to the respective team coaches comment on the action. At the end is an interactive quiz for the viewer.

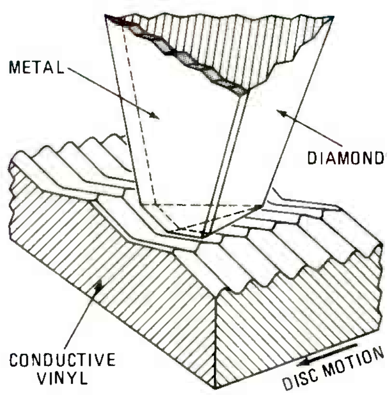
The disc is never turning when the player lid is open. At 1800 rpm, a rotating disc could become a dangerous device indeed.

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 sound carrier has a maximum deviation of 100 kHz. The bandpass of the video carrier extends from below 4 MHz to above 12 MHz so that all necessary sidebands can be included.

Advantages of the optical videodisc include no disc wear after repeated playings, no stylus wear; the disc is difficult to damage and is easy to clean. Slow motion, stop motion and random access are easy to provide. The unit delivers stereo sound.

Disadvantages are a complicated servo system required to enable the laser to track the signal path on the disc and therefore a more expensive player.

I like the optical system because of the "no wear" feature. It means that once I buy a videodisc to play it can be used "forever," assuming I don't physically break the disc. I also like the random-access feature. Theoretically someone could offer a disc that contained more than 60,000 individual pictures on it (30,000 to a side). I could pick the ones I wanted to see and then view them, one at a time, in any order for as long as I wanted to. **R-E**



CAPACITANCE PICKUP RIDES the groove in the RCA videodisc system.

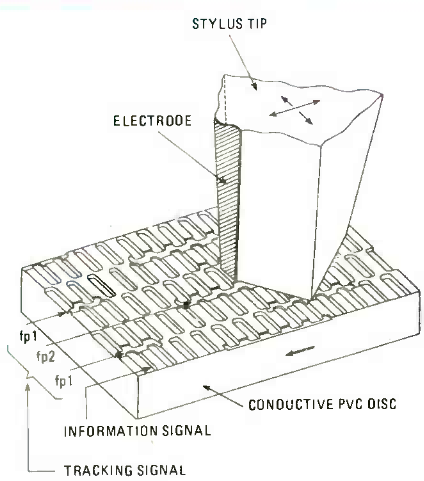
The player is simple to operate. The videodisc is stored in a protective plastic sleeve or "caddy." The caddy and disc are inserted into the player. The caddy insures that the disc is always correctly loaded as well as protected when the disc is not being played. When the caddy is removed the disc remains in the player.

The RCA CED videodisc can store two hours of recorded picture and stereo sound on a disc. A spiral "V" shaped groove guides the diamond pickup stylus as the disc rotates at 450 RPM. The tip of a thin metallic electrode on the flat trailing-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.

Advantages of the CED system include low cost for both the player and the disc (the disc is much simpler to make than the optical videodisc). The player is extremely easy to use and relatively uncomplicated.

On the negative side, there is disc wear. Discs do wear out. The stylus does have to be replaced periodically. The player now being sold does not deliver stereo sound. Stop-motion and random access are not currently available. However, if you are going to use your player for watching motion pictures and to see your favorite singers, the lower cost can outweigh these other factors.

I have personal reservations about the CED system. When it becomes available delivering stereo sound, stop motion, and random access, I will re-evaluate my current impressions, because the newer players (today still on the drawing board), may be completely different from those now on sale. **R-E**



THERE'S NO GROOVE in the JVC VHD videodisc. It too is a capacitive type disc.

RCA system. JVC's claim is 2000 hours.

Demonstrations of these players at the Consumer Electronics Show this last January were very impressive. Video quality was excellent and all the optional features worked. The equipment is not yet available, although you may be seeing early models before the end of this year.

The video signal carrier is at 6.6 MHz and has a 1.8-MHz frequency deviation. Luminance bandwidth is 3.1 MHz. Both audio channels have a 20-kHz bandwidth with a 60 dB signal-to-noise ratio.

As a combination video-audio player, the VHD system appears to hold great promise. If it were available today with all its options, I would probably like it better than either the optical videodisc or the CED system. Unfortunately, it is not available today. Further, pricing for the complete system is not known. Therefore, I would not recommend waiting for the VHD players to appear before deciding on a videodisc system for your home.

Again, I must stress that I have not yet had the personal use of this system. My comments might favor this system even more after I do use it, or I might find it less desirable.

In the interim I must conclude that all three systems deliver great TV pictures...probably the best ones you have ever seen on the screen of any home TV set. Audio quality is also first rate. One thing is certain, Videodisc today is ready for the home. It is here, it is viable, and I for one will be buying a system for my home in the next month or two.

One last note. A videodisc system, no matter how good, is no good at all if you can't buy anything to play on it. Whichever way you decide, do make sure that software is available. Otherwise you could end up with an expensive electronic paperweight. **R-E**

RCA SelectaVision Videodisc

FOR THE VERY FIRST TIME WE WERE able to get our hands on a "CONFIDENTIAL" copy of the technical manual for the RCA STF100 VideoDisc Player. It is very complete and comprehensive. As a result, this article, describing all of the important technical features and operation of the RCA CED-type players, became possible.

Figure 1, a block diagram, gives you a complete overview of all of the operating circuitry of the player. Most of these elements clearly divide into two basic categories—system control and signal processing circuits. The system control electronics are supervised by an on-board microprocessor. It receives inputs from user controls and uses that information to oversee player operation.

This microprocessor is also responsible for decoding the Digital Auxiliary Information (DAXI) code supplied by the videodisc that permits the player to determine time indications. Most of the system control electronics are mounted on a single circuit board that is physically positioned above the disc player's turntable, hidden inside the case.

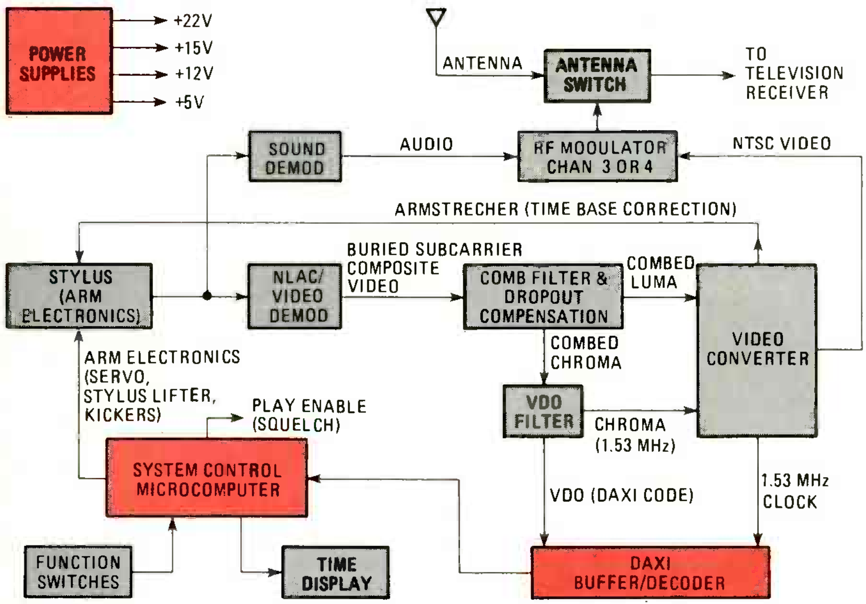


FIG. 1—BLOCK DIAGRAM OF THE VIDEODISC player. This diagram shows all of the elements that retrieve the signal from the disc.

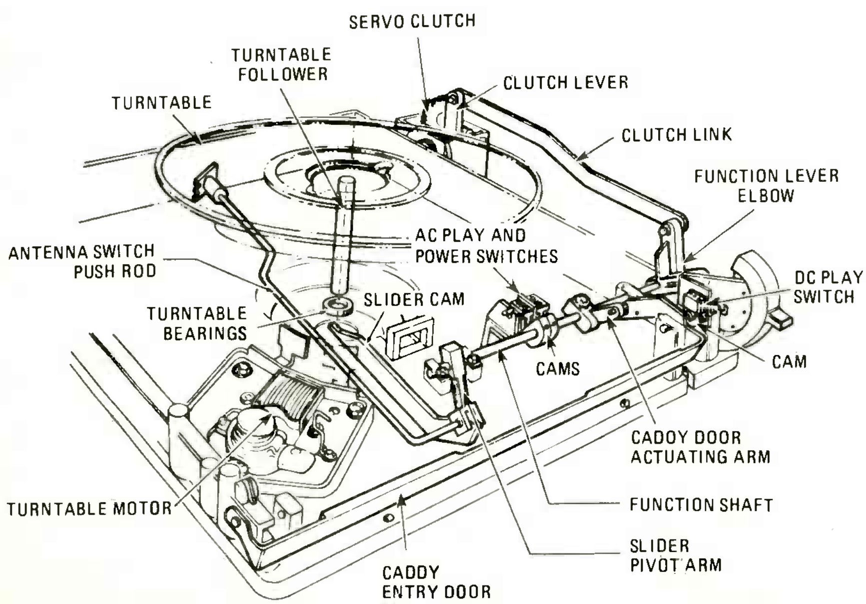


FIG. 2—THIS DRAWING SHOWS HOW THE FUNCTION SWITCH controls the player's operations.

The signal-processing circuits together with some processing circuits located in the arm assembly, detect the video information on the disc, demodulate this information, process it through a comb filter and then use it to modulate the output of a Channel 3 or 4 modulator. This signal is then coupled to a standard color TV receiver.

Six integrated circuits do the job. They comprise almost the entire signal processing circuitry.

Mechanical operation

When the machine is put into use the operator uses the FUNCTION lever, a front-panel switch. This is actually the visible portion of a mechanical linkage connected through cams to operate four switches and to raise the turntable to the play position. You can see the details of this arrangement in Fig. 2.

The switches are the AC POWER switch, the AC PLAY switch, the DC PLAY switch and the ANTENNA switch.

When the FUNCTION switch is moved to the LOAD position, the mechanical system lowers the turntable to allow the caddy housing the videodisc to be inserted into the player. When the lever is placed into the PLAY position, after the disc caddy has been removed from the player, the turntable is raised to support and rotate the videodisc.

The FUNCTION lever also controls, as mentioned a moment ago, the ANTENNA switch. When the player is in its OFF mode, the antenna switch connects the external antenna to the TV set through the disc player's RF output jack. In the PLAY and LOAD positions the ANTENNA switch is activated by the linkage to disconnect the external antenna and to connect the output from the internal RF modulator to the RF output jack.

As you can see in Fig. 2, the FUNCTION lever is connected to a tapered slider cam that is mounted directly under the center of the turntable. The turntable center shaft, or follower, rests on this slider cam. In the PLAY mode, the slider cam raises the turntable until it contacts the disc that has been inserted into the player.

Videodisc signal retrieval

As you probably already know, the RCA player uses the CED, capacitive pick-up system. In this system FM modulated carrier signals are stored on a conductive plastic disc by varying the depth of the grooves. The FM TV signal is retrieved by detecting changing capacitance between a metallized electrode on the stylus and the conductive disc. Figure 3 is an enlarged diagram showing this process.

The varying capacitance that results is then coupled to a 910-MHz tuned line in the resonator assembly that is driven by a 915-MHz oscillator. The changing capacitance from the stylus modulates the resonant frequency of the 910-MHz tuned line, thus changing the operating point of the 915-MHz oscillator energy on the tuned line. This in turn amplitude modulates the 915-MHz oscillator signal (see Fig. 4). The modulated 915-MHz signal is then applied to a peak detector circuit.

The signal recovered by peak-detecting the oscillator signal is an electrical replication of the information in the grooves of the videodisc.

Stylus operation

The diamond stylus recovers the signal from the disc. This stylus has a thin metalization on the trailing edge. This metalization is typically 2500 angstroms thick (.0000098 inches). The typical depth of the modulation on the video disc is approximately 850 angstroms (.0000033 inches) (see Fig. 5).

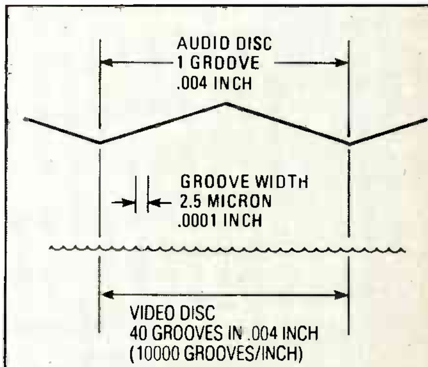
As the videodisc groove passes by the metalization on the diamond stylus, the effective capacitance between the metalized electrode on the stylus and the disc varies at the same rate as the distance between the tip of the electrode and the disc surface. Therefore, a signal recorded on the videodisc, a 5-MHz sinewave for instance, causes the capacitance between the electrode and the disc to vary at a 5-MHz rate.

Note that the diamond stylus is used only as a holding mechanism for the metalized electrode on the back of the stylus. The stylus itself does not pick up the video signal from the disc. Nor is it absolutely necessary for the stylus tip to be in mechanical contact with the disc. Signal is retrieved even if the stylus leaves the disc surface momentarily.

The stylus electrode and its flylead (conductive shank) are connected to one end of a tuned line in the resonator cavity. This tuned line is connected through a small capacitance to the cathode of a varactor diode that controls the frequency of the 915-MHz oscillator.

The resonant frequency of the stylus flylead tuned line is controlled by an AFT voltage that is coupled back from the PW 900 preamplifier circuit. The DC voltage from the AFT circuit is applied to the cathode of the varactor diode thus changing the tuned line center frequency. This ensures that the 915-MHz oscillator is always operating at the midpoint of the trailing slope of the 910-MHz tuned line. As a result, the amplitude modulation of the 915-MHz oscillator will be linear in both positive and negative directions. This prevents the tuned line center frequency from shifting due to changes in stray capacitance at the stylus, thus causing a nonlinear amplitude modulated signal at the output of the detector.

Now that you have a general picture of the RCA disc player we'll give you till next month to digest this information. Then we will continue with a circuit by circuit description of the player. **R-E**



DETAILS OF GROOVE DENSITY of the RCA videodisc are shown here.

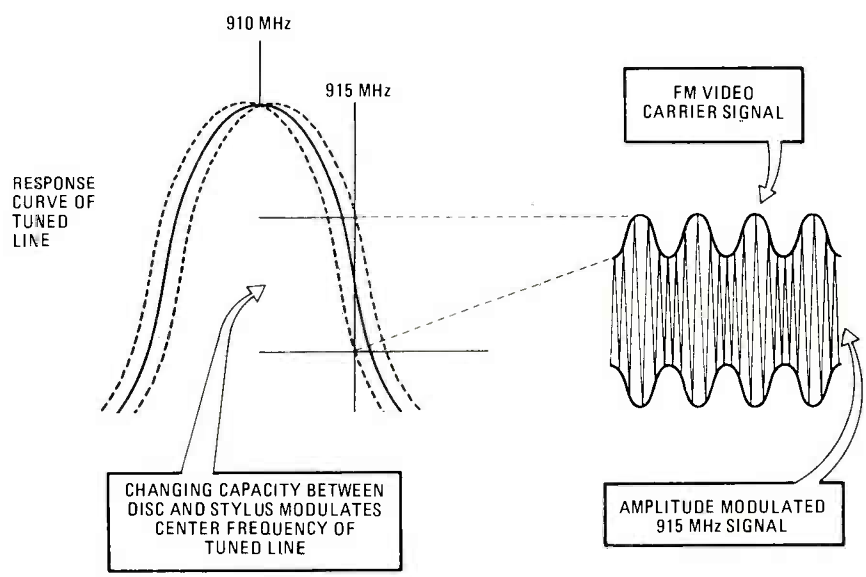


FIG. 4—VIDEO SIGNAL IS RETRIEVED FROM THE DISC by modulating a 915-MHz oscillator.

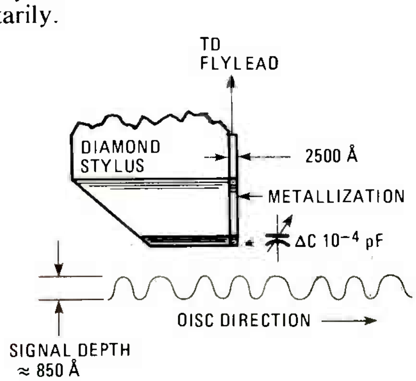


FIG. 3—STYLUS PICKUP OPERATION is detailed in the enlarged view.

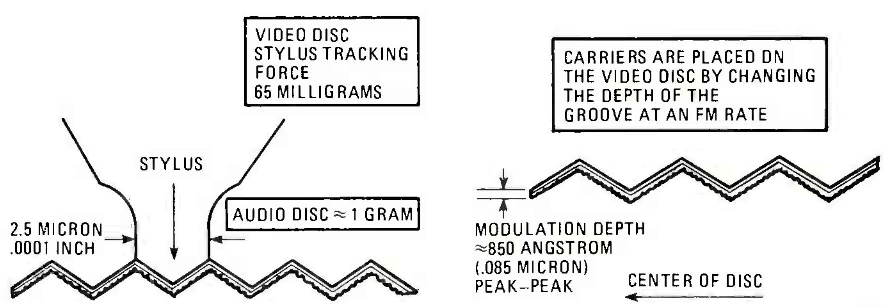


FIG. 5—DEPTH OF MODULATION on the videodisc (RCA's CED version) is approximately .0000033 inch. The stylus (right) rides the groove with a mere .065 grams of force tracking.

Computer-to-Se

E. G. BROONER

THE IBM *SELECTRIC* TYPEWRITER/TERMINAL, with its famous "bouncing ball" typing element, is perhaps one of the best and most successful printing devices ever made. There are many versions and imitations of the *Selectric*, most including someone else's electronics built around the IBM mechanism, and all have achieved a good reputation. As used *Selectric* terminals come on the market, advertised as microcomputer printers, there is naturally a lively interest in them.

Many articles have been written about the conversion of these terminals to ASCII and their use with small computers. Most of those articles deal with mating one particular model of *Selectric* to one particular type of computer. This one will describe the conversion of what is advertised as the "Datel" *Selectric*—but it will also deal with generalities that should help the experimenter in working with various other versions available on the surplus market.

First, a word of warning: The conversions are not easy. They should not be attempted by anyone who is not a "tinkerer" (or by anyone who can afford a daisy wheel printer). The main reasons for taking on a project like this are the relatively low cost, and the fun of doing it. At best, the result is a slow (but otherwise nice) typewriter-quality printer. At worst, you may run into difficulties and need help from the local IBM service rep, at something like $60 per service call. But when the project is successfully completed, you will have a printer whose output is every bit as nice as that of a daisy wheel printer, at a small fraction of the cost.

Coding

All, or nearly all, of those surplus machines use some code other than ASCII. IBM has implemented as many as three different codes over the years. That is one of the first stumbling blocks in purchasing a used terminal—the buyer usually worries about which code is used, and how to translate it to ASCII. However, it really does not matter which code was used, as translation is not necessary if the printer is used only with your own computer. You can make up your own, and the way to do that will be explained later.

Characters

The *Selectric* handles two kinds of characters, printable and control. The control characters each operate from a single solenoid and therefore use only one bit of the data word. The control characters are: LINE FEED (called INDEX by IBM), CARRIAGE RETURN, SPACE, BACK-SPACE, TAB and SHIFT. The correct bit for each can be determined easily by experiment. In a *Selectric* printer there will normally be about a dozen control lines going to the solenoids; we are concerned with six control lines plus those needed for printable characters. A logic "low" is usually required to operate the solenoid driver. That can be confirmed by a voltmeter or logic probe and handled accordingly, depending on whether a "high" or "low" is used by your particular machine.

Data Lines

Considering that eight data lines are used for all operations, the control functions can be coded by placing each function on one data line. For example, if you want bit-seven to be a carriage return, the binary code for that operation is 10000000 (80 hex or 128 decimal). The other control bits can be similarly assigned. Note that there are more control and print signals than there are bits in the data word. Some multiplexing will have to be done.

Print Functions

Printable characters are a little more difficult to generate than control characters, but not much. Lower-case characters are all selected by six control lines. Those are described as TILT 1, TILT 2, ROTATE, ROTATE 2, ROTATE 2A, and ROTATE 5. As the names imply, those signals tilt and rotate the ball until the correct character is in the print position. The four "rows" on the ball are selected by various combinations of the tilt signals, and the "columns" are accessed by combinations of rotate signals. Figure 1 shows a "map" of a typical typing ball, which may be thought of as a 4 × 11 matrix.

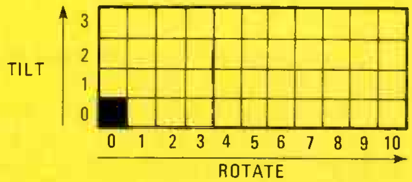


FIG. 1—TILT AND ROTATE positions for IBM *Selectric* "golf ball." Use a chart like this to record functions and characters for your machine.

The lower left corner of that "map" may be thought of as a "home" position. If the striking mechanism is operated at this position, that particular character will print. If, however, a TILT 1 and ROTATE ONE signal are applied at the same time, the printed character will be that located at 1,1 on Fig. 1. Any of the 44 positions can be addressed by some combination of tilt and rotate signals.

Now for upper case: A shift signal turns the ball 180 degrees, and on the "back" side of the ball, the upper-case characters equivalent to those of the "front," are found in the corresponding position. Shift and tilt/rotate signals use a total of seven bits. The one remaining operates the cycle clutch. That last bit controls the actual printing, by causing the ball to strike the paper.

Ball deciphering

The question now arises: How can we tell which line is ROTATE 2, for example, and which activates some other function? One method would be to place a signal on each line and see what it does. A simpler approach is just to transmit a number to the machine and see what character results. (That will be covered in more detail after we consider the interfacing techniques that can be used.) For now, just accept the fact that translation between ASCII and your printer is not going to be any problem. Be assured, also, that the same data bits can be used for both printable and control characters, as you will only be transmitting a single kind of character at any one time. The cycle clutch line is the key to that "multiplexing." It

lectric Interface

Part 1—Need a letter-quality printer for your computer? Here's a way to use an IBM Selectric printer mechanism without having to worry about ASCII conversion.

operates only for letters, and is inoperative for control functions. Its signal tells the machine how the bits are to be interpreted.

Hardware

Now we can consider, briefly, the actual hardware interface. The surplus printer will have had some kind of interface in its previous life. That may still be present, in modified or unmodified form. It may or may not work, and there may or may not be documentation for it. It will probably be better to just rip it out and build your own.

As an example, we once obtained some machines that had been part of a time-sharing network. The interfaces were supposed to work, but didn't last long, and the documentation was no help. Those particular models used nearly 100 IC's to convert data from serial to parallel form, and to control the solenoid lines. We eventually used the machines as parallel devices, with a four-IC interface of our own design. They could easily have been made to operate as serial by the addition of a UART and a few more support IC's.

Typefaces

Some IBM type-balls contain the corner brackets used in BASIC programs to indicate "greater-than" and "less-than." They also have the caret, or up-arrow, used to indicate exponentiation, and the backslash that is so useful in CBASIC. It is, therefore, a good idea to order that sort of ball from IBM if the printer is to be used for listing programs. If it is to be used only for word processing, you may want some other special type font. That point is mentioned because the used machines sometimes come equipped with a ball that is worn or otherwise unsuitable, and may have to be replaced anyway. (IBM will need to know the type and model number of the *Selectric* mechanism your printer contains.)

The conversion

With the printer at hand, and working properly from the keyboard, it's time for conversion for use with your computer. It should be noted that it has to be in top mechanical shape for computer use. A sticky carriage return, or tab key, can be tolerated in manual use, since you can always hit the key a second time. The computer, though, will just go on whether or not it worked the first time. Some of the mechanical problems we encountered, strangely enough, were the result of over-zealous lubrication by whoever "refurbished" our machines before putting them on the market! Removing a thick layer of "axle grease," and replacing it with just a touch of *WD-40*, took care of most problems.

An inspection—and adjustment, if necessary—is money well spent at this point, especially if you don't fancy yourself a typewriter mechanic. IBM service reps are happy to work on anything IBM ever made if it has not been mutilated or severely modified, and to say that they are perfectionists is an understatement.

The first step in the conversion is the identification of the wiring associated with the solenoid operation, and with the keys, if they were wired. If the machine was used for both send and receive, the keys will have been configured to close switches. In the Datels (and presumably in any typewriter intended for I/O) there is a fairly large cable harness going from front to rear (see Fig. 2). There is also a small PC board "up front," containing the transistors that operate the solenoids. That rather bulky cable carries all the incoming and outgoing TTL-level send/receive pulses, and also the power for the transistors and the solenoids.

In the models we converted, the cable terminates in a large plug and

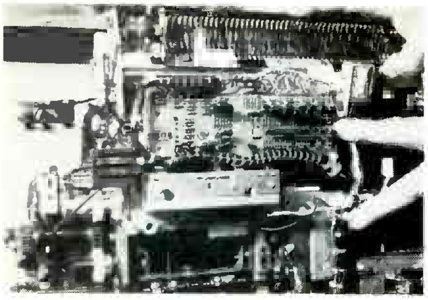


FIG. 2—BOTTOM VIEW of *Selectric* mechanism showing solenoid-driver board. Note thick cable assembly running from board.

socket near the rear of the machine. Disconnecting the cable at this point separates the mechanical from the electrical functions and makes troubleshooting a lot easier when it is required.

Try to have documentation, if any is available, as it simplifies identifying the cable wiring. If none is available, the wires carrying power can be identified with a meter. If the machine was used for input, as well as for output, the keys will operate switches. Each key will close one or more contacts, briefly, each time it is struck. The pulses generated are too short to show on a meter, but can be "caught" by a logic probe.

While repeatedly striking a key, (for example, lower-case "a"), use a logic probe to find which tilt and rotate outputs are being keyed. Continue that process for every lower-case character. Keep notes!

The control-character lines are even easier to identify. Placing a "low" (in some models it may be a high) on the correct line will cause the function to take place. You simply activate one line at a time and note which ones operate which function. In this context, the SHIFT function can be considered a control character. Its operation will cause the ball to rotate 180 degrees. SPACE will advance the mechanism one space, and so on. The only line with a "repeat" function is the cycle clutch. It can be identified by the method just discussed and will respond with a rapid *series* of responses when the line is activated. For each response, the ball will be driven against the platen and will print whatever character is located at the ball's "home" position.

The interface hardware

At this point let's discuss the hardware interface. Although it is theoretically possible to perform the entire transformation by means of either hardware or software, we chose to use a combination of the two. Operating the solenoids is the only function this interface has to perform; the translation from ASCII is done by software. The other critical part of the printing process, time-delay generation, is also much easier to do in software than it would be in hardware. That latter fact accounts for the relative simplicity of the hardware part of the conversion.

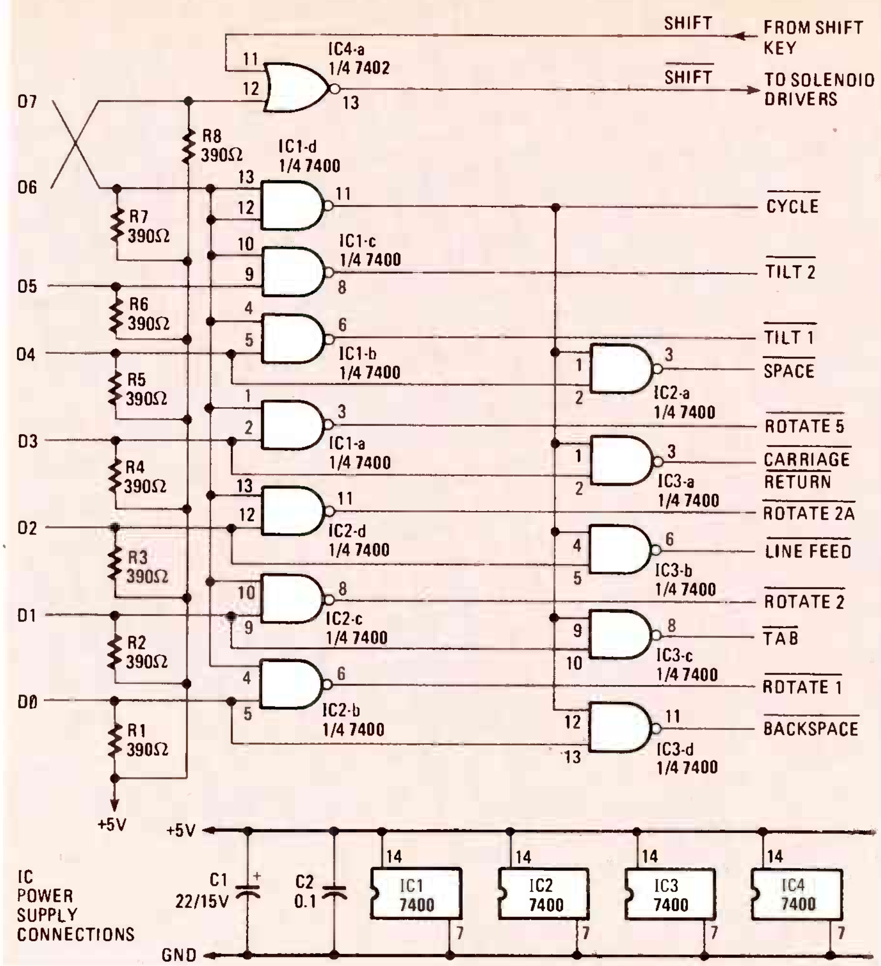


FIG. 3—FUNCTIONS PERFORMED by each IC section are clearly indicated. Bar over function description represents a logic-"low" output.

The hardware interface is easily constructed on perforated construction board using wire-wrap techniques and consists of 12 2-input NAND gates, (in this case, three type-7400 TTL IC's) and a single NOR gate, one section of a 7402. The operational theory will be described briefly, making reference to the schematic diagram shown in Fig. 3.

The NOR gate is used only for shifting between upper and lower case. In the unmodified unit, the shift is electrical, even when operated from the keyboard. In the conversion, therefore, provision must be made to operate the shift magnet from either the keyboard switch or the computer—hence the two-input gate, in which a "low" at either input will place a "low" on the magnet driver.

The NAND gates all operate with one input for signal and one for an enable pulse. A bank of five gates, all enabled at the same time, control the non-printing (control) characters, such as SPACE and CARRIAGE RETURN. The remaining seven gates are also all enabled at the same time; the schematic shows that either the seven printable-character gates or the five non-printing-character gates are enabled at any one time, but never both sets at the same time. Thus, we can use each data line, if necessary, for two different purposes. Data line Ø, (zero), for example, is connected to both the ROTATE-1 gate and the BACKSTAGE gate. Which of those recognized by the printer is determined by the output of the CYCLE-CLUTCH gate. If the cycle-clutch signal is present, meaning that a printable character is intended, then the gate's output is "low." A "low" at that point engages the clutch and disables all the gates for non-printing characters, (control functions). The same philosophy holds true for each control function or print-enabling signal on the data bus. If printing is intended, the CYCLE-CLUTCH signal will be present and if a control function is to be executed, the gates for TILT and ROTATE are disabled and the gates for control characters are enabled. The only remaining feature of the print cycle, still to be established, is the timing, and this will be accomplished by the software to be described in Part 2 of this article.

The power supply

Another part of the conversion is the modification of the power supply. In

PARTS LIST—INTERFACE BOARD

Resistors, ¼ watt, 5%
R1-R8—390 ohms
Capacitors
C1—22 μF, 15 volts, electrolytic
C2—0.1 μF, ceramic disc
Semiconductors
IC1-IC3—7400 quad 2-input NAND gate
IC4-7402 quad 2-input NOR gate
Miscellaneous: perforated construction board, four 14-pin wire-wrap IC sockets, wire-wrap materials.

PARTS LIST—POWER SUPPLY

Capacitors
C3—2200 μF, 25 volts, electrolytic
C4—0.1 μF, ceramic disc
Semiconductors
IC5—7805 five-volt regulator
D1-D4—1N4001
T1—6.3 volts, 600 mA or greater
Miscellaneous: perforated construction board, wire, mounting hardware.

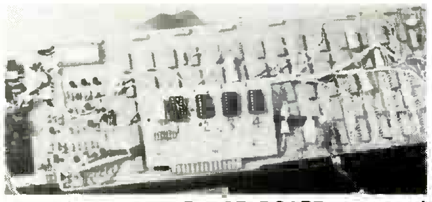


FIG. 4—NEW INTERFACE BOARD compared with old. Capacitor C2 is mounted on wiring-side of board.

our printer, there was a five-volt supply that powered nearly 100 TTL IC's—see Fig. 4. Removing that load, and replacing it with only four IC's, resulted in a tendency for that supply to output a higher voltage than was required. There are several solutions to that kind of

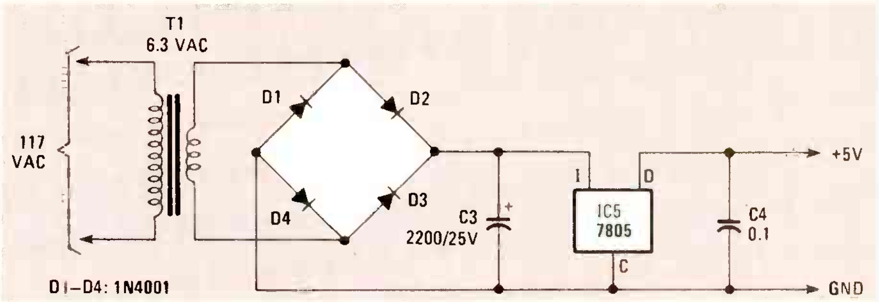


FIG. 5—THIS POWER SUPPLY can easily meet the demands of the new interface board.

problem—keeping the old load or dividing the output with heavy resistors are two possibilities. We chose the latter.

It might be just as easy to install a new, small, transformer for the five-volt supply. A six-volt filament transformer, bridge rectifier, capacitor and three-terminal regulator (7805) would provide a cheap but adequate supply for the four IC's. A schematic for such a supply is shown in Fig. 5. In the models we converted, the five-volts also drove some small transistors that were part of the magnet-driven arrangement. The current drain for that is negligible.

Troubleshooting the hardware

When you are reasonably sure that the hardware conversion is complete, and that the typewriter is in working order, some tests can be made. By placing a signal on each data line, one at a time, the control functions can be tested; you can also verify that each line will activate one TILT or ROTATE operation *if the cycle clutch is activated at the same time*. Unless you are using a method that allows you to control the pulse timing, the functions may repeat. That is normal.

If the cycle clutch is energized by itself the machine should repeatedly print the "home" character—in most cases a "minus" sign. If the cycle clutch, plus one or more TILT/ROTATE lines are pulsed, a different printable character should be generated. Following the schematic, and the map of the ball, it can be determined whether or not the interface is working properly.

If the right combinations do not produce the right results, look for trouble in your interface wiring first of all. Then check the magnet-driver board (or its equivalent in a different model typewriter) and, finally, make sure that no solenoids are sticking open or closed for mechanical reasons.

At this time you might also wish to try transmitting one or more characters from the computer, by means of the OUT instruction. Using OUT without time delays, will cause each character to repeat until the next one is sent. At this point it is probably better to just get on with the software, which will be presented in both 8080 machine code and a TRS-80 BASIC program in Part 2. **R-E**

What's News

Electronic credit card makes debut in France

Ten banks in three French cities are testing use of a "smart card" in banking. That type of card, which has already been used experimentally by the Italian telephone system, is an electronic credit card with its own memory — a microprocessor IC — built in.

When the card is put into a payment machine or terminal and a personal code entered, the memory identifies the bearer, indicates the current money value of the card, and automatically dates and records the transaction that has taken place.

In the three-city trial, the French banks are using smart cards instead of cash. The cardholder deposits a sum into an account, from which he can then draw with the help of his card. It is expected that in the near future, he can pay bills, receive cash, or obtain his bank statement or other information, simply by inserting his card in a terminal. Such information will be displayed on a home terminal by inserting the card in an add-on card reader.

INSERTING THE SMART CARD in the reader to the right of the display terminal shows the cardholder his bank balance. It also supplies any other information for which the system may be programmed, or may transfer funds according to his instructions.

1-IC PROGRAMMABLE

Need to control music or sound effects from software without overtaxing your computer? Here are two new IC's that make it possible.

BONAVENTURA ANTONY PATURZO

REALISM IS ONE OF THE MAIN ATTRACTIONS of the microprocessor-based games (handheld and video) that have become so popular in recent years. That realism is enhanced by the ingenious sound effects that are an important part of most of those games.

Hobbyists and experimenters also want realism in their projects, but duplicating those sound effects is not that easy. A microprocessor can create sounds with just a speaker, but considering the processor time required to sustain even a single note, it would be incapable of doing much else.

General Instruments has developed two LSI circuits that have solved that problem. The AY-3-8910 and AY-3-8912 PSG's (*P*rogrammable *S*ound *G*enerator) are designed to work with a microprocessor/microcomputer to produce complex sounds under software control. The AY-3-8910 has two 8-bit parallel ports and comes in a 40-lead DIP package. The AY-3-8912 has one port and 28 leads.

The PSG's have a wide range of applications. Those devices can create a simple noise such as a gunshot or explosion for use with an electronic game, or they can create complex musical notes and chords for use with even high-end electronic instruments. You

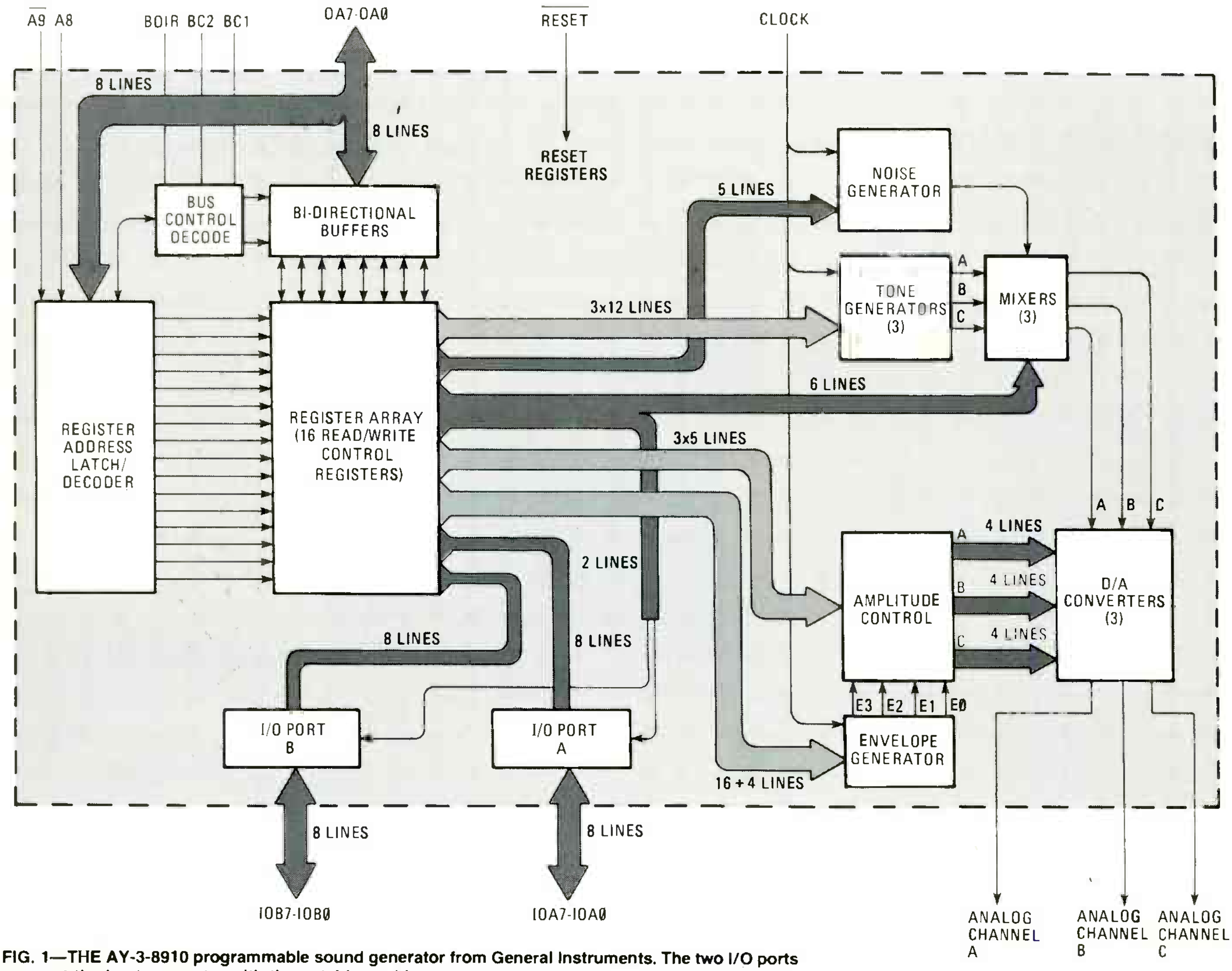


FIG. 1—THE AY-3-8910 programmable sound generator from General Instruments. The two I/O ports connect the host computer with the outside world.

SOUND GENERATOR

may even want to use one of the PSG's to generate sound effects for the Unicorn-1 robot. (*Note: If you come up with a sound effects circuit for the Unicorn-1, send it to us at: Editorial Department,* ***Radio-Electronics,*** *200 Park Ave. S., New York, NY 10003. We'll pass the better ones along to our readers*—Editor.)

To generate sounds, the host processor gives the PSG instructions as to what sound is to be produced by writing to specific registers within the PSG. Once done, the processor is free to do other chores while the PSG generates the desired sounds.

The PSG

The AY-3-8910/AY-3-8912 contain the following sound generating blocks (Fig. 1):

Tone generators — three square-wave generators which, depending on the clock frequency used, can produce tones from sub-audible to supra-audible in frequency.

Noise generator — produces a frequency-modulated pseudo-random pulse-width squarewave output.

Mixers — combine the outputs of the tone generators and the noise generator (there's one mixer for each channel).

Amplitude control — provides the internal D/A (Digital to Analog) converters with either a fixed or variable amplitude pattern. The fixed amplitude pattern is under control of the CPU, while the variable amplitude pattern comes from use of the envelope generator.

Envelope generator — provides amplitude modulation of the output from each mixer. Both shape and cycle of the envelope can be set by the user.

D/A converters — the three converters each produce an output signal of up to 16 levels as determined by the amplitude control.

Additionally, the I/O ports can be used to interface the host processor and the outside world. (Refer to Fig. 2 for a pin-out diagram of the PSG).

Sixteen registers control the sound-generating blocks and I/O ports of the PSG. Those registers are memory-mapped and appear to the processor as a 16-word block out of 1024 possible addresses. The four low-order data/address bits on the PSG (D∅-DA3) select one of the 16 registers. Data/address bits DA4-DA7 must be low, pin A8 must be high, and pin $\overline{A9}$ must be low when selecting a register. After the desired register has been selected, DA∅-DA7 are used for either a read-from, or write-to, PSG operation. The bus direction input (BDIR-pin 18), BC1 (pin 20), and BC2 (pin 19) are used to select whether to latch an address into the PSG, perform a write-to or read-from PSG, or go into the inactive state.

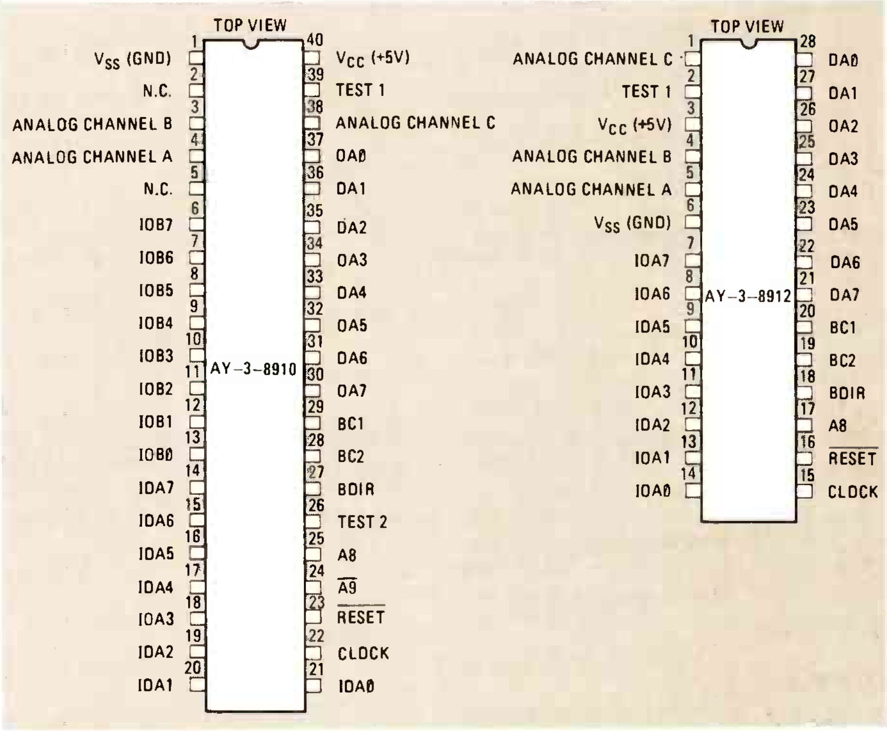


FIG. 2—PINOUT for the AY-3-8910 and the AY- 3-8912 programmable sound generators.

TABLE 1

BDIR	BC1	BC2	PSG FUNCTION
∅	1	∅	INACTIVE — the PSG DA7-DA∅ are in a high impedance state.
∅	1	1	READ FROM PSG — causes contents of currently addressed register to appear on DA7-DA∅.
1	1	∅	WRITE TO PSG — latch data on DA7-DA∅ into currently addressed register.
1	1	1	LATCH ADDRESS — the PSG DA7-DA∅ contain a register address (select the register whose address appears on DA7-DA∅).

Table 1 summarizes the operations.

Before going into the different operations of the PSG, it is necessary to understand the proper sequence of signals to and from the devices. During a register-addressing sequence, the bus controls (see Table 1) should assume an "inactive" state and then a "latch address" state; the address is then placed on the bus, followed by an "inactive" state. A write-to-PSG sequence would involve sending "inactive", placing the data on the bus, sending a

REGISTER	BIT	B7	B6	B5	B4	B3	B2	B1	BØ
RØ	CHANNEL A TONE PERIOD	8-BIT FINE TUNE A							
R1						4-BIT COARSE TUNE A			
R2	CHANNEL B TONE PERIOD	8-BIT FINE TUNE B							
R3						4-BIT COARSE TUNE B			
R4	CHANNEL C TONE PERIOD	8-BIT FINE TUNE C							
R5						4-BIT COARSE TUNE C			
R6	NOISE PERIOD				5-BIT PERIOD CONTROL				
R7	ENABLE	IN/OUT		NOISE			TONE		
		IOB	IOA	C	B	A	C	B	A
R1Ø	CHANNEL A AMPLITUDE				M	L3	L2	L1	LØ
R11	CHANNEL B AMPLITUDE				M	L3	L2	L1	LØ
R12	CHANNEL C AMPLITUDE				M	L3	L2	L1	LØ
R13	ENVELOPE PERIOD	8-BIT FINE TUNE E							
R14		8-BIT COARSE TUNE E							
R15	ENVELOPE SHAPE/CYCLE					CONT	ATT	ALT	HOLD
R16	I/O PORT A DATA STORE	8-BIT PARALLEL I/O ON PORT A							
R17	I/O PORT B DATA STORE	8-BIT PARALLEL I/O PORT B							

FIG. 3—DETAIL of the read/write control resister array shown in Fig. 1. Note registers R16 and R17 that restore the parallel port taken up by the PSG and, in the case of the AY-3-8910, add another.

"write-to PSG" signal, and finally sending an "inactive" signal. A read-from-PSG sequence involves sending "inactive", then a "read-from-PSG" signal, reading the data on the bus, and finally sending an "inactive" signal. Note that the read/write data sequences normally (though not necessarily) follow the register-addressing operation. That allows for multiple reads and writes of the same register without re-addressing.

Operation

Figure 3 shows the various register arrays contained within the PSG and their corresponding functions. Bits B7-BØ correspond to DA7-DAØ once the specific register has been selected.

As seen in Fig. 3, registers RØ-R5 control the frequencies of the three tone generators. Note that each channel (the PSG has 3 independently-programmable analog output channels) has an eight-bit fine-tune and four-bit coarse-tune register. The equations for the tone frequency output are:

1. $f_T = \dfrac{f_{CLOCK}}{16TP_{10}}$

2. $TP_{10} = 256CT_{10} + FT_{10}$

Where: f_T = desired tone frequency
f_{CLOCK} = input clock frequency
TP_{10} = decimal equivalent of the tone period bits TP11—TPØ.
CT_{10} = decimal equivalent of the coarse-tune register bits B3—BØ (TP11—TP8)
FT_{10} = decimal equivalent of the fine-tune register bits B7—BØ (TP7—TPØ)

Note that TP is the 12-bit combination of the coarse- and fine-tune registers. Equation 2 breaks TP into its component parts. Rearranging the equations:

a. $TP_{10} = \dfrac{f_{CLOCK}}{16f_T}$

b. $CT_{10} + \dfrac{FT_{10}}{256} = \dfrac{TP_{10}}{256}$

The following examples should help clarify the math involved:

Example 1:

$f_T = 1$ kHz
$f_{CLOCK} = 2$ MHz

$$TP_{10} = \frac{2\times10^6}{16(1\times10^3)} = 125$$

Substituting this result in equation (b):

$$CT_{10} + \frac{FT_{10}}{256} = \frac{125}{256}$$

$CT_{10} = 0 = ØØØØ$ (B3—BØ)
$FT_{10} = 125_{10} = Ø11111Ø1$ (B7—BØ)

Example 2:

$f_T = 100$ Hz
$f_{CLOCK} = 2$ MHz

$$TP_{10} = \frac{2\times10^6}{16(1\times10^2)} = 1250$$

Substituting this result in equation (b):

$$CT_{10} + \frac{FT_{10}}{256} = \frac{1250}{256} = 4 + \frac{226}{256}$$

$CT_{10} = 4_{10} = Ø1ØØ$ (B3—BØ)
$FT_{10} = 226_{10} = 111ØØØ1Ø$ (B7—BØ)

Register R6 controls the noise-generator frequency. The equation for determining the noise frequency is:

$$f_N = \frac{f_{CLOCK}}{16\ NP_{10}}$$

Where: f_N = desired noise frequency
f_{CLOCK} = input clock frequency
NP_{10} = decimal equivalent of the noise period register bits B4—BØ.

Rearranging the equation:

$$NP_{10} = \frac{f_{CLOCK}}{16\ f_N}$$

Using that second equation, you can solve directly for the required value of NP for a specific noise frequency.

Register 7 controls the three noise/tone mixers and the two I/O ports (one I/O port in the 8912 IC). Bits BØ-B2 control whether or not a tone is enabled and bits B3-B5 enable/disable the noise on each analog output channel. Two of the truth tables shown in Table 2 summarize the enable/disable conditions. Bits B6 and B7 control the status of the I/O ports as shown in the third truth table in Table 2.

Simply disabling the noise and tone generators does not turn off an analog output channel. Turning a channel off is done by writing all zeroes into the channel's amplitude-control register.

The outputs of the three mixers are sent to three D/A converters. Each D/A converter's output amplitude is either set to a user-specified level or modulated by the PSG's internal envelope gen-

TABLE 2

NOISE ENABLE TRUTH TABLE:

R7 Bits B5	B4	B3	Noise Enabled on Channel		
Ø	Ø	Ø	C	B	A
Ø	Ø	1	C	B	—
Ø	1	Ø	C	—	A
Ø	1	1	C	—	—
1	Ø	Ø	—	B	A
1	Ø	1	—	B	—
1	1	Ø	—	—	A
1	1	1	—	—	—

TONE ENABLE TRUTH TABLE:

R7 Bits B2	B1	BØ	Tone Enabled on Channel		
Ø	Ø	Ø	C	B	A
Ø	Ø	1	C	B	—
Ø	1	Ø	C	—	A
Ø	1	1	C	—	—
1	Ø	Ø	—	B	A
1	Ø	1	—	B	—
1	1	Ø	—	—	A
1	1	1	—	—	—

I/O PORT TRUTH TABLE:

R7 Bits B7	B6	I/O Port Status IOB	IOA
Ø	Ø	Input	Input
Ø	1	Input	Output
1	Ø	Output	Input
1	1	Output	Output

erator. Registers 10, 11, and 12 control the amplitudes of channels A, B, and C, respectively. If the amplitude-mode bit, B4, is set to logic Ø, then the user can control the output amplitude by supplying a 4-bit code to BØ-B3. Figure 4 shows the output levels for all possible values of BØ-B3. As previously mentioned, writing all zeroes on bits BØ-B3 turns a channel off.

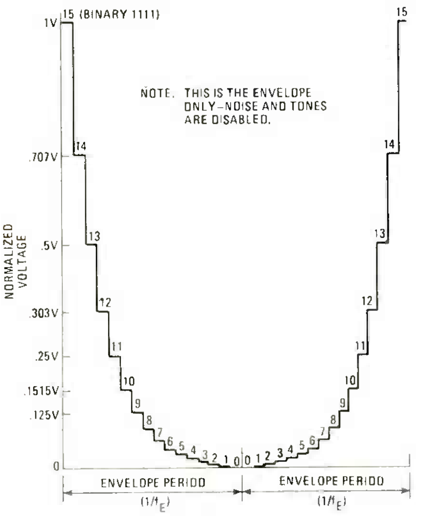


FIG. 4—OUTPUT LEVELS for all possible combinations of bits BØ-B3. Writing ØØØØ on bits BØ-B3 turns a channel off.

When the amplitude-mode bit of a channel's amplitude-control register is set high, then that channel's output amplitude is varied by the PSG's internal envelope generator. The envelope's frequency, shape, and cycle pattern can be varied, allowing quite complex envelope patterns.

Registers R13 and R14 control the period of one envelope cycle; R14 is the coarse-tune register while R13 is the fine-tune register. The envelope frequency equations are:

$$f_E = \frac{f_{CLOCK}}{256EP_{10}}$$

$$EP_{10} = 256CT_{10} + FT_{10}$$

Where: f_E = desired envelope frequency

f_{CLOCK} = input clock frequency

EP_{10} = decimal equivalent of the envelope-period bits

CT_{10} = decimal equivalent of the coarse-tune register bits B7—BØ

FT_{10} = decimal equivalent of the fine-tune register bits B7—BØ

Rearranging the equations:

a.) $EP_{10} = \frac{f_{CLOCK}}{256f_E}$

b.) $CT_{10} + \frac{FT_{10}}{256} = \frac{EP_{10}}{256}$

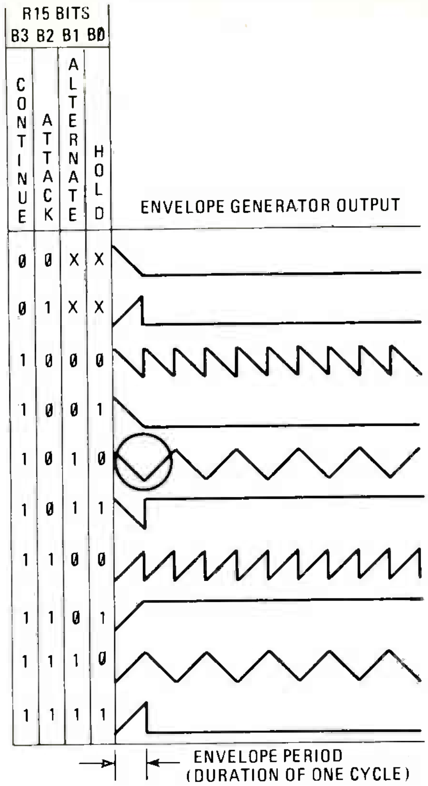


FIG. 5—THE ENVELOPE is determined by the R15 bits. The X's denote a don't-care condition.

An example, using the above equations:

f_E = 0.5 Hz
f_{CLOCK} = 2 MHz

$$EP_{10} = \frac{2\times10^6}{256(0.5)} = 15{,}625$$

Substituting this result in equation (b).

$$CT_{10} + \frac{FT_{10}}{256} = \frac{15{,}625}{256} = 61 + \frac{9}{256}$$

$CT_{10} = 61_{10}$ = ØØ111101 (B7—BØ)
$FT_{10} = 9_{10}$ = ØØØØ1ØØ1 (B7—BØ)

As shown in Fig. 3, register R15 provides control of the envelope shape and cycle pattern. Bit Ø is "hold", bit 1 is "alternate", bit 2 is "attack", and bit 3 is "continue". Figure 5 provides a graphical presentation of the patterns that can be generated, using the above functions (note: "X" in Fig. 5 indicates a don't-care condition—the bit can be either Ø or 1).

Interfacing

Figure 6 shows an economical circuit (using a color-burst crystal) that provides not only the clock for the PSG, but also the system clock for the microprocessor that controls the PSG.

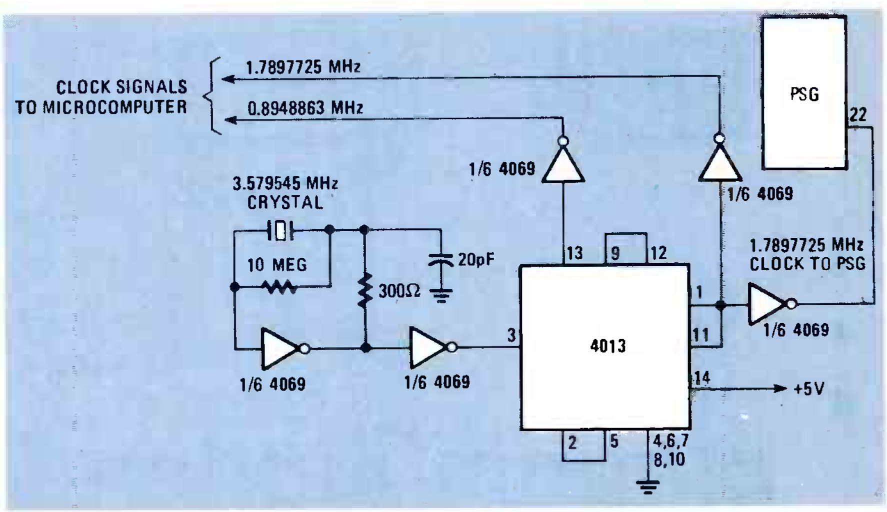


FIG. 6—A COLOR-BURST CRYSTAL is used in this circuit that provides a clock for the host microcomputer as well as for the PSG.

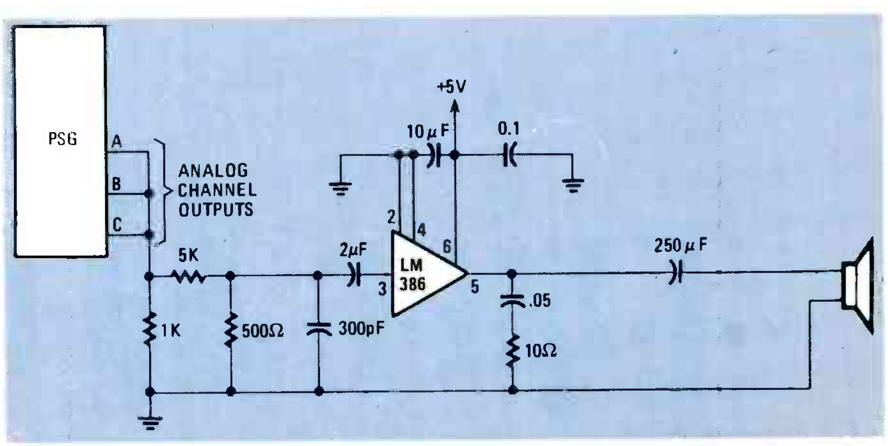


FIG. 7—THIS circit sums the PSG's three analog channels, amplifies them, and drives a speaker.

The circuit shown in Fig. 7 sums the three analog channel outputs and amplifies the sum with a standard low-voltage IC amplifier. The advantage of using that IC is obvious—you can tap the five-volt supply for the IC's biasing. Position all components as close to the IC as possible, especially the decoupling components.

To access the PSG's registers and to read-from and write-to those registers, the microprocessor must interface with the eight data/address lines (DA∅-DA7) of the PSG plus the bus control lines, BDIR, BC2, and BC1. Since BC2 can be left high (see Table 1), the bus-control lines needed can be reduced to two. The PSG's eight data/address lines can be tied directly to the microprocessor's data lines if decoding is provided to place the PSG in its "inactive" mode (see Table 1) when the PSG is not being accessed.

The PSG's can be interfaced to the 6800 and 6502 microprocessors very easily, as shown in Fig. 8. A PIA (*P*eripheral *I*nterface *A*dapter) IC is used between the microprocessor and the PSG. (See **Radio-Electronics,** Nov. 1980 issue.) The setup for the 6800 is shown. For the 6502, a 6520 would be used as the PIA. Both of those microprocessors treat I/O and memory the same so that immediate control of the PSG would consist of "load accumulator" and "store accumulator at" instructions.

Figure 9 shows a typical S-100 bus interface. That design provides for reading-from and writing-to the PSG using only an 8080 IN or OUT instruction to the proper address. The proper address is the memory location where the PSG resides, set by the switches going to the 7485's. Table 3 provides software routines written in 8080 assembly language.

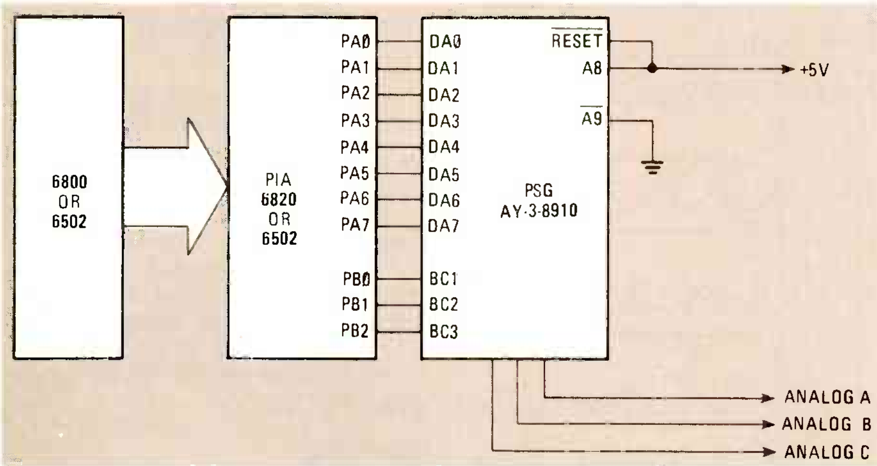


FIG. 8—A PIA (*P*eripheral *I*nterface *A*dapter) is needed if a 6800 or 6502 microprocessor is used.

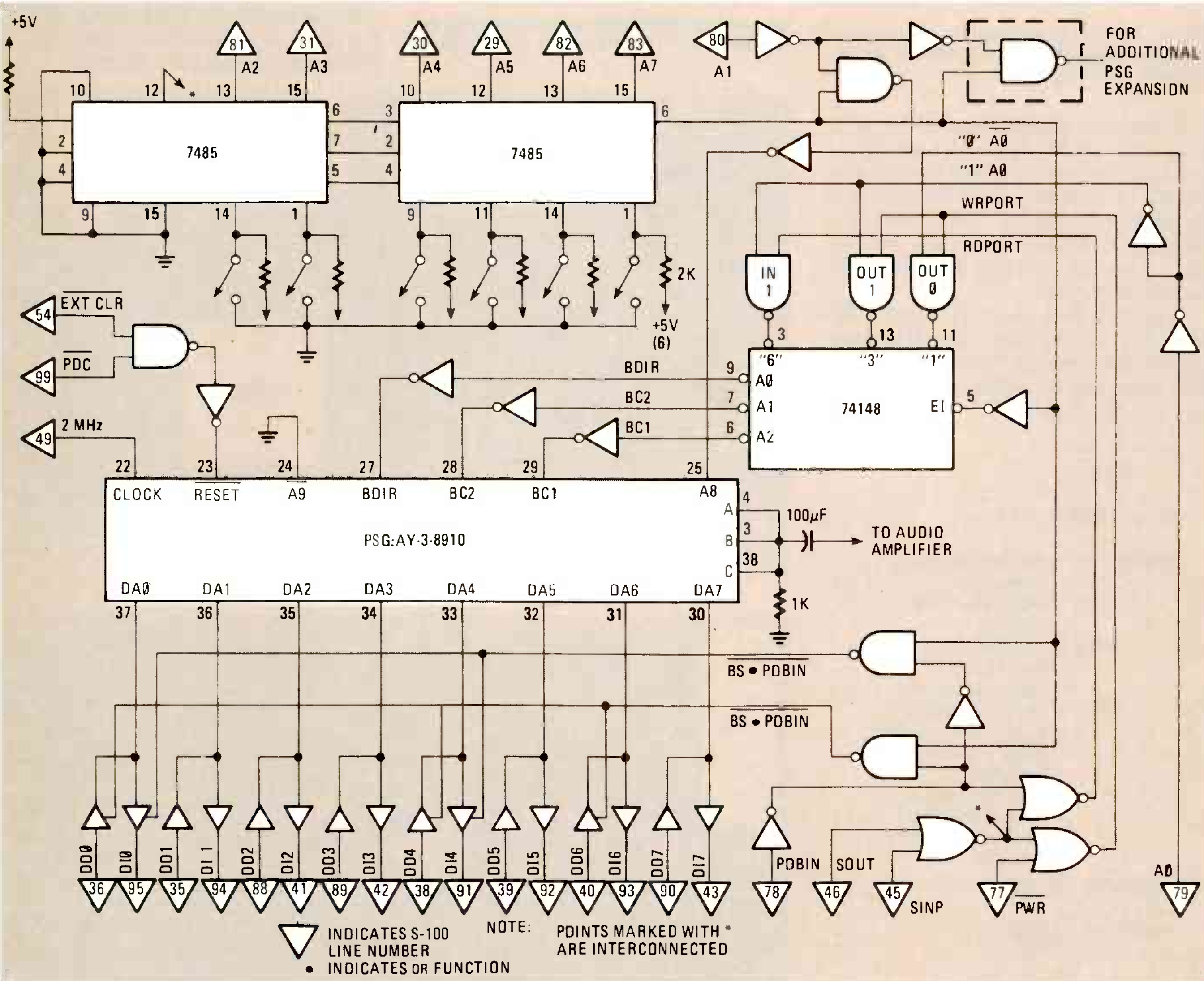


FIG. 9—TYPICAL INTERFACE for the S-100 bus. This design requires only an 8080 IN or OUT instruction to read-from or write-to the PSG.

TABLE 3

LATCH ADDRESS ROUTINE

```
PORTADDR EQU 80H ; ADDRESS TRANSFER PORT ADDRESS
PORTDATA EQU 81H ;DATA TRANSFER PORT ADDRESS
;
;THIS ROUTINE WILL TRANSFER THE CONTENTS OF
;8080 REGISTER C TO THE PSG ADDRESS REGISTER
PSGBAR     MOV    A,C ;GET C IN A FOR OUT
           OUT    PORTBAR ;SEND TO ADDRESS PORT
           RET
```

WRITE DATA ROUTINE

```
;
;
;ROUTINE TO WRITE THE CONTENTS OF 8080 REGISTER B
;TO THE PSG REGISTER SPECIFIED BY 8080 REGISTER C
;
PSGWRITE   CALL   PSGBAR ;GET ADDRESS LATCHED
           MOV    A,B, ;GET VALUE IN A FOR TRANSFER
           OUT    PORTDATA ;PUT TO PSG REGISTER
           RET
```

READ DATA ROUTINE

```
;
;
;ROUTINE TO READ THE PSG REGISTER SPECIFIED
;BY THE 8080 REGISTER C AND RETURN THE DATA
;IN 8080 REGISTER B
;
PSGREAD    CALL   PSGBAR
           IN     PORTDATA ;GET REGISTER DATA
           MOV    B,A ;GET IN TRANSFER REGISTER
           RET
```

TABLE 4

GUNSHOT SOUND EFFECT

Register #	Octal Load Value	Explanation
Any not specified	000	—
R6	017	Set Noise period to mid-value.
R7	007	Enable Noise only on Channels A, B, C.
R10	020	Select full amplitude range under direct control of Envelope Generator.
R11	020	
R12	020	
R14	020	Set Envelope period to 0.586 seconds.
R15	000	Select Envelope "decay", one cycle only.

TABLE 5

EXPLOSION SOUND EFFECT

Register #	Octal Load Value	Explanation
Any not specified	000	—
R6	000	Set Noise period to max. value.
R7	007	Enable Noise only, on Channels A, B, C.
R10	020	Select full amplitude range under direct control of Envelope Generator.
R11	020	
R12	020	
R14	070	Set Envelope period to 2.05 seconds.
R15	000	Select Envelope "decay", one cycle only.

TABLE 6

LASER SOUND EFFECT

Register #	Octal Load Value	Explanation
Any not specified	000	—
R7	076	Enable Tone only on Channel A only.
R10	017	Select maximum amplitude on Channel A.
R0	060 (start)	Sweep effect for Channel A Tone period via a processor loop with approximately 3 mS wait time between each step from 060 to 160 (0.429 mS/2330Hz to 1.0ms/1000Hz).
R0	160 (end)	
R10	000	Turn off Channel A to end sound effect.

Application examples

Many computer programs, most obviously game programs, could be livened up by using appropriate sound effects. The PSG can generate a wide variety of sounds. The gunshot and explosion sound effects (Tables 4 and 5) consist of pure noise, modified by a decaying envelope. Table 6 shows a laser sound that uses a frequency-sweeping effect. Other sounds that can be created using that effect include a racing car sound, a wolf whistle, and a whistling bomb. The PSG can also produce simple tone sound effects.

Although not shown in Tables 4, 5, and 6, care must be taken to observe the proper sequence of bus-control signals to the PSG, as explained earlier in this article.

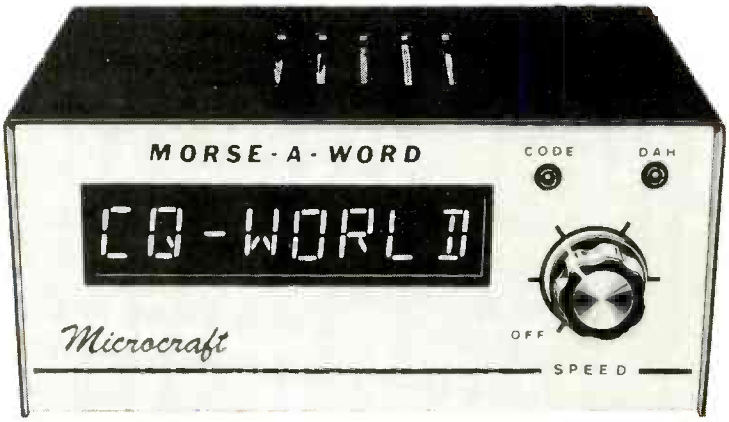
Sound effects do not have to be limited to game programs. They can signal you at the end of a long computation (if you have better things to do than watch a CRT screen for an answer); they can serve as a debugging tool, indicating audibly which direction a program is taking; and they can create a loud sound to wake you in the morning, just before the coffee pot is switched on.

There are eight full octaves of notes that the PSG can provide. Since the PSG has three channels, three note chords can also be played. Use of the various envelope patterns together with variable noise will allow the simulation of musical instruments to a certain degree. Because the tone frequency as well as output amplitude can be controlled by the microprocessor, effects such as vibrato and tremolo are possible.

Musical applications for the PSG seem endless. They will provide envelopes for an external musical instrument (such as a synthesizer). They can provide backup rhythm; with them you can easily transpose music to match your vocal range or "play" a composition you haven't yet mastered yourself. They will provide different instrumental sounds for your own compositions. And they will even give that automated coffee pot a musical tongue.

At first glance the PSG's may seem complicated to use and understand. That's because there is a wide variety of musical sounds and effects that can be generated by those devices and each of those sounds can be produced and controlled to a sometimes astonishing degree. So, although the PSG's may seem complex, that is only because of the versatility of those devices. For more information on the AY-3-8910/8912, consult General Instrument's excellent data manual. You can write to General Instrument Corporation, 600 West John St., Hicksville, NY 11802. **R-E**

TUNE IN WITH MORSE & RTTY DECODERS



A new generation of SWL and ham accessories makes listening to Morse and radioteletype communications easier than ever.

DANNY GOODMAN

IF YOU HAVE EVER TUNED A SHORTWAVE receiver to the frequencies outside the broadcast bands, you probably wondered what those unintelligible squeals, squawks, and tones were all about. You may have recognized some signals as Morse code but the rest sounded more like invaders from space. In either case, there seemed to be no way you could decipher those transmissions.

Veteran shortwave listeners (SWL's) who specialize in eavesdropping on international aircraft, ship-to-shore, and overseas telephone communications have long found the "utility" bands a fascinating alternative to the daily broadcast fare. But until recently, even those utility DX'ers, as they are called, had to pass over a veritable treasure chest of information-filled non-voice communications: Morse code and radioteletype (Baudot code).

Now, with the help of the microprocessor and other low-cost integrated circuits, several Morse and Baudot (pronounced baw-doh) decoders let you copy those signals off the air electronically, without requiring great technical expertise (like learning Morse code or knowing how to maintain a complicated teleprinter) and, in many cases, without spending a lot of money. Some are as easy to hook up as plugging in a cable to the receiver headphone jack; others convert your personal computer to a receiver video terminal.

There are, to be sure, several other non-voice modes in use on the bands. Facsimile and codes of many kinds are frequently used. However, there are enough Morse and standard Baudot transmissions to keep the novice and experienced utility DX'er alike glued to the receiver. Here are some examples of what awaits the casual listener:

Amateur Radio. In addition to the normal two-way ham conversations (QSO's) on Morse (abbreviated CW, for "continuous wave") and radioteletype (abbreviated RTTY), the American Radio Relay League transmits daily bulletins on all amateur bands about new FCC regulations, weather-satellite tracking data, and radio-propagation conditions forecasts. The CW and RTTY bulletins usually come through the crowded amateur bands much better than the League's phone (SSB) transmissions.

News Wires. Dozens of news agencies (including United Press International and Associated Press) transmit RTTY dispatches to their subscribers all over the world. Tass (USSR) and Xinhua (China) are two examples of English-language foreign news wires you can receive. Subscribers (newspapers, radio stations, etc.) pay a fee to receive each service and are thereby authorized to use this information received over the wire for rebroadcast or reprinting. Private individuals receiving and decoding the wires as non-subscribers cannot reuse or disseminate the information for any purpose.

Third-party Traffic. Predominatly CW, this category of transmissions includes messages sent from passengers and crews on ocean vessels to friend or relatives back home and other one-way communications (cablegrams, telegrams, etc.) over long distances. Many believe that satellite and cable links carry all the international word traffic. Such is not the case. There are very few circuits open in the existing transponders and cables compared with the demand for them. Consequently, a large percentage of international third-party traffic is still handled on CW or RTTY in the 3-30 MHz (hf) region of the spectrum.

Embassy/Government Communications. Surprisingly, there are many transmissions by government agencies and other international organizations (United Nations, Interpol, etc.) that do not further encode their CW and RTTY transmissions to discourage the "passer-by" from listening to the contents. For example, you can copy bulletins to American embassies and consulates which clearly state that the material is intended for internal use only.

Weather Bulletins. Aircraft, ships, and ground stations rely heavily on detailed weather reports transmitted on RTTY and CW all over the world. During the hurricane season, for instance, you can track the extact latitude and longitude of various storms from the bulletins.

As in the case of the news wires, the Communications Act of 1934 forbids the retransmission or reprinting of the content of any utility broadcast picked up by your receiver. The prohibition, rather than being a deterrent, adds excitement to that facet of shortwave listening, in that it gives you the feeling of eavesdropping on the behind-the-scenes events of the world. It's like listening to a worldwide public-service-band radio.

The signals you hear

Morse and Baudot are codes in that each character we know in our common language (letters, numerals, and punctuation) is represented by a corresponding Morse or Baudot character.

A Morse code character is created by keying a transmitter to send a series of short ("dit") and long ("dah") carrier bursts (See Fig. 1-a). A character can be as brief as a single dit (the letter "E") or considerably longer, like dah-dah-dit-dit-dah-dah (a comma).

The job of the operator at the receiving end is to recognize that a dit, followed by a short space is an "E" or that a dah-dah-dit with a space is a "G" and instantaneously convert the tones in his ear to a hand-printed or typewritten character.

A longer gap between letters indicates a space between words. He must rely on the sender to properly encode a written copy to dits and dahs on his telegraph key, as well as insert adequate spaces between letters and words. As you can see, at least until the proliferation of electronic keyboard send-receive equipment, Morse required human skills in the encoding and deciphering of the code.

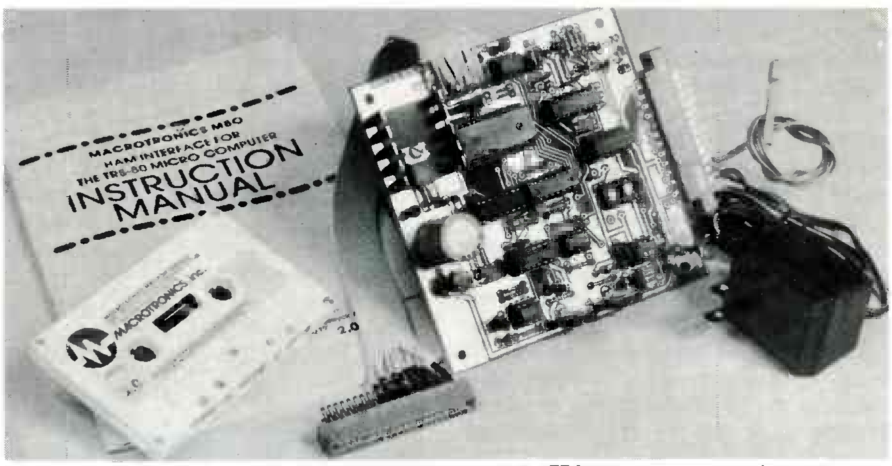
With radioteletype, however, all translation from our alphabet, numerals, and punctuation is performed mechanically or electronically. While the RTTY signal characteristics are more complex than that of CW, its ease of operation permit just about anyone (who knows how to type) to send, and requires no attendant at all to receive.

The RTTY signal is actually sent on two different frequencies, though the signal appears on only one frequency at a time (See Fig. 1-b). The keying circuitry at the transmitter literally shifts the frequency on the transmitter slightly to form a series of high and low signals. A similar system, called audio-frequency shift keying, sends the highs and lows as audible tones over a single sideband or FM signal.

This is where the "code" part comes into play. Each character's code consists of a specific sequence of high and low tones (called "space" and "mark" bits, respectively). Unlike CW, the RTTY characters are all the same length: 5 bits long, plus both a start (space) and stop (mark) bit to aid synchronization on the receiving end. In the transmit mode, the RTTY frequency shift keyer keeps the transmitter on the space frequency as a steady carrier signal. When the operator presses a key on the typewriter-like keyboard, the keyer shifts the frequency in the correct code sequence representing that character, plus the start and stop bits. That all happens very quickly, taking only 163 milliseconds per character, even at the slowest conventional speed of 60 words per minute.

The amount of actual frequency shift is controlled by the keyer. Three frequency shifts are in common use on the utility bands: narrow shift (170 Hz), medium shift (425 Hz), and wide shift (850 Hz). RTTY sent in those shifts can appear at various speeds, though most systems adhere to 60, 66 or 100 wpm.

In contrast to CW, very little of what you hear in commercial RTTY is being sent by an operator at a keyboard at the same time you hear it. Often, a punched paper tape of the message is prepared



MACROTRONICS ***model M-80*** **interface and software for the TRS-80 personal computer.**

at say a 45 wpm, a comfortable typing speed for an operator. The tape can then be put through a reader at much higher speeds at specified times (as in bulletins). Even hams, who type most of their messages in "real time," often have "brag" tapes which describe the equipment set-up, details of the ham's family or community, and even RTTY art, pictures formed by line after line of carefully placed characters giving a mosaic effect.

Before the microprocessor revolution, printing RTTY messages was possible only with a noisy (for the home, at least) and bulky mechanical teleprinter that needed constant maintenance, or a technical knowledge of the mechanism to keep it running smoothly. They are still in wide use today. A receiver

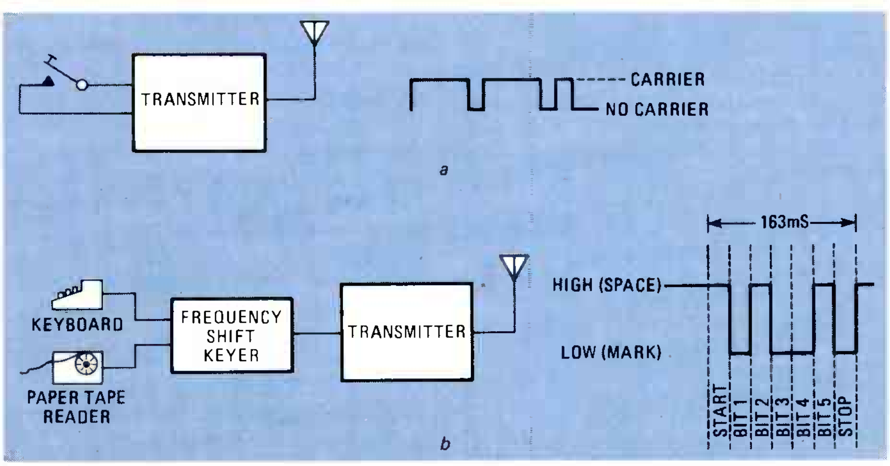


FIG. 1—CONTINUOUS WAVE (Morse) and radioteletype (Baudot) transmitting systems. The waveform in *a* shows the absence or presence of a signal and the waveform in *b* shows a change in frequency.

demodulator converts the mark and space signals to on/off currents which mechanically activate the right keys on the printer.

Receiver requirements

Regardless of the decoding system you choose, a good receiving station is essential for utility DX'ing. Since most of the stations broadcasting CW and RTTY are at much lower powers than the shortwave broadcasters, your receiver needs to be as sensitive as possible, with the best possible antenna. Many transmitters operate at power levels much like ham radio rigs (around 1000 watts), so you will want to be sure you can hear the weak ones from afar. You may only need to add a preselector or tuned preamplifier to your existing receiver to make it "hot" enough to pull in the exciting DX.

To receive CW and RTTY, your receiver will also need a BFO (*B*eat *F*requency *O*scillator), which gives the carrier signal a tone you can hear. Tuning across the bands without a BFO, you may think that you don't need it because you can hear audible tones. What you are hearing, however, are tones beating against adjacent signals—total gibberish to the input of a decoder. The BFO provides a constant signal to beat against the desired signal, ensuring stable tone-generation.

Most important of all is the stability of the receiver and BFO. The tones generated by the received signal must be tuned to within a small range of audio frequencies for the decoders to "hear" them. The decoders have that narrow passband built into their input circuits to help reject adjacent signal interference, allowing only the desired signal to pass through to the decoding sections. An unstable receiver will require constant retuning to keep the tones in the passband of the decoder, causing gaps in the copy and considerable inconvenience.

Lastly, a digital frequency readout is strongly recommended. You will probably want to keep a logbook with a listing of frequencies, times, dates, information content, and types of stations heard. You may also want to recheck several stations periodically to see what they are transmitting on a given day. A digital readout will let you retune to the exact spot where you first heard the station, thus saving time in searching around for the one you want to hear. And, like listening to public-service stations on a VHF/UHF scanner, many stations transmit intermittently, so you will want to be sure you're on the exact frequency when their signal comes on the air.

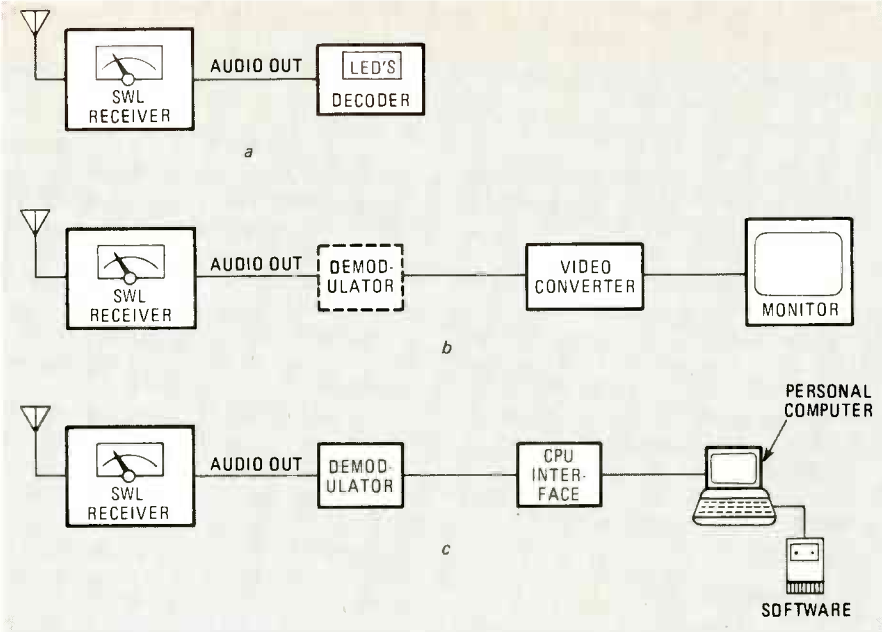


FIG. 2—THREE common systems for decoding Morse and Baudot transmissions electronically. A demodulator or terminal unit is often required in system *b*.

Decoding systems

The three basic choices in decoding systems are a dedicated CW and/or RTTY unit with built-in LED display, a dedicated decoder with video output, and personal computer peripherals. Most systems have ASCII code capability. Though that seven-bit code is the common language of computers, very little of it appears over the air. Hams have recently been authorized to use ASCII, so expect some signals to show up on the amateur bands.

THE INFO-TECH model M200-F video converter does not require a terminal unit.

The dedicated CW and/or RTTY unit with built-in display is the most compact, coming usually in a convenient desk-top size. It is also the simplest system to set up, requiring only a connection from the audio output of the receiver to the unit, and one from the unit to the nearest wall socket (See Fig. 2-a).

With the help of a tuning indicator on the unit, you carefully tune the receiver so the desired signal falls within the passband of the decoder. On CW, that means getting the indicator to flicker in step with the incoming signal. For RTTY, a two-light indicator is preferred with one light each for the mark and space frequencies. They will flicker alternately, as the received signal shifts in frequency. If the shift (narrow, medium, wide) is unknown, you can use the indicators to help you select the correct one as both LED's will flicker only when the demodulator is on the right shift.

From there, you try the different combinations of speed (usually 60, 66, or 100 wpm) and normal or reverse shift until intelligible copy appears on the alphanumeric LED display. At first, the 100-wpm speed seems to race by almost too quickly to read, but with a little practice, it is easily mastered.

Microcraft Corporation offers a low-cost model for CW, the *Morse-A-Word II*, and for Baudot, the *RTTY Reader*. Both are available factory assembled or in kit form. Kantronics combines both RTTY and CW decoders in its *Field Day II* reader, which also comes in a

continued on page 98

TABLE 1

FREQUENCY	SERVICE
7000 - 7150 kHz	Amateur Radio
7300 - 8200 kHz	Fixed Service
8200 - 8800 kHz	Maritime Mobile
10,100 - 11,175 kHz	Fixed Service
12,000 - 12,330 kHz	Fixed Service
12,330 - 13,200 kHz	Maritime Mobile
13,360 - 14,000 kHz	Fixed Service
14,000 - 14,100 kHz	Amateur Radio
14,080 kHz	Ham RTTY calling frequency
14,350 - 14,990 kHz	Fixed Service
15,450 - 16,460 kHz	Fixed Service

BUILD THIS

JAMES A. GUPTON, JR.

TO COMPLETE CONVERTING YOUR ROBOT to radio control, using the method outlined previously, three more circuits have to be added. They are: a *Touch-Tone encoder board*, a *decoder board*, and a *latch board*. Those, together with the boards constructed earlier, will allow the robot to be controlled remotely.

UNICORN-1 ROBOT

Part 9—This installment of the Unicorn-1 series finishes equipping the robot for remote-control operation with tone-encoder, tone-decoder and latch boards.

Encoder board

The *Touch-Tone* encoder board is designed for use with a 16-key *Touch-Tone* keypad. In addition to the numbers zero through nine and the "#" and "*" signs, that pad also has keys labeled "A" through "D."

The keys are arranged in an array of four rows by four columns. Each row and column has a particular tone frequency assigned to it, as shown in Table 1. Pressing any key causes a unique tone pair to be generated. Those tone pairs are generated by the encoder board, whose schematic is shown in Fig. 72.

The encoder IC, a 7206JPE, is designed to take a "row" input and a "column" input and to output the appropriate tone pair, deriving those tones by dividing down the output of a 3.579545-MHz TV color-burst crystal. The tone pair appears at pin 15 of the IC.

An LED is included in the circuit to indicate visually that tones are being generated. Similarly, Q1, a medium-gain NPN transistor, can be used to drive a speaker so the tones can be heard. The speaker can be eliminated if desired, or, as shown in the schematic, you can insert a resistor in the circuit to reduce the volume of the audio output.

The signal fed to the FM transmitter described in the previous part of this series is taken from the base of Q1. A dropping resistor (whose value may range from several hundred kilohms to several megohms) may be necessary between this point and the transmitter input to avoid overdriving the transmitter.

A 9-volt battery operates the encoder very nicely. If the encoder and transmitter are packaged together, use a separate battery for each one.

The foil pattern for the small, single-sided, encoder board is in Fig. 73. Component placement is in Fig. 74.

TABLE 1

ROW	1	697 Hz
"	2	770 Hz
"	3	852 Hz
"	4	941 Hz
COLUMN	1	1209 Hz
"	2	1336 Hz
"	3	1477 Hz
"	4	1633 Hz

Decoder board

The transmitted tones are picked up at the robot-end of the radio link by a standard portable FM receiver. It can be mounted inside the robot's body with a whip antenna mounted externally.

Output to drive the decoder board can be taken from the radio's earphone jack or, if you want the tones to be heard coming from the robot, from the speaker terminals. The audio can also be fed to the robot's on-board amplifier. Again, a dropping resistor may be required.

Figure 75 is the schematic of the decoder. The tone pair is fed to resistor R9, the level control, and from there to eight 567 PLL tone-decoders. Each 567 is set to respond to one of the eight tones that can be produced by the encoder board. Each tone pair causes the output lines (pin 8) of *two* of the 567's—one for each of the two tones—to go to a logic-low state.

Those outputs are NOR'd by IC9 through IC12, producing a logic-high at the IC output-pin corresponding to the key pressed.

Because of its complexity, that circuit is designed around a double-sided PC board. Figure 76 shows the "foil" side of the pattern, while Fig. 77 shows the pattern for the "component" side of the board. (For those who do not have the facilities to make double-sided boards, sources have been provided—see the note at the end of the parts list.) Parts placement is shown in Fig. 78 and an assembled board in Fig. 79.

The board requires a well-regulated

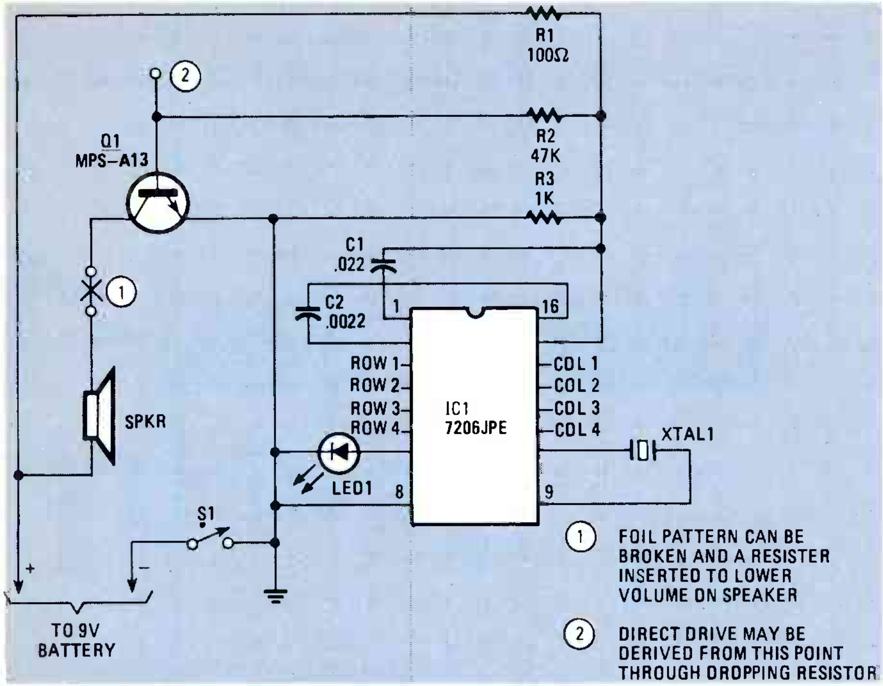


FIG. 72—HEART OF THE *Touch-Tone* encoder is the ICM7206JPE IC that converts "row" and "column" inputs into tone pairs. Speaker shown is optional.

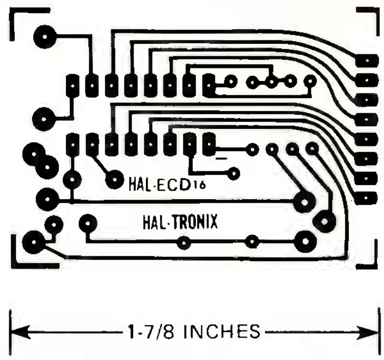


FIG. 73—ACTUAL-SIZE PC board foil pattern for *Touch-Tone* encoder. Eight pads at right are for connection to keypad.

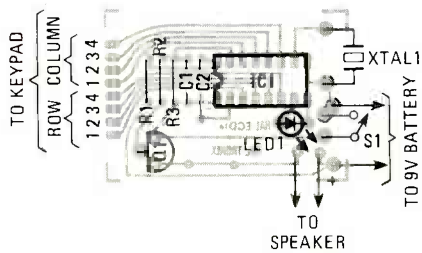


FIG. 74—WHEN CONNECTING encoder board to FM transmitter, make sure that battery polarities agree.

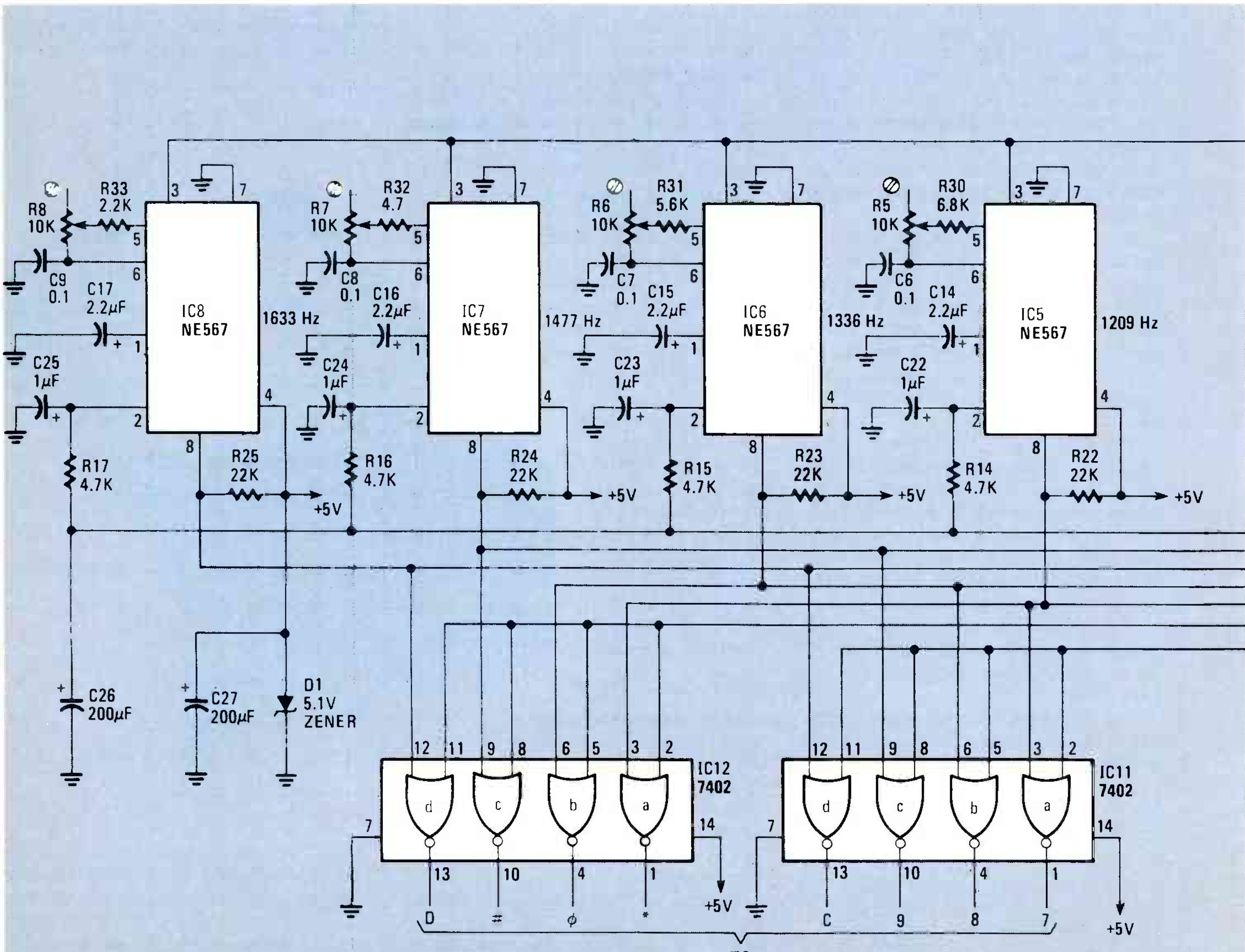
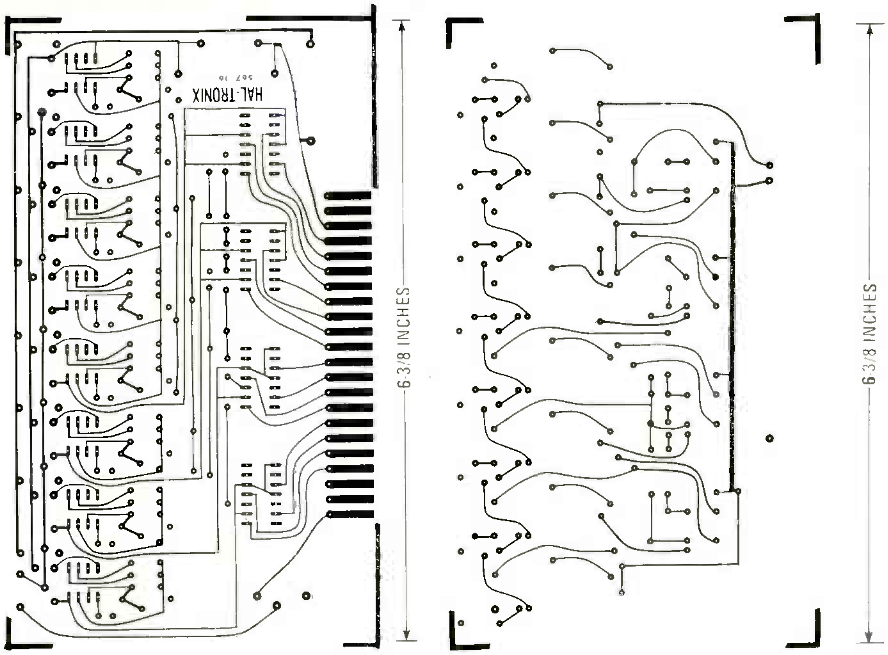


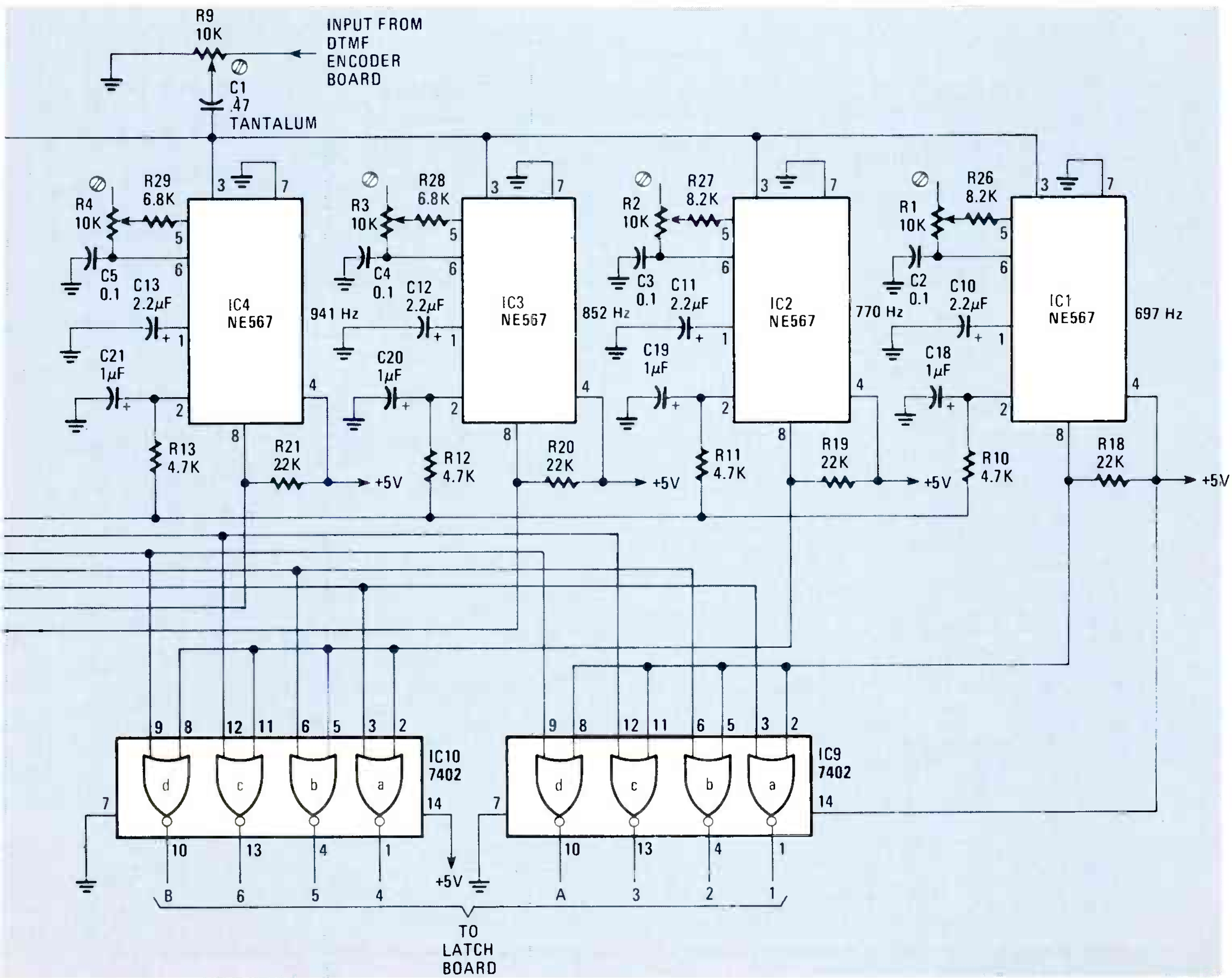
FIG. 75—TONE PAIRS are fed to all eight 576 phase-lock loop IC's on decoder board. Decoded tone pairs are NOR'd to produce a one-of-sixteen logic-"high" output.



FIGS. 76 & 77—DECODER BOARD is double-sided. Pattern at left is for bottom; pattern at right for top (component side). If you make your own board, holes that go to foil traces on both sides must either be plated through, or jumpers run from one side of board to the other.

PARTS LIST—DTMF ENCODER BOARD

All resistors ¼ watt, 5%
R1—100 ohms
R2—47,000 ohms
R3—1000 ohms
Capacitors
C1—0.022 μF, ceramic disc
C2—0.0022 μF, Mylar
C3—39 μF, tantalum
Semiconductors
IC1—7206JPE DTMF tone generator
Q1—MPSA-13 or equivalent NPN-type
LED1—jumbo red LED
XTAL1—3.579545 MHz TV color-burst crystal
S1—SPDT push button switch
Miscellaneous: PC board, IC socket, 8-ohm speaker, 16-key keypad (Digitran KL0049 or equivalent), cabinet, battery clip, etc.



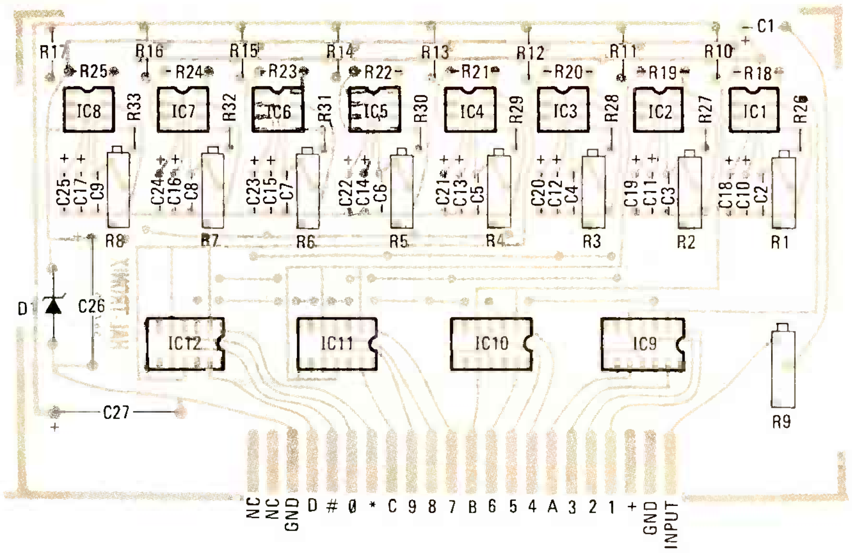


FIG. 78—THE DTMF DECODER BOARD has all signals brought out to edge connector and also available on the board itself.

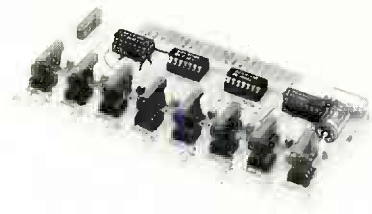


FIG. 79—WHEN MOUNTING POTENTIOMETERS make certain to allow clearance between them and IC sockets for screwdriver adjustment.

We've been receiving a lot of correspondence from readers who are building—or contemplating building—their own versions of Unicorn-1. We'd like to see more, along with nice sharp photographs, so we can publish a segment showing off those robots and presenting some of the innovations that you've come up with. Write to **Radio-Electronics**, 200 Park Avenue South, New York, NY 10003 and mark your envelope "ROBOT UPDATE."

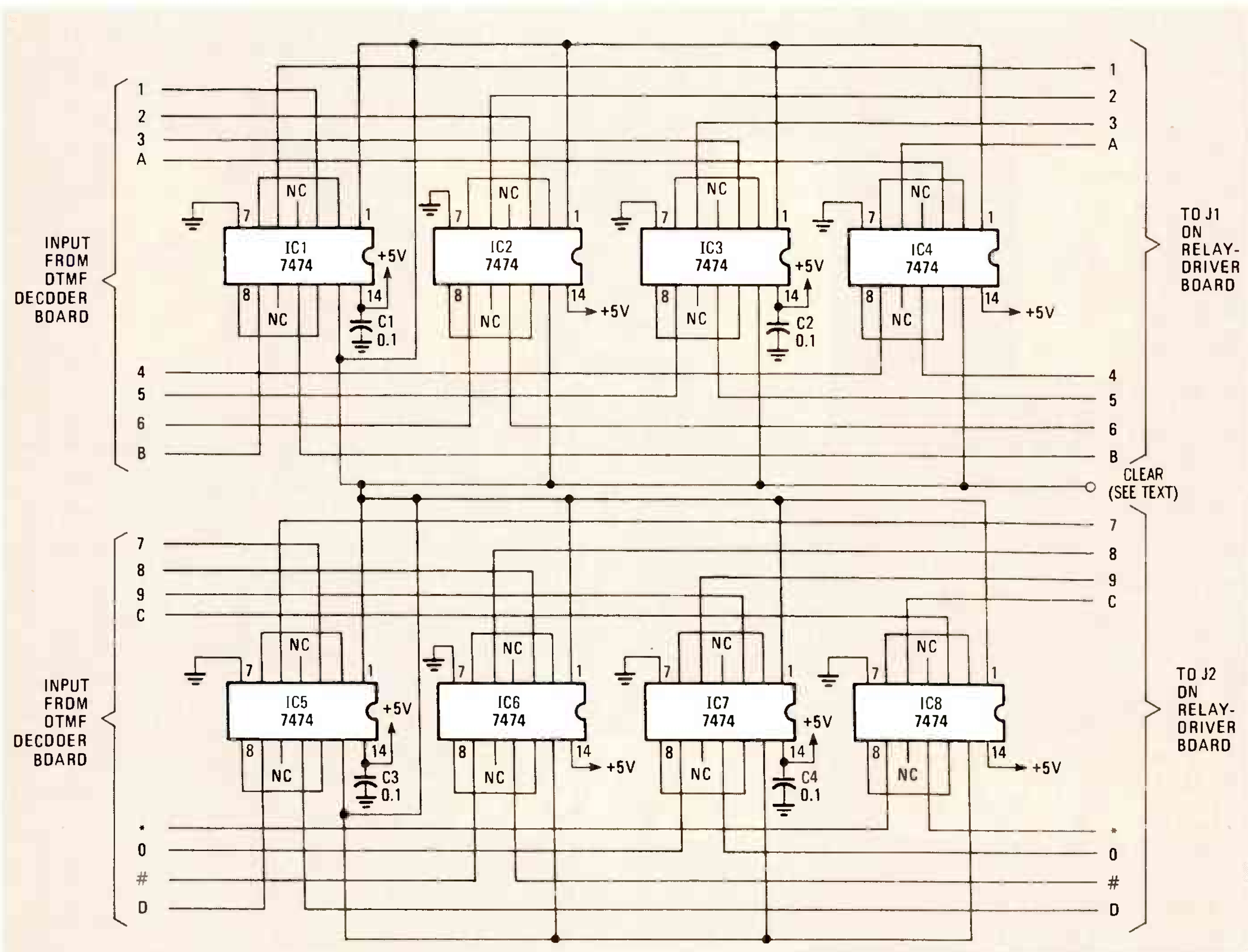


FIG. 80—LATCH BOARD takes output of decoder board and "remembers" commands until second output disables latches. This feature allows commands sent out sequentially to be carried out simultaneously.

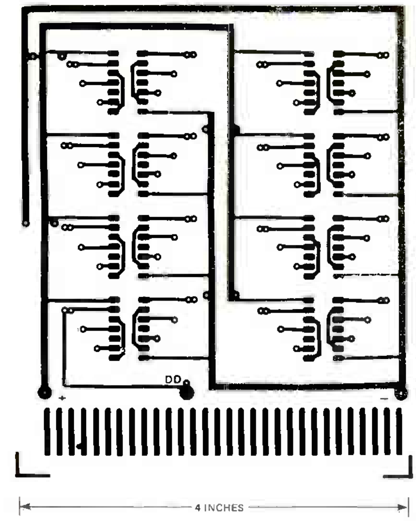


FIG. 81—IF "DROP-DEAD" feature is desired, "double-donut" pads must be jumpered together.

PARTS LIST—LATCH BOARD

Capacitors
C1-C4—0.1 μF, ceramic disc
Semiconductors
IC1-IC8—7474 dual "D" edge-triggered flip-flop
Miscellaneous: PC board, IC sockets, ribbon cable, etc.
The following are available from: Hal-Tronix, PO Box 1101, Southgate, MI 48195, Tel. (313) 285-1782: encoder kit, including case (ECD-16DL), $39.95; encoder kit less case (ECD-16K), $29.00; PC board only (ECD-16PC), $8.00. Decoder kit (no case) (567-16K), $69.95; double-sided, plated-through PC board only (567-16PC), $21.00. Latch board kit (LB-16K), $18.95; PC board only (LB-16PC), $11.95. Also available from the same source: ICM7206JPE IC, $8.95; 16-key keypad, $11.95. Please add $2.00 shipping & handling on orders under $20.00. Visa and MC accepted. Boards and kits are also available from: The Robot Mart, Room 1113, 19 W. 34th St., New York, NY 10001 (catalog $3.00).

PARTS LIST—DTMF DECODER BOARD

All resistors ¼ watt, 5% unless otherwise specified
R1-R9—10,000 ohms, ten-turn trimmer potentiometer (Bourns 3006P or equivalent)
R10-R17, R32—4700 ohms
R18-R25, R33—2200 ohms
R26, R27—8200 ohms
R28-R30—6800 ohms
R31—5600 ohms
Capacitors
C1—0.47 μF, tantalum, or ceramic disc
C2-C9—0.1 μF, Mylar or monolithic
C10-C17—2.2 μF, tantalum or aluminum electrolytic
C18-C25—1 μF, tantalum or aluminum electrolytic
C26, C27—200 μF, electrolytic
Semiconductors
IC1-IC8—NE567 PLL tone decoder
IC9-IC12—7402 quad NOR gate
D1—5.1 volts, 1 watt, Zener
Miscellaneous: double-sided, plated-through PC board, IC sockets, ribbon cable, etc.

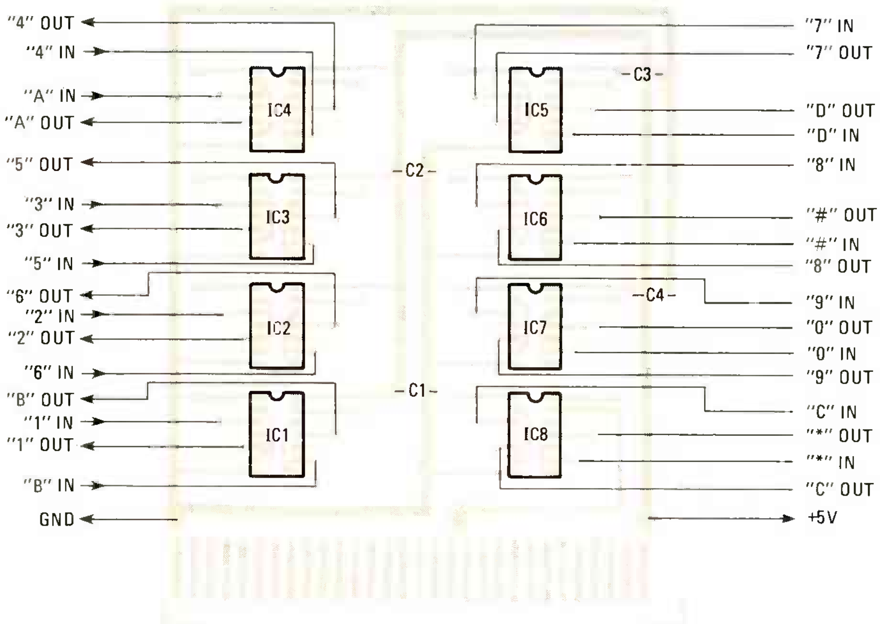


FIG. 82—LATCH BOARD SIGNALS *are not* brought out to edge connector. Connections must be made to pads on board. The use of multicolored ribbon cable is suggested.

five-volt supply to operate properly. Alignment is simple: Starting with IC1, connect a frequency counter to pin 5 of the 567 (no signal input is necessary). Adjust the 10K potentiometer associated with the IC until the frequency indicated on the schematic for that IC is obtained.

Proper tone-decoding can be verified by applying a tone pair to the input of the board and checking for a logic-high at the corresponding output pin of the 7402 NOR gates with a logic probe.

If the probe's HIGH LED does not stay on steadily, it indicates that one or both of the 567's associated with that tone pair is not quite on frequency and needs a slight adjustment. If you have to make such an adjustment, proceed carefully—remember, each 567 is responsible for *four* individual outputs and you must check them all.

Latch board

While it is possible to operate the robot without the latch board, there are two important reasons why it should be included.

Firstly, it eliminates the need to keep a function key depressed. With the latch board, the key is pressed once to initiate the function desired, and pressed again to stop it. Not only does that save wear and tear on the batteries (and fingers) but it also brings us to the other reason for using the latch board.

Without it, only one function at a time could be carried out by the robot. With it, however, as many functions as desired can be operated at the same time and they can be switched on and off at will.

The latch board (Fig. 80) uses eight 7474 dual D, edge-triggered, flip-flop IC's to form 16 latches. The latching action is handled by cross-coupling each gate's inverting output (pin 6 or 8) to the "D" input (pin 2 or 12) of the IC. The status of the "D" input determines the status of the outputs. If it is "high," the normal (non-inverting) output (pin 5 or 9) is also "high," and the inverting output is "low." If it is "low," the status of the outputs is reversed.

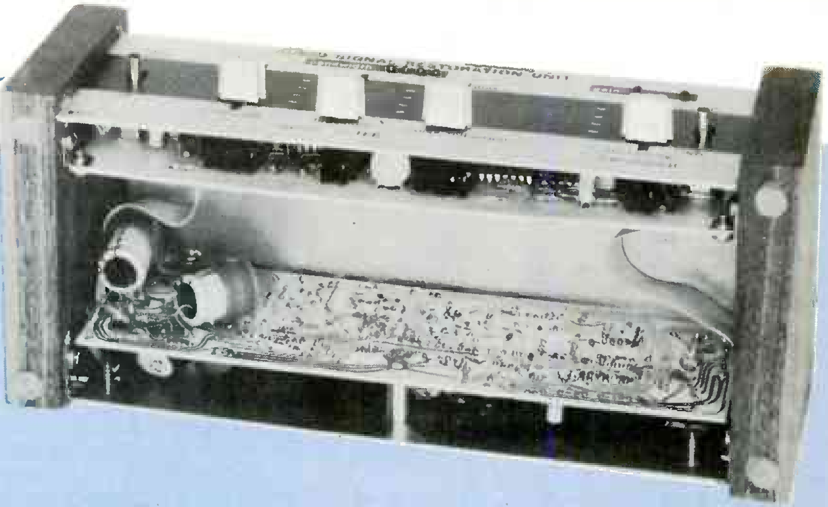
The 7474 triggers on a "low" to "high" transition of the input (clock) signal (pin 3 or 11). When a signal from the decoder board is applied, a "high" to "low" transition takes place and the normal (non-inverting) output of the gate goes "high" and stays "high." Simultaneously, the inverting output goes "low." That forces the "D" input "low," which means that the next "high" to "low" transition at the input will cause the output to go "low," and so on.

That means that the first time a function key is pressed, a function will be called into play. The next time it is pressed, that function will stop. And since, once the latch has been set, the function continues, another key can be pressed and another function called up while the first is running.

The CLEAR inputs of the IC's (pins 1 and 13) are also brought out to the board (the double donut pads in Fig. 81—if used they should be jumpered together) for future use. If the CLEAR inputs are grounded, the latches immediately go to a "low" state. That feature can be used as a "drop dead" switch to completely disable the robot by pushing a single key, if it becomes necessary.

The "drop dead" feature could also be
continued on page 88

BUILD THIS



HI-FI NOISE FILTER/Range Expander

Part 2—This month we'll look at the expander and noise reduction circuits in more detail and show you how to build the ASRU.

JOSEPH M. GORIN

IN THE FIRST PART OF THIS ARTICLE (March 1981 issue of **Radio-Electronics**) we discussed in general terms how the expander and noise-reduction sections of the ASRU (*A*udio *S*ignal *R*estoration *U*nit) work. We'll now cover those circuits in more detail.

Expander-circuit description

Figure 10 is a schematic of the right channel and control circuits of the expander portion of the ASRU. The signal is applied through R301 to IC6-a, a digital logic gate acting as a voltage-controlled resistor. Figure 11 shows the circuit of one of the six inverters that comprise the CD4049 IC and will help explain that unusual, but very effective and economical, circuit. The CD4049 CMOS hex inverter differs from most CMOS IC's because protection diode D_Z is intentionally omitted to allow driving the input from 10-volt logic signals while using a 5-volt power supply. In the ASRU, the "+" supply is connected to ground. That insures that the P-channel FET's, Q_A, are always off. That leaves us with Q_B active. As a result, we are left with six matched (see Fig. 11) N-Channel FET's because they are all fabricated on the same chip. The FET's are enhancement-mode devices, which means that after applying about 1.5-volts to the gate, the FET begins to turn on and the resistance between the source and drain decreases as the gate voltage is increased.

That causes IC6-a and R301 to form a voltage-controlled attenuator. The resistance of IC6-a varies between 55 and 90 ohms. At higher input levels, the gate voltage is reduced by the control circuits to reduce the attenuation. The output of the attenuator goes through C302 to operational amplifiers IC4 and IC5. Section IC6-f and its associated circuitry vary the amount of feedback around that op-amp combination and thus control the gain. Resistor R302 and capacitors C301 and C302, along with other parts in the feedback path, make sure that, at low audio frequencies, the signal does not go through the attenuators and is not expanded (see Fig. 6) of Part 1.

High attenuation in the early stages of the circuit reduces distortion by reducing signal levels, but makes noise a potential problem. The high gain and low noise required make the double op-amp combination (IC5-a and IC4-b) necessary. The front-end of that, op-amp IC5, is exceptionally quiet (4/n V $\sqrt{\text{Hz}}$) and is used as an input-differential pair of transistors.

Integrated circuit IC7-b serves to add 1.2 times the drain voltages onto the gates of IC6's FET's in a compensation scheme that further reduces distortion. The net result is an expansion block that is both quiet and undistorted. To derive the control signal, the two channels are summed by resistors R501 and R502. The gain of the control channel is varied with sensitivity control R503. Capacitors C506 and C502 reduce the low-frequency gain, and C501 rolls off the higher frequencies to obtain the curve shown in Fig. 3 of Part 1. The gain-stage of that filter is IC11-d. That IC and its associated components form a full-wave rectifier, such that the sum of the current through R509 and R510 is proportional to the absolute value of the filtered waveform. That makes the expansion polarity-independent so that all signals are expanded properly, regardless of their phase.

The currents in R509 and R510 and a bias current through R511 are converted by IC11-b, R512-R514, and D503-D505 to a voltage that is approximately proportional to the logarithm of the current. It is the non-linear impedance of the resistor-diode network that forms the gradual slope shown in Fig. 2 of Part 1. A rapid upward change in signal level causes D507 and D508 to turn on, and C504 and C505 can be rapidly charged. A slower rise will turn on only D507, so that C505 is charged more slowly through R517; that dual-mode reduces distortion for steady-state signals. For falling signal amplitudes, C504 and C505 must discharge slowly through R515 and R517.

The voltage on C505 is amplified by IC11-a. If the control voltage (IC11, pin 3) is below 4 volts, D515 is off and the signal is attenuated by R525-R527, to control FET gate-voltage deriver IC7-d. Figure 12 shows a block diagram of the gate-voltage deriver. Varying either the input voltage or drain current (I_D) will cause the op-amp to change the FET gate-voltage so that $V_{IN} = I_D \times R_{FET}$. In that case, increasing signal levels will increase V_{IN} and thus R_{FET}. Since IC7-d drives the gates of both IC6-a and b, their resistances will track its output.

In summary, increased signal levels will increase the control voltage, and thus the resistance of IC6-a, reducing the attenuation. As the control voltage gets even higher, diode D515 turns on, and the increasing current from R525 flows into the drain of IC6-c. That

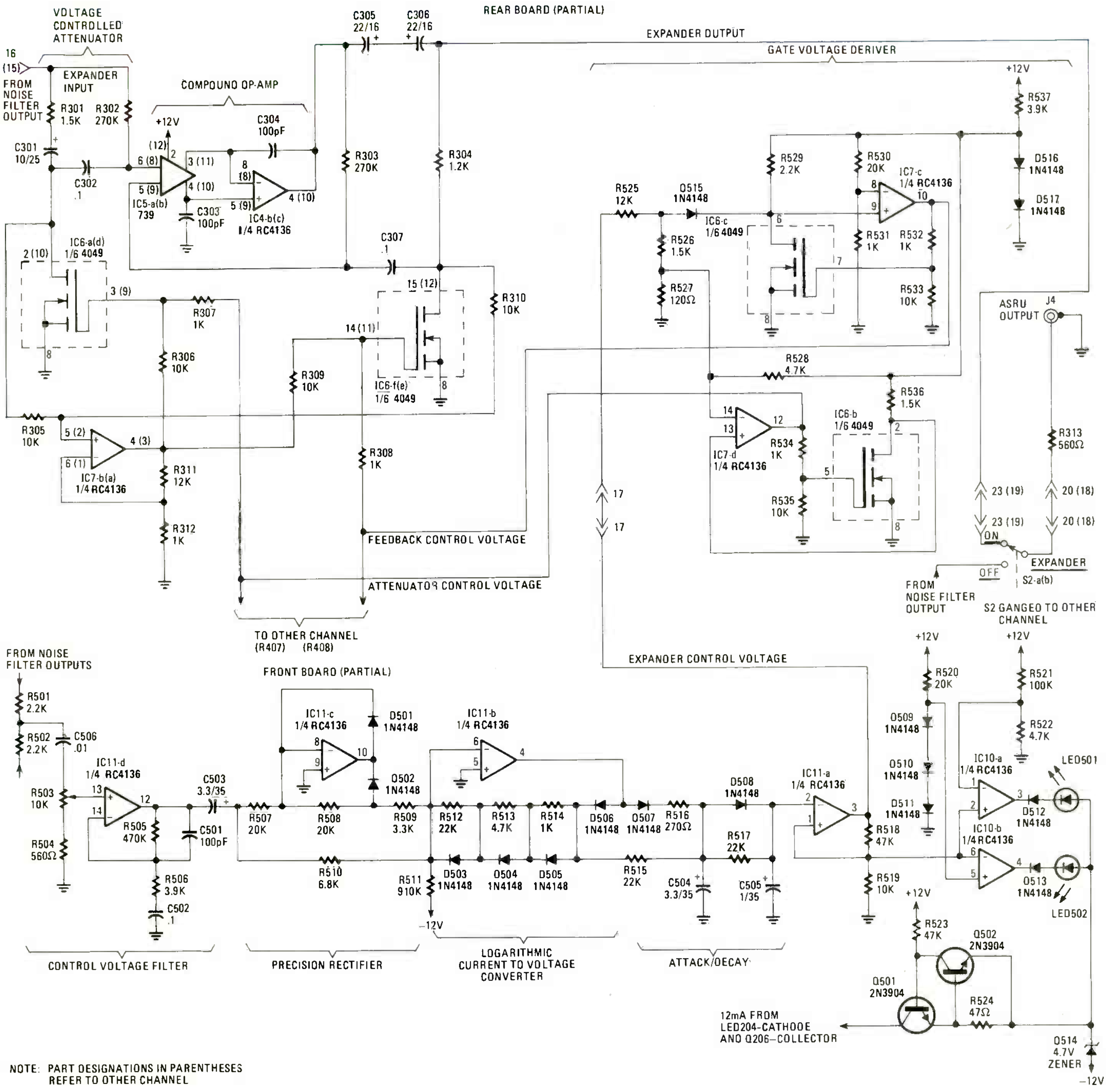


FIG. 10—RIGHT CHANNEL and control circuits of the expander portion. To find left-channel part numbers, add 100 to right-channel part numbers.

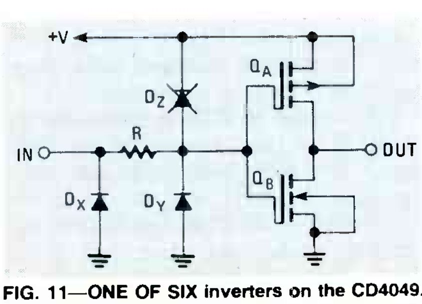


FIG. 11—ONE OF SIX inverters on the CD4049. Only the Q_B sections—six matched N-channel FET's—are used in the ASRU.

causes the IC7-c gate-voltage deriver to reduce the resistance of IC6-c and IC6-f, increasing the gain of the op-amp combination, IC4-IC5.

The op-amps driving LED501 (−6 dB) and LED502 (+1 dB) are used as comparators and absorb the current from Q501 through their respective LED's if the gain is either less than −6 dB or more than +1 dB. Transistors Q501 and 502 act as a constant 12 mA current source that is used for the display of the noise filter part of the ASRU. Zener diode D514 makes sure that the current source can still operate when both LED501 and LED502 are off.

Even the power supply (Fig. 13) is unusual. To maintain the exceptional signal-to-noise ratio desirable in a noise-reduction accessory, without requiring extensive magnetic shielding or coaxial wiring, the transformer is of the wall-plug type, and is physically separate from the ASRU. This type of transformer has a single, untapped secondary. To get both plus- and minus-12-volt

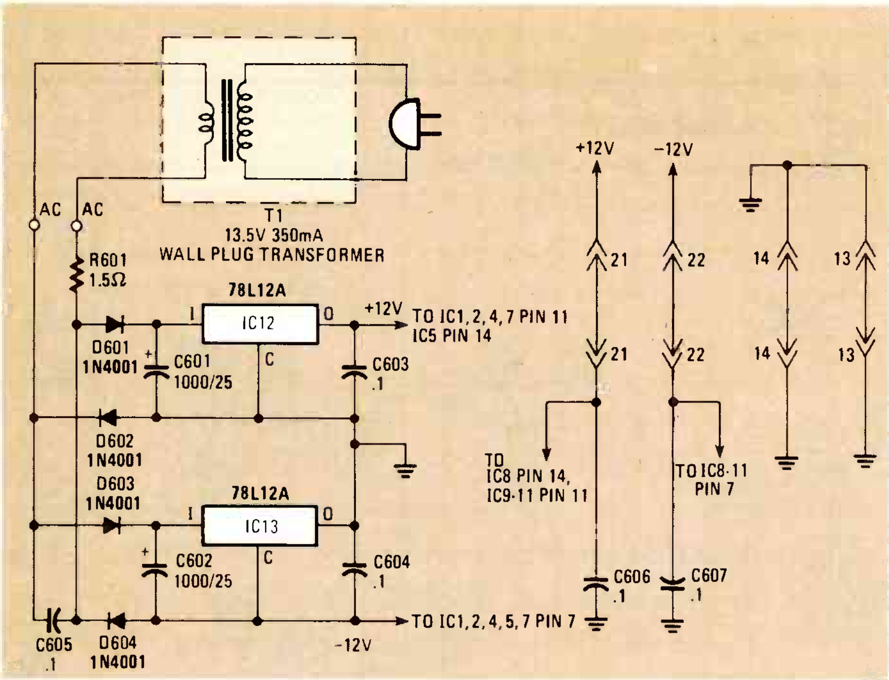


FIG. 13—POWER SUPPLY of the ASRU uses a separate wall-plug transformer, eliminating a potential source of hum.

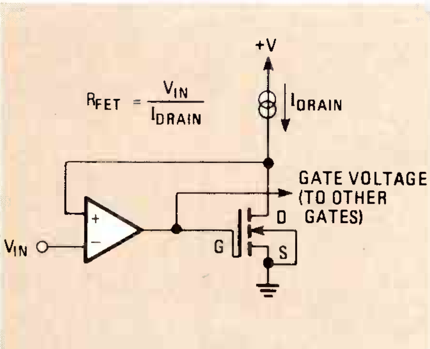


FIG. 12—GATE-VOLTAGE DERIVER, IC7-d, is used to control gain of op-amps IC4 and IC5.

supplies using economical positive voltage regulators, the circuit operates as follows. On positive half-cycles of the transformer output, C601 is charged up through D601 and D602. A standard IC regulator, IC12, is used. On negative half-cycles D603 and D604 charge up C602, which powers regulator IC13, except in this case, the regulator's output is grounded, and the terminal that is normally grounded supplies −12-volts.

Noise-reduction circuit description

The noise-reduction-section schematic is shown in Fig. 14. One of the variable integrators is formed by resistor R6, IC2-a, C1, R8 and IC3-b. With just R6 as an input resistor, and C1 as a feedback capacitor, IC2-a would be a fixed-gain integrator. The attenuator—consisting of R8 and IC3-b—in the feedback loop allows the gain to that integrator to be varied.

Capacitor C2 provides AC coupling to prevent DC errors (such as voltage-offsets) from causing "thumps" when the resistance of IC3-b changes. Resistor R7 provides bandwith compensation for the op-amp.

Capacitor C3 and resistor R9 do two things: They filter the control signal to keep it from acting too quickly and also feed back drain voltage to the gate of this section of the IC to cancel some of the FET's distortion.

The summing network (see Fig. 7 in Part 1) is made up of IC1-b and R2-R5. The reason there are two "−" inputs and one "+" input is because the design of the integrators causes the signal to be inverted. The input impedance is kept high by using IC1-a as an input buffer. The output buffer, IC10-d, acts to keep the output impedance low. Resistor R16 is used to vary the amount of noise reduction.

The highpass and bandpass signals are added by R14 and R114, and by R15 and R115, respectively. Two 19-kHz filters to remove any residual pilot tone from FM multiplex signals—preventing interference with the action of the noise filter—are made up of C201 and L201, and C204 and L202.

It is important that strong fundamental tones below 1 kHz and non-musical signals above 25 kHz not be allowed to affect the control-voltage-determining circuits. High sensitivity, though, is necessary to allow the filter to respond to low-level, high-frequency signals such as those produced by triangles (the percussion instrument that goes "ding"). The A739—IC8—provides that high sensitivity at a very low noise figure.

That IC is run in an *open loop* configuration (without feedback) at the frequencies where most musical activity takes place. Resistors R206 and R207, and capacitors C210 and C211 provide feedback to control the biasing of the op-amp and to roll off the low-frequency gain. Resistors R204 and R205 reduce the open-loop gain, and capacitors C206-C209, along with C203, roll off the high-frequency gain. Low-frequency gain is also rolled-off by C202, C205, C212 and C213.

Capacitors C212 and C213 also couple the highpass and bandpass signals into precision rectifiers IC9-b and IC9-c. The combined gain of those two IC's is about 2000. By obtaining that gain through two stages—IC8, whose output is a current, and IC9 (together with R208 and R209), that changes that current to a voltage—it is possible to get a gain with rectification that is normally very difficult to obtain due to stray capacitive feedback.

The weighted-difference blocks (Fig. 8, Part 1) are made from resistors R212-R214. they subtract, rather than add, because IC9-c is a *positive*-output rectifier, while IC9-b has a *negative* output. The bandpass channel is clamped by diode D205 that turns on at about three volts, allowing the energy in the highpass section to push the bandwidth all the way out at high levels. The action of the bandpass channel is slowed by C214. That helps cause filter corner-frequency overshoot during transients.

The fast-attack/slow-decay circuit consists of IC9-d and its associated components. The attack time is 4 mS; the decay time 80 mS. Low-impedance drive for the exponential curve-shaping and display network, R224-R228 and Q204-Q206, is provided by IC9-a. When low-level control voltages are present at C216, all the transistors are off, and the resistors act as a simple voltage divider.

As the voltage at the capacitor increases to a few tenths of a volt, Q202 turns off, Q201 turns on, and LED201 goes out. At higher voltages, Q204 turns on, and LED202 goes out. Since the base-emitter voltage of Q204 cannot be much greater than 0.6 volt, R224 is eliminated from the voltage divider, increasing its output dramatically. In turn, Q205 and Q206 turn on with the same effect. As the voltage on R228 approaches 1.2 volts, D210 and Q203 turn on and clamp the voltage at C216 in a feedback path to prevent driving the voltage-controlled filter too hard. Thus, until the limit is reached, attenuation constantly declines exponentially.

The voltage on R228 is offset slightly by R230 so that, even with no input signal, the filter bandwidth can never go below 1.2 kHz. As was explained previously, IC4-a, IC3-c and IC3-d, together with their associated parts, form a gate-voltage deriving circuit.

Control-circuit gain is varied by R202 and R203. That sensitivity control

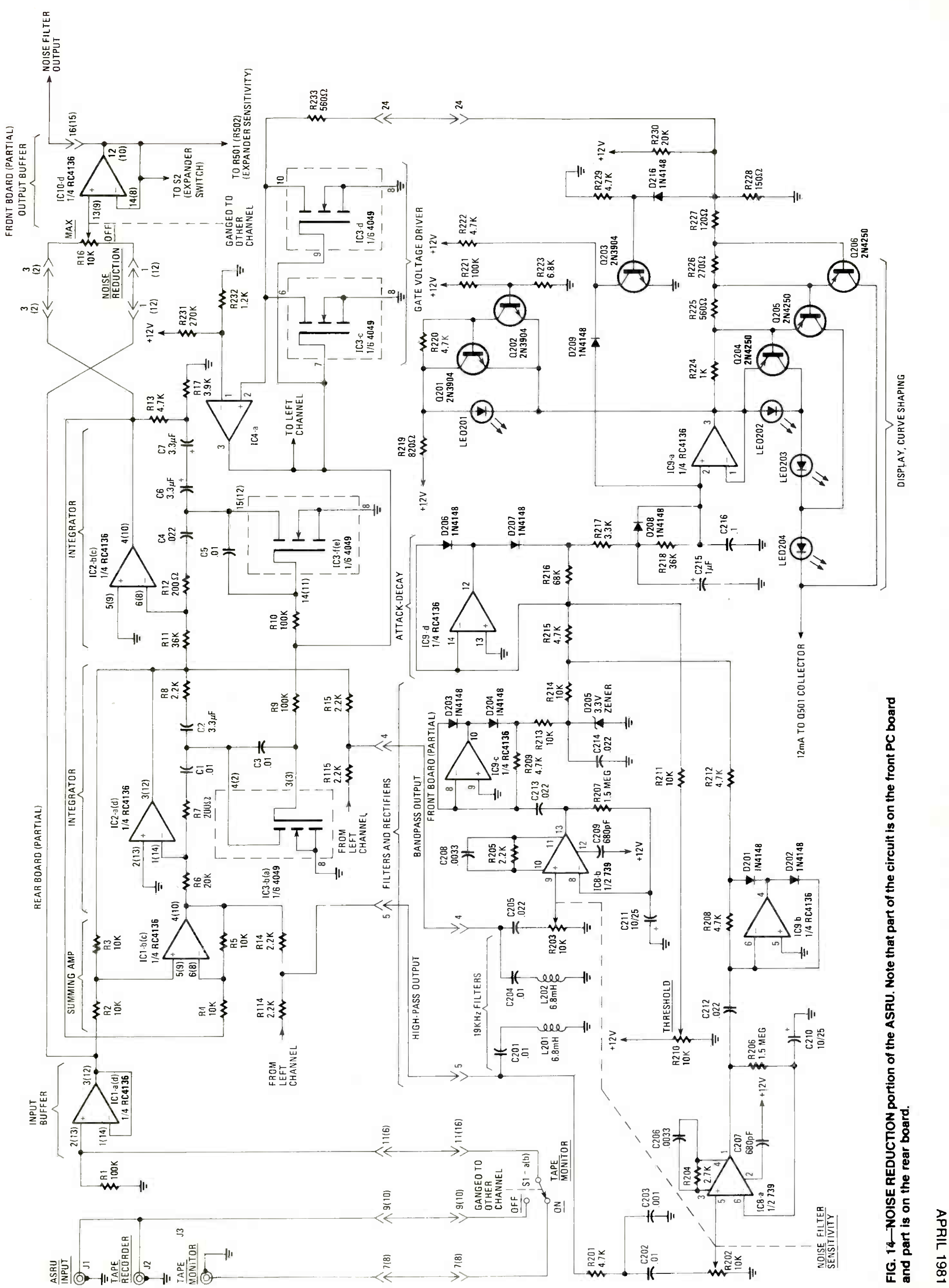


FIG. 14—NOISE REDUCTION portion of the ASRU. Note that part of the circuit is on the front PC board and part is on the rear board.

determines the ASRU's response to transients. Resistor R210, the THRESHOLD control, supplies a bias current to the attack/decay circuit; if there is enough noise to change the 1.2-kHz quiescent corner frequency, that current can keep that from happening.

Construction

Because of the complexity of this project, the use of PC boards is recommended. A single foil pattern, Fig. 15, can be etched on one piece of copper-clad material that can then be cut in two to provide both the front and rear single-sided ASRU boards.

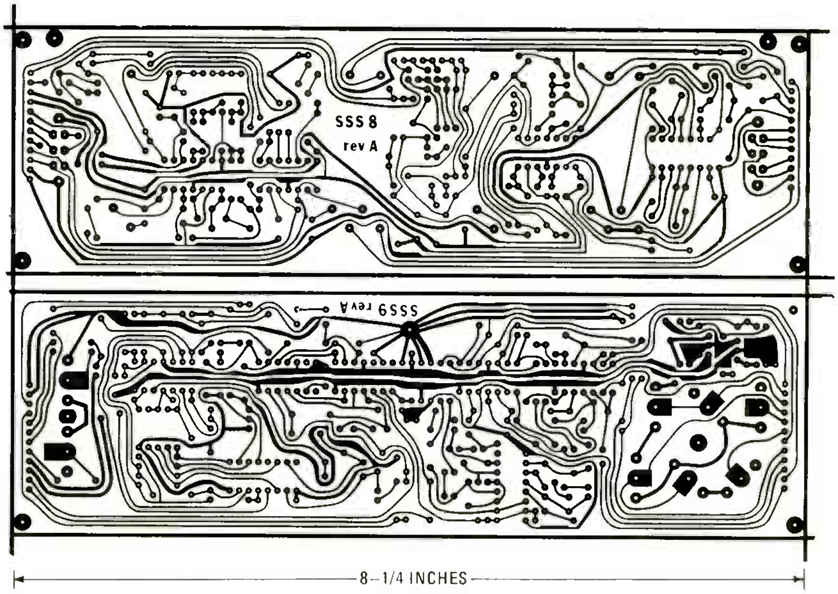


FIG. 15—FOIL PATTERN for the front and rear PC boards. Both patterns can be etched on a single copper-clad board (as shown) if you wish.

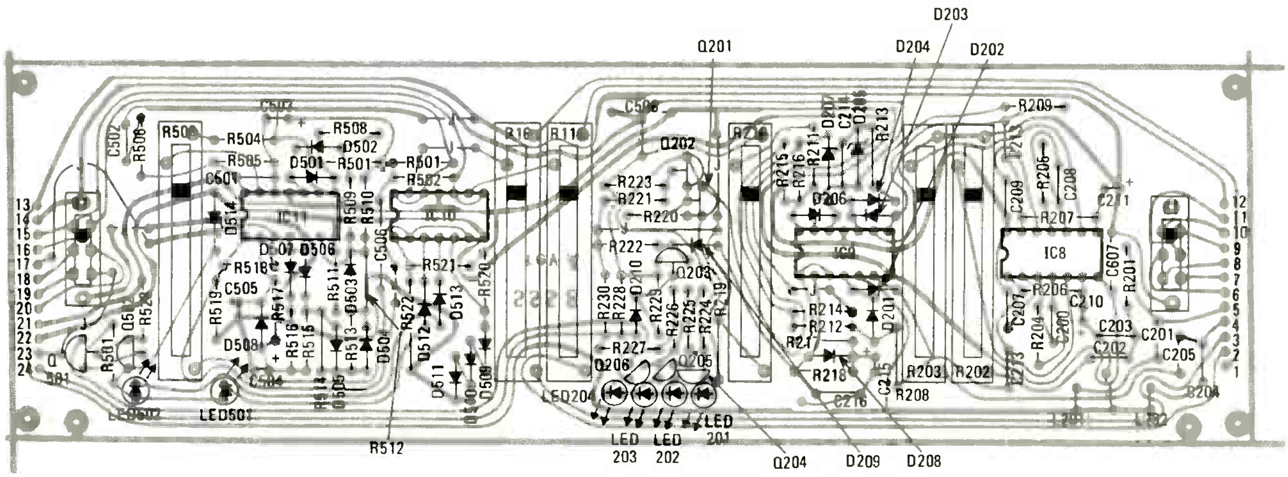


FIG. 16—PARTS PLACEMENT guide for the front PC board. The use of IC sockets is recommended.

Parts-placement diagrams for the front and rear boards are shown in Figs. 16 and 17. Use those, together with Fig. 18, to help you in stuffing the boards.

The use of IC sockets is recommended. Install those first, followed, in sequence, by the resistors, diodes, capacitors, transistors, and other components. Make sure that all 24 jumpers (12 on each board) are accounted for.

In the prototype (Fig. 18), the LED's were mounted in a 16-pin IC socket that had been cut in half, lengthwise. That allowed them to protrude far enough forward to reach the holes in the front panel.

The front and the rear boards are mounted back to back. Use two short pieces of 12-conductor ribbon cable to connect the two boards by means of the holes located at the ends of the boards. Hole 1 on the rear board is connected to hole 1 on the front board, hole 2 to hole 2, etc.

Be particularly careful when installing IC3 and IC6—they're static-sensitive. Keep them in their protective foam or tubes until you need them. Before handling them ground both yourself and the PC board to discharge any static electricity that may be present.

The two power-supply capacitors, C601 and C602, are mounted on the back (foil side) of the rear board and secured with plastic cable clamps. The clamps are attached through a spacer to the hole between jacks J1 and J6.

Make sure, of course, that every polarized component is correctly oriented.

The two PC boards are supported by wooden end-panels and a metal cover may be added for appearance's sake and to protect the boards. Since the power transformer is of the wall-plug type and is isolated by distance from the ASRU, hum is not a problem.

Installation

Like most other signal processors, the ASRU is connected to a receiver or amplifier using the tape-monitor loop. Its input is connected to the TAPE RECORDER or TAPE OUTPUT jacks, and the output to the TAPE MONITOR, TAPE PLAY or TAPE IN jacks.

Used that way, the TAPE MONITOR switch can be used to bypass the ASRU or to bring it into the circuit. (The EXPANDER and NOISE REDUCTION controls, if turned to the OFF position, will also take the ASRU out of the circuit, and the TAPE MONITOR switch can always be left in the ON position.)

A tape deck can be connected to the ASRU just as it had been connected to your receiver or amplifier before the ASRU took over that unit's tape-monitor jacks.

Operation

It takes some effort to learn how to set up and use the ASRU properly at first. Things become easier with practice, though. The LED's give you an idea of what's happening in the system, and the controls are not very critical (because of the spectral-tracking loop

continued on page 104

BIG BASS from small speakers

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

Here's a look at an ultra-small speaker system that has good sound quality and delivers 95 dB of sound-pressure level. Dynamic equalization makes it possible.

AVID FOLLOWERS OF WHAT'S NEW IN audio (and particularly in loudspeaker development) have no doubt heard about a series of ultra-small speaker systems recently introduced by KLH. The smallest of those "computer controlled speaker systems" is the *model KLH-3* and although its volume is a mere 0.25 cubic feet the speaker can deliver up to 95 dB of sound-pressure level with a cut-off frequency of 40 Hz (its −3 dB point). Each pair of speakers is sold with KLH's *Analog Bass Computer*. It would more aptly be described as a dynamic equalizer that constantly senses an electrical replica of the woofer cone motion and adjusts the electrical frequency response and gain of the equalizer whenever the transducer or loudspeaker signals would be likely to exceed a safe level.

Although I have heard those speakers and been impressed with their small size and unusual bass-output capability on more than one occasion, it was not until I attended the Audio Engineering Society Convention, in London, England, that I was offered a full explanation of how the equalized loudspeakers work. That explanation was provided by the engineer who helped KLH with the design of the speakers, Daniel R. von Recklinghausen. At the AES convention, Dan von Recklinghausen presented a technical paper, titled "Dynamic Equalization for Loudspeakers," that finally clarified the subject.

As has been stated many times, one of the most important limitations on smoothness of response of a given loudspeaker system is the interface between that speaker and the room in which it is installed. Reflections from boundary walls and excitation of room modes can easily cause as much as a ±20 dB variation in sound-pressure level reaching the listener. That is true even for a speaker that would show totally flat response to within a dB or two, if measured in an anechoic chamber.

Many manufacturers encourage their customers to experiment with loudspeaker location and listening position until best results are obtained. Unfortunately, when you are dealing with the "real world" of large-speaker enclosures, fixed room decor, and limitations imposed by room dimensions, wall-surface openings, windows, and the like, finding the best speaker position and listener position is not easy. That is one reason why trying to make loudspeakers smaller has always seemed like a good idea. Other obvious benefits are lower cost and consumer acceptance.

In an earlier article about speaker-system enclosure design I pointed out that all loudspeaker systems, regardless of enclosure type, have a number of inter-related parameters such as small-signal low-frequency limit, enclosure cubic volume, and efficiency. Once you choose the type of enclosure (closed, vented, etc.), the choice of two of those parameters automatically determines the third. Once the type of enclosure is chosen, an extension of low-frequency response by one full octave would require either an increase in enclosure size by a factor of 8:1 or a drop in efficiency of 9 dB, or a combination of both.

A vented enclosure will have a lower low-frequency cutoff than a sealed box, if both systems have been designed for the best flat response down to their cut-off frequencies. And a flat vented enclosure with two-pole equalization results in a still lower low-frequency cut-off. Further extension of the low-frequency limit of a loudspeaker system involves several other criteria which may dictate the actual limit possible. For example, changing over to a loudspeaker that uses fixed electrical equalization may cause amplifier or speaker overload. Reducing the possibility of that overload is one of the purposes of

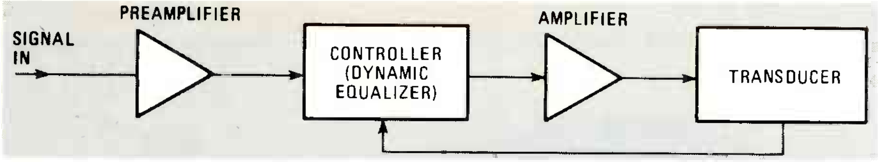


FIG. 1—THE DYNAMIC EQUALIZATION CIRCUITS ARE CONNECTED between the preamplifier and the amplifier of the sound system.

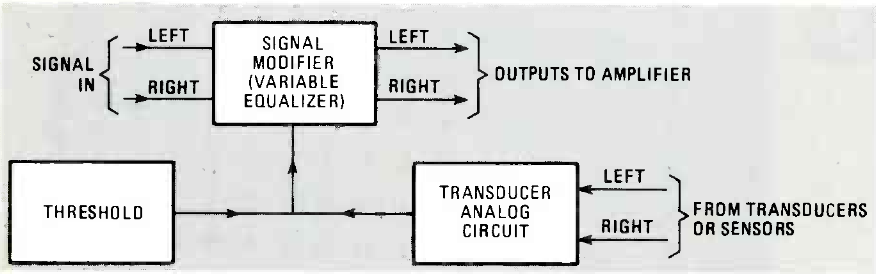


FIG. 2—SIMPLIFIED DYNAMIC EQUALIZER CONSISTS OF A TWO-CHANNEL TRANSDUCER analog-circuit, a common threshold circuit, and a two-channel signal-modifier circuit.

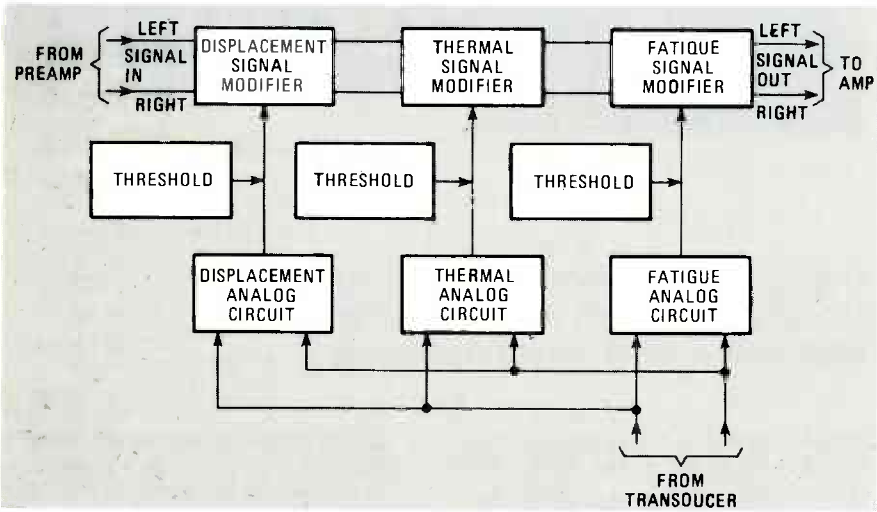


FIG. 3—EACH ANALOG CIRCUIT REPRODUCES A DIFFERENT DRIVER CHARACTERISTIC. The output from those circuits control the appropriate signal-modifier circuits.

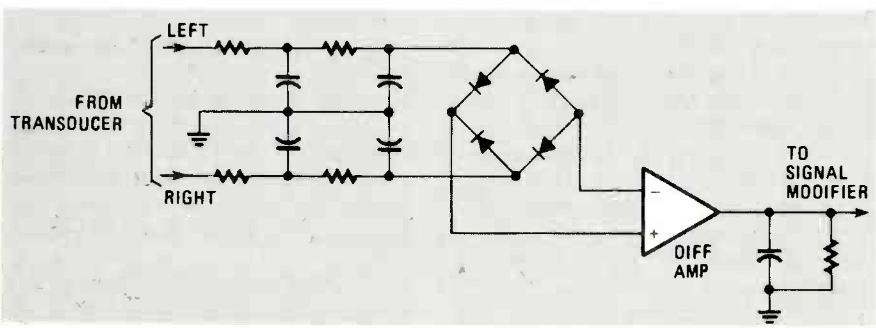


FIG. 4—SIMPLIFIED SCHEMATIC OF A CONE-DISPLACEMENT ANALOG-CIRCUIT. The filter output is proportional to the cone displacement and vent air velocity.

dynamic equalization and is an important feature of that form of equalization when compared with fixed equalization, provided by some loudspeaker manufacturers as part of their systems.

How dynamic equalization works

As can be seen from Fig. 1, in a loudspeaker system equipped with a dynamic equalizer, the equalizer senses an electrical equivalent of the speaker cone's motion. The equalizer adjusts its own electrical frequency response and gain whenever the loudspeaker signals exceed a previously determined safe level. The amplifying and equalizing circuits are connected between the preamplifier and the power amplifier of the system. If the equalizer is to be used with an all-in-one receiver or an integrated amplifier, it may be placed in the signal path by using the tape monitor loop.

Figure 2 is a block diagram of one form of dynamic equalizer or controller. It consists of three sections: a two-channel transducer analog circuit, a common threshold circuit, and a two-channel signal modifying circuit that operates from the common control of the analog and threshold circuits. As a first attempt at dynamic equalization, you might attach various sensors to the loudspeaker, each one detecting various characteristics of the driver such as cone motion, temperature, etc. However, if the loudspeaker is a known entity and its characteristics are stable from unit to unit, the driving signal applied to the speaker (that is, the amplifier's outut signal) may be processed in a number of different ways to produce signals that are proportional to the driver characteristics that are of concern (cone displacement, temperature rise, etc.).

Figure 3, a more detailed block diagram of a dynamic equalizer/protector circuit, shows several two-channel analog circuits connected in parallel. Each of those produce separate output signals that in turn control separate two-channel signal-modifying circuits connected in series. There are separate threshold circuits for each function.

Figure 4 shows a simplified version of the cone-displacement analog circuit. Cone displacement in a vented enclosure, like the ones used in the KLH designs, show maximum displacement at very low frequencies, where suspension stiffness controls the cone motion. Displacement reaches a minimum at the resonant frequency determined by the vent/cabinet combination and then rises to second maximum level (lower than the first) and eventually falls, approaching −12 dB per octave in the mass-controlled region.

Since the designers felt it desirable to limit the maximum air velocity in the vent, all of those effects can be combined into a simple second-order lowpass filter having a Q of 0.45 and a corner frequency near 60 Hz. The filter transforms the driving signal derived from the associated amplifier's output terminals into a signal proportional to the combination of cone displacement and vent-air velocity.

The output of each lowpass filter is rectified by a full-wave bridge. The highest peak is compared with a threshold voltage and is used to control the signal-modifier circuit. The peak voltage is reached just before the peak cone displacement.

Signal-modifier circuitry

The combined low-frequency equalization and cone-displacement signal-modifier circuitry is shown in Fig. 5. A

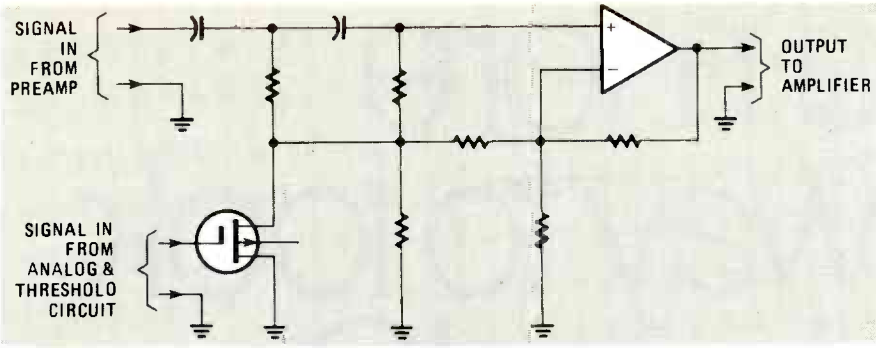


FIG. 5—COMBINED LOW-FREQUENCY EQUALIZATION and cone-displacement signal-modifier circuits.

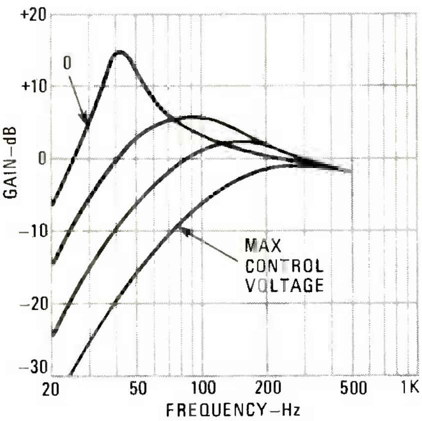


FIG. 6—FREQUENCY RESPONSE of the low-frequency equalizer/protector used in the *KLH-3*.

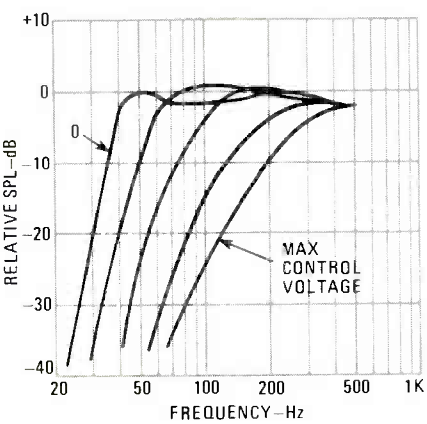


FIG. 7—OVERALL FREQUENCY RESPONSE of the equalized loudspeaker system.

two-section R-C highpass filter connected between the input of the control circuit and the non-inverting input of an operational amplifier has positive feedback applied to it from a voltage divider fed by the inverting or feedback terminal of the operational amplifier. That circuit is the equivalent of a two-pole highpass filter. By choosing components properly, both the cut-off frequency and the Q can be controlled, independent of the operational amplifier that only needs to have high loop gain. A field-effect transistor, connected in parallel with the grounded end of the attenuator, controls the Q and the cut-off frequency in the circuit.

The control voltage causes the gain at 40 Hz to vary over a range of more than 30 dB while varying the effective cut-off frequency over a range of more than 4:1. Signals below the minimum frequency are attenuated in all cases. At zero control voltage, the electrical response of the equalizer complements the frequency response of the loudspeaker system without equalization. That achieves the wildest "flat" frequency response possible. Similar designs are used in the signal-modifier circuits that sense and control temperature rise and driver fatigue.

Figure 6 is a graph of the measured frequency response of the low-frequency equalizer/protector used in the *KLH-3* system. When no control voltage is developed, the response curve marked "0" is obtained. At the maximum control voltage, no peak is obtained and the system has the highest cut-off frequency.

Figure 7 shows the overall frequency response of the equalized loudspeaker system, again beginning with "0" control voltage and extending to maximum control. The −3 dB cut-off point in the response varies from 40 Hz to 160 Hz, depending upon the control voltage, and has only a few dB of amplitude variation above cut-off. When listening to music, response is curtailed only when large, low-frequency signals occur. Most of the time the widest frequency response is maintained, since, for most musical signals reproduced at moderate to high loudness levels, there is likely to be little or no control voltage developed.

According to the inventors and designers of the system, the four main purposes of the electronic equalizer/protector module, or Analog Bass Computer, as they prefer to call it, are:

1. To provide steep-cut highpass filtering, removing frequency components of the signal below the loudspeaker cut-off (in this case 40 Hz).
2. To provide a frequency compensated output in conjunction with the acoustical alignment used in the loudspeakers so that flat response is obtained above the cut-off frequency.
3. To provide an "analog" frequency/level sensitive control-signal that drives the frequency-compensating circuits.
4. To compensate for any mid-band irregularities in sound energy output caused by placing the system too near to, or too far from, a solid surface.

Interestingly, the system works in such a way that although substantial equalization is used to reproduce low-level signals, maximum amplifier output is reduced at low frequencies and high levels, minimizing possible amplifier overload problems. In other words, the amplifier is not called on to work into the load if useful output from the loudspeaker is not obtained. As most readers will appreciate, that situation differs from what occurs with fixed, static equalizers sold with some speaker systems for the sole purpose of trying to "lift" the speaker's sagging low-end response.

According to KLH, the greatest benefit of such small speakers is the freedom to place them where they sound best. The biggest difference between a large concert hall and the average living room is size, and therefore smooth response at long wavelengths. Adjusting the ratio of direct to reflected sound, or rigorously specifying the location of the loudspeakers can not overcome those response variations. Letting the listener make the best of his or her room is the major reason for making speakers small. And if the small speakers are able to produce good sound quality from an unobtrusive source (as these little KLH units seem able to do) so much the better. **R-E**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CIRCLE 36 ON FREE INFORMATION CARD

TRONICS 2000 HEADQUARTERS are announced by this sign that sits outside their offices in Bloomington, IN.

RICHARD W. LAY*

Franchising the consumer electronic industry
What it can do for electronic service in the 1980's

A NEW COMPANY — TRONICS 2000 — OPENED its first franchised electronics repair center in Bloomington, IN about 12 months ago.

Today, operating in four areas—central Florida, Louisville, KY, Cincinnati, OH, and the northern environs of Chicago—the company expects within the next 12 months to expand operations to an electronics servicing network comprised of about 400 serviceshops.

And, according to President David J. Hagelin, that's just the beginning. It's all part of Hagelin's franchising plan for the $3.5 billion a year independent consumer-electronics service industry. If successful, Hagelin says, the effort will result in thousands of existing shops carrying the Tronics 2000 name by 1985.

In the process, he says, the program would:

—Help an industry populated with many one- and two-man companies suffering from the same problems facing all small businesses, and ill-equipped to handle the repair end of the revolution in microelectronics.

—Give consumers a trustworthy name they can rely on—similar to the *Century-21* concept in real estate—and foster consumer education in a field that few consumers know anything about.

—Make it easier for electronics manufacturers to educate both the service industry and the public about their latest electronic products.

"We're just seeing the tip of the iceberg as far as the impact of electronics on the consumer is concerned. It's fine and dandy for the manufacturers to build all of the electronics products, but somewhere along the line someone's going to have to fix them. There really is a serious consumer backlash building if the industry does not address its service problems immediately," according to Hagelin.

Does it really work?

Do any of those functions performed by the franchisor really work. Let's take a look at just one—identity — through an analogy.

Whether or not you like hamburgers, it is about a 99-to-1 shot your kids do. While that is not surprising, the fact remains that when they get into a car to go out to eat it always seems to be, "Let's go to *McDonalds'*," not, "Let's go for hamburgers."

That illustrates a real identity problem. An identity *problem*, that is, if you happen to be looking for "Joe's Hamburger Shop." But, an identity *plus* for *McDonalds'*.

Using that analogy on the number of currently existing consumer-electronics serviceshops—around 35,000—you can draw a rather vivid picture of the present state of the service industry. Out of approximately 35,000 serviceshops you might be able to identify perhaps 300 throughout the United States that would be considered truly large in scope.

From surveys on the consumer-service market, we know that well over half of the remaining 34,700—about 60%—are definitely in the "Joe's Hamburger" class, with the remaining shops floating somewhere in between those two extremes.

The small operator, probably doing between $60,000 and $150,000 a year in service-business volume, is plagued by: the technological complexity of the microprocessor age; an avalanche of products for the American home never before dreamed possible; and the unavailability of qualified, experienced technicians—they've been drained off by industry. In addition, he's saddled with a workload which dictates that instead of managing his shop, his head is stuck in the back end of a broken television set.

How Tronics 2000 operates

"The operating philosophy of Tronics 2000," Hagelin says, "is to construct consumer-service 'networks' within a given geographical area—a group of service centers that would be able to handle all of the complex electronics headed for the American home during the coming decade. Everything from video, to audio, to home security, to appliances and computer systems."

"The theory is that if one of our shops can't handle a specific type of product—say digital audio—another one of our shops within that area would. What that means to the consumer is that he is no longer saddled with searching for service—either calling, or carrying his broken unit around to three or four service shops only to be told to

*Director of Internal Operations, Tronics 2000 Corp., Bloomington, IN.

SHOP MANAGER LARRY SULLIVAN inside University Electronics.

"The major factor was the assistance. Everything from management, to promotional packages, to inventory control."

That's the way Larry Sullivan, the manager of the first Tronics-2000 franchise operation—University Electronics in Bloomington, IN—characterized the impact on his business since Tronics 2000 began working with his shop on a continuing basis.

"One important factor is name recognition. I actually had one of our new accounts call me up to ask if we would do his service simply because he had heard of the name. He didn't really know me from Santa Claus," Sullivan said. This new customer, incidentally, managed a large retail sales outlet and was dissatisfied with his current service arrangement.

"But the biggest factor to our success is the overall increase in efficiency of our shop and technicians. It's really picked up and I can see it in the profit and loss statement." One important contribution here was the new inventory-control system Sullivan placed into operation with the aid of Tronics-2000 consultation.

"There's no question in my mind that the Tronics 2000 has made me a better businessman," Sullivan said. "They showed me how to be aggressive and acquire new accounts. In the past few months we've gone into video servicing and already we are one of the largest service outlets for videodisc, large-screen video, and VCRs in southern Indiana."

As to the future, Sullivan says he sees problems—but problems stemming from growth. "We're gaining new business so fast I can foresee in the not too distant future where I will be outgrowing my 3,300 square foot shop. It is really a question now of how to cope with expansion."

"Really, it was inevitable. You can take a look at just about every other retail industry in this country and see that franchising really was in fact the salvaging influence for the independent business community."

Those thoughts were expressed by Robert P. Neal, owner of Able Electronics, Waukegan, IL, a veteran of 19 years in the electronic-service business and one of the largest servicers in northern Illinois outside of Chicago.

Neal's Able Electronics became a Tronics 2000 shop officially last Dec. 20. But in addition, Neal, along with several partners, purchased the Illinois territory of Lake, McHenry, and Boone counties and will act as the territorial developer for that area.

"The consumer-electronics service industry has been the whipping boy of consumer electronics since it began," Neal says. "The business we're in has a negative image from the start. When you deal with the public it's because someone has a problem. When you deal with the manufacturer, it's because one of his products broke down and he's not happy. When you deal with the suppliers, you face parts problems and out-of-stocks. On top of that, you're left to fend for yourself in keeping your technicians up to date on high-technology microelectronics.

ROBERT P. NEAL, owner of Able Electronics.

"Finally, I feel that with Tronics 2000 and the national organization it portends, I've finally got a business partner who's on my side and who has a real stock in my success or failure.

"Without such an organization in place and working by 1985 at the latest, the American public would face the largest crisis in service ever to hit us.

"It's simply an idea whose time has come."

take it somewhere else. As far as the consumer is concerned, he makes one stop. If our service center can't handle it, he arranges to have that unit fixed through the Tronics-2000 outlet in his area that is equipped to handle the job professionally."

Tronics 2000 operates under a two-tiered franchising system. The corporation, based in Bloomington, IN, offers franchises to "territorial" franchisees who purchase a defined developmental territory for an initial fee of $10,000. That territory is based on a minimum population of 600,000. The franchisee can further subdivide his territory into up to ten small franchises. Those small franchises would be available for $5000 each. That is one way for the franchisee to recoup his original investment, as he would retain 50% of the selling price.

Current programs

Programs that Tronics 2000 currently offers members, and which are expressly designed to impact most every aspect of a franchise business, are: volume-purchase programs for trucks, cars, and other shop vehicles; group-insurance benefits in health, life, liability, and retirement; volume-buying programs for electronic test equipment; computerized shop analysis, where members are assisted in identifying "weak" spots in purchasing, inventory, or technician productivity; and buying programs on forms, stationery, and signage. Contract-sales programs where members are assisted in pricing and marketing service contracts will also be available at a later date.

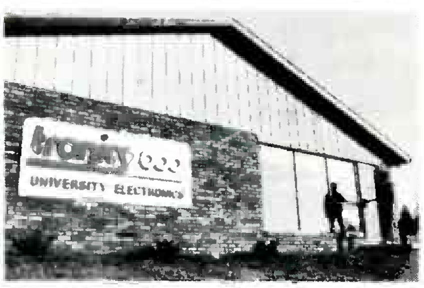
A specific example of just one area is insurance. In that case a Tronics 2000 franchise was able to realize a savings of 27% a year on liability insurance while upgrading that same coverage. And, for eight employees, the same franchise saved 44% a year on health coverages. For that particular member, it means a dollar savings of $470 per month—or $5,640 a year. That saving amounts to more than the initial $5,000 entry fee.

What about the public?

But what about the public: What is, or should be, the impact of a franchise on the public?

"Right or wrong," Hagelin says, "in the eyes of the consumer, bigness, high quality, and value often go hand in hand. That is the great advantage that the national-chain type of operation enjoys over the small, independent, and basically isolated operator. When it comes to consumer-electronics service, the public is even more confused than ever."

"Our business philosophy is simple. We want to insure not only the survival but the growth of the electronics-service industry, and we want to instill in the consumer, the idea that Tronics 2000 stands for quality service, convenience, and equitable pricing on a nationwide basis." R-E



THE FIRST FRANCHISEE—University Electronics in Bloomington.

hobby corner

Lower or raise the volume on your TV set, or anything else, by remote control.

EARL "DOC" SAVAGE, K4SDS, HOBBY EDITOR

HERE IS A SIMPLE LITTLE TRICK YOU CAN use to change the volume of an amplifier by remote control. It may be a TV, radio, stereo, or whatever. It may be because of the telephone, the doorbell, or objectionable loud commercials. The point is that there are times when you would like to reduce the volume temporarily without making two trips to the set. There even may be times when you would like to increase the volume. Increasing the volume is just as simple as decreasing it.

There are a number of ways to attack the problem of changing the volume of an audio amplifier by remote control. Several are more practical than throwing your shoe across the room. We'll look at two points of attack and two methods, then you can pick the combination that best suits your equipment and your junk-box.

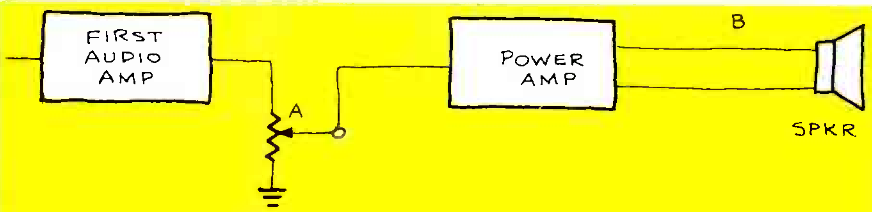


FIG. 1

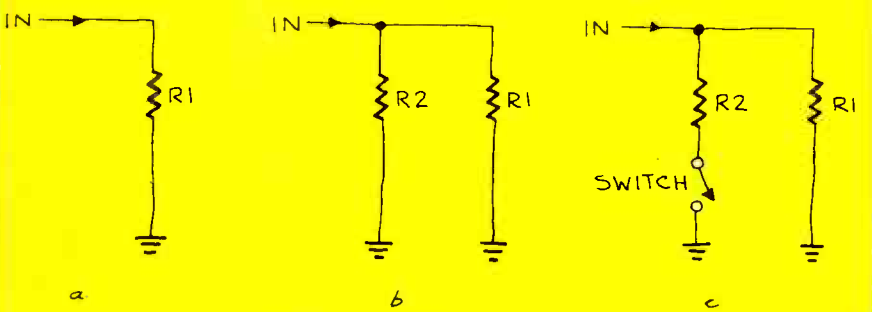


FIG. 2

The block diagram in Fig. 1 shows two points in any amplifier where the audio signal is readily accessible. One is the volume control (A) and the other is the output to the speaker (B). For our purposes, we'll consider points A and B to be the same.

Now, look at Fig. 2 for a quick review of how parallel resistors affect a circuit. In 2-a, all of the input signal goes through R1. In 2-b, resistor R2 has been added and the signal will be split, with some of it going through each resistor.

The amount of signal going through each resistor depends upon their values. For example, if R1 and R2 are equal, half of the signal will go through each one. In that case, adding R2 has cut the signal in R1 by one-half. Therefore, we can change the amount of signal going through R1 from full to half and back again anytime we wish by switching R2 in or out of the circuit (Fig. 2-c).

If that doesn't give you any ideas, take a look at Fig. 3. Resistor R1 is shown as the volume control in 3-a and as the speaker in 3-b. Turning the switch on in either case "sidetracks" part of the audio signal and that results in decreased audio output.

Let's pause and consider the value of the added resistor, R2. No specific values can be given because they depend upon the value of the particular R1 with which it is used and the amount of volume change desired. However, there are some general guidelines that can help you find a specific value.

A good beginning is to choose R2 so that it is the same value as R1. Typically volume controls are in the range of 5K to 25K ohms. Controls used in transistor amplifiers have values in the lower part of that range, while controls used in tube amplifiers have values in the higher part. Speaker impedances are generally 3 or 4 ohms—though they may be higher, especially in transistor amps.

If you cannot find the actual value for the control or speaker in your amp, tack-solder or clip a resistor (R2) of one of the above values across the control or speaker and listen to the change. Replace it with a higher-value resistor if the change is too great and with a smaller-value one if the change is too small.

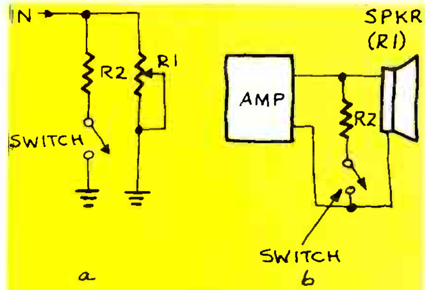


FIG. 3

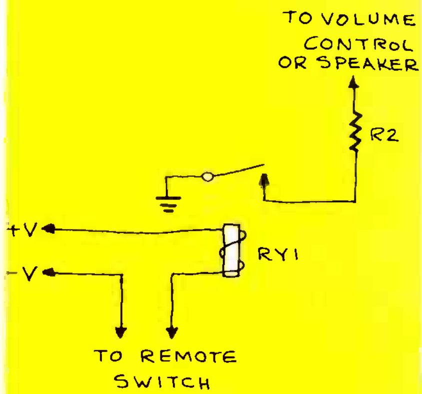


FIG. 4

So far so good—we have changed the volume. However a switch on the amplifer doesn't solve the original problem and it is often unsatisfactory to run long audio lines around a room. That means that we must find some way to operate the switch by remote control.

The obvious choices are to use a relay or a transistor for the switch. Either can be controlled remotely. Figure 4 shows how a relay would be placed in the circuit. I recommend a relay over a transistor in this case because it will be quite difficult to make a transistor work properly in some types of amplifiers. In either case, the operating voltage can be taken from the amplifier, making a separate power supply unnecessary.

If a relay is used, it should have a low-

continued on page 84

HOBBY CORNER
continued from page 82

voltage coil. A latching-type relay would complicate matters a bit, but it would not have to be powered all the time that you want the volume low.

The pair of lines labeled "remote switch" in Fig. 4 can go through a long pair of wires across the room to a SPST or a momentary switch located by the telephone, your chair, or wherever.

There are a variety of means you can use to achieve a no-wires-control over the relay or transistor. A flashlight beam can operate a phototransistor or a cadmium-sulfide photoresistor. Surplus "sound switches" are available at very low prices. Of course, you can get quite fancy with radio control.

Up to this point, we have been discussing how to decrease the volume of an amplifier. You can just as easily decrease it to zero. In Fig. 5-a, the audio signal is cut off when the relay is energized.

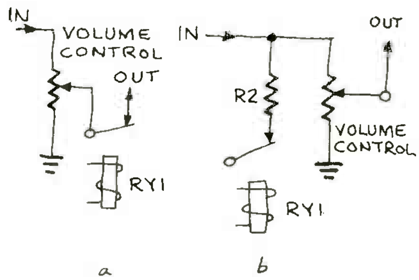
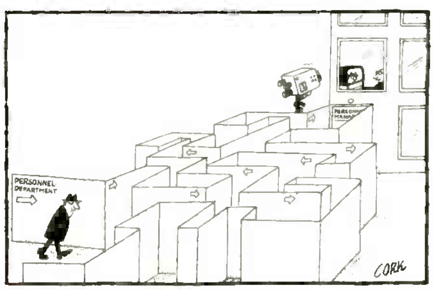


FIG. 5

Increasing the volume only takes some minor changes in the circuit of Fig. 4. The relay connection is shown in Fig. 5-b. In this case, the volume is set at normal with R2 in the circuit. Energizing the relay removes R2 from the circuit and the full signal goes to the volume control and out.

You will have noticed of course, that no component values have been given. One circuit will not work in all amplifiers because there are too many variables. Enough information has been provided however, so that you should be able to work one out with little if any difficulty.

Now, get busy and remote the volume on your TV. You will not only save yourself time and trouble but your rug will last much longer! **R-E**



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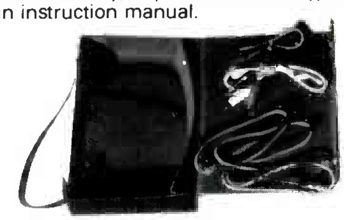

FREE CASE

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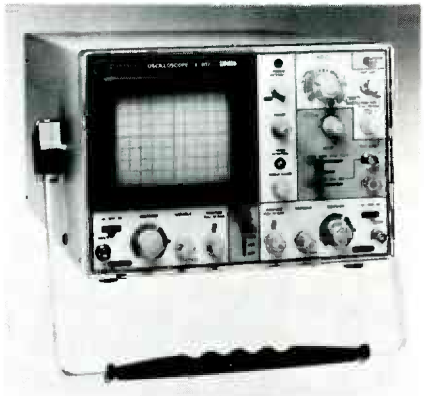
new products

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

20 MHz DUAL TRACE SCOPE, *model V-202*, offers a 5.5-in. square CRT with an internal graticule. It features vertical sensitivty of 1 mV/div to 7 MHz (using × 5 amplifier) and 5 mV/div over the full bandwidth. Dynamic range for the vertical



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amplifier is eight divisions or more. The display modes are Ch 1, Ch 2, Dual, Add, and Diff.

Other features include Z-axis modulation, continuously variable scale illumination, trace rotation, front-panel X-Y operation, and built-in TV sync separator. The weight is 19 lbs., and the measurements are 11 × 7.6 × 16 in. Price $850.00 with two ×1/×10 probes included.—**Hitachi Denshi America Ltd.**, 175 Crossways Park West, Woodbury, NY 11797.

OSCILLOSCOPE/COMPONENT TESTER, *model HM307*, is a compact, lightweight single-trace oscilloscope designed for both field service and laboratory applications. It has a built-in component tester that tests common semiconductors and passive components in circuit. (Transistors, diodes, resistors, capacitors, and most other components can be checked.) The *model HM307* changes from an oscilloscope to a component tester with the press of a single button while the oscilloscope settings are left undisturbed.

The component tester applies ±8.6 volts RMS maximum to the device with current limiting to 28 mA; the resulting V/I display instantly reveals most bad semiconductors. No drift compensation is needed, and the *model HM307* will trigger on signals as small as 3mm up to 30 MHz. Vertical sensitivity ranges from 5 mV to 20 V/cm in 12

CIRCLE 152 ON FREE INFORMATION CARD

calibrated steps. The time base is from 2 seconds to 0.2 μsec/cm with auto and external triggering that ranges from 2 Hz to 30 MHz.

All critical DC voltages are regulated. The input AC transformer can be connected to operate from 110 to 237 volts AC, 50 to 60 Hz. The built-in 1 kHz, 0.2-volt (±1%) squarewave generator is used for checking probe compensation. The *model HM307* comes housed in an all-metal low-profile case—4.5 × 8.3 × 10.4 in.—designed for rugged field-service use. There is a handy carry handle and retractable tilt-up stand that pulls down from under the unit. Accessories include ×1 probes, ×10 probes, ×100 probes, demodulator probes, test cables, viewing hood, carrying case, and scope chart. Price $405.00 —**Hameg, Inc.**, 191 Main Street, Port Washington, NY 11050.

MULTITESTER, *model M20*, features a fuse-protected ohms circuit, three-color coded scale plate and front panel, diode-protected meter

CIRCLE 153 ON FREE INFORMATION CARD

movement, compact ABS plastic case, easy-to-read bold numerals on the scale plate, and a one-year warranty. The 12-range multitester handles most electrical/electronic measuring jobs and weighs 6 ounces.

The *model M20* can check power supplies and logic circuits, measure line and control voltages, and test diodes, transistors and resistors. Test leads, battery, and instruction booklet are included. Price $13.95.—**Universal Enterprises, Inc.**, 14270 W. Science Park Drive, Portland, OR 97229.

PLUG-IN AC POWER CONDITIONER, *model 300*, is designed to protect sensitive electronic devices that use microprocessor and semiconductor circuitry from transients, and continuous or intermittent power-line noise. It is for use with

continued on page 88

UNICORN-1 ROBOT

continued from page 69

tied into the FM receiver. Now, if the carrier from the transmitter were lost, the robot would immediately stop functioning—a nice safety feature for long-range work.

This board also requires a good five-volt power supply. Connect it directly to the board—the fingers at the edge are intended for mounting purposes (there aren't enough of them on a single-sided board for all the inputs and outputs).

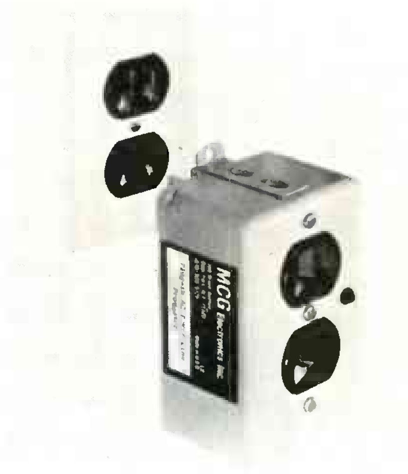
The connections are called out in Fig. 82. Use ribbon cable to connect the decoder and latch boards and to connect the latch board to jacks J1 and J2 on the relay-driver board.

With these three boards installed, the conversion to radio control is complete. In the next installment we'll discuss what would be involved in interfacing the robot to a computer. **R-E**

NEW PRODUCTS

continued from page 86

computers, terminals, modems, and printers, as well as office, laboratory, and communications equipment. It incorporates a wall-socket type fixture, so that all equipment can be plugged in easily and any 117-volt AC wall outlet is thus converted into a "dedicated" line.



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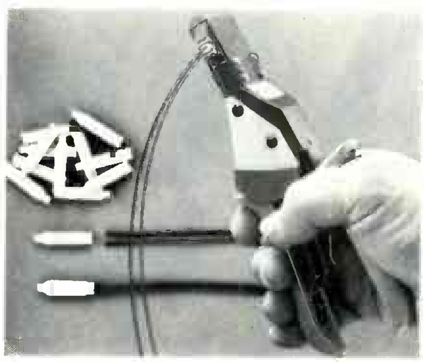
The *model 300* clamps high-energy transients and filters RFI (*R*adio *F*requency *I*nterference) from the AC line. Should a severe transient take place, the device will "fail safe," protecting the equipment without interruption of service or loss of data. The status of the protection is continuously monitored by a LED.

Both low and high-impedance loads are protected from common- and transverse-mode transients. The *model 300* holds down voltage spikes to safe levels, absorbing up to 80 joules of transient energy. It is easily portable, weighing only one pound. Price $135.00—**MCG,** 160 Brook Avenue, Deer Park, NY 11719.

"D" CONNECTOR TOOL, *model CP-200,* is designed to crimp "B"-type insulated wire connectors onto the ends of unstripped wires. Metal "teeth" within the connector penetrate the wire insulation and engage the conductor when the connector is crimped. A built-in ratchet assures that a complete pressing cycle is made before the handles are released. A factory-set mechanical stop prevents over-pressing, thus assuring a high-quality conductive joint.



CIRCLE 155 ON FREE INFORMATION CARD

"B" connectors are available both plain and "jelly"-filled. The latter features "silicone-type grease packing" which wards off contamination of the connection and inhibits oxidation. Both types of connectors are available in packages of 250, 500, and 1000 pieces. Prices: *CP-200*—$55.00; 250 "B" Connectors—$12.00 for the plain, $17.33 for the jelly-filled.—**OK Machine and Tool Corporation,** 3455 Conner Street, Bronx, NY 10475. **R-E**

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

THE NEW EXPLORER/85 SYSTEM

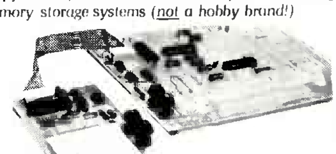
Special! *Full 8" floppy, 64k system for less than the price of a mini! Only* $1499.95!

(Also available wired & tested. $1799.95)

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

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

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



Level "A" With Hex Keypad/Display.

LEVEL "A" SPECIFICATIONS

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

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

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

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

HEX KEYPAD/DISPLAY SPECIFICATIONS

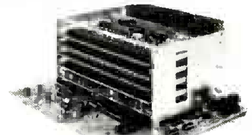
Calculator type keypad with 24 system-defined and 16 user-defined keys. Six digit calculator-type display, that displays full address plus data as well as register and status information.

LEVEL "B" SPECIFICATIONS

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

LEVEL "C" SPECIFICATIONS

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



Explorer/85 With Level "C" Card Cage.

LEVEL "D" SPECIFICATIONS

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

LEVEL "E" SPECIFICATIONS

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

DISK DRIVE SPECIFICATIONS

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

DISK CONTROLLER/ I/O BOARD SPECIFICATIONS

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

DISK DRIVE CABINET/POWER SUPPLY

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

ORDER A COORDINATED EXPLORER/85 APPLICATIONS PAK!

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

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

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

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

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

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

Please send the items checked below:

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

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CIRCLE 37 ON FREE INFORMATION CARD

communications corner

Those popular cordless telephones. Here's a look at what they're all about. **HERB FRIEDMAN,** COMMUNICATIONS EDITOR

MANUFACTURERS AND INDUSTRY GROUPS occasionally conduct surveys to determine the products consumers prefer. But one of the best survey methods is to simply observe which "free gift" consumers want most when their neighborhood bank runs a "free gift to new depositors" program.

One of the gifts that almost precipitated a riot in my area was something called a "cordless telephone." A bank near me offered that device as a gift and the line stretched three times around the block with people actually fearful that the supply of phones would run out. When I saw that my immediate reaction was: "That's going to be a hot item in the stores, too." It turned out to be a top seller all right, and probably will be for quite some time.

The cordless telephone is simply a *duplex* (simultaneous receive and transmit) radiotelephone in the shape of an ordinary telephone handset or miniature walkie-talkie that can be clipped on the belt. If you're working out back, in the shop, or helping a next-door neighbor, you don't have to worry about missing an important phone call. If someone calls, you can answer the call with the handset right where you are. Some models also permit the user to dial out through a standard *Touch-Tone* key pad. It has a working range of about 300 feet.

The hardware necessary for a cordless telephone would have cost about $1000 in the days of vacuum tubes and $300-$500 in the early days of solid-state. Today, a cordless phone costs from about $100 to $200, depending on its features. As you might have guessed, it involves rather sophisticated circuitry.

A cordless telephone is actually two devices: a base-station *transponder* and the wireless phone, called a *handset*. The transponder uses 117 volts AC and features a plug-in charger compartment that trickle-charges the handset's nickel-cadmium battery pack when the handset is not in use. The transponder also contains a 1.7-MHz carrier-current (carrier-current uses power-line wiring to propagate an RF signal) transmitter that is coupled to the AC power-line wiring through the power cord, a 49-MHz receiver with a small telescopic antenna, and the hardware to connect to the telephone line—including a protective module and an electronic pulse-dialer.

FIG. 1

The handset contains a 1.7-MHz receiver with an internal rod antenna, a 49-MHz transmitter with a small telescopic (or optional "rubber ducky") antenna, a continuous 5.3-kHz pilot-tone oscillator, a function switch, and a *Touch-Tone* pad if the handset permits dialing out.

How it works.

The transponder, which is connected to your phone line through a modular plug or 4-terminal adaptor, is always on. When someone dials your phone, the 48-volt, 20-Hz, ringing signal activates the transponder's 1.7-MHz transmitter. A bell-tone oscillator modulates the transmitter. The signal is radiated through the powerline and it is received by the handset. (The handset must be on to receive a signal.) The detected tone is demodulated and used to release the audio squelch. That permits the bell tone to be heard over the handset's speaker.

To answer a call, the handset's selector is set to TALK. That simultaneously turns on the 49-MHz transmitter and a 5.3-kHz continuous pilot tone. The transponder receives the 49-MHz signal and the pilot tone through a tone decoder IC. That causes a relay to connect the transponder to the telephone line. The connection is maintained as long as the transponder receives the pilot tone.

We now have two-way simultaneous (duplex) communications. Everything said into the handset modulates the 49-MHz transmitter. The signal is received and demodulated by the transponder and fed into the phone line through a hybrid repeat coil. (Hybrid coils, or transformers, are used to prevent self-oscillation and we'll cover their theory in a future column.) The signal from the telephone line passes through the same hybrid coil and modulates the transponder's 1.7-MHz transmitter. The signal is received by the handset.

You hang up by setting the handset's selector switch to ON or OFF. That turns off the 49-MHz transmitter. Since the transponder no longer receives the pilot tone, the relay that connects the transponder to the telephone line opens, disconnecting the line.

To originate a call from the handset, the selector is set to TALK, turning on the transmitter and the pilot tone. That

continued on page 92

A LIFETIME GUARANTEE AND 11 OTHER REASONS TO BUY AN "OPTOELECTRONICS" FREQUENCY COUNTER

1. SENSITIVITY: Superb amplifier circuitry with performance that can't be matched at twice the price. Average sensitivity of better than 15 mV from 10 Hz to 500 MHz on every model and better than 30 mV from 500 MHz to 1.1 GHz on the Series 8010A and 8013.

2. RESOLUTION: 0.1 Hz to 12 MHz, 1 Hz to 50 MHz, 10 Hz over 50 MHz.

3. ALL METAL CASES: Not only are the heavy gauge aluminum cases rugged and attractive, they provide the RF shielding and minimize RFI so necessary in many user environments.

4. EXTERNAL CLOCK INPUT/OUTPUT: Standard on the 8010/8013 series and optional on the 7010 series is a buffered 10 MHz clock time base input/output port on the rear panel. Numerous uses include phase comparison of counter time base with WWVB (U.S. National Bureau of Standards). Standardize calibration of all counters at a facility with a common 10 MHz external clock signal, calibrate scopes and other test equipment with the output from precision time base in counter, etc., etc.

5. ACCURACY: A choice of precision to ultra precision time base oscillators. Our ± 1 PPM TCXO (temperature compensated xtal oscillator) and ± 0.1 PPM TCXO are sealed units tested over 20-40°C. They contain voltage regulation circuitry for immunity to power variations in main instrument power supply, a 10 turn (50 PPM) calibration adjustment for easy, accurate setability and a heavily buffered output prevents circuit loads from affecting oscillator. Available in the 8010 and 8013 series is our new ultra precision micro power proportional oven oscillator. With ± .05 PPM typical stability over 10-45°C, this new time base incorporates all of the advantages of our TCXO's and virtually none of the disadvantages of the traditional ovenized oscillator: Requires less than 4 minutes warm-up time, small physical size and has a peak current drain of less than 100 ma.

6. RAPID DISPLAY UPDATE: Internal housekeeping functions require only .2 seconds between any gate or sample time period. At a 1 second gate time the counter will display a new count every 1.2 seconds, on a 10 second gate time a new count is displayed every 10.2 seconds. (10.2 seconds is the maximum time required between display updates for any resolution on any model listed).

7. PORTABILITY: All models are delivered with a 115 VAC adapter, a 12 VDC cord with plug and may be equipped with an optional ni-cad rechargeable battery pack installed within its case. The optional Ni-Cad pack may be recharged with 12 VDC or the AC adapter provided.

8. COMPACT SIZES: State-of-the-Art circuitry and external AC adapters allowed design of compact easy to use and transport instruments.
Series 8010/8013: 3" H x 7-1/2" W x 6-1/2" D
Series 7010: 1-3/4" H x 4-1/4" W x 5-1/4" D

9. MADE IN U.S.A.: All models are designed and manufactured at our modern 13,000 square foot facility at Ft. Lauderdale, Florida.

10. CERTIFIED CALIBRATION: All models meet FCC specs for frequency measurement and provided with each model is a certificate of NBS traceable calibration.

11. LIFE TIME GUARANTEE Using the latest State-of-the-Art LSI circuitry, parts count is kept to a minimum and internal case temperature is only a few degrees above ambient resulting in long component life and reliable operation. (No custom IC's are used.) To demonstrate our confidence in these designs, all parts (excluding batteries) and service labor are 100% guaranteed for life to the original purchaser. (Transportation expense not covered).

12. PRICE: Whether you choose a series 7010 600 MHz counter or a series 8013 1.3 GHz instrument it will compete at twice its price for comparable quality and performance.

MODEL 8010A/8013 1.1 GHz/1.3 GHz

MODEL 7010A 600 MHz

MODEL	RANGE (From 10 Hz)	10 MHz TIME BASE: STABILITY	10 MHz TIME BASE: AGING	10 MHz TIME BASE: DESIGN	AVG. SENSITIVITY: 10 Hz to 500 MHz	AVG. SENSITIVITY: 500 MHz to 1.1 GHz	GATE TIMES	RESOLUTION: 12 MHz	RESOLUTION: 60 MHz	RESOLUTION: Max. Freq.	EXT. CLOCK INPUT/OUTPUT	SENSITIVITY CONTROL	NI-CAD BATTERY PACK
7010A	500 MHz	± 1 PPM	<1 PPM/YR	TCXO*	15 mV	N/A	(3) 1, 1, 10 sec	1 Hz	1 Hz	10 Hz (600 MHz)	YES OPTIONAL	NO	YES OPTIONAL
7010.1A		± 0.1 PPM											
8010A	1.1 GHz	± 1 PPM	<1 PPM/YR	TCXO*	15 mV	30 mV	(4) .01, 1, 1, 10 sec	1 Hz	1 Hz	10 Hz (1.1 GHz)	YES STANDARD	YES	YES OPTIONAL
8010.1A		± 0.1 PPM											
8010.05A		± .05 PPM		OCXO**									
8013.1	1.3 GHz	± 0.1 PPM	1 PPM/YR	TCXO*	15 mV	30 mV	(4) .01, 1, 1, 10 sec	1 Hz	1 Hz	10 Hz (1.3 GHz)	YES STANDARD	YES	YES OPTIONAL
8013.05		± .05 PPM		OCXO**									

*TCXO = Temperature Compensated Xtal Oscillator **OCXO = Proportional Oven Controlled Xtal Oscillator

SERIES 7010A

#7010A	600 MHz Counter - 1 PPM TCXO	$199.95
#7010.1A	600 MHz Counter - 0.1 PPM TCXO	$249.95
OPTIONS:		
#70-H	Handle/Tilt Bail (not shown)	$2.95
#Ni-Cad-701	Ni-Cad Battery Pack & Charging Circuitry Installed Inside Unit	$19.95
#EC-70	External Clock Input/Output	$35.00
#CC-70	Carry Case - Padded Black Vinyl	$9.95

SERIES 8010A/8013

#8010A	1.1 GHz Counter 1 PPM TCXO	$399.00
#8010.1A	1.1 GHz Counter 0.1 PPM TCXO	$450.00
#8010.05A	1.3 GHz Counter .05 PPM Oven	$499.00
#8013.1	1.3 GHz Counter 0.1 PPM TCXO	$550.00
#8013.05	1.3 GHz Counter .05 PPM Oven	$599.00
OPTIONS		
#Ni-Cad-801	Ni-Cad Battery Pack & Charging Circuitry Installed Inside Unit	$49.95
#CC-80	Carry Case - Padded Black Vinyl	$9.95

ACCESSORIES

#TA-100	Telescope antenna with right angle BNC	$9.95
#P-100	Probe, 50 Ohm, 1X	$13.95
#P-101	Probe, Lo-Pass Audio Usage	$16.95
#P-102	Probe, Hi-Z General Purpose	$16.95
#LFM 1110	Low Frequency Multiplier X 10, X 100, X 1000 For High Resolution of Audio Freq	$119.95

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CIRCLE 58 ON FREE INFORMATION CARD

COMMUNICATIONS CORNER
continued from page 90

causes the transponder's relay to connect to the telephone line. Pressing a button on the keypad causes a keypulser IC to interrupt the pilot tone a number of times equal to the number marked on that key. The pilot tone drops in and out causing the hook relay to pulse open and closed, thereby dialing the desired phone number. The dial pulses are generated at a given speed and make-break ratio. Some cordless telephone models provide for two make-break ratios, though that is rarely, if ever, required in the U.S.

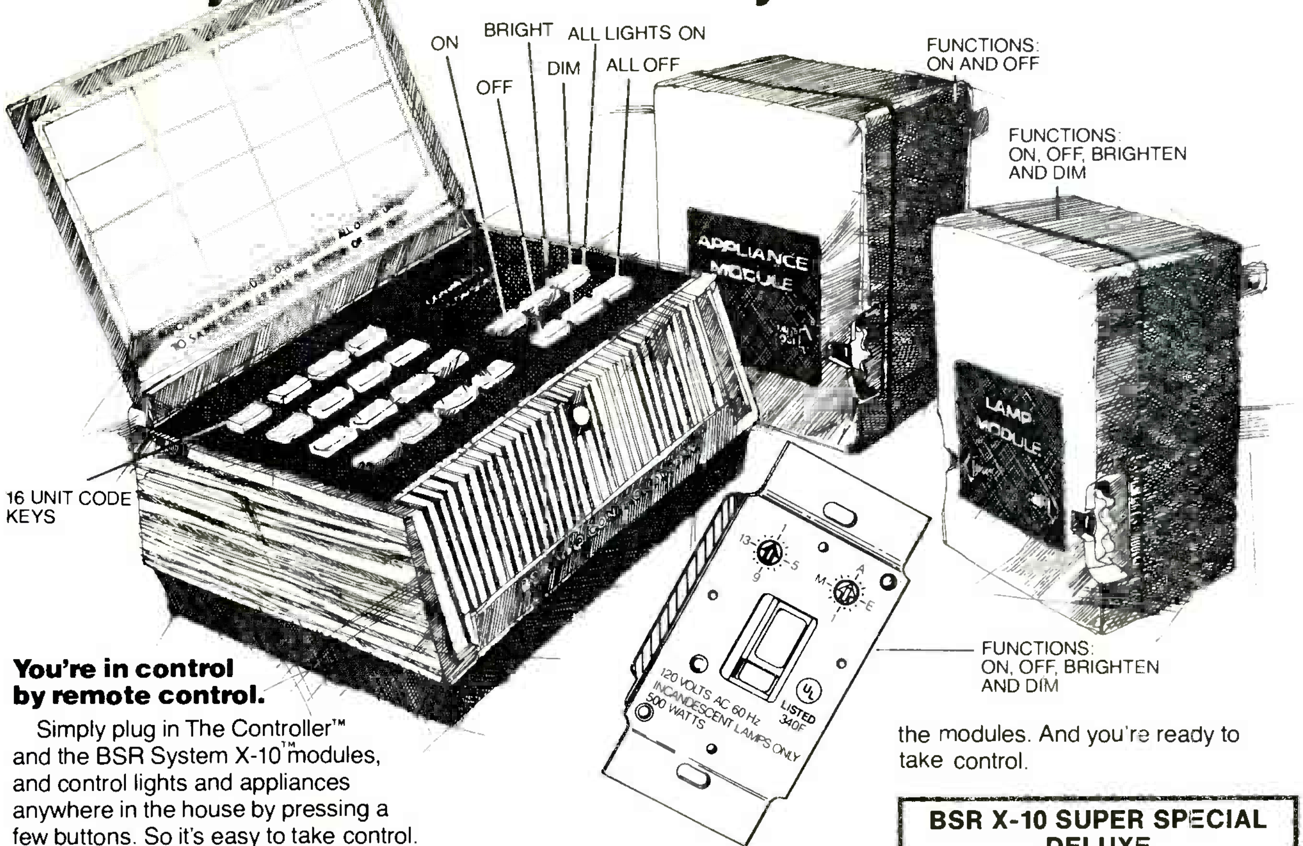
Because *Touch-Tone* circuits accept pulse dialing but pulse circuits do not accept *Touch-Tone*, all cordless telephones use pulse dialing.

Since the transmissions are FM, there is very little noise pickup in either direction. Although different operating frequencies are used, it is possible for you and your neighbor to wind up on the same one. On most models, such as the Electra Bearcat *Freedom Phone* (Fig. 1), some degree of privacy can be achieved by keeping the handset in the transponder's charging compartment when not in use. When that is done, a switch locks out the connection to the telephone line. Although some units come with a separate charger so you can hide the transponder in a basement or attic, those chargers do not automatically disconnect the transponder from the phone line. If someone in the house wants to let the handset user know that there is a call, the handset can be paged by pressing a CALL button on the transponder.

The handset weighs about eight ounces, so when it is clipped to your belt, you may even forget you're carrying it. That is, of course, until that important phone call. It's no wonder that those cordless telephones became so popular, so quickly. **R-E**

"OK—That's one businessman's lunch, one WK7Q3's lunch, and one WL74K's lunch."

An in-depth look at the only "plug-in" remote control system you'll ever need for your home.



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You can turn on the TV, radio or stereo in the morning to help you wake up without getting up from bed. Or at night, turn on the lights before going downstairs so you don't have to fumble in the dark. Turn off unnecessary lights and help get your electric bill under control. Or, dim the lights and save energy, too.

And when it's time to turn in, just push a button and turn everything off. And sleep soundly. But, if you hear a strange noise in the middle of the night, you can press a button to turn on all the lights and scare the daylights out of an intruder.

The Controller is designed to control every room in the house.

By pressing the buttons on the Command Console keyboard, command signals are transmitted over existing household wiring to the module of your choice. The Lamp Module turns on, off or dims any incandescent lamp up to 300 watts. The Appliance Module turns appliances like TVs, window fans or stereos on and off. And the Wall Switch Module is designed to turn on, off or dim any light or lamp up to 500 watts normally operated by a wall switch.

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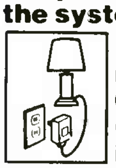

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Modules of your choice

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radio products

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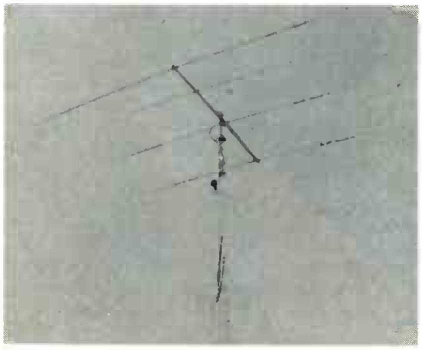
NEW TRI-BAND BEAM HAM ANTENNA, *model SA-7010*, is a tri-band yagi beam in kit form. The 4-element 20, 15, and 10-meter *SA-7010* features three active elements on each band and has a separate reflector for correct monoband spacing on 10 meters. The antenna is said to provide 8.3 dB gain over a dipole and to have a front-to-back ratio of 25 dB. VSWR is less than 1.5:1 at reso-



CIRCLE 100 ON FREE INFORMATION CARD

nance on each band. The boom length of this tri-bander is 16 feet, with the longest element being 31 feet. Turning radius is 17 feet, 5 inches, and wind surface area is 5.8 square feet. The beam is rated for full legal power. Mail order price of the *SA-7010* is $219.95, FOB Benton Harbor.—**Heath Company**, Benton Harbor, MI 49022.

MOBILE RADIO, the *Clearchannel Logic Trunked Radio (LTR)*, is a two-way FM system that eliminates the waiting time for channel access caused by frequency congestion. It uses a method of trunked channel assignment, whereby combining subaudible data transmissions with voice, every unit is constantly updated as to system status and channel availability. The *Clearchannel LTR* is a five-channel trunked system, but a digital syn-

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thesizer allows expansion up to 20 channels and results in a channel-access time of $^3/_{10}$ of a second. The system also provides increased privacy for operators with a microprocessor that functions to exclude other user groups in the system. It also features dual-diversity antenna switching. The receiver automatically selects the antenna with the highest signal level, thereby reducing the effects of multipath, fading, and dead spots. Suggested retail price is $1833 and up, depending upon what options are purchased.—**E.F. Johnson Co.**, 299 10th Ave., S.W., Waseca, MN 56093.

FIXED-STATION MICROPHONE, *model 444D*, for amateur radio applications, is similar to the *model 444*, but offers added features. It has an impedance-selector switch located on the bottom of the base that allows selecting either high or low output impedance and a slide switch for switching between normal or VOX operation. The *model 444D* also has a momentary or locking push-to-talk bar, which turns on the microphone and an

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external relay or control circuit by fingertip action. Other features are a coiled cable, availability of a personalized nameplate with the amateur's station call letters, and a wiring guide with instructions for wiring the mike to major brands of ham equipment. Suggested retail price is $55.50—**Shure Brothers, Inc.**, 222 Hartrey Ave., Evanston, IL 60204.

TRANSCEIVER, the *model 580 Delta*, covers 160 through 10 meters and has the present six high-frequency bands plus 10-, 18-, and 24.5-MHz bands. Features include a low-noise double-conversion receiver with 0.3 μV sensitivity, 85-dB dynamic range plus switchable 20-dB attenuator,

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standard 8-pole monolithic SSB filter with a 2.4 kHz bandwidth, optional 200-Hz and 500-Hz 6-pole CW filters, offset tuning, and WWV recep-

continued on page 96

RADIO PRODUCTS

continued from page 94

tion. The *model 580 Delta* has a power input of 200 watts on all channels and also features adjustable-threshold ALC and drive with LED indicator, adjustable sidetone level and pitch, vernier tuning, and an optional noise blanker. The *model 580 Delta* has black and bronze color styling with a two-piece aluminum case and tilt-up bail. Price is $849.—**TEN-TEC, Inc.,** Highway 411 East, Sevierville, TN 37862.

ALL-BAND COMMUNICATIONS RECEIVER, *model DX-302* features quartz-controlled frequency-synthesized tuning for accurate coverage of 10 kHz to 30 MHz in thirty tunable ranges; five 7-segment LED's in a large digital frequency display indicate the exact frequency tuned.

A two-position IF bandwidth control selects either a six- or nine-element ceramic filter for wide or narrow selectivity. All silicon solid-state circuitry is used throughout for maximum efficiency with minimum noise. Emergency operation

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is automatic, switching over to a battery back-up if the AC power fails.

Also included are a key jack that allows Morse-code practice by plugging in an optional code key, a tape-output jack for off-air taping, built-in speaker, external speaker jack, RF gain control, combination signal strength/battery meter, six-band RF preselector with calibrated tuning dial, BFO pitch adjustment, and signal-attenuator switch. The *model DX-302* can receive AM, upper and lower sidebands, and CW (code) signals. It will operate from 120 VAC, and 12 VDC or from eight self-contained "C" cells.

The *model DX-302* is priced at $399.95.—**Radio Shack,** 1300 One Tandy Center, Fort Worth, TX 76102.

CB ANTENNA, the *MR480,* is designed for owners of fiberglass RV's and other vehicles with non-metallic roofs. The *MR480* is only 53 inches high, thus reducing overhead obstruction clearance to a minimum. It combines a base-loading coil encased in high-impact with plastic with a white fiberglass whip. The antenna also uses a slim heavy-duty stainless steel shock spring. The mounting base is a standard roof-type requiring a ⅜-inch diameter hole, and is designed to mount

CIRCLE 125 ON FREE INFORMATION CARD

on fiberglass roofs up to ⅜-inches thick. Comes with 24 feet of coax cable plus connector. Suggested list price is $45.50.—**The Antenna Specialists Co.,** Consumer Products Div., 12435 Euclid Ave., Cleveland, OH 44106.

RECEIVER PREAMPLIFIERS, *models P-305* and *P-308,* are continuously tunable and cover the shortwave bands from 1.8 to 54 MHz. They provide 20 dB gain with a dual-gate FET for low noise figure. The gain and the low noise figure improve reception on most receivers, particularly on the higher-frequency bands; added selectivity reduces image and spurious response.

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Gain is continuously variable to prevent overloading the receiver. A step attenuator is also provided, along with a selector switch for two antennas.

The *model P-305* operates from a 9-volt battery and is priced at $77.95. *Model P-308* has a built-in 115-volt AC power supply, and is priced at $87.95.—**Palomar Engineers,** PO Box 455, 1520-G Industrial Avenue, Escondido, CA 92025. **R-E**

Save on Scanners!
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Communications Electronics,™ the world's largest distributor of radio scanners, celebrates Father's Day early with big savings on *Bearcat* scanners. Electra Company, the manufacturers of *Bearcat* scanners is offering consumer rebates on their great line of scanners, when purchased between April 1 and May 15, 1981.

With a scanner, you can monitor the exciting two-way radio conversations of police and fire departments, intelligence agencies, mobile telephones, energy/oil exploration crews, and more. Some scanners can even monitor aircraft transmissions! You can actually hear the news *before* it's news. If you do not own a scanner yourself, now's the time to buy your scanner from **Communications Electronics**. Choose the scanner that's right for you, then call our *toll-free* number to place your order with your Visa or Master Charge.

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

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

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

Bearcat® 300

List price $549.95/**CE price $349.00/$25.00 rebate**
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Bands: 32-50, 118-136 AM, 144-174, 421-512 MHz.

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

NEW! Bearcat® 350

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Get a coupon good for a $25 rebate when you purchase a *Bearcat* 300, 250, 220 or 210XL; $20 rebate on model 160; $10 rebate on model Four-Six Thin Scan and $5 rebate on the *Bearcat* 5. To get your rebate, mail this coupon with your original dated sales receipt and the *Bearcat* model number from the carton to Electra. You'll receive your rebate in four to six weeks. Offer valid only on purchases made betwen April 1, 1981 and May 15, 1981. All requests must be postmarked by May 30, 1981. Limit of one rebate per household. Coupon must accompany all rebate requests and may not be reproduced. Offer good only in the U.S.A. Void where taxed or prohibited by law. Resellers, companies, clubs and organizations–both profit and non-profit–are not eligible for rebates. Employees of Electra Company, their advertising agencies, distributors and retailers of *Bearcat* Scanners are also not eligible for rebates. Please be sure to send in the correct amount for your scanner. Pay the listed **CE** price in this ad. *Do not* deduct the rebate amount since your rebate will be sent directly to you from Electra. Orders received with insufficient payments will not be processed and will be returned.

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Your final cost is a low $254.00

50 Channels • Crystalless • Searches Stores • Recalls • Digital clock • AC/DC Priority Channel • 3-Band • Count Feature.

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

The *Bearcat* 250 performs any scanning function you could possibly want. With push button ease you can program up to 50 channels for automatic monitoring. Push another button and search for new frequencies. There are no crystals to limit what you want to hear. A special search feature of the *Bearcat* 250 actually stores 64 frequencies and recalls them, one at a time, at your convenience.

Bearcat® 220

List price $449.95/**CE price $289.00/$25.00 rebate**
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Aircraft and public service monitor. *Frequency range 32-50, 118-136 AM, 144-174, 420-512 MHz.*

The *Bearcat* 220 is one scanner which can monitor all public service bands plus the exciting AM aircraft band channels. Up to twenty frequencies may be scanned at the same time.

Not only does this new scanner feature normal search operation, where frequency limits are set and the scanner searches between your programmed parameters, it also searches marine or aircraft frequencies by pressing a single button.

Bearcat® 210XL

List price $349.95/**CE price $229.00/$25.00 rebate**
Your final cost a low $204.00

18 Channels • 3 Bands • Crystalless • AC/DC

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

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

NEW! Bearcat® 160

List price $299.95/**CE price $189.00/$20.00 rebate**
Your final cost is a low $169.00

16 Channels • 3 Bands • AC only • Priority Dual Scan Speeds • Direct Channel Access

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

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

This scanner presents a new dimension in scanning form and function. Look at the smooth keyboard. No buttons to punch. No knobs to turn. Instead, finger-tip pads provide control of *all* scanning operations, including On/Off, Volume and Squelch. Of course the *Bearcat* 160 incorporates other advanced *Bearcat* features such as Priority, Direct Channel Access, Dual Scan Speeds, Automatic Channel Lockout, Scan Delay and Auxiliary. All this performance in sleek, contemporary styling. And at a price so low, it astounds even us!

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8 Crystal Channels • 3 Bands • AC only

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

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

Bearcat® Four-Six ThinScan™

List price $189.95/**CE price $124.00/$10.00 rebate**
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Frequency range: 33-47, 152-164, 450-508 MHz.

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

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Fanon Slimline 6-HLU

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

Low cost 6-channel, 3-band scanner!

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

Fanon Slimline 6-HL

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

6-Channel performance at 4-channel cost!

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

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

FANON SCANNER ACCESSORIES

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AUC-3 Auto lighter adapter/Battery Charger	$15.00

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FB-E Frequency Directory for Eastern U.S.A.	$12.00
FB-W Frequency Directory for Western U.S.A.	$12.00
FFD Federal Frequency Directory for U.S.A.	$12.00
MK350 Mobile mounting kit for *Bearcat* 350	$12.00
B-4 1.2 V AAA Ni-Cad's for ThinScan™ and Fanon	$9.00
A-135cc Crystal certificate	$3.00

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

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MORSE & RTTY DECODERS
continued from page 64

special SWL model with extra shielding to prevent the microprocessor hash from getting into your receiver's circuits. That is particularly important, because hash is a common occurrence in microprocessor-based equipment, even personal computers.

The second kind of system utilizes a group of circuits that convert the decoded CW and RTTY signals to a video signal for display on a video monitor (See Fig. 2-b). A video display can make for easier understanding of the signals being monitored, especially when compared to LED displays. First of all, you don't have to watch the unit constantly to see the message. With a video unit, the screen fills up with up to 25 lines of text so you can let several lines accumulate while attending to something else, then read the text before it moves off the top of the screen.

Second, under different signal conditions (fading, severe adjacent signal interference, atmospheric static, etc.), having several lines of text in front of you helps you fill in the characters or words that may become garbled in the decoding process. The more data you can see at one time from an unknown station, the quicker you will be able to identify it and determine the kind of messages it is sending. And, seeing RTTY messages in their original "page" format, with indentations, line spaces, and columns can help you decipher the transmission.

Some video decoders require a separate demodulator between the receiver audio output and the decoder input. While there are many demodulators on the market, most are targeted for amateur radio use, as part of a complete terminal unit containing a frequency shift keyer for transmitting. Because hams send RTTY mostly in 170-Hz—and sometimes in 850-Hz—shifts, many terminal units have only two shift selections from the front panel (though they may be adjusted to different shifts internally).

For utility DX'ing, however, you will want to have all three common shifts readily available for trial-and-error tuning. Therefore, if you choose a system requiring a terminal unit, make sure it has all three shifts selectable from the front panel, as on the HAL Communications *ST-6K* kit of *ST-6000* units.

If you prefer to avoid a terminal-unit-based system, the Info-Tech model *M-200F* video converter has a three-shift demodulator and many other features built into its desk top cabinet. The only connections required are to the receiver's audio output and to the input of a video monitor. The *M-200F* also has outputs cabable of driving an RS-232 serially-interfaced printer. A hard copy of a transmission may be of value in evaluating the text. But be careful to retain it for your own information only.

If you own a personal computer (*TRS-80*, *Apple*, *PET*, *Sorcerer*, etc.), you already have a major portion of the third kind of CW/RTTY decoder, computer peripherals (see Fig. 2-c). That group is made up of plug-in hardware additions to your computer, and programs (normally on cassette). Sources for this type of equipment include Xitex (hardware only) and Macrotronics (hardware and software). Because those systems were designed primarily for amateur radio use, the hardware and software is capable of producing electronically generated CW and RTTY for a ham transmitter. That is something to keep in mind if you have your eye on a ham ticket. For utility DX'ing, however, you will also need a receiver demodulator to make sure that all three RTTY shifts can be copied.

Valuable guide books

No CW/RTTY DX'er should be without two books available from Gilfer Shortwave. The *Confidential Frequency List* ($6.95) lists thousands of loggings and International Telecommunications Union registrations of CW and voice utility stations. Arranged by frequency, the list provides each station's call sign, location, transmitting power, and the nature of the transmissions.

The *Guide To RTTY Frequencies* ($8.95) lists the same data for RTTY stations (yes, there is a bookful of them). The guide begins with an excellent introduction to RTTY DX'ing and a discussion of the other codes in use on the bands by veteran DX'er Webb Linzmayer. Both volumes are invaluable aids in identifying stations by frequency.

Utility monitoring, in any mode, is fun, and gives shortwave listeners a different perspective on the use of available spectrum. After listening for only a short while, and hearing how much of the world's communications takes place in the hf bands, you will see why frequency allocations were guarded jealously at the 1979 World Administrative Radio Conference. Because of the wide diversity of CW and RTTY communications in process 24 hours a day, hunting through the bands for "unlisted" and "secret" stations is a thrill we can all enjoy. **R-E**

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service clinic

Phase-controlled regulators. How they work and how to service them.

JACK DARR, SERVICE EDITOR

I've had several questions about the phase-controlled regulator circuit used in the RCA *CTC-58* and similar RCA chassis. The most common question is, "What do they mean, phase-controlled?" It's an appropriate name and if we look at some older circuits, it's easy to see how they work. Older voltage-regulator circuits frequently use SCR's triggered by a pulse at various points in the cycle. The circuit is turned on by a pulse from an error-amplifier and turned off by feeding the SCR rectified AC. When each AC pulse reaches zero, the SCR turns off. That's used in 60-Hz circuits.

The RCA circuit works in exactly the same way, but it works on the horizontal-scan frequency. The circuit is turned on by a pulse from an error-amplifier, but since the SCR is fed DC, it needs a turn-off pulse. That pulse is taken from a special winding of the flyback and is negative-going at the SCR anode.

What the circuit does is regulate the DC voltage supply to the horizontal-output stage. That type of circuit can react much faster than the 60-Hz type due to its higher operating frequency. One thing common to all solid-state horizontal-output circuits is this: If the DC-voltage supply is held constant at all times, all of the outputs (high voltage, sweep, boost, and the flyback-derived low-voltage DC supplies for the rest of the set) are held at the correct level.

The SCR controls the charging of a capacitor that is shunted by a small winding on the flyback. The SCR charges the capacitor at various points during the scan. At the end of scan the SCR is turned off by a negative pulse that is developed during retrace. So, it actually regulates the DC voltage supply for each horizontal line of scan.

At start of scan, the SCR is off. It's turned on by a pulse from the pulse transformer. That transformer is fed by an "oscillator switch" (actually a Schmitt trigger). The Schmitt trigger in turn is controlled by a frequency control stage that, in turn, is controlled by the voltage sensed from the +110-volt supply line to the horizontal output transistor. Figure 1 shows a partial schematic of that circuit. The voltage sensor reads the DC voltage at the start of each scan line. When it has dropped far enough (very little!) it turns the SCR on. That discharges the capacitor into the supply circuit and pulls the voltage up to normal. The winding on the flyback and the capacitor form a parallel-resonant circuit, probably at the horizontal frequency.

Note that the SCR "switch" is in series with the flyback-winding. While the SCR

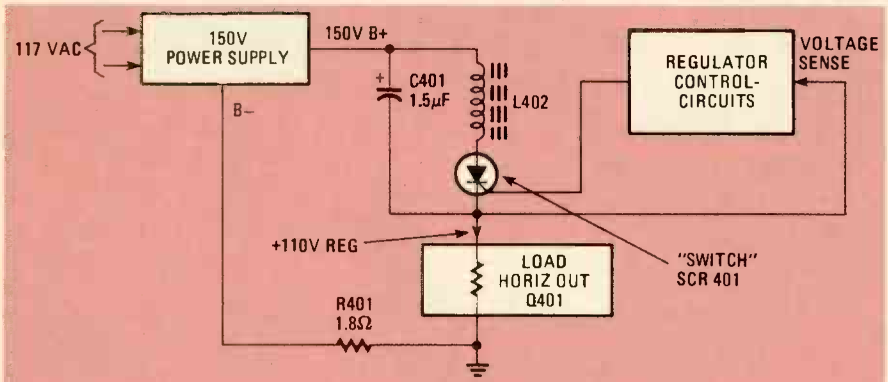

FIG. 1

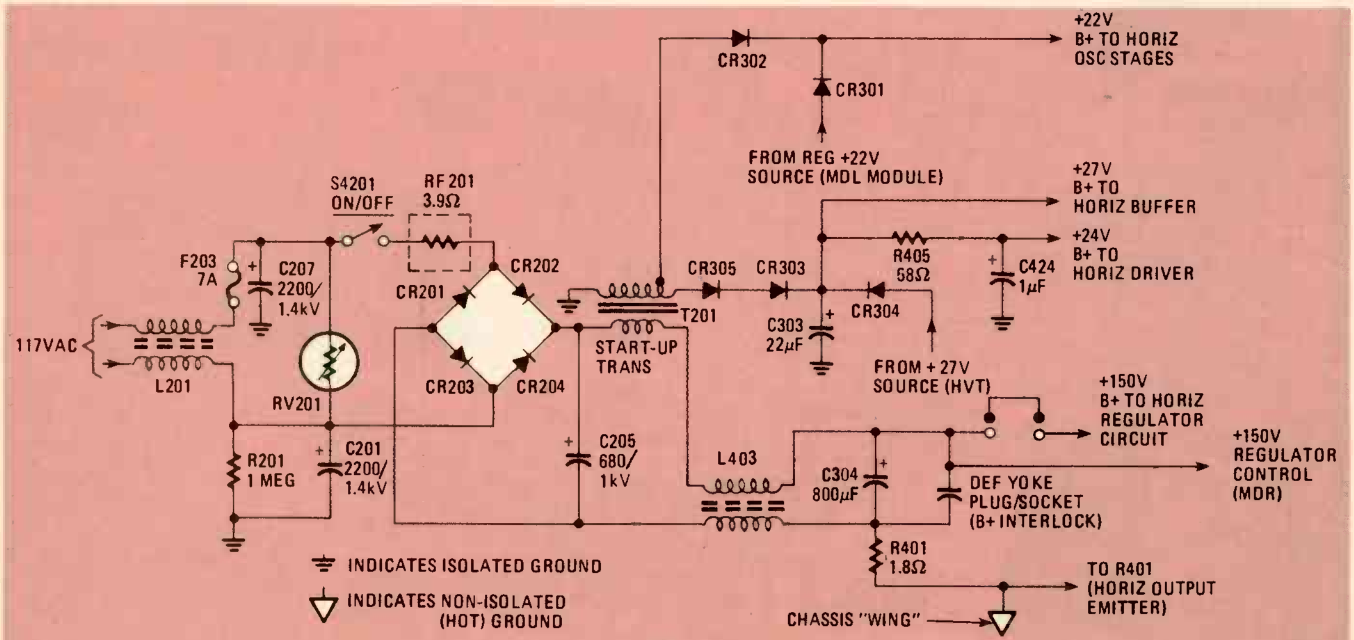

FIG. 2

is turned off, the capacitor charges from the +150-volt line. The switch "closes" and discharges the capacitor into the +110-volt line. Backtracking a bit, the longer the switch is open, the more energy is fed to the capacitor; shorter off-time means less energy in the capacitor, and reduced output voltage.

Where would you start to service that circuit, with a dead-set condition (nothing working)?

The best thing to do is to make all the stock tests. See if the +150-volts DC is present at the output of the bridge rectifier. That is *not* isolated from the AC line so an isolation transformer is necessary for testing all of those sets. If the +150-volts is there, but the set still does not work, check the horizontal oscillator. That circuit must be running. Remember that the voltage regulator is controlled by horizontal-sync pulses and those must come from the oscillator to begin with.

If the oscillator isn't running, check the DC-voltage supplies to that module. The *CTC-58* (and several other RCA chassis) uses a "start-up" circuit. That is in the low-voltage DC power supply. It is actually another pulse-operated circuit. When power is applied, current flows from the rectifiers, through the primary of the start-up transformer T201 (see Fig. 2, adapted from the RCA schematic), and charges filter capacitor C304 (800 μF). That causes a pulse of current in the secondary of T201. The current pulse is rectified by the start-up diodes. The resulting DC is fed to the horizontal-oscillator stage, giving it enough voltage to start. The oscillator starts instantly and keeps running for a few cycles.

That is enough time to get the horizontal-output stage going, and the flyback develops the normal operating voltage for the oscillator. Blocking diodes are used to keep the operating voltage out of the start-up circuit.

To check problems in the start-up circuit, hook a DC voltmeter to the +27-volt DC source for the start-up circuit. With the set cool and C304 discharged, turn the set on. You should see a momentary kick of the meter needle. (Use an analog meter for that.) If that kick doesn't appear, check the three start-up diodes: CR302 for +22 volts; CR303 and CR305 for +27 volts; and the blocking diodes, CR301 and CR304. Check reservoir capacitor C303 (22 μF) to see if it is open or shorted.

For testing, the oscillator circuit may be started, with the power on, by applying an external voltage (22—27-volts DC) to the +27-volt start up point. That is terminal 6 on the MDL-001 module, and it is accessible from the back. Be sure to put the negative lead of the external voltage source to the "cold" main-chassis ground and *not* to the non-isolated ground of the input power supply! Note the dual grounds shown in the schematic; the triangles indicate the non-isolated hot grounds, and the three-horizontal-line symbol is the cold or chassis ground. All DC voltages on the chassis must be referenced to the chassis ground. If the problem is in the start-up circuits, when the external power pulse is applied, the set will start up and keep working.

Possible problems in the horizontal-output stage can be checked by pulling the yoke plug, which is interlocked to the B+. Doing that opens the B+ supply to this stage. Take some resistance readings. The resistance from the case of the horizontal-output transistor to chassis ground must be at least 50K ohms. If it's lower, replace the horizontal output transistor and repeat the test. If it's still low, check the damper diode.

If the +150-volts DC isn't present, check fusible resistor RF201 (3.9 ohms) in the input to the bridge. If that is open, check all the diodes in the bridge, and the filter capacitors, for shorts. Everything here is referenced to the *hot* ground.

The MDR-001 regulator module contains the error-amplifier, frequency-control stage, and the shutdown stage. There are several very critical components used here, especially in the voltage-sensing circuit, and RCA recommends that the module be replaced rather than repaired.

Actually, there isn't anything really new in the phase-controlled regulator circuit—only the frequency and application differ. It does work very well, as long as all of the parts are good! If you run into what seems to be an unusual problem, sit back and think, then start testing to narrow down the number of possible causes for any fault you see. That works for a lot of other problems, too! **R-E**

service questions

GREEN PICTURE

When this Magnavox T-995 is turned on the picture is OK. After only a short time, it turns green. Controls have no effect. On my test jig, it works very well. Back in cabinet, same thing. Why?—F.K., Pittsburgh, PA.

The crystal ball says that you have a heater-cathode short in the green gun of the set's picture tube. That is evidently a hot short which does not show up when the tube is tested cold. (If it works on the jig, there is nothing wrong on the chassis!) Try this: get a picture tube brightener of the isolating type. Set it to isolate—not brighten—install it. That can help, and it is about the only thing that will, aside from a new picture tube.

NO COLOR

I've got a problem. This is a hotel-motel GE, and the number seems to be CBR630 or EN-609. No color, but good black-and-white picture. No DC voltage on grid of

the 6M11 burst-gate tube. Should be −120 volts. Where does it come from?—R. K., Marina, CA.

My GE index shows that a "CBR630" is a KD chassis. The "EN-609" is a run number, and not significant otherwise. Bias voltage on burst-gate; I finally remembered a quirk in the KD's. The gating pulse to the 6M11 is fed *through* a neon lamp! If this lamp is bad, no burst, and no color. The lamp is on top of the chassis, near the 6M11, and must glow when the set's working. If the bulb is blackened, replace it. Shown as NE-85/35AH but I have used plain old NE-2's here with good results. You can do that by clipping the leads to the old one close to the glass, and then tacking the new one in. Caution: Some of those do not use the neon lamp; if so, trace gating pulse back to flyback winding.

BURNING DIODE

You hit the nail on the head with a problem in this Sears 528.4196; it was diode D773. I replaced it with a fast-recovery type and the set worked perfectly. (Sears had changed the part number!) (Editor's note—That happens! In many cases, such diodes are not identified as fast-recovery types. In all of those circuits, all diodes MUST be fast-recovery.) Now, I've got a similar problem on the same chassis! Diode D774 (shaping diode on horizontal-output collector) burnt up and the horizontal-output transistor shorted. I replaced it along with C782, C710, and C779. Now the new D774 burns up in a few seconds. Can you rub the crystal ball?—J.P., Hollywood, FL.

As mentioned above, Sears often is confused on those diodes. It sounds as if the replacement you got was a plain diode. Try using one that you *know* is the right type; RCA has a whole page of them in the RCA *SK Series Replacement Guide*. Just for luck, you might try using a new type that RCA has just developed. That is a "special high-voltage diode", part number 142569. A friend of mine found retrace diodes burning up in one RCA. Finally got hold of that high-voltage diode and it held up. If it'll stand up there, it should in your application.

PICTURE TUBE BURNOUT

I've got a problem; this Panasonic black-and-white T125A has burned out two picture tubes in less than three years. I figured that something should be wrong, at that rate! Tube gets gradually weaker then is exhausted. What's causing it?—K.W., New Carrolton, MD.

Well, that is an unusual problem. In older sets, the picture-tube heater voltage was from a transformer, and couldn't go too high. However, in some of the late sets, the heater of the CRT is fed from a winding on the flyback. So: If the DC voltage regulator isn't working properly, that could easily be putting much too high a voltage on the tube and causing the short life.

From some of the DC voltages you included, I suspect that that is what has happened. Go through that whole voltage-regulator circuit and find out why it won't hold the voltages down to the normal level. Likely suspects would be leaky transistors, drifted resistors, etc.

NO PIX, NO SOUND

There's no pix and no sound in this Sears 528.42000400 chassis. Customer says it started as small picture with no sound. I replaced the power-supply module. Now I get a heavy hum and L101 gets very hot, but still no picture or sound. Need help!—F.K., Pt. Hope, MI.

L101 is a choke in the +114-volt output. If it's heating with those symptoms, something is loading it very heavily. Note one thing: The 1.5-amp fuse in that line does *not* blow out. If the short were in the loads, it would; so, something's happening before the DC gets that far.

There is a 1400-μF electrolytic capacitor, C103. That is not on the power supply board; it is on the output side of L101 and before the fuse. From the symptoms, I'd say that that capacitor is shorted very badly. Check it.

HOT RESISTOR

I asked about a hot resistor in a Magna-

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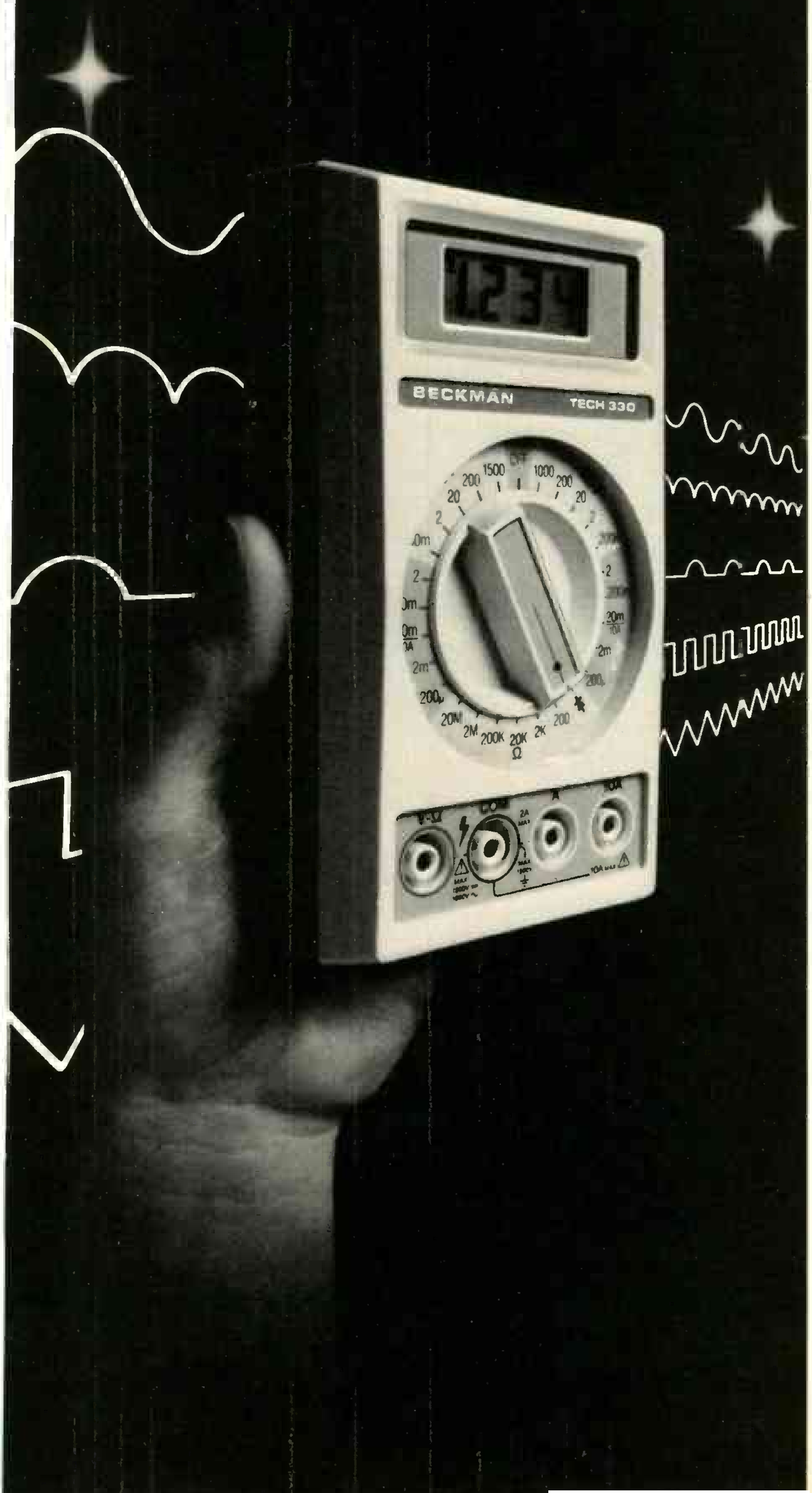

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Measurement Comparison Chart

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

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vox *T-940*. It was R302 on *Sams Photofact No. 1144*. You suggested that an open capacitor on the load side might be allowing a high pulse-current through it. The DC current load was normal. I checked C107 and it was OK. However, there was a very high 120-Hz ripple on the B+. The input-filter-capacitor C105A was found to be open.—K.W. Yost, Marysville, MI.

ARCING

I asked you about arcing in a Zenith *25DC56*. You said to space off the metal shield near the ultor button. That didn't help. You also mentioned a possible open shunt-capacitor on the horizontal-output stage. There were two of those capacitors and one of them was open! Replacing those, the high-voltage went down to normal and the arcing stopped. Thanks for the help.—James Grillo, San Francisco, CA. **R-E**

EQUIPMENT REPORTS

continued from page 44

matching transmitter, it is handy during transceive functions. The *model R7* RIT circuit permits excursions ± 3 kHz without touching the main tuning knob. Preselector tuning is never required in any mode.

Another feature of the *model R7* is a "store" function. Drake calls that feature a "visual scratch pad" as it lets you store your operating frequency and then tune elsewhere in search of a signal. If you wish to return to your original frequency, it can be displayed on the readout allowing you to retune with a minimum of guesswork. That feature is particularly useful for network operation where stations often move off frequency for a short time.

The *model R7* tunes through its ranges in 500-kHz increments. The frequency is selectable both by a rotating switch and by pushbutton UP and DOWN commands. For users who desire fixed-frequency (crystal-controlled) reception, an auxiliary control board (*AUX-7*) is available at extra cost.

Designed for flexibility, a six-position antenna switch lets you interconnect converters, antennas, or an external receiver.

Up to eight fixed frequencies may be switch-selected from the front panel when you use the optional auxiliary frequency boards. Four AGC release times (0, 0.075, 0.4, and 2 seconds) can be pushbutton-selected.

Without an antenna attached, a few spurious signals were detected but they were all low enough in level to pose little threat to effective reception. The spurious signals were especially noticeable below the standard broadcast band and were apparently caused by the rectifier circuit. A good antenna however, should provide adequate signal levels to override these low-level phantom signals.

Our overall estimate of the receiver is positive. With manufacturing costs spiraling upward, it is a real challenge for manufacturers to provide an outstanding piece of equipment at a reasonable cost. Drake seems to have managed with their *model R7* receiver. The *model R7* sells for $1449 from R.L. Drake Co., 540 Richard St., Miamisburg, OH 45342. **R-E**

HI FI NOISE FILTER

continued from page 74

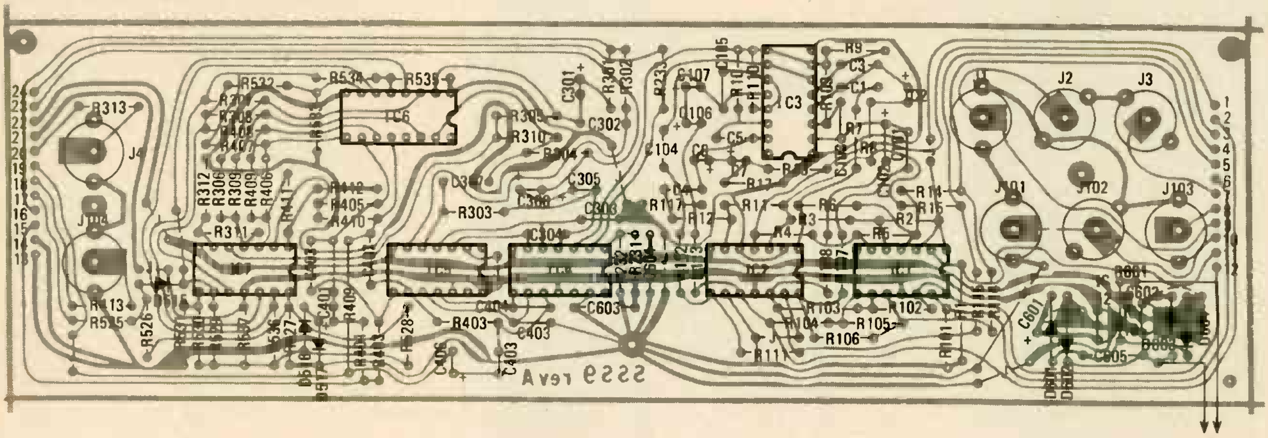

FIG. 17—PARTS PLACEMENT guide for the rear PC board. Capacitors C601 and 602 are mounted on the *foil* side of the board.

noise filter and shallow-slope expander) once they are set for your system.

The noise-filter sensitivity should be adjusted so that there is an adequate change in bandwidth during musical transients. That is the most difficult part; you should experiment by watching the display and listening carefully with the NOISE REDUCTION control at its maximum setting and the THRESHOLD control at its minimum setting. If you set the sensitivity too high, you will hear noise come and go during "unspectacular" musical passages—a sign that the ASRU is working too hard.

If the sensitivity is set too low, you'll hear normal signals being rolled off too much. Don't be fooled by the *apparent* lack of treble—it's there, but people who habitually listen to recorded music often feel it's reduced when listening to a system with noise reduction.

It's possible to set the sensitivity of the unit high enough to make the noise in the signal cause the bandwidth to open up too easily. If that happens, advance the THRESHOLD control until, during a silent passage, the lowest LED of the display flickers occasionally.

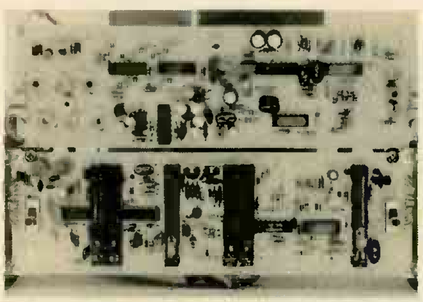

FIG. 18—COMPONENT SIDE of the front and rear PC boards. The two boards are connected by 12-conductor ribbon cable.

The NOISE REDUCTION control setting is largely a matter of personal taste. Start with it turned about three-quarters of the way up, and listen carefully when the bandwidth is reduced.

The expander's SENSITIVITY control should be set so that the right-hand (highest) LED flickers during peaks.

After everything has been adjusted, you may still have to reset the expander's sensitivity from time to time for use with different sources (e.g., if the tuner's output level is higher than the phono's). The THRESHOLD setting may also have to be changed, depending on the amount of noise in your program material. For very noisy material, reduce the noise-filter sensitivity and increase the noise reduction to maximum.

You now have a top-notch signal processor that will greatly enhance your listening pleasure. Use it well!

Acknowledgement

The concept of the spectral-tracking loop for noise reduction was invented by Fred Ives of Hewlett-Packard Company while at MIT. Pat Bosshart of MIT also worked on the concept and introduced it to me. **R-E**

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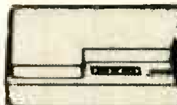

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7427N	.32	74S03N	.48	74LS123N	.64
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74178N	1.15	74LS10N	.19	74LS373N	1.38
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CD4019BE	.56	CD4049BE	.42	CD4104BE	2.36	CD4582BE	.72
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LED222	T-1¾ 5 mm Green	.24
LED224	T-1¾ 5 mm Yellow	.16

DISPLAYS

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DL1416		25.00

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ILCT6	Dual Opto Isolator	1500V	1.29
MCT2	Opto Coupler	1500V	.54
TIL111	Opto Coupler	1500V	.54
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TIP29B	.38	TIP41C	.59	TIP125	.72
TIP29C	.39	TIP42A	.57	TIP126	.77
TIP30A	.39	TIP42B	.59	TIP127	.84
TIP30B	.42	TIP42C	.64	TIP140	1.44
TIP30C	.42	TIP110	.54	TIP141	1.64
TIP31A	.38	TIP111	.57	TIP142	1.96
TIP31B	.42	TIP112	.64	TIP145	1.84
TIP31C	.45	TIP115	.55	TIP146	1.98
TIP32A	.42	TIP116	.59	TIP147	2.25
TIP32B	.45	TIP117	.64	TIP2955	.83
TIP32C	.48	TIP120	.64	TIP3055	.70
TIP41A	.55	TIP121	.68	FT3055	.59

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2N697	.29	2N3440	.56	2N3704	.099	2N5401	.15
2N706	.24	2N3771	1.29	2N3706	.099	2N5550	.11
2N1613	.29	2N3772	1.29	2N3710	.099	PN2222A	.089
2N1711	.29	2N3773	1.89	2N3904	.069	PN2907A	.089
2N1893	.29	2N6133	.56	2N3906	.069	PN5138	.099
2N2222A Special	.19			2N4123	.075	MPSA05	.12
2N2369A	.24			2N4124	.075	MPSA06	.12
2N2484	.24			2N4125	.075	MPSA13	.12
2N2905A	.36			2N4126	.075	MPSA56	.12
2N2907A Special	.19			2N4401	.075	MPSA42	.14
2N3053	.29			2N4402	.079	MPSA92	.14

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SPECIFICATIONS:

Range:	20 Hz to 600 MHz
Sensitivity:	Less than 10 MV to 150 MHz Less than 50 MV to 500 MHz
Resolution:	0.1 Hz (10 MHz range) 1.0 Hz (60 MHz range) 10.0 Hz (600 MHz range)
Display:	9 digits 0.4" LED
Time base:	Standard-10.000 mHz, 1.0 ppm 20-40°C. Optional Micro-power oven-0.1 ppm 20-40°C
Power:	8-15 VAC @ 250 ma

7 DIGITS 525 MHz $99.95 WIRED

SPECIFICATIONS:

Range:	20 Hz to 525 MHz
Sensitivity:	Less than 50 MV to 150 MHz Less than 150 MV to 500 MHz
Resolution:	1.0 Hz (5 MHz range) 10.0 Hz (50 MHz range) 100.0 Hz (500 MHz range)
Display:	7 digits 0.4" LED
Time base:	1.0 ppm TCXO 20-40°C
Power:	12 VAC @ 250 ma

The CT-70 breaks the price barrier on lab quality frequency counters. Deluxe features such as; three frequency ranges - each with pre-amplification, dual selectable gate times, and gate activity indication make measurements a snap. The wide frequency range enables you to accurately measure signals from audio thru UHF with 1.0 ppm accuracy - that's .0001%! The CT-70 is the answer to all your measurement needs, in the field, lab or ham shack.

PRICES:

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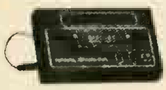
AC-1 AC adapter	3.95
BP-1 Nicad pack + AC adapter/charger	12.95



7 DIGITS 500 MHz $79.95 WIRED

PRICES:

MINI-100 wired, 1 year warranty	$79.95
MINI-100 Kit, 90 day part warranty	59.95
AC-Z Ac adapter for MINI-100	3.95
BP-Z Nicad pack and AC adapter/charger	12.95

Here's a handy, general purpose counter that provides most counter functions at an unbelievable price. The MINI-100 doesn't have the full frequency range or input impedance qualities found in higher price units, but for basic RF signal measurements, it can't be beat! Accurate measurements can be made from 1 MHz all the way up to 500 MHz with excellent sensitivity throughout the range, and the two gate times let you select the resolution desired. Add the nicad pack option and the MINI-100 makes an ideal addition to your tool box for "In-the-field" frequency checks and repairs.

SPECIFICATIONS:

Range:	1 MHz to 500 MHz
Sensitivity:	Less than 25 MV
Resolution:	100 Hz (slow gate) 1.0 KHz (fast gate)
Display:	7 digits, 0.4" LED
Time base:	2.0 ppm 20-40°C
Power:	5 VDC @ 200 ma

8 DIGITS 600 MHz $159.95 WIRED

NEW READ RECEIVER FREQUENCY

SPECIFICATIONS:

Range:	20 Hz to 600 MHz
Sensitivity:	Less than 25 mv to 150 MHz Less than 150 mv to 600 MHz
Resolution:	1.0 Hz (60 MHz range) 10.0 Hz (600 MHz range)
Display:	8 digits 0.4" LED
Time base:	2.0 ppm 20-40°C
Power:	110 VAC or 12 VDC

The CT-50 is a versatile lab bench counter that will measure up to 600 MHz with 8 digit precision. And, one of its best features is the Receive Frequency Adapter, which turns the CT-50 into a digital readout for any receiver. The adapter is easily programmed for any receiver and a simple connection to the receiver's VFO is all that is required for use. Adding the receiver adapter in no way limits the operation of the CT-50, the adapter can be conveniently switched on or off. The CT-50, a counter that can work double-duty!

PRICES:

CT-50 wired, 1 year warranty	$159.95
CT-50 Kit, 90 day parts warranty	119.95
RA-1, receiver adapter kit	14.95
RA-1 wired and pre-programmed (send copy of receiver schematic)	29.95

DIGITAL MULTIMETER $99.95 WIRED

PRICES:

DM-700 wired, 1 year warranty	$99.95
DM-700 Kit, 90 day parts warranty	79.95
AC-1, AC adaptor	3.95
BP-3, Nicad pack +AC adapter/charger	19.95
MP-1, Probe kit	2.95

The DM-700 offers professional quality performance at a hobbyist price. Features include; 26 different ranges and 5 functions, all arranged in a convenient, easy to use format. Measurements are displayed on a large 3½ digit, ½ inch LED readout with automatic decimal placement, automatic polarity, overrange indication and overload protection up to 1250 volts on all ranges, making it virtually goof-proof! The DM-700 looks great, a handsome, jet black, rugged ABS case with convenient retractable tilt ball makes it an ideal addition to any shop.

SPECIFICATIONS:

DC/AC volts:	100uV to 1 KV, 5 ranges
DC/AC current	0.1uA to 2.0 Amps, 5 ranges
Resistance:	0.1 ohms to 20 Megohms, 6 ranges
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2N682	4.14
2N683	5.23
2N684	6.15
2N685	7.05
2N686	7.86
2N687	8.46
2N688	9.88
2N689	11.80
2N690	12.71
2N691	17.30
2N692	19.80
2N697	.60
2N699	.80
2N703	4.52
2N706	1.80
2N706A	2.18
2N706B	2.73
2N708	.60
2N711	.45
2N711B	.60
2N718	.87
2N718A	.83
2N720A	2.20
2N736	3.22
2N740	3.38
2N834	3.33
2N869A	1.66
2N910	2.66
2N914	1.60
2N915	1.40
2N916	1.73
2N918	.80
2N929	.42
2N930	.42
2N930A	2.20
2N956	1.61
2N998	5.59
2N1132	.40
2N1132A	3.53
2N1595	1.76
2N1596	2.45
2N1597	3.37
2N1598	3.96
2N1599	9.34
2N1613	.45
2N1711	.45
2N1842	4.25
2N1842A	4.33
2N1843	4.40
2N1843A	4.47
2N1844	4.77
2N1844A	4.84
2N1845	5.56
2N1845A	5.63
2N1846	6.47
2N1846A	6.54
2N1847	7.41
2N1847A	7.48
2N1848	8.01
2N1848A	8.08
2N1849	9.52
2N1849A	9.59
2N1850A	11.01
2N1850A	11.09
2N1890	9.04
2N1893	.45
2N1990	3.92
2N1991	7.35
2N2060	5.03
2N2060A	4.26
2N2102	1.50
2N2160	1.60
2N2193	.75
2N2218	.58
2N2218A	.60
2N2219	.56
2N2219A	.58
2N2221	.40
2N2221A	.42
2N2222	.40
2N2222A	.42
2N2223	4.26
2N2223A	4.52
2N2270	1.32
2N2297	2.00
2N2322	2.29
2N2323	2.80
2N2324	3.52
2N2325	5.13
2N2326	6.55
2N2327	9.15
2N2328	10.12
2N2329	13.33
2N2368	1.74
2N2369	.42
2N2369A	.45
2N2405	2.86
2N2453	4.39
2N2453A	4.52
2N2476	.60
2N2476	.60
2N2480	3.59
2N2480A	3.86
2N2481	.73
2N2483	.39
2N2484	.45
2N2501	8.78
2N2540	7.78
2N2573	5.51
2N2574	5.55
2N2575	7.99
2N2576	8.48
2N2577	10.09
2N2578	10.66
2N2579	12.46
2N2604	1.66
2N2605	.90
2N2608	1.80
2N2639	3.33
2N2640	3.19
2N2641	2.93
2N2642	3.99
2N2643	3.72
2N2644	3.33
2N2646	.80
2N2647	.95
2N2652	3.86
2N2652A	4.79
2N2687	2.87
2N2688	3.33
2N2689	7.04
2N2690	8.86
2N2713	.16
2N2720	4.52
2N2722	3.99
2N2723	4.12
2N2723	4.12
2N2785	3.86
2N2800	6.05
2N2857	1.80
2N2894	3.19
2N2895	2.86
2N2896	4.12
2N2897	2.46
2N2903	8.85
2N2903A	4.52
2N2904	.56
2N2904A	.58
2N2905	.56
2N2905A	.58
2N2906	.36
2N2906A	.39
2N2907	.36
2N2907A	.39
2N2913	3.33
2N2914	3.72
2N2915	10.64
2N2916	5.59
2N2917	4.66
2N2918	5.32
2N2919	5.59
2N2920	5.99
2N2924	.30
2N2925	.30
2N2944	4.32
2N2945	4.06
2N2946	4.59
2N2947	26.91
2N2959	4.72
2N3009	2.99
2N3011	1.66
2N3012	2.73
2N3013	1.08
2N3014	2.06
2N3019	.75
2N3020	5.05
2N3043	40.00
2N3044	34.00
2N3045	28.00
2N3046	37.00
2N3047	31.00
2N3048	28.00
2N3053	.48
2N3053A	1.73
2N3054	.90
2N3054A	1.69
2N3055	1.10
2N3055A	1.98
2N3073	1.40
2N3114	9.11
2N3133	7.52
2N3135	7.91
2N3137	3.02
2N3227	4.32
2N3244	23.87
2N3245	23.87
2N3249	7.58
2N3250	.70
2N3250A	.80
2N3251	.70
2N3251A	.75
2N3252	2.06
2N3253	2.40
2N3297	55.10
2N3299	1.30
2N3300	1.66
2N3301	1.30
2N3202	1.70
2N3303	21.50
2N3307	16.70
2N3308	14.20
2N3330	1.30
2N3375	19.00
2N3390	.26
2N3391A	.25
2N3414	22
2N3416	.25
2N3425	4.50
2N3436	1.80
2N3437	1.90
2N3438	2.00
2N3439	1.40
2N3440	1.30
2N3441	1.40
2N3442	2.10
2N3444	18.20
2N3445	5.80
2N3446	6.30
2N3447	7.40
2N3448	7.90
2N3467	3.70
2N3468	3.80
2N3485	8.20
2N3485A	8.60
2N3486	9.60
2N3486A	10.50
2N3494	14.80
2N3495	19.30
2N3793	.25
2N3796	4.90
2N3797	4.90
2N3798	5.00
2N3799	5.40
2N3806	4.12
2N3807	4.12
2N3808	5.60
2N3809	5.90
2N3810	6.12
2N3811	6.70
2N3811A	13.60
2N3812	27.40
2N3813	27.40
2N3814	29.40
2N3815	31.00
2N3816	35.50
2N3816A	43.10
2N3817	43.10
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2N3498	9.40
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2N3500	16.00
2N3501	17.90
2N3506	17.70
2N3507	20.00
2N3508	8.60
2N3509	8.60
2N3510	1.90
2N3511	2.60
2N3546	3.70
2N3553	1.80
2N3563	.15
2N3564	.25
2N3565	.20
2N3566	.25
2N3567	.20
2N3568	.30
2N3569	.20
2N3583	1.60
2N3584	2.40
2N3585	2.50
2N3632	24.00
2N3634	20.02
2N3635	21.95
2N3636	24.20
2N3637	21.80
2N3638	.25
2N3638A	.26
2N3640	.25
2N3642	.20
2N3643	.35
2N3645	.25
2N3647	3.70
2N3648	4.30
2N3668	5.00
2N3669	6.00
2N3670	10.20
2N3677	3.80
2N3687	2.10
2N3693	.19
2N3694	.19
2N3700	2.10
2N3702	.20
2N3703	.20
2N3704	.20
2N3705	.20
2N3706	.20
2N3707	.19
2N3708	.19
2N3709	.19
2N3710	.19
2N3711	.19
2N3712	3.90
2N3713	1.80
2N3714	1.90
2N3715	1.80
2N3716	1.90
2N3719	7.10
2N3720	9.80
2N3721	.20
2N3724	.90
2N3725	1.46
2N3725A	1.68
2N3726	9.98
2N3727	5.30
2N3731	3.60
2N3734	3.26
2N3735	6.45
2N3736	7.00
2N3737	7.00
2N3738	2.20
2N3739	2.70
2N3740	2.20
2N3741	2.00
2N3742	19.80
2N3743	19.80
2N3762	8.05
2N3763	16.50
2N3764	8.05
2N3765	16.50
2N3766	2.00
2N3767	2.30
2N3771	2.40
2N3772	2.50
2N3773	3.60
2N3789	1.80
2N3790	1.80
2N3791	1.70
2N3792	1.80
2N3819	.40
2N3821	1.60
2N3822	1.58
2N3823	1.05
2N3824	1.20
2N3825	.23
2N3827	.19
2N3838	22.30
2N3839	2.25
2N3843	.50
2N3859	.25
2N3860	.20
2N3866	1.54
2N3866A	2.00
2N3867	1.80
2N3868	1.90
2N3870	5.00
2N3871	6.30
2N3872	8.00
2N3873	10.10
2N3877A	.25
2N3896	5.40
2N3897	6.50
2N3898	8.32
2N3899	10.20
2N3903	.30
2N3904	.19
2N3905	.20
2N3906	.20
2N3909	1.33
2N3926	20.40
2N3927	21.80
2N3933	1.50
2N3946	3.90
2N3947	3.60
2N3948	2.70
2N3950	39.10
2N3957	2.55
2N3959	4.90
2N3960	5.80
2N3962	.51
2N3963	.57
2N3964	.68
2N3965	.68
2N3966	3.20
2N3970	1.30
2N3971	1.20
2N3972	1.20
2N3980	4.20
2N3993	2.80
2N3994	2.90
2N4013	2.70
2N4014	2.80
2N4015	10.12
2N4016	11.31
2N4030	.69
2N4031	.75
2N4032	.81
2N4033	1.40
2N4036	.66
2N4037	.60
2N4058	.19
2N4060	.20
2N4061	.19
2N4062	.19
2N4072	2.30
2N4091	1.14
2N4092	1.07
2N4093	1.05
2N4117	2.20
2N4117A	1.60
2N4118	1.90
2N4118A	1.50
2N4119	1.80
2N4119A	1.60
2N4123	.19
2N4124	.19
2N4125	.20
2N4126	.25
2N4141	.20
2N4142	.20
2N4143	.20
2N4167	6.35
2N4168	6.44
2N4169	6.70
2N4167	6.35
4168	6.44
2N4169	6.70
2N4170	6.80
2N4171	7.10
2N4172	7.50
2N4173	8.50
2N4174	10.30
2N4183	6.30
2N4184	6.35
2N4185	6.60
2N4186	6.80
2N4187	7.10
2N4188	7.55
2N4189	8.50
2N4190	10.30
2N4199	68.20
2N4200	95.20
2N4201	118.40
2N4202	152.50
2N4203	178.20
2N4204	208.00
2N4208	3.90
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2N4216	5.00
2N4217	5.70
2N4218	8.30
2N4219	12.40
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2N4220A	1.50
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2N4223	1.58
2N4224	1.50
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2N4232A	1.90
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2N4234	1.50
2N4235	1.65
2N4236	1.80
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2N4256	.20
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2N4395	1.30
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2N4851	1.31
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2N4896	3.60
2N4897	4.50
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2N4899	2.08
2N4900	2.30
2N4901	2.20
2N4902	3.10
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2N4904	2.50
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2N4906	3.50
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2N4915	2.38
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2N4924	3.10
2N4925	3.80
2N4926	4.70
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2N4929	7.52
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2N4931	10.18
2N4937	11.80
2N4938	4.02
2N4939	3.64
2N4940	22.00
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2N4948	1.16
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2N4957	5.31
2N4958	3.75
2N4959	3.00
2N4983	1.10
2N4984	1.50
2N4987	.75
2N4988	1.20
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2N4991	.75
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2N5023	1.45
2N5032	3.19
2N5038	4.50
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2N5050	3.46
2N5051	4.46
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2N5058	4.33
2N5059	3.46
2N5060	.59
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2N5063	.73
2N5064	.84
2N5067	1.58
2N5068	1.79
2N5069	1.98
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2N5108	4.60
2N5109	.40
2N5131	.25
2N5132	.20
2N5133	.20
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2N5165	4.18
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2N5171	7.74
2N5172	.20
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2N5193	.85
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2N5220	.20
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2N5223	.19
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2N5227	.19
2N5228	.37
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2N5231	6.44
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2N5323	.81
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2N5429	4.75
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2N5451	.25
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2N5484	.55
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2N5550	.27
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2N5635	14.50
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2N5637	20.60
2N5638	.70
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2N5769	.24
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2N5772	.24
2N5777	.90
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2N5783	1.50
2N5784	1.50
2N5785	1.35
2N5786	1.35
2N5817	.40
2N5822	.60
2N5824	.25
2N5827	.30
2N5828	.40
2N5828A	.40
2N5830	.27
2N5831	.27
2N5835	3.86
2N5836	4.60
2N5837	5.40
2N5841	13.80
2N5842	11.60
2N5847	18.50
2N5848	20.60
2N5849	27.60
2N5862	76.50
2N5875	1.35
2N5876	1.47
2N5877	1.35
2N5878	1.65
2N5941	30.60
2N5944	12.30
2N5945	15.30
2N5946	19.30
2N5947	12.30
2N5961	.19
2N5974	2.71
2N5975	3.05
2N5976	3.60
2N5977	2.48
2N5978	2.80
2N5979	3.30
2N5980	3.40
2N5981	3.90
2N6982	4.70
2N5983	2.60
2N5984	2.90
2N5985	3.60
2N5986	3.70
2N5987	4.10
2N5988	4.50
2N5989	3.50
2N5990	3.90
2N5991	4.30
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2N6014	.70
2N6027	.50
2N6028	.60
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2N6031	8.40
2N6032	24.00
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2N6035	1.30
2N6036	1.40
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2N6044	2.70
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2N6051	2.60
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2N6074	2.08
2N6075	2.51
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2N6129	1.23
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2N6132	1.26
2N6133	1.41
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2N6145	6.90
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2N6153	4.70
2N6154	2.67
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2N6157	4.83
2N6158	5.70
2N6159	7.30
2N6160	7.10
2N6161	8.42
2N6162	10.40
2N6163	8.80
2N6164	10.10
2N6165	12.10
2N6166	54.00
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2N6168	5.50
2N6169	7.30
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2N6211	2.48
2N6212	2.98
2N6213	3.40
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2N6226	1.69
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2N6228	2.19
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2N6230	3.56
2N6231	4.36
2N6233	7.55
2N6234	7.85
2N6235	8.14
2N6236	.94
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2N6241	2.74
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2N6255	2.80
2N6256	10.70
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2N6384	5.90
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2N6288	.72
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2N6292	.78
2N6294	2.30
2N6295	2.50
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2N6298	2.70
2N6299	2.90
2N6300	2.20
2N6301	2.40
2N6303	9.80
2N6304	2.10
2N6305	1.80
2N6306	3.80
2N6307	4.60
2N6308	6.00
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2N6314	2.30
2N6315	1.70
2N6316	1.90
2N6317	2.10
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2N6326	3.20
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2N6329	3.60
2N6330	4.00
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2N6338	8.50
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2N6377	22.70
2N6378	30.80
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2N6385	2.54
2N6386	1.05
2N6387	1.17
2N6388	1.26
2N6394	1.80
2N6395	1.82
2N6396	1.90
2N6397	2.60
2N6398	4.10
2N6399	5.70
2N6400	2.20
2N6401	2.40
2N6402	2.60
2N6403	3.40
2N6304	5.20
2N6405	8.50
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2N6403	3.40
2N6304	5.20
2N6420	1.80
2N6421	2.30
2N6422	2.35
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2N6425	2.60
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2N6428	.76
2N6428A	1.00
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2N6431	2.80
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2N5437	16.00
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2N6490	1.20
2N6491	1.29
2N6497	2.79
2N6498	3.40
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2N6501	28.00
2N6503	23.10
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2N6515	.82
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2N6520	1.01
2N6530	1.26
2N6531	1.35
2N6532	1.50
2N6533	1.80
2N6542	3.20
2N6543	4.30
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2N6547	8.40
2N6548	1.16
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2N6556	1.17
2N6557	1.03
2N6558	1.13
2N6559	1.33
2N6569	1.12
2N6591	1.13
2N6592	1.26
2N6593	1.40
2N6603	13.60
2N6604	13.60
2N6609	4.60
2N6648	2.20
2N6649	2.50
2N6666	1.50
2N6667	1.60
2N6668	1.80
2N6671	6.00
2N6672	6.60
2N6673	7.50
2N6674	7.80
2N6675	9.00
3N83	1.80
3N84	1.80
3N85	3.00

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NAME

ADDRESS

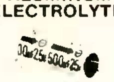
CITY STATE

ZIP PHONE NO.

Coupons accepted only with full name and address filled in

CAPACITORS • CAPACITORS • CAPACITORS

ALUMINUM ELECTROLYTIC



MFD	10V	16V	25V	35V	50V
1	.12	.13	.14	.15	.16
5	.13	.14	.17	.20	.24
10	.14	.15	.18	22	26
22	.15	.16	.21	23	.28
33	.16	.17	.22	.24	.30
47	.17	.18	.24	.25	.32
100	.18	.20	.26	.30	35
220	.23	25	.35	.40	.50
330	.30	.33	.40	.45	.55
470	.35	.40	.45	.60	.80
1000	--	--	.65	80	1 20
2200	--	--	1.30	1.60	2.50

50V CERAMIC DISC—$1.00 Per Pack

9/pkg	5pf	7/pkg	300pf	9/pkg	.0047mfd
9/pkg	15pf	7/pkg	330pf	9/pkg	.005mfd
9/pkg	25pf	7/pkg	390pf	9/pkg	.01mfd
9/pkg	27pf	7/pkg	470pf	8/pkg	.015mfd
8/pkg	47pf	7/pkg	560pf	8/pkg	.02mfd
8/pkg	68pf	7/pkg	680pf	8/pkg	.022mfd
8/pkg	100pf	9/pkg	.001mfd	8/pkg	.03mfd
8/pkg	150pf	9/pkg	.0015mfd	7/pkg	.039mfd
8/pkg	220pf	9/pkg	.0022mfd	7/pkg	.047mfd
7/pkg	270pf	9/pkg	.003mfd	6/pkg	.1mfd

ELNA DIPPED TANTALUM

MF	V	$	MF	V	$	MF	V	$
.1	35	.33	1.5	35	.40	10.0	25	.45
.15	35	33	2.2	20	.33	10.0	35	.90
.22	35	.33	2.2	35	.40	15.0	20	.45
.33	35	.33	3.3	35	.42	15.0	35	1.32
.47	35	.33	4.7	35	.45	22.0	16	.45
.68	35	.33	6.8	16	.40	33.0	20	1.32
1.0	35	.33	6.8	35	.45	47.0	20	1.53
			10.0	16	.42	68.0	16	1.62

PLESSEY

SAMPLER

SERIES 160 MINIBOX

METALLIZED POLYESTER CAPACITORS

$26.00

300 METALLIZED CAPACITORS 18 DIFFERENT STD VALUES

PLESSEY POLYESTER (MINI-BOX)

MF	V	$	MF	V	$	MF	V	$
.001	1000	.14	.01	630	.14	.1	100	.17
.0012	1000	.14	.012	630	.14	.12	100	.18
.0015	1000	.14	.015	400	.15	.15	100	.20
.0018	1000	.14	.018	400	.15	.18	100	.21
.0022	1000	.14	.022	400	.15	22	100	.23
.0027	1000	.14	.027	400	.15	.27	100	.26
.0033	1000	.14	.033	250	.15	.33	100	.30
.0039	630	.14	.039	250	.15	.39	100	.33
.0047	630	.14	.047	250	.15	.47	100	.36
.0056	630	.14	.056	250	.15	.56	100	.44
.0068	630	.14	.068	250	.15	.68	100	.47
.0082	630	.14	.082	250	.17	.82	100	.54
						1.0	100	.60

ZENER DIODES 1 WATT — 5%

Type	V	Price	Type	V	Price
1N4728A	3.3	.40	1N4745A	16	.40
1N4729A	3.6	.40	1N4746A	18	.40
1N4730A	3.9	.40	1N4747A	20	.40
1N4731A	4.3	.40	1N4748A	22	40
1N4732A	4.7	.40	1N4749A	24	.40
1N4733A	5.1	.40	1N4750A	27	.40
1N4734A	5.6	.40	1N4751A	30	.40
1N4735A	6.2	.40	1N4752A	33	.40
1N4736A	6.8	.40	1N4753A	36	.40
1N4737A	7.5	.40	1N4754A	39	.40
1N4738A	8.2	.40	1N4755A	43	.40
1N4739A	9.1	.40	1N4756A	47	.40
1N4740A	10	.40	1N4757A	51	40
1N4741A	11	.40	1N4758A	56	.40
1N4742A	12	.40	1N4759A	62	.40
1N4743A	13	.40	1N4760A	68	.40
1N4744A	15	.40	1N4761A	75	.57

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1N5246B	16	.22	1N5256B	30	.22	1N5266B	68	.22	1N5235B	6.8	.22
1N5247B	17	.22	1N5257B	33	.22	1N5267B	75	.22	1N5236B	7.5	.22
1N5248B	18	.22	1N5258B	36	.22	1N5223B	2 7	.22	1N5237B	8.2	22
1N5249B	19	.22	1N5259B	39	.22	1N5224B	2.8	.22	1N5238B	8.7	.22
1N5250B	20	.22	1N5260B	43	.22	1N5225B	3.0	.22	1N5239B	9 1	.22
1N5251B	22	22	1N5261B	47	.22	1N5226B	3.3	.22	1N5240B	10	.22
1N5252B	24	.22	1N5262B	51	.22	1N5227B	3.6	.22	1N5241B	11	.22
1N5253B	25	.22	1N5263B	56	.22	1N5228B	3.9	.22	1N5242B	12	.22
1N5254B	27	.22	1N5264B	60	.22	1N5229B	4.3	22	1N5243B	13	.22
1N5255B	28	22	1N5265B	62	22	1N5230B	4.7	.22	1N5244B	14	22
						1N5231B	5.1	.22	1N5245B	15	.22
						1N5232B	5.6	.22			
						1N5233B	6.0	.22			
						1N5234B	6.2	22			

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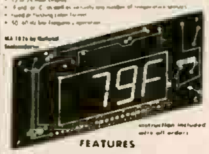

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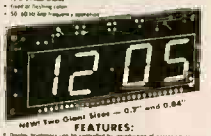

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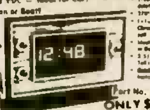

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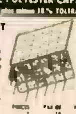

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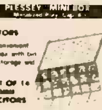

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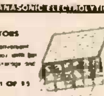

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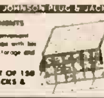

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A18WG	1.01	1.00	.99	.98
A20WG	1.23	1.22	1.21	1.20
A22WG	1.35	1.34	1.33	1.32
A24WG	1.43	1.42	1.41	1.40
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74LS175N	.49
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MBD102	.28	MC1352P	2.01	MC1488L	1.61	MC8311P	2.50
MBD201	1.03	MC1355P	2.10	MC1489AL	1.48	MC9819P	2.73
MBD501	1.57	MC1357P	1.55	MC1489L	1.48	MC10104P	.92
MC663P	3.20	MC1358P	1.50	MC1489P	1.39	MC10109L	1.24
MC664P	3.20	MC1364P	2.01	MC1494L	6.04	MC10116L	1.24
MC665P	1.91	MC1372P	6.48	MC1495L	5.28	MC10116P	.92
MC667P	3.20	MC1373P	5.19	MC1496G	1.80	MC10123L	2.39
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MC857L	2.46	MC1445G	4.20	MC3423P1	1.66	MC14457P	6.60
MC857P	1.50	MC1445L	4.15	MC3438L	4.33	MC14458P	13.73
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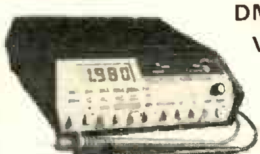

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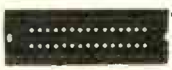

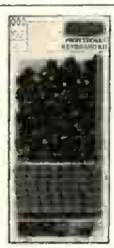

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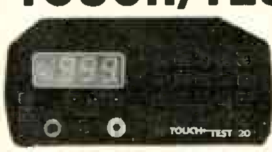

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22	68	220	680	2.2K	6.8K	22K	68K	220K	680K	2.2M	6.8M
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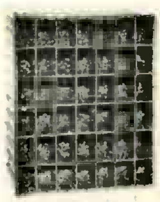

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3.3Ω	33Ω	330Ω	3.3KΩ	33KΩ	330KΩ	3.3MΩ
4.7Ω	47Ω	470Ω	4.7KΩ	47KΩ	470KΩ	4.7MΩ
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XR-095CP	1.74	1.40	1.16
XR-096CP	1.74	1.40	1.16
XR-246P	2.61	2.09	1.74
XR-346CP	1.95	1.56	1.30
XR-346-2CP	1.95	1.56	1.30
XR-205CN	6.00	4.80	4.00
XR-210CN	4.22	3.38	2.81
XR-215CN	4.22	3.38	2.81
XR-C240	10.22	8.18	6.81
XR-C262	9.28	7.43	6.19
XR-C277	8.06	6.45	5.38
XR-320P	1.39	1.11	.93
XR-555CP	.64	.51	.43
XR-L555CP	1.11	.89	.74
XR-556CP	.96	.77	.64
XR-L556CP	1.89	1.51	1.26
XR-558CP	2.01	1.61	1.34
XR-559CP	2.01	1.61	1.34
XR-567CP	1.18	.94	.79
XR-L567CP	1.13	.90	.75
XR-1458CP	.84	.67	.56
XR-1468CN	2.57	2.06	1.71
XR-1488P	1.09	.87	.73
XR-1489AP	1.09	.87	.73
XR-1524M	13.93	11.14	9.29
XR-1568N	3.36	2.69	2.24
XR-2200CP	1.18	.94	.79
XR-2201CP	1.18	.94	.79
XR-2202CP	1.18	.94	.79
XR-2203CP	1.18	.94	.79
XR-2204CP	1.18	.94	.79
XR-2206CP	4.22	3.38	2.81
XR-2207CP	3.28	2.63	2.19
XR-2208CP	2.79	2.23	1.86
XR-2209CP	2.63	2.10	1.75
XR-2211CP	4.93	3.94	3.29
XR-2212CP	4.31	3.45	2.88
XR-2216CP	3.21	2.57	2.14
XR-2228CP	2.79	2.23	1.86
XR-2240CP	1.99	1.59	1.33
XR-2242CP	1.91	1.53	1.27
XR-2271CP	1.16	.93	.78
XR-2272CP	1.18	.93	.78
XR-2276CP	1.99	1.59	1.33
XR-2284CP	3.68	2.93	2.44
XR-2288CP	8.72	6.98	5.81
XR-2524P	4.03	3.22	2.69
XR-2556CP	2.14	1.71	1.43
XR-2567CP	1.88	1.50	1.25
XR-3403CP	1.20	.96	.80
XR-3524CP	3.11	2.49	2.07
XR-4136CP	1.24	.99	.83
XR4151CP	1.29	1.03	.86
XR-4195CP	1.37	1.10	.91
XR-4212CP	1.28	1.02	.85
XR-4558CP	.79	.63	.53
XR-4741CP	1.29	1.03	.86
XR-5533P	2.42	1.94	1.61
XR-5533AP	3.13	2.50	2.09
XR-5534CP	1.99	1.59	1.33
XR-5534ACP	2.64	2.11	1.76
XR-6118P	2.25	1.80	1.50
XR-6128P	2.25	1.80	1.50
XR-8038CP	3.75	3.00	2.50
XR-13600CP	1.82	1.46	1.21

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CIRCLE 17 ON FREE INFORMATION CARD

DATA PRECISION®

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MODEL	DESCRIPTION	PRICE
175	3½ Digit Portable D.M.M.	$219.00
245	4½ Digit Portable D.M.M.	385.00
248	4½ Digit Portable True RMS D.M.M.	385.00

100-Hour Mini-Portable 4½-Digit LCD Multimeter

• 25 Ranges, including five each AC and DC, both voltage and current, plus five resistance ranges! • Sensitivities of 10μV, 10nA, 100mΩ, and maximum readings of 100 volts (500 AC), 2A, 20 megohms! • Basic accuracy of ±0.03%, supported by lab-grade T.C. — typically, ±(0.003% rdg. + 0.001% rng.)/°C • Rechargable 100-hour battery portability, plus line operation (while charging) • Big, clear, high contrast 0.43" high LCD readout, readable anywhere you can see to work . . . including bright sunlight!

MODEL 255 . . . . $295.00

258	4½ Digit Portable True RMS D.M.M.	385.00
585	8 Digit Portable 250MHz Frequency Counter	395.00

3½ Digit – LCD Display DIGITAL MULTIMETER

• Unique Audible "Eyes-Off" multi-testing • Fast testing without taking your eyes off the circuit you're probing. • Continuity Test works on three lowest resistance ranges. • Repetitive Alarm warns of AC overload or accidental applications of AC voltage to OHMS input. • Single-tone alarm on negative DC overvoltage. • Also tests logic levels – logic transistors — relay or switch opening and closing — diode and transistor junctions – event occurences.

MODEL 936. . . . . $190.00

Capacitance Meter

- Easy to use - plug in capacitor, push range button and read the value to 0.1%
- 0.5 in. liquid crystal display
- Exclusive "Δcharge/Δvolt" measurement circuit (patent pending) holds ±0.1% basic accuracy for a full year.
- Up to 200 hrs operation on standard 9V Batt.
- 8 easy pushbutton ranges cover 0.1pf to 1999 microfarads.
- Best of all it's easy on the budget - only

MODEL 938 $185

0.1° Resolution, LCD Display TEMPERATURE METER

• WIDE-RANGING — (–) 65°C to +150°C°(–)85° to 302°F • ACCURATE — ± .4°C/ ±0.7°F over most of range • FAST— 8 seconds to 99% of final change in reading • VERSATILE — switch-selectable resolution (0.1° or 1°) and degrees C or F • HANDY — easy to carry, hold, use, read • TOUGH — takes everyday field usage yet maintains calibration. • COMPLETE — includes full-measurement range probe. • USED EVERYWHERE — internal 9V battery or line operation (115AC, 47 – 63 Hz) with optional battery eliminator.

MODEL 940 . . . . $195.00

1350	3½ Digit Bench D.M.M.	215.00
1351	3½ Digit Bench D.M.M. with 20A current range	205.00
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2480	4½ Digit Bench/Portable D.M.M.	330.00
2480R	4½ Digit Bench/Portable True RMS D.M.M.	350.00
5740	7 Digit 100MHz Multifunction Counter	325.00
5800	8 Digit 520MHz Bench/Portable Frequency Counter	485.00
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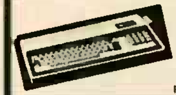

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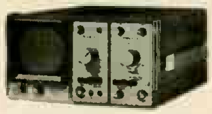

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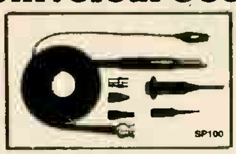

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SWITCHABLE X1 and X10 Attenuation Factor

KEY ADDITIONAL FEATURES: • 100MHz bandwidth • Heavy duty tip • Break resistant center conductor • Slender, flexible cable • 6ft. cable length • Wide compensation range • Fits all scopes • Ground reference can be activated at tip • Includes SPRUNG HOOK, I.C. TIP, BNC ADAPTOR, INSULATING TIP and TRIMMER TOOL ACCESSORIES.

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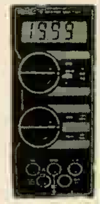

3½ Digit Hand-Held DIGITAL MULTIMETER

MODEL 130 — 0.5% basic DCV accuracy • 25 ranges and 5 functions: DC volts, AC volts, DC amps, AC amps and ohms • Auto zero and auto polarity • Low battery indicator and much much more $115.00

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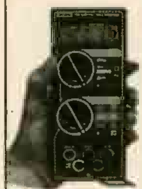
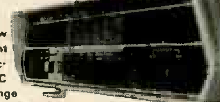


4½ Digit LCD Hand-Held DIGITAL MULTIMETER

0.05% DCV accuracy • 4½-digit resolution • 5 functions • Easy to read, 0.6" LCD display • 100-hour life from an akaline battery • Annunciator warns user when 10% of battery life remains • Reliable rotary switches clearly display range and function • Fully protected from overload: 1000V max DCV, 1000V peak ACV and 300V max Ohms • 10A current range • ACV bandwidth to 20KHz

MODEL 135 . . . . $219.00

4½ Digit Bench/Portable DIGITAL MULTIMETER



MODEL 176 — 0.5% accuracy below 20VDC and 20KHz AC • 20000 count display • 0.6" LCD display • 5 Functions: DC volts, AC volts, DC amps, AC amps and ohms • Function and range annunciators • 1000 hour battery life typical

MODEL 176 . . . . $249.00

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1304	Carrying Case.	$10.00
1766	Battery Eliminator	40.00
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4½ Digit LCD Bench/Portable DIGITAL MULTIMETER

• 2000 count display • 0.6" LCD display • Function and range annunciators • 5 Functions: DC volts, DC amps, AC volts, AC amps and ohms • Fully protected • 1-year battery life from alkaline battery • Quality and performance

The Keithley 169 provides full capability for many general purpose applications. Seldom-used functions have been eliminated to keep the price/performance ratio high.

MODEL 169 . . . . $169.00

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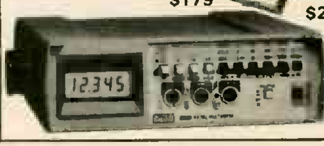

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Pulse Generator (left on bottom)

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- Period Range 200ns — 200μs (5MHz — 5Hz)
- Pulse Width Range 100ns — 100μs
- Varible 50Ω and Fixed TTL Outputs
- TTL Output Capable of Driving 20 Standard TTL Loads
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- 10Hz — 200MHz (Resolution 1ppm across measurement range • 5 Selectable Gate Times • Input Better than 30mV rms Across Full Range and Better than 10mV rms from 20Hz — 100MHz • ½" 8-Digit LCD Display • Automatically Positioned Decimal Point
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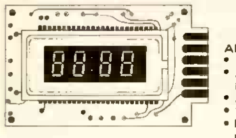
CIRCLE 18 ON FREE INFORMATION CARD

National Semiconductor Clock Modules



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National Semiconductor

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- Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.
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- Special conductive foam liner eliminates static build-up.
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- Four .630"ht. and two .300"ht. common anode displays
- Uses MM5314 clock chip
- Switches for hours, minutes and hold functions
- Hours easily viewable to 30 feet
- Simulated walnut case
- 115VAC operation
- 12 or 24 hour operation
- Includes all components, case and wall transformer
- Size: 6¾" x 3-1/8" x 1¾"

JE747 .... $29.95

6-Digit Clock Kit

- Bright .300 ht. comm. cathode display
- Uses MM5314 clock chip
- Switches for hours, minutes and hold modes
- Hrs. easily viewable to 20 ft.
- Simulated walnut case
- 115 VAC operation
- 12 or 24 hr. operation
- Incl. all components, case & wall transformer
- Size: 6¾" x 3-1/8" x 1¾"

JE701 .... $19.95

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General Description: The JE215 is a Dual Power Supply with independent adjustable positive and negative output voltages. A separate adjustment for each of the supplies provides the user unlimited applications for IC current voltage requirements. The supply can also be used as a general all-purpose variable power supply.

FEATURES:
- Adjustable regulated power supplies, pos. and neg. 1.2VDC to 15VDC.
- Power Output (each supply): 5VDC @ 500mA, 10VDC @ 750mA, 12VDC @ 500mA, and 15VDC @ 175mA.
- Two, 3-terminal adj. IC regulators with thermal overload protection.
- Heat sink regulator cooling
- LED "on" Indicator
- Printed Board Construction
- 120VAC input
- Size: 3-1/2"w x 5-1/16"L x 2"H

JE215 Adj. Dual Power Supply Kit (as shown) . . $24.95

(Picture not shown but similar in construction to above)
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ADC0804LCN	8-Bit A/D Converter (1 LSB)	4.95
DAC0806LCN	8-Bit D/A Converter (0.78% Lin.)	2.25

DATA ACQUISITION (CONTINUED)		
ADC0809CCN	8-Bit A/D Converter (8-Ch. Multi.)	5.25
ADC0817CCN	8-Bit A/D Converter (16-Ch. Multi.)	10.95
DAC1000LCN	10-Bit D/A Conv. Micro. Comp. (0.05%)	13.95
DAC1008LCN	10-Bit D/A Conv. Micro. Comp. (0.20%)	8.95
DAC1020LCN	10-Bit D/A Converter (0.05% Lin.)	8.49
DAC1022LCN	10-Bit D/A Converter (0.20% Lin.)	5.95
DAC1222LCN	12-Bit D/A Converter (0.20% Lin.)	9.95
CD4051N	8-Channel Multiplexer	1.19
AY-5-1013	30K BAUD UART	5.95

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	5.95
2114L	1024x4 Static 450ns Low Power	6.95
2114-3	1024x4 Static 300ns	7.49
2114L-3	1024x4 Static 300ns Low Power	7.95
2117	16,384x1 Dynamic 550ns (housemarked)	4.95
4116 (UPD416)	16K Dynamic 250ns	4.95
MM2147J	4096x1 Fast 70ns	19.95
5101	256x4 Static	7.95
MM5261	1024x1 Dynamic Fully Decoded	.99
MM5262	2Kx1 Dynamic	.25
MM5280/2107	4096x1 Dynamic	4.95
MM5290J-2(4116)	16K Dynamic 150ns (UPD416)	6.95
MM5298J-3A	8K Dyn. 200ns (lower ½ of MM5290J)	4.95
7489	16x4 Static	1.75
UPD414/MK4027	4K Dynamic 16-pin	4.95
TMS4044-45NL	4K Static	14.95
TMS4045	1024x4 Static	14.95

PROMS/EPROMS		
1702A	2K UV Erasable PROM	5.95
2708	8K EPROM	9.95
TMS2716	16K EPROM (-5V, +5V, +12V)	19.95
2716 Intel(2516)TI	16K EPROM (Single +5V)	17.95
2732 Intel(2532)TI	32K EPROM	49.95
2758	8K EPROM (450ns) (Single +5V)	7.95
5203	2048 PROM	14.95
82S23(74S188)	32x8 PROM (Open Collector)	4.95
82S115	4096 Bipolar PROM	19.95
82S123(74S288)	32x8 Tri-State Bipolar PROM	4.95
82S185	8K PROM	29.95

ROM'S		
2513(2140)	Character Generator (Upper Case)	9.95
2513(3021)	Character Generator (Lower Case)	9.95
2516N	Character Generator	10.95
MM5230N	2048-Bit Read Only Memory	1.95

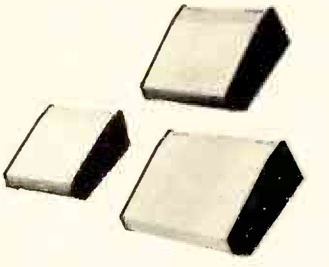
NMOS READ ONLY MEMORIES		
MCM66710P	128x9x7 ASCII Shifted w/Greek	13.50
MCM66740P	128x9x7 Math Symbol & Pictures	13.50
MCM66750P	128x9x7 Alpha. Control Char. Gen.	13.50

MICROPROCESSOR MANUALS		
M-Z80	User Manual	7.50
M-COP1802	User Manual	7.50
M-2650	User Manual	5.00

SPECIAL FUNCTION		
DS0025CN	Dual MOS Clock Driver (5MZ)	3.50
DS0026CN	Dual MOS Clock Driver (5MZ)	1.95
INS1771N-1	Floppy Disc Controller	24.95
INS2651N	Communication Chip	19.95
MM58167N	Microprocessor Real Time Clock	8.95
MM58174N	Microprocessor Compatible Clock	11.95
COP402N	Microcontroller with 64-Digit RAM and Direct LED Drive	6.95
COP402MN	Microcontroller with 64 Digit RAM & Direct LED Drive w/N Buss Int.	7.49
COP470N	32-Seg. VAC Fluor. Driver (20-pin pkg.)	3.25

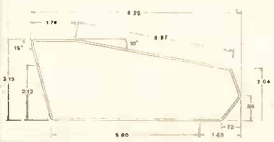
TELEPHONE/KEYBOARD CHIPS		
AY-5-9100	Push Button Telephone Dialer	14.95
AY-5-9200	Repertory Dialer	14.95
AY-5-9500	CMOS Clock Generator	4.95
AY-5-2376	Keyboard Encoder (88 keys)	11.95
HD0165-5	Keyboard Encoder (16 keys)	7.95
74C922	Keyboard Encoder (16 keys)	5.49
74C923	Keyboard Encoder (20 keys)	5.75
MM53190N	Push Button Pulse Dialer	7.95
MM57499N	96/144 Key Serial Keyboard Encoder	8.95

DESIGNERS' SERIES
Blank Desk-Top Electronic Enclosures



- High strength epoxy molded end pieces in mocha brown finish.
- Sliding rear/bottom panel for service and component accessibility.
- Top/bottom panels .080 thk alum. Alodine type 1200 finish (gold tint color) for best paint adhesion after modification.
- Vented top and bottom panels for cooling efficiency.
- Rigid construction provides unlimited applications.

CONSTRUCTION:
The "DTE" Blank Desk Top Electronic Enclosures are designed to blend and complement today's modern computer equipment and can be used in both industrial and home. The end pieces are precision molded with an internal slot (all around) to accept both top and bottom panels. The panels are then fastened to ¼" thick tabs inside the end pieces to provide maximum rigidity to the enclosure. For ease of equipment servicing, the rear/bottom panel slides back on slotted tracks while the rest of the enclosure remains intact. Different panel widths may be used while maintaining a common profile outline. The molded end pieces can also be painted to match any panel color scheme.



Enclosure Model No.	Panel Width	PRICE
DTE-8	8.00"	$29.95
DTE-11	10.65"	$32.95
DTE-14	14.00"	$34.95

$10.00 Min. Order – U.S. Funds Only
Calif. Residents Add 6% Sales Tax
Postage – Add 5% plus $1 Insurance

Spec Sheets — 25¢
Send 41¢ Postage for your FREE 1981 JAMECO CATALOG

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4/81

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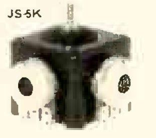
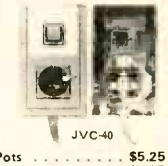




JS-5K	5K Linear Taper Pots	$5.25
JS-100K	100K Linear Taper Pots	$4.95
JVC-40	40K (2) Video Controller in case	$5.95

AC and DC Wall Transformers

Ideal for use with clocks, games, power supplies or any other type of AC or DC application.

Part No.	Input	Output	Price
AC 250	117V/60Hz	12 VAC 250mA	$3.95
AC 500	117V/60Hz	12 VAC 500mA	$4.95
AC1000	117V/60Hz	12 VAC 1 amp	$5.95
AC1700	117V/60Hz	9 VAC 1.7 amp	$6.95
DV 9200	117V/60Hz	9 VDC 200mA	$3.25
DC 900	120V/60Hz	9 VDC 500mA	$3.95

CONNECTORS

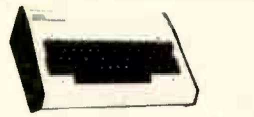
DB25P	D-Subminiature Plug	$2.95
DB25S	D-Subminiature Socket	$3.50
DB51226	Cover for DB25P/S	$1.75
22/44SE	P.C. Edge (22/44 Pin)	$2.95
UG88/U	BNC Plug	$1.79
UG89/U	BNC Jack	$3.79
UG175/U	UHF Adapter	$ .49
SO239	UHF Panel Recp.	$1.29
PL258	UHF Adapter	$1.60
PL259	UHF Plug	$1.60
UG260/U	BNC Plug	$1.79
UG1094/U	BNC Bulkhead Recp.	$1.29

TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K.
Kit comes complete with:
★ 8 ea. MM5290 (UPD416/4116) 16K Dyn. Rams (*NS)
★ Documentation for Conversion

TRS-16K2 *150NS $49.95
TRS-16K4 *250NS $39.95

JE610 ASCII Encoded Keyboard Kit



The JE610 ASCII Keyboard Kit can be interfaced into most any computer system. The kit comes complete with an industrial grade keyboard switch assembly (62-keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and −12V @ 10 mA for operation. Features: 60 keys generate the 126 characters, upper and lower case ASCII set. Fully buffered. Two user-define keys provided for custom applications. Caps lock for upper-case-only alpha characters. Utilizes a 2376 (40-pin) encoder read-only memory chip. Outputs directly compatible with TTL/DTL or MOS logic arrays. Easy interfacing with a 16-pin dip or 18-pin edge connector. Size: 3½"H x 14½"W x 8¾"D

JE610/DTE-AK (as pictured above) . . .**$124.95**

JE610 Kit 62-Key Keyboard, PC Board, & Components (no case). . . . **$ 79.95**

K62 62-Key Keyboard (Keyboard only) . . . **S 34.95**

DTE-AK (case only — 3¾"Hx11"Wx8¾"D) **S 49.95**

JE600 Hexadecimal Encoder Kit

FULL 8-BIT LATCHED OUTPUT 19-KEY KEYBOARD

The JE600 Encoder Keyboard Kit provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8-bit microprocessor or 8-bit memory circuits. Three additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with 9 LED readouts. Also included is a key entry strobe. Features: Full 8-bit latched output for microprocessor use. Three user-define keys with one being bistable operation. Debounce circuit provided for all 19 keys. 9 LED readouts to verify entries. Easy interfacing with standard 16-pin IC connector. Only +5VDC required for operation. Size: 3½"H x 8¼"W x 8¾"D

JE600/DTE-HK (as pictured above) **$99.95**

JE600 Kit 19-Key Hexadec. Keyboard, PC Board & Cmpnts. (no case) . . **$59.95**

K19 19-Key Keyboard (Keyboard only) **$14.95**

DTE-HK (case only — 3½"Hx8¼"Wx8¾"D) **$44.95**

CIRCLE 8 ON FREE INFORMATION CARD

7400

SN7400N	.25
SN7401N	.20
SN7402N	.25
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SN7404N	.25
SN7405N	.29
SN7406N	.29
SN7407N	.35
SN7408N	.29
SN7409N	.29
SN7410N	.25
SN7411N	.29
SN7412N	.35
SN7413N	.40
SN7414N	.69
SN7416N	.29
SN7417N	.29
SN7420N	.25
SN7421N	.29
SN7422N	.45
SN7423N	.29
SN7425N	.29
SN7426N	.29
SN7427N	.25
SN7428N	.49
SN7430N	.25
SN7432N	.29
SN7437N	.25
SN7438N	.40
SN7439N	.25
SN7440N	.20
SN7441N	.89
SN7442N	.59
SN7443N	1.10
SN7444N	1.10
SN7445N	.89
SN7446N	.79
SN7447N	.69
SN7448N	.79
SN7450N	.20
SN7451N	.20
SN7453N	.20
SN7454N	.20
SN7459A	.25
SN7460N	.20
SN7470N	.29
SN7472N	.29
SN7473N	.35
SN7474N	.35
SN7475N	.49
SN7476N	.35
SN7479N	5.00
SN7480N	.50
SN7482N	.99
SN7483N	.69
SN7485N	.89
SN7486N	.35
SN7489N	1.75
SN7490N	.49
SN7491N	.59
SN7492N	.45
SN7493N	.45
SN7494N	.69
SN7495N	.69
SN7496N	.69
SN7497N	3.00
SN74100N	1.49
SN74107N	.35
SN74109N	.39
SN74116N	1.95
SN74121N	.35
SN74122N	.55
SN74123N	.55
SN74125N	.49
SN74126N	.49
SN74132N	.75
SN74136N	.75
SN74141N	.99
SN74142N	3.25
SN74143N	3.49
SN74144N	3.49
SN74145N	.79
SN74147N	1.95
SN74148N	1.29
SN74150N	1.25
SN74151N	.69
SN74152N	.69
SN74153N	.79
SN74154N	1.25
SN74155N	.79
SN74156N	.79
SN74157N	.69
SN74160N	.89
SN74161N	.89
SN74162N	.89
SN74163N	.89
SN74164N	.89
SN74165N	.89
SN74166N	1.25
SN74167N	2.79
SN74170N	1.95
SN74172N	4.95
SN74173N	1.39
SN74174N	.99
SN74175N	.89
SN74176N	.79
SN74177N	.79
SN74179N	1.49
SN74180N	.79
SN74181N	2.25
SN74182N	.79
SN74184N	2.49
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SN74190N	1.25
SN74191N	1.25
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SN74194N	.89
SN74195N	.69
SN74196N	.89
SN74197N	.89
SN74198N	1.49
SN74199N	1.49
SN74221N	1.25
SN74251N	.99
SN74276N	1.95
SN74279N	.79
SN74283N	1.49
SN74284N	3.95
SN74285N	3.95
SN74365N	.69
SN74366N	.69
SN74367N	.69
SN74368N	.69
SN74390N	1.49
SN74393N	1.49

74LS

74LS00	.29
74LS01	.29
74LS02	.29
74LS03	.29
74LS04	.35
74LS05	.35
74LS08	.29
74LS09	.35
74LS10	.29
74LS11	.75
74LS12	.35
74LS13	.59
74LS14	.99
74LS15	.35
74LS20	.29
74LS21	.35
74LS22	.35
74LS26	.35
74LS27	.35
74LS28	.35
74LS30	.29
74LS32	.35
74LS33	.59
74LS37	.45
74LS38	.49
74LS40	.35
74LS42	.89
74LS47	.89
74LS48	1.15
74LS49	1.15
74LS51	.29
74LS54	.29
74LS55	.29
74LS73	.45
74LS74	.45
74LS75	.59
74LS76	.45
74LS78	.49
74LS83	.89
74LS85	1.25
74LS86	.45
74LS90	.59
74LS92	.75
74LS93	.75
74LS95	.99
74LS96	1.15
74LS107	.45
74LS109	.45
74LS112	.45
74LS113	.49
74LS114	.49
74LS122	.89
74LS123	1.25
74LS125	.89
74LS126	.55
74LS132	.99
74LS133	.89
74LS136	.49
74LS138	.89
74LS139	.89
74LS151	.89
74LS153	.89
74LS154	1.75
74LS155	1.19
74LS156	1.19
74LS157	.89
74LS158	.89
74LS160	1.15
74LS161	1.15
74LS162	1.15
74LS163	1.15
74LS164	1.25
74LS165	1.25
74LS168	1.19
74LS169	1.19
74LS170	2.49
74LS173	1.39
74LS174	.99
74LS175	.99
74LS181	2.95
74LS190	1.25
74LS191	1.25
74LS192	1.15
74LS193	1.15
74LS194	1.15
74LS195	1.15
74LS197	1.19
74LS221	1.19
74LS240	1.95
74LS241	1.95
74LS242	1.95
74LS243	1.95
74LS244	1.95
74LS245	2.95
74LS247	1.19
74LS248	1.19
74LS249	1.19
74LS251	1.49
74LS253	.99
74LS257	.89
74LS258	.99
74LS260	.69
74LS266	.69
74LS273	1.95
74LS279	.75
74LS283	1.09
74LS290	.99
74LS293	.99
74LS298	1.25
74LS352	1.29
74LS353	1.29
74LS365	.75
74LS366	.75
74LS367	.75
74LS368	.75
74LS373	1.95
74LS374	1.95
74LS375	.89
74LS386	.69
74LS393	2.49
74LS399	2.49
74LS670	2.49
81LS95	1.95
81LS97	1.95

74S

74S00	.50
74S02	.50
74S03	.50
74S04	.55
74S05	.55
74S08	.50
74S09	.50
74S10	.50
74S11	.50
74S15	.50
74S20	.50
74S22	.50
74S30	.50
74S32	.55
74S40	.55
74S51	.50
74S64	.50
74S65	.50
74S74	.79
74S86	.79
74S112	.79
74S113	.79
74S114	.79
74S133	.55
74S134	.69
74S135	1.19
74S136	1.75
74S138	1.35
74S139	1.35
74S140	1.35
74S151	1.35
74S153	1.35
74S157	1.35
74S158	1.35
74S174	1.59
74S175	1.59
74S188	4.95
74S194	1.95
74S195	1.95
74S196	3.95
74S240	2.95
74S241	2.95
74S242	3.25
74S243	3.25
74S244	3.25
74S251	1.45
74S253	1.45
74S257	1.35
74S258	1.35
74S260	.79
74S280	2.95
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74S474*	21.95
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74S570*	7.95
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74S572*	19.95
74S573*	19.95
74S940	3.15
74S941	3.15

* LIMITED AVAILABILITY ON THESE PROMS

CA—LINEAR

CA3013H	2.15
CA3023H	3.25
CA3039H	1.35
CA3046N	1.30
CA3059N	3.25
CA3060N	3.25
CA3080H	1.25
CA3081N	2.00
CA3082N	2.00
CA3083N	1.60
CA3086N	.85
CA3089N	3.75
CA3096N	3.95
CA3130H	1.39
CA3140H	1.25
CA3160H	1.25
CA3401N	.59
CA3600N	3.50

CD—CMOS

CD4000	.39
CD4001	.39
CD4002	.39
CD4006	1.19
CD4007	.25
CD4009	.49
CD4010	.49
CD4011	.39
CD4012	.25
CD4013	.49
CD4014	1.39
CD4015	1.19
CD4016	.59
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CD4018	.99
CD4019	.49
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CD4021	1.39
CD4022	1.19
CD4023	.29
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CD4027	.69
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CD4029	1.49
CD4030	.49
CD4035	.99
CD4040	1.49
CD4041	1.49
CD4042	.99
CD4043	.89
CD4044	.89
CD4046	1.79
CD4047	2.50
CD4048	1.35
CD4049	.49
CD4050	.69
CD4051	1.19
CD4052	1.19
CD4053	1.19
CD4056	2.95
CD4059	9.95
CD4060	1.49
CD4066	.79
CD4068	.39
CD4069	.45
CD4070	.55
CD4071	.49
CD4072	.49
CD4073	.39
CD4075	.39
CD4076	1.39
CD4078	.55
CD4081	.39
CD4082	.39
CD4093	.99
CD4098	2.49
CD4506	.75
CD4507	.99
CD4508	3.95
CD4510	1.39
CD4511	1.29
CD4514	3.95
CD4515	2.95
CD4516	1.49
CD4518	1.79
CD4519	.89
CD4520	1.29
CD4526	1.79
CD4528	1.79
CD4529	2.49
CD4543	2.79
CD4562	11.95
CD4566	2.79
CD4583	2.49
CD4723	1.95
CD4724	1.95
MC14409	14.95
MC14410	14.95
MC14411	14.95
MC14412	11.95
MC14419	4.95
MC14433	13.95

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MULTI-DIGIT REFLECTOR ARRAYS FOR CLOCKS

PART NUMBER	CHAR. HT. (IN.)	POLARITY	DESCRIPTION	LIGHT OUTPUT (MCD) TYP	LIGHT OUTPUT MIN	LIGHT OUTPUT @mA	FORWARD VOLTAGE SEGMENT (V) I_F = 20mA TYP	FORWARD VOLTAGE MAX	CONTINUOUS FORWARD CURRENT PER SEGMENT (mA) MAX	PRICE
DL 4500 (Red) / DL 4507 (Red)		C.C. MPX		8	5 / 10					2.49 / 2.49
DLO 4507 (orng) / DLG 4507 (grn) / DL 4620A (red)	50	C.C non MPX	4 Digit 7 Segment With Colon And Auxiliary Indicators	8	5	10	17	20	30	4.95 / 4.95 / 2.49
DL 4120A (red)	10	C.C non MPX		15	9		34	40		4.95

MULTI-DIGIT REFLECTOR ARRAYS

PART NUMBER	CHAR. HT.	POLARITY	DESCRIPTION	TYP	MIN	@mA	TYP	MAX	(mA) MAX	PRICE
DL 2300 (Red)	30	C.C. MPX	7 Seg. 2 Digit D.P. Right	25	11	30	17	20	30	.99
DLG 2535 (green)	50	C.A. MPX	8 Seg. 2 Digit		25	20		3.5	25	1.49
DL 4608 (Red)	50	C.C. MPX	8 Seg. 4 Digit D.P. Right	8	5	10	17	20	30	2.49
DL 6500 (Red)	50	C.C. MPX	7 Seg. 6 Digit D.P. Right	8	5	10	17	20	30	2.95
DL 6530 (Red)	50	C.A. MPX	7 Seg. 6 Digit D.P. Right	8	5	10	17	20	30	2.99
DL 3130 (Red)	10	C.A. MPX	7 Seg. 3 Digit D.P. Right	15	10	10	34	40	30	3.95

DISCRETE LEDS

XC556R	.200" red		5/$1
XC556G	.200" green		4/$1
XC556Y	.200" yellow		4/$1
XC556C	.200" clear		4/$1
XC22R	.200" red		5/$1
XC22G	.200" green		4/$1
XC22Y	.200" yellow		4/$1
MV10B	.170" red		4/$1
MV50	.085" red		6/$1
XC209R	.125" red		5/$1
XC209G	.125" green		4/$1
XC209Y	.125" yellow		4/$1
XC526R	.185" red		5/$1
XC526G	.185" green		4/$1
XC526Y	.185" yellow		4/$1
XC526C	.185" clear		4/$1
XC111R	.190" red		5/$1
XC111G	.190" green		4/$1
XC111Y	.190" yellow		4/$1
XC111C	.190" clear		4/$1

XC556 RED LED, METAL MTG. HDW. 2-6" LEADS.
RL-2 . . $.39 ea. or 3/$1.00

DISPLAY LEDS

C.A. — Common Anode · C.C. — Common Cathode

Type	Polarity	Ht	Price
MAN 1	C.A.—red	.270	2.95
MAN 2	5x7 D.M.—red	.300	4.95
MAN 3	C.C.—red	.125	.25
MAN 52	C.A.—green	.300	1.25
MAN 54	C.C.—green	.300	1.25
MAN 71	C.A.—red	.300	.75
MAN 72	C.A.—red	.300	.75
MAN 74	C.C.—red	.300	1.25
MAN 82	C.A.—yellow	.300	.49
MAN 84	C.C.—yellow	.300	.99
MAN 3620	C.A.—orange	.300	.49
MAN 3630	C.A.—orange ± 1	.300	.99
MAN 3640	C.C.—orange	.300	.99
MAN 4610	C.A.—orange	.400	.99
MAN 6610	C.A.—orange—DD	.560	.99
MAN 6630	C.A.—orange ± 1	.560	.99
MAN 6640	C.C.—orange—DD	.560	.99
MAN 6650	C.C.—orange ± 1	.560	.99
MAN 6660	C.A.—orange	.560	.99
MAN 6710	C.A.—red—DD	.560	.99
MAN 6750	C.C.—red ± 1	.560	.99
MAN 6780	C.C.—red	.560	.99
DLO304	C.C.—orange	.300	1.25
DLO307	C.A.—orange	.300	1.25
DLG500	C.C.—green	.500	1.25
DLG507	C.A.—green	.500	1.25
DL704	C.C.—red	.300	1.25
DL707	C.A.—red	.300	1.25
DL728	C.C.—red	.500	1.49
DL741	C.A.—red	.600	1.25
DL746	C.A.—red ± 1	.630	1.49
DL747	C.A.—red	.600	1.49
DL750	C.C.—red	.600	1.49
DLO847	C.A.—orange	.800	1.49
DLO850	C.C.—orange	.800	1.49
DL33B	C.C.—red	.110	.35
FND358	C.C. ± 1	.357	.99
FND359	C.C.	.357	.75
FND503	C.C. (FND500)	.500	.99
FND507	C.A. (FND510)	.500	.99
HDSP-3401	C.A.—red	.800	1.50
HDSP-3403	C.C.—red	.800	1.50
5082-7751	C.A., R.H.D.—red	.430	1.25
5082-7760	C.C., R.H.D.—red	.430	1.75
5082-7300	4x7 sgl. dig. RHD	.600	22.00
5082-7302	4x7 sgl. dig. LHD	.600	22.00
5082-7304	Overnge. char. (±1)	.600	19.95
4N28	Photo Xsistor Opto-Isol.		.99
LIT-1	Photo Xsistor Opto-Isol.		.69
MOC3010	Optically Isol. Triac Driver		1.25

POTENTIOMETERS

$2.95 each
2 Watt @ 70°C ± 10%
7/8" Slotted Shaft
Linear Taper
Meets Mil-R-94

Part No.		
CMU 1021	RV4NAY SD - 102A	1K
CMU 5021	RV4NAY SD - 502A	5K
CMU 1031	RV4NAY SD - 103A	10K
CMU 2531	RV4NAY SD - 253A	25K
CMU 5031	RV4NAY SD - 503A	50K
CMU 1041	RV4NAY SD - 104A	100K
CMU 1052	RV4NAY SD - 105A	1Meg

$1.35 each
3/4 Watt @ 70°C
15 turn pot. Linear taper. Printed circuit mount.

Part No.	Part No.	Part No.
830P-50ohm	830P-5K	830P-100K
830P-100ohm	830P-10K	830P-200K
830P-500ohm	830P-20K	830P-500K
830P-1K	830P-50K	830P-1Meg
830P-2K		

LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100
8 pin LP	.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100
14 pin ST	.27	.25	.24
16 pin ST	.30	.27	.25
18 pin ST	.35	.32	.30
24 pin ST	.49	.45	.42
28 pin ST	.99	.90	.81
36 pin ST	1.39	1.26	1.15
40 pin ST	1.59	1.45	1.30

SOLDERTAIL (GOLD) STANDARD

	1-24	25-49	50-100
8 pin SG	.39	.35	.31
14 pin SG	.49	.45	.41
16 pin SG	.54	.49	.44
18 pin SG	.59	.53	.48
24 pin SG	.79	.75	.69
28 pin SG	1.10	1.00	.90
36 pin SG	1.65	1.40	1.26
40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100
8 pin WW	.59	.54	.49
10 pin WW	.69	.63	.58
14 pin WW	.79	.73	.67
16 pin WW	.85	.77	.70
18 pin WW	.99	.90	.81
20 pin WW	1.19	1.08	.99
22 pin WW	1.49	1.35	1.23
24 pin WW	1.39	1.26	1.14
28 pin WW	1.69	1.53	1.38
36 pin WW	2.19	1.99	1.79
40 pin WW	2.29	2.09	1.89

1/4 WATT RESISTOR ASSORTMENTS – 5%

ASST. 1	5 ea.	10 Ohm 12 Ohm 15 Ohm 18 Ohm 22 Ohm / 27 Ohm 33 Ohm 39 Ohm 47 Ohm 56 Ohm	50 pcs.	$1.95
ASST. 2	5 ea.	68 Ohm 82 Ohm 100 Ohm 120 Ohm 150 Ohm / 180 Ohm 220 Ohm 270 Ohm 330 Ohm 390 Ohm	50 pcs.	$1.95
ASST. 3	5 ea.	470 Ohm 560 Ohm 680 Ohm 820 Ohm 1K / 1.2K 1.5K 1.8K 2.2K 2.7K	50 pcs.	$1.95
ASST. 4	5 ea.	3.3K 3.9K 4.7K 5.6K 6.8K / 8.2K 10K 12K 15K 18K	50 pcs.	$1.95
ASST. 5	5 ea.	22K 27K 33K 39K 47K / 56K 68K 82K 100K 120K	50 pcs.	$1.95
ASST. 6	5 ea.	150K 180K 220K 270K 330K / 390K 470K 560K 680K 820K	50 pcs.	$1.95
ASST. 7	5 ea.	1M 1.2M 1.5M 1.8M 2.2M / 2.7M 3.3M 3.9M 4.7M 5.6M	50 pcs.	$1.95
ASST. 8R		Includes Resistor Assts. 1-7 (350 pcs.)		$10.95 ea.

$10.00 Min. Order – U.S. Funds Only
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1355 SHOREWAY ROAD, BELMONT, CA 94002
PRICES SUBJECT TO CHANGE

4/81

INTERSIL

Part No.	Function	Price
7045IPI	CMOS Precision Timer	14.95
7045EV/Kit*	Stopwatch Chip, XTL	22.95
7106CPL	3½ Digit A/D (LCD Drive)	16.95
7106EV/Kit*	IC, Circuit Board, Display	34.95
7107CPL	3½ Digit A/D (LED Drive)	15.95
7107EV/Kit*	IC, Circuit Board, Display	28.95
7116CPL	3½ Digit A/D LCD Dis. HLD.	18.95
7117CPL	3½ Digit A/D LED Dis. HLD.	17.95
7201IDR	Low Battery Volt Indicator	2.25
7205IPG	CMOS LED Stopwatch/Timer	12.95
7205EV/Kit*	Stopwatch Chip, XTL	19.95
7206CJPE	Tone Generator	5.15
7206CEV/Kit*	Tone Generator Chip, XTL	9.95
7207AIPD	Oscillator Controller	6.50
7207AEV/Kit*	Freq. Counter Chip, XTL	11.10
7208IPI	Seven Decade Counter	17.95
7209IPA	Clock Generator	3.95
7215IPG	4 Func. CMOS Stopwatch CKT	13.95
7215EV/Kit*	4 Func. Stopwatch Chip, XTL	19.95
7216AIJI	8-Digit Univ. Counter C.A.	32.00
7216CIJI	8-Digit Freq. Counter C.A.	26.95
7216DIPI	8-Digit Freq. Counter C.C.	21.95
7217IJI	4-Digit LED Up/Down Counter	12.95
7218CIJI	8-Digit Univ. LED Drive	10.95
7224IPL	LCD 4½ Digit Up Counter DRI	11.25
7226AIJL	8-Digit Univ. Counter	31.95
7226AEV/Kit*	5 Function Counter Chip, XTL	74.95
7240IJE	CMOS Bin Prog. Timer/Counter	4.95
7242IJA	CMOS Divide-by-256 RC Timer	2.05
7250IJE	CMOS BCD Prog. Timer/Counter	6.00
7260IJE	CMOS BCD Prog. Timer/Counter	5.25
7555IPA	CMOS 555 Timer (8 pin)	1.45
7556IPD	CMOS 556 Timer (14 pin)	2.20
7611BCPA	CMOS Op Amp Comparator 5MV	2.25
7612BCPA	CMOS Op Amp Ext. Cmvr. 5MV	2.95
7621BCPA	CMOS Dual Op Amp Comp. 5MV	3.95
7631CCPE	CMOS Tri Op Amp Comp. 10MV	5.35
7641CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7642CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7660CPA	Voltage Converter	2.95
8069CCQ	50ppm Band—GAP Volt Ref. Diode	2.50
8211CPA	Volt Ref/Indicator	2.50
8212CPA	Volt Ref/Indicator	2.50

* INTERSIL'S EVALUATION KITS

74C

74C00	.39
74C02	.39
74C04	.39
74C08	.39
74C10	.39
74C14	.75
74C20	.39
74C30	.39
74C42	1.39
74C48	1.95
74C73	.79
74C74	.79
74C85	1.95
74C86	.99
74C89	6.95
74C90	1.29
74C93	1.29
74C95	1.59
74C106	.75
74C107	1.89
74C151	2.95
74C154	3.95
74C157	2.25
74C160	1.69
74C161	1.69
74C162	1.49
74C163	1.69
74C164	1.59
74C173	1.39
74C174	1.39
74C175	1.39
74C192	1.69
74C193	1.69
74C195	1.59
74C221	1.95
74C240	2.25
74C244	2.25
74C373	2.49
74C374	2.59
74C901	.89
74C903	1.15
74C911	10.95
74C912	10.95
74C915	1.69
74C917	10.95
74C922	5.49
74C923	5.75
74C925	7.50
74C926	7.50
80C95	.79
80C97	.79

LINEAR

LH0002CN	6.85
LM10CLH	4.50
LM11CLH	4.75
LH0070-OH	6.05
TL071CP	.79
TL072CP	1.39
TL074CN	2.49
LH0082CD	35.80
TL082CP	1.19
TL084CN	2.19
LH0094CD	36.80
LM300H	.99
LM301CN	.35
LM302H	1.95
LM304H	1.95
LM305H	.99
LM307CN	.45
LM308CN	1.00
LM309H	1.95
LM309K	1.25
LM310CN	1.75
LM311H	.90
LM312H	2.49
LM317MP	1.15
LM317T	1.75
LM317K	3.95
LM318CN	1.95
LM319N	1.95
LM320K-5	1.35
LM320K-12	1.35
LM320K-15	1.35
LM320T-5	1.25
LM320T-12	1.25
LM320T-15	1.25
LM323K-5	5.95
LM324N	.99
LM329DZ	.65
LM331N	3.95
LM334Z	1.30
LM335Z	1.40
LM336Z	1.75
LM337T	1.95
LM337MP	1.15
LM338K	6.95
LM339N	.99
LM340K-5	1.35
LM340K-12	1.35
LM340K-15	1.35
LM340T-5	1.25
LM340T-12	1.25
LM340T-15	1.25
LM341P-5	.75
LM341P-12	.75
LM341P-15	.75
LM342P-5	.69
LM342P-12	.69
LM342P-15	.69
LM348N	1.25
LM350K	5.75
LF351N	.60
LF353N	1.00
LF355N	1.10
LF356N	1.10
LM358N	1.00
LM359N	1.79
LM370N	4.49
LM373N	3.25
LM377N	2.95
LM380N	1.25
LM381N	1.95
LM382N	1.79
LM384N	1.95
LM386N-3	1.29
LM387N	1.45
LM389N	1.35
LM392N	.69
LF398N	4.00
LM399H	5.00
TL494CN	4.49
TL496CP	1.75
NE510A	6.00
NE529A	4.95
NE531H	3.95
NE536H	6.00
NE540H	6.00
NE544N	4.95
NE550A	1.30
NE555V	.39
LM556N	.99
NE564N	3.95
LM565N	1.25
LM566CN	1.95
LM567V	1.25
NE570N	4.95
LM702H	.79
LM703CN	.89
LM709N	.29
LM710N	.79
LM711N	.79
LM723N	.69
LM733N	1.00
LM739N	1.19
LM741CN	.35
MC1741SCG	3.00
LM747N	.79
LM748N	.59
LM1014N	2.75
LM1310N	1.95
LM1458CN	.59
LM1488N	1.25
LM1489N	1.25
LM1496N	1.95
LM1556V	1.75
LM1800N	2.95
LM1877N-9	3.25
LM1889N	3.20
LM1896N	1.75
LM2002T	1.49
LM2877P	2.05
LM2878P	2.25
LM2896P-1	2.25
LM3189N	2.95
LM3900N	.69
LM3905CN	1.25
LM3909N	1.25
LM3914N	3.95
LM3915N	3.95
LM3916N	3.95
RC4136N	1.25
RC4151NB	3.95
RC4194TK	5.95
RC4195TK	5.49
KB4428	4.25
KB4429	5.95
LM4500A	3.25
ICL8038B	4.95
LM13080N	1.29
LM13600N	1.49
75138N	1.95
75450N	.89
75451CN	.39

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

Value	1-9	10-99	100+	Value	1-9	10-99	100+
10 pf	.08	.06	.05	.001µF	.08	.06	.05
22 pf	.08	.06	.05	.0047µF	.08	.06	.05
47 pf	.08	.06	.05	.01µF	.08	.06	.05
100 pf	.08	.06	.05	.022µF	.08	.06	.06
220 pf	.08	.06	.05	.047µF	.09	.07	.06
470 pf	.08	.06	.05	.1µF	.15	.12	.10

100 VOLT MYLAR FILM CAPACITORS

.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022mf	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (Solid) CAPACITORS

.1/35V	.39	.34	.29	1.5/35V	.41	.37	.29
.15/35V	.39	.34	.29	2.2/35V	.51	.45	.34
.22/35V	.39	.34	.29	3.3/25V	.53	.47	.37
.33/35V	.39	.34	.29	4.7/25V	.63	.56	.45
.47/35V	.39	.34	.29	6.8/25V	.79	.69	.55
.68/35V	.39	.34	.29	15/25V	1.39	1.25	.95
1.0/35V	.39	.34	.29	22/6V	.79	.69	.55

MINI. ALUMINUM ELECTROLYTIC CAPACITORS

Axial Lead				Radial Lead			
.47/50V	.16	.14	.10	.47/25V	.15	.13	.13
1.0/50V	.16	.14	.12	.47/50V	.16	.14	.13
3.3/50V	.16	.14	.11	1.0/16V	.15	.13	.12
4.7/25V	.18	.15	.11	1.0/25V	.16	.14	.13
10/25V	.18	.15	.11	1.0/50V	.17	.15	.14
10/50V	.19	.16	.12	4.7/16V	.15	.13	.12
22/25V	.19	.16	.12	4.7/25V	.16	.14	.13
22/50V	.24	.20	.18	4.7/50V	.17	.15	.14
47/25V	.25	.21	.19	10/16V	.15	.13	.12
47/50V	.29	.25	.23	10/25V	.16	.14	.13
100/25V	.28	.24	.22	10/50V	.17	.15	.14
100/50V	.41	.37	.34	47/50V	.25	.21	.19
220/25V	.39	.34	.33	100/16V	.21	.17	.14
220/50V	.49	.45	.41	100/25V	.25	.23	.21
470/25V	.54	.49	.45	100/50V	.37	.34	.31
1000/16V	.79	.69	.60	220/16V	.25	.21	.19
2200/16V	.89	.79	.69	470/25V	.35	.31	.27

CIRCLE 8 ON FREE INFORMATION CARD

INTERNATIONAL ELECTRONICS UNLIMITED

CERAMIC CAPACITORS

1pf	22pf	56pf	120pf	270pf		.0047uf	.030uf
5pf	27pf	68pf	150pf	390pf	.001uf	.01uf	.050uf
7pf	33pf	82pf	180pf	470pf	.0015uf	.015uf	.1uf
10pf	47pf	100pf	220pf	600pf	.003uf	.022uf	

1pf - .050uf				.1uf		
Total	EA.	PK-10	PK-100	EA.	PK-10	PK-100
1-1000	$.20	$.95	6.50	.25	1.25	9.00
1000-	.20	.85	6.00	.25	1.10	8.00

CERAMIC CAPACITOR KIT
CK-c2 5ea. of the above values $11.50
CK-c3 10ea. of the above values 20.50

POLYESTER FILM CAPACITORS - 100V ± 10%

	EA.	PK-10	PK-100		EA.	PK-10	PK-100
.001uf	$.15	.95	6.50	.033uf	$.20	1.00	10.00
.0015uf	.15	.95	7.50	.047uf	.20	1.15	10.50
.0022uf	.15	.95	7.50	.068uf	.25	1.30	12.00
.0033uf	.15	.95	7.50	.1uf	.30	1.75	13.50
.0047uf	.15	.95	7.50	.15uf	.35	2.25	14.00
.0068uf	.15	.95	7.50	.22uf	.40	2.55	20.00
.01uf	.15	.95	7.50	.33uf	.45	2.75	25.00
.015uf	.15	.95	7.50	.47uf	.50	3.50	30.00
.022uf	.15	.95	7.50				

TOTAL QTY. 1000 pcs. -10%, 5000 pcs. -15%

POLYESTER CAPACITOR KIT
5 ea of the above values $14.95

TANTALUM CAPACITORS

solid dipped ± 20%

		10			10			10
.1uf/35V	.30	.25	4.7uf/16V	.38	.30	22uf/16V	.50	.40
.22uf/35V	.30	.25	4.7uf/25V	.45	.35	22uf/35V	.60	.55
.33uf/35V	.30	.25	6.8uf/6V	.35	.28	33uf/6V	.55	.45
1uf/20V	.30	.25	6.8uf/16V	.45	.39	33uf/10V	.60	.50
1.5uf/20V	.30	.25	10uf/20V	.42	.35	47uf/6V	.60	.50
2.2uf/20V	.35	.25	15uf/6V	.42	.35	47uf/15V	.65	.55
2.2uf/35V	.38	.28	15uf/20V	.50	.40	56uf/6V	.85	.75
3.3uf/35V	.40	.30						

TANTALUM CAPACITOR ASST.
5 ea. of above - $37.50

ELECTROLYTIC CAPACITORS - axial

	1-9	10-99	100-		1-9	10-99	100-
1u/16V	.13	.11	.09	22u/16V	.15	.13	.11
1u/30V	.14	.12	.10	22u/50V	.16	.14	.12
1u/160V	.17	.15	.12	33u/25V	.18	.16	.14
2.2u/25V	.14	.12	.10	47u/25V	.18	.16	.14
2.2u/50V	.14	.12	.10	50u/25V	.18	.16	.14
2.2u/63V	.14	.12	.10	100u/10V	.18	.16	.14
3.3u/250V	.16	.14	.12	150u/25V	.22	.20	.17
4.7u/10V	.14	.12	.10	220u/16V	.23	.21	.18
5u/25V	.12	.10	.08	220u/25V	.25	.22	.20
10u/16V	.13	.11	.10	470u/35V	.33	.29	.26
10u/25V	.14	.12	.10	1000u/35V	.89	.85	.80
10u/50V	.15	.13	.11	1000u/50V	1.00	.95	.90
10u/150V	.18	.16	.14				

SOCKETS — LOW PROFILE, SOLDER TAIL

	ea		100
8 pin	.20	.18 pk-10	.16ea
14 pin	.25	.21 pk-10	.19
16 pin	.26	.22 pk-10	.20
18 pin	.32	.28 pk-8	.26
24 pin	.48	.45 pk-3	.38
28 pin	.65	.60 pk-3	.55
40 pin	.75	.70 pk-2	.63

TRANSISTORS

2N3904 NPN TO-92 $.25ea 10/$1.65 25/$3.25 100/$12.00
2N3906 PNP TO-92 $.25ea 10/$1.65 25/$3.25 100/$12.00
2N2222A NPN TO-18 $.45ea 10/$3.50 25/$8.00 100/$29.50

DIODES

1N4148 (1N914) 400mw 15/$1.00 100/$5.00 1000/$40.00
1N4001 50PIV 12/$1.00 100/$7.00 1000/$60.00
1N4007 1000PIV 10/$1.25 100/$11.00 1000/$10.00

VOLTAGE REGULATORS

10% OFF ON $25.00
15% OFF ON $50.00

LM320T-5	Negative 5 V reg (7905)	1.19
LM320T-12	Negative 12 V reg (7912)	1.19
LM320T-15	Negative 15 V reg (7915)	1.19
LM340T-5	Positive 5 V reg (7805)	1.19
LM340T-8	Positive 8 V reg (7808)	1.19
LM340T-12	Positive 12 V reg (7812)	1.19
LM340T-15	Positive 15 V reg (7815)	1.19

DISCRETE LED'S

JUMBO LED
.20"dia, diffused
Red, Clear or White 10/$1.00 25/$2.00 100/$8.00
Green or Yellow 7/$1.00 25/$2.85 100/$9.75
SUBMINITURE LED
.125"dia, diffused
Red or Clear 10/$1.00 25/$2.00 100/$8.00
Green or Yellow 7/$1.00 25/$2.85 100/$9.75

TTL

10% OFF ON $25.00
15% OFF ON $50.00

7400	$.18	7464	.30	74155	.50
7401	.18	7465	.30	74156	.64
7402	.18	7470	.49	74157	.60
7403	.18	7472	.32	74158	.75
7404	.20	7474	.18	74160	.70
7405	.25	7475	.49	74161	.79
7406	.20	7576	.49	74162	.85
7407	.20	7480	.35	74163	.85
7408	.27	7482	.25	74164	.85
7409	.27	7483	.58	74166	.85
7410	.18	7485	.50	74170	1.50
7415	.29	7486	.42	74173	1.25
7416	.20	7489	1.75	74174	1.05
7417	.20	7490	.59	74175	.85
7420	.20	7491	.64	74176	.70
7425	.39	7492	.59	74177	.70
7426	.35	7493	.35	74180	.35
7427	.25	7494	.59	74181	1.85
7430	.25	7495	.35	74182	.35
7432	.20	7496	.35	74189	.50
7437	.20	74105	.48	74190	1.15
7438	.18	74107	.35	74191	1.15
7440	.18	74121	.35	74192	.50
7441	.59	74122	.39	74193	.79
7442	.35	74123	.39	74194	.85
7443	.55	74125	.50	74195	.69
7444	.60	74126	.50	74196	.80
7445	.50	74132	.75	74197	.75
7446	.59	74141	.35	74198	1.40
7448	.59	74145	.50	74199	1.25
7450	.18	74148	1.25	74S200	3.75
7451	.22	74150	1.35	74279	.65
7453	.18	74151	.50		
7454	.18	74153	.35		
7460	.18	74154	1.45		

8000 (Signetics)
8263 2.95 8267 1.75 8281 .95

9000 Series
9601 .25 9602 .29

CMOS

10% OFF ON $25.00
15% OFF ON $50.00

4000 Series CMOS

4000	$.25	4020	1.14	4050	.45
4001	.39	4021	.95	4051	1.15
4002	.25	4022	.95	4066	.79
4006	.95	4023	.30	4069	.39
4007	.39	4024	.75	4071	.29
4008	.95	4025	.22	4072	.39
4009	.46	4027	.59	4073	.39
4010	.45	4028	.85	4078	.39
4011	.45	4030	.49	4081	.39
4012	.25	4035	.95	4082	.30
4013	.59	4040	1.15	4518	1.25
4014	.95	4041	1.20	4528	1.50
4015	.95	4042	.95	4585	1.50
4016	.64	4043	.85	4901	.59
4017	1.08	4046	1.69		
4018	.95	4049	.45		

LINEAR CIRCUITS

10% OFF ON $25.00
15% OFF ON $50.00

LM300H	$ .30	LM565N	.55
LM301CN	.28	LM565H	1.39
LM302H	.28	LM566H	1.69
LM304H	.80	LM566CN	1.45
LM307CN	.32	LM567CN	1.19
LM307H	.40	LM703H	.59
LM308CN	.45	LM703CN	.39
LM309H	1.05	LM709N	.29
LM309K	1.15	LM709H	.39
LM310CN	.75	LM710N	.45
LM310H	.75	LM711N	.35
LM311CN	.39	LM723H	.59
LM318CN	1.45	LM723N	.49
LM319N	1.20	LM733H	.45
LM320K-5	.95	LM739N	.45
LM320K-5.2	.95	LM741CN	.29
LM320K-15	.95	LM741	.29
LM322N	.45	LM741CH	.45
LM324N	1.19	LM747H	.79
LM339N	.25	LM747N	.69
LM340K-6	.95	LM748CN	.25
LM340K-8	.95	LM1310N	2.50
LM340K-12	.95	LM1414N	.35
LM340K-15	.95	LM1456CN	1.29
LM340K-24	.95	LM1458CN	.65
LM370N	.95	LM1496N	.89
LM372N	1.25	LM1800N	2.40
LM376CN	.30	ULN2208	.79
LM380N	1.19	ULN2209	.79
LM380CN	.45	CA3046N	1.29
LM381N	1.75	CA3081N	1.25
LM382N	1.75	CA3082N	1.25
LM385K	.49	LM3900N	.45
LM386CN	.99	LM7524N	.45
LM387CN	.99	LM7525N	.45
NE546A	1.79	LM7535	.89
NE550A	1.25	80388	3.79
LM555CN	.45	75450N	.35
LM556N	.79	75451CN	.35
LM560N	2.95	75452CN	.35
		75453CN	.35
		75454CN	.35
		75491N	.75
		75492N	.85

IMMEDIATE DELIVERY OF QUALITY RESISTORS **Rohm** QUALITY RELIABILITY

METAL FILM RESISTORS,

METAL FILM ±1%
RN60 (R.Ohm CRB60FY) 1/4watt
Low temp coef - 50ppm/0C
.138"dia X .355"long (body)
color banded

total quantity	ea	pk-10	pk-25	pk-100	pk-250
1-999	$.25	1.00	2.00	7.50	17.50
1000-	.20	.90	1.80	7.00	16.25
5000-	.20	.85	1.70	6.50	15.00
10000-	.20	.80	1.55	6.00	13.75

10 or more resistors - not individually packaged - mixed - specify any assortment of values $.15ea

VALUES STOCKED (ohms)
Standard 1% metal film values from 10 ohm to 1.21M 1/4 watt

10.0	12.1	14.7	17.8	22.6	27.4	33.2	40.2	48.7	59.0	71.5	88.7
10.2	12.4	15.0	18.2	23.2	28.0	34.0	41.2	49.9	60.4	73.2	90.9
10.5	12.7	15.4	18.7	23.7	28.7	34.8	42.2	51.1	61.9	75.0	93.1
10.7	13.0	15.8	19.1	24.3	29.4	35.7	43.2	52.3	63.4	76.8	95.3
11.0	13.3	16.2	19.6	24.9	30.1	36.5	44.2	53.6	64.9	80.6	97.6
11.3	13.7	16.5	20.0	25.5	30.9	37.4	45.3	54.9	66.5	82.5	
11.5	14.0	16.9	20.5	26.1	31.6	38.3	46.4	56.2	68.1	84.5	
11.8	14.3	17.4	22.1	26.7	32.4	39.2	47.5	57.6	69.8	86.6	

and multilples of 10 of the above values to 1.21M
i.e. 10.0 100 1.0K 10.0K 100K 1M etc

METAL FILM RESISTORS

METAL FILM ±1%
RN55 (R.Ohm CRB14FY) 1/8watt
Low temp coef - 50ppm/0C
.094"dia X .225"long (body)
color banded

total quantity	ea	pk-10	pk-50	pk-100	pk-500
1-999	$.25	1.00	4.00	7.50	35.00
1000-	.20	.90	3.60	7.00	32.50
5000-	.20	.85	3.40	6.50	30.00
10000-	.20	.80	3.10	6.00	27.50

10 or more resistors - not individually packaged - mixed - specify any assortment of values $.15ea

VALUES STOCKED (ohms) 1/8 watt

10.0	27.4	75.0	348	1.74K	5.11K	11.0K	20.5K	31.6K	54.9K	140K	324K
10.2	28.7	78.7	402	1.87K	5.36K	11.3K	21.0K	32.4K	57.6K	147K	332K
11.0	30.1	84.5	475	1.96K	5.49K	11.5K	21.5K	33.2K	60.4K	150K	348K
11.5	31.6	90.9	487	2.05K	5.76K	12.1K	22.1K	34.8K	64.9K	158K	374K
12.1	33.2	100	499	2.21K	6.04K	12.4K	22.6K	36.5K	68.1K	165K	402K
13.0	35.7	107	604	2.43K	6.49K	12.7K	23.2K	37.4K	69.8K	174K	432K
14.0	37.4	121	649	2.49K	6.81K	13.0k	23.7K	39.2K	75.0K	182K	453K
14.7	40.2	127	715	2.74K	7.15K	13.3K	24.3K	40.2K	76.8K	191K	464K
15.0	43.2	137	750	2.87K	7.50K	14.0K	24.9K	41.2K	82.5K	200K	475K
16.2	45.3	150	909	3.01K	8.25K	14.7K	25.5K	43.2K	90.9K	205K	1M
17.4	47.5	165	1.00K	3.16K	8.66K	15.0K	26.1K	45.3K	95.3K	210K	
18.2	49.9	191	1.02K	3.32K	9.09K	15.4K	26.7K	46.4K	100K	221K	
19.1	54.9	200	1.10K	3.57K	9.53K	16.2K	27.4K	47.5K	105K	232K	
20.0	57.6	210	1.21K	4.22K	9.76K	16.9K	28.0K	48.7K	110K	249K	
22.1	60.4	232	1.27K	4.53K	10.0K	17.4K	28.7K	49.9K	115K	255K	
23.2	64.9	249	1.30K	4.75K	10.2K	18.2K	29.4K	51.1K	121K	287K	
24.9	68.1	301	1.47K	4.87K	10.5K	19.1K	30.1K	52.3K	130K	294K	
26.1	71.5	316	1.50K	4.99K	10.7K	20.0K	30.9K	53.6K	137K	301K	

CARBON FILM RESISTORS

CARBON FILM ±5%
1/4watt (R.Ohm R25)
.095"dia X .250"long (body)
1/2watt (R.Ohm R50)
.146"dia X .354"long (body)

PRICING 1/4 & 1/2 watt

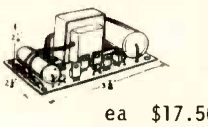
total quantity	ea	pk-10	pk-100	pk-1000
1-999	$.10	.45	2.00	
1000-	.10	.40	1.80	15.00
5000-	.10	.30	1.70	14.50
10000-	.10	.25	1.55	13.00

25 or more resistors - not individually packaged - mixed - specify any assortment of values $.04ea

VALUES STOCKED (ohms)

.5	3.9	16	68	300	1.2K	5.1K	22K	91K	390K	1.6M	*6.2M
1.0	4.3	18	75	330	1.3K	5.6K	24K	100K	430K	1.8M	*6.8M
1.1	4.7	20	82	360	1.5K	6.2K	27K	110K	470K	2.0M	*7.5M
1.2	5.1	22	91	390	1.6K	6.8K	30K	120K	510K	2.2M	*8.2M
1.3	5.6	24	100	430	1.8K	7.5K	33K	130K	560K	2.4M	*9.1M
1.5	6.2	27	110	470	2.0K	8.2K	36K	150K	620K	2.7M	*10M
1.6	6.8	30	120	510	2.2K	9.1K	39K	160K	680K	3.0M	*11M
1.8	7.5	33	130	560	2.4K	10K	43K	180K	750K	3.3M	*12M
2.0	8.2	36	150	620	2.7K	11K	47K	200K	820K	3.6M	*13M
2.2	9.1	39	160	680	3.0K	12K	51K	220K	910K	3.9M	*15M
2.4	10	43	180	750	3.3K	13K	56K	240K	1.0M	4.3M	(* 1/2w
2.7	11	47	200	820	3.6K	15K	62K	270K	1.1M	4.7M	only)
3.0	12	51	220	910	3.9K	16K	68K	300K	1.2M	5.1M	
3.3	13	56	240	1.0K	4.3K	18K	75K	330K	1.3M	5.6M	
3.6	15	62	270	1.1K	4.7K	20K	82K	360K	1.5M		

POWER SUPPLY KIT

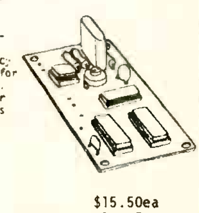


±5V, ±12V, ±15V
A regulated power supply using a 115V/29V CT transformer, 3-LM340T and 3-LM320T regulators to supply the above voltages. Heat sink provided for +5V

PARTS INCLUDED
Transformer
6 regulators
PC board
4 diodes
Capacitor 1000 uf
Capacitor 500 f
3 Capacitors 10 uf

ea $17.50
10- 16.00
25+ 15.00
+ shipping

CRYSTAL CONTROLLED TIME BASE KIT



Produces accurate 1hz, 10hz and 60hz outputs--three of the most popular frequencies for any piece of test equipment. The crystal frequency output may be tuned with a frequency counter for increased accuracy. All outputs are buffered. The input voltage range is 5-18VDC. Low power requirement permits the use of a 9V battery as the power source for a convenient laboratory unit. The completed board is designed to fit the PCB slots of Hammond case 1591DGY which IEU stocks.

PARTS INCLUDED
MM5369 divider
4049 buffer
2-4018 counter
3-12pf var. cap
47pf cap
.1uf cap
2-10Mohm res
1Kohm res
3.57954 Mhz crystal
PC board (1 5/3" X 3")

	$15.50ea
10-24	13.75ea
25-	12.50ea

Payment by check, M.O., UPS/COD, M/C or VISA. Add $1.25 for shipping/handling in U S, Canada and Mexico. Additional charge for UPS COD or BLUE LABLE. Other Countries $1 25 + 5% of order total. California residents add sales tax. Minimum order $10.00
SCHOOLS AND GOVERNMENT ORDERS ACCEPTED ON OFFICIAL PURCHASE ORDERS.

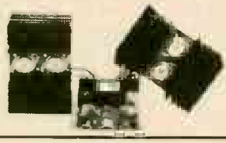
INTERNATIONAL ELECTRONICS UNLIMITED
435 First St Suite 19
Solvang, Ca 93463
805-688-2747

CIRCLE 45 ON FREE INFORMATION CARD

100 W CLASS A POWER AMP KIT

Dynamic Bias Class "A" circuit design makes this unit unique in its class. Crystal clear, 100 watts power output will satisfy the most picky fans. A perfect combination with the TA-1020 low T.I.M. stereo pre-amp.

Specifications:
- Output power: 100W RMS into 8-ohm 125W RMS into 4-ohm
- Frequency response: 10Hz - 100 KHz
- T.H.D.: less than 0.008%
- S/N ratio: better than 80dB
- Input sensitivity: IV max.
- Power supply: ±40V @ 5 amp



TA-1000 KIT $51.95
Power transformer $18.00 each

REGULATED VARIABLE D.C. POWER SUPPLY KIT

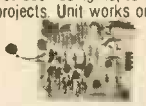
Uses UA723 I.C. and 2N3055 power transistor as regulator. Output voltages can be adjusted from 0~30V at an internal resistance of less than 0.005 ohm; ripple and noise less than 1 MV; with built on board LED and audible overload indicator. Kit comes with P.C. board; all electronic components, transformer; connectors; 2 panel meters for voltage and amp; a professional look metal cabinet and instructions.

Model TR-88A 0~15V D.C. 3 amp
Model TR-88B 0~30V D.C. 2 amp

$59.50 per kit NEW

NEW WHISTLE ACTIVATED SWITCH BOARD

All boards are pre-assembled and tested. Your whistle to its FET condenser microphone from a distance, as far as 30 feet away (sensitivity can be easily adjusted) will turn the switch on, then latched you whistle to it again then it turns off. Ideal for remote control toys, electrical appliance such as lights, coffee pots, TV, Hi-Fi, radio or other projects. Unit works on 9V D.C.



Model 968 $4.50 each

SUB MINI SIZE FET CONDENSER MICROPHONE

Specification:
Sensitivity: − 65dB ± 3db
FEQ. Response: 50 Hz 8 KHz
Output Impedance: 1K ohm max.
Polar Pattern: Omni-directional
Power Supply: 1.5V 10V D.C.
Sound Pressure Level: Max. 120dB
EM4RP $2.50 ea. or 2 for $4.50

NEW MARK III

9 Steps 4 Colors

LED VU

Stereo level indicator kit with arc-shape display panel!!! This Mark III LED level indicator is a new design PC board with an arc-shape 4 colors LED display (change color from red, yellow, green and the peak output indicated by rose). The power range is very large, from −30dB to +5dB. The Mark III indicator is applicable to 1 watt - 200 watts amplifier operating voltage is 3V - 9V DC at max 400 MA. The circuit uses 10 LEDs per channel. It is very easy to connect to the amplifier. Just hook up with the speaker output!

IN KIT FORM $18.50

2 WATT AUDIO AMP

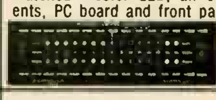
Pre assembled units. All you need is to hook up the speaker and the volume control. Supply voltage from 9~15V D.C. measures only 2" x 3½", making it good for portable or discrete applications. Comes with hook up data.

BUY 2 FOR **$4.99**

MARK IV 15 STEPS LED POWER LEVEL INDICATOR KIT

This new stereo level indicator kit consists of 36 4-color LED (15 per channel) to indicate the sound level output of your amplifier from −36dB ~ +3dB. Comes with a well-designed silk screen printed plastic panel and has a selector switch to allow floating or gradual output indicating. Power supply is 6~12V D.C. with THG on board input sensitivity controls. This unit can work with any amplifier from 1W to 200W!

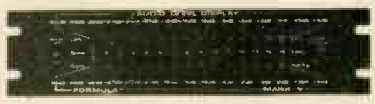
Kit includes 70 pcs. driver transistors, 38 pcs. matched 4-color LED, all other electronic components, PC board and front panel.



MARK IV KIT $31.50

NEW MARK V 15 STEPS LED POWER OUTPUT INDICATOR KIT

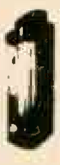
All functions same as Mark IV but this is with heavy duty aluminum front plate and case. Can be easily slot into the front panel of your auto, truck or boat. Operates on 12V DC.



$41.50 EACH KIT

BATTERY POWERED FLUORESCENT LANTERN

MODEL 888 R



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

$10.50 EA

30W + 30W STEREO HYBRID AMPLIFIER KIT

It works in 12V DC as well! Kit includes 1 PC SANYO STK-043 stereo power amp. IC LM 1458 as pre amp. all other electronic parts, PC Board, all control pots and special heat sink for hybrid. Power transformer not included. It produces ultra hi-fi output up to 60 watts (30 watts per channel) yet gives out less than 0.1% total harmonic distortion between 100Mz and 10KHz.

$32.50 PER KIT

5W AUDIO AMP KIT

2 LM 380 with Volume Control
Power Suply 6 18V DC
ONLY $6.00 EACH

PROFESSIONAL PANEL METERS

Type MU-52E

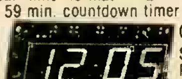
- A. 0-50UA 8.50 ea.
- B. 0-30VDC 8.50 ea.
- C. 0-50VDC 8.50 ea.
- D. 0-3ADC 9.00 ea.
- E. 0-100VDC 9.00 ea.

All meters white face with black scales. Plastic cover.

SPECIAL 0.5" LED SALE ALARM CLOCK MODULE

ASSEMBLED! NOT A KIT!

Features: • 4 digits 0.5" LED Displays • 12 hours real time format • 24 hours alarm audio output • 59 min. countdown timer • 10 min. snooze control.



ONLY $7.00 EACH
SPECIAL TRANSFORMER FOR CLOCK
$2.50

DIGITAL AUTO SECURITY SYSTEM

4 DIGITS PERSONAL CODE!!

SPECIAL $19.95

- proximity triggered
- voltage triggered
- mechanically triggered

This alarm protects you and itself! Entering protected area will set it off, sounding your car horn or siren you add. Any change in voltage will also trigger the alarm into action. If cables within passenger compartment are cut, the unit protects itself by sounding the alarm. **3-WAY PROTECTION!**

All units factory assembled and tested — Not a kit!

SANYO HYBRID AUDIO POWER AMPLIFIER I.C.

70 WATTS

100 WATTS

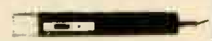
Typical ratings
Operating case temp. 85°C.
T.H.D. = 0.5% f = 20~20KHZ
Input resistance Po = 0.1W 30KΩ
Power band width 20HZ~20KHZ
Freq. response 10HZ~100KHZ
Output resistance = 8Ω
With built in protection circuit.
All units come with data sheet.

PART	OUTPUT (W)	SUPPLY VOLTAGE	PRICE
STK040	10W+10W Stereo	±16V D.C.	$14.50
STK041	15W+15W Stereo	±20V D.C.	$18.50
STK043	20W+20W Stereo	±22V D.C.	$22.50
STK054	23 WATTS	±23V D.C.	$13.50
STK056	30 WATTS	±22V D.C.	$18.50
STK050	50 WATTS	±35V D.C.	$26.50
STK070	70 WATTS	±42V D.C.	$32.50
STK1050	100 WATTS	±50V D.C.	$40.50

PROFESSIONAL FM WIRELESS MICROPHONE

TECT model WEM-16 is a factory assembled FM wireless microphone powered by an AA size battery. Transmits in the range of 88-108MHz with 3 transistor circuits and an omni-directional electric condenser. Element built-in plastic tube type case; mike is 6¼" long. With a standard FM radio, can be heard anywhere on a one-acre lot; sound quality was judged very good.

$16.50



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We also have transformer, capacitors set, resistors set antenna transformer. Please call for price.

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NIC1200 (12 hr) $24.50 EA.
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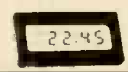
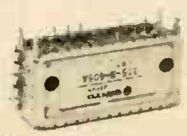


SANYO UHF VARACTOR TUNER

For UHF CH 14~83

Tuning voltage + 1V~+ 28V/D.C. Input impedance 75 OHM. I.F. band width 7~16 MHZ. Noise figure 11.5 dB MAX. Size 2⅜" x 1¼" x ¾". Supply voltage 15V D.C. Sound I.F. = 58.0 MHZ. Video I.F. = 62.5 MHZ



All units are brand new from Sanyo.
MODEL 115-B-405A
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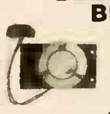
Brand new preassembled module for a toy factory. The board gives out 6 different selectable space sound with LED light effect. Sounds include UFO take-off, space gun blast, wave, and space chime. 7 LED on the board will work with the sound. Requires 9V battery to operate. Speaker not included.

SPECIAL $3.99 EACH SPEAKER $1.25 EACH

ELECTRONIC PIEZO BEEP BUZZER



Unique surplus ⅞" Dia. piezo ceramic disc on circuit board gives a distinct high freq. buzz. Unit contains an I.C., 2 caps, 6 resistors and is already preassembled. Requires 9V battery to operate.

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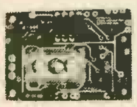

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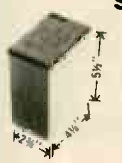

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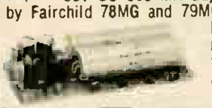

Kit includes all electronic parts, filter capacitors, I.C., heat sinks and P.C. board.

$12.50 PER KIT

AA SIZE NI-CD

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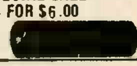
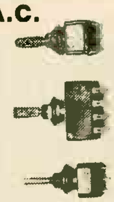
4 FOR $6.00

RECHARGEABLE BATTERIES
LIMITED QUANTITY AVAILABLE



SUB MINIATURE TOGGLE SWITCH 6 AMP 125V A.C.



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ELECTRONIC SWITCH KIT

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uses 7473 I.C. and 12V relay
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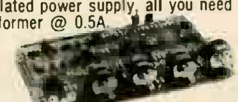
Kit comes with regulated power supply, all you need is a 48V C.T. transformer @ 0.5A.



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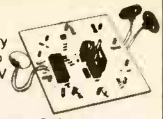

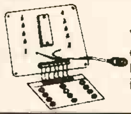

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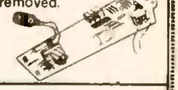

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Complete variable rate strobe light kit. Contains all parts, PC board, line cord and instructions.
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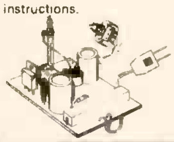

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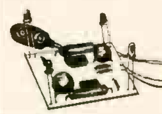

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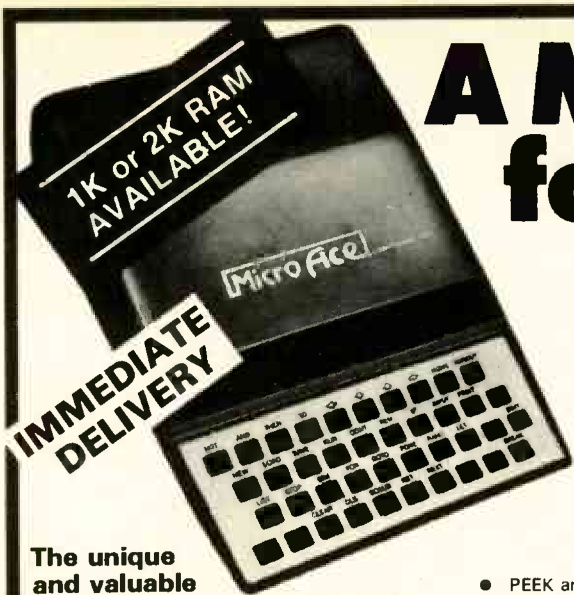
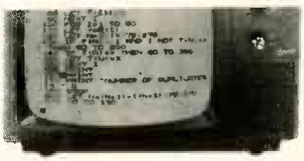


The MicroAce - a new generation of miniature computers



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- Excellent string-handling capability — takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison). The MicroAce also has string input — to request a line of text when necessary. Strings do not need to be dimensioned.
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- Variable names of any length.
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Fewer chips, compact design, volume production-more power per Dollar!

The MicroAce owes its remarkable low price to its remarkable design: the whole system is packed on to fewer, newer, more powerful and advanced LSI chips. A single SUPER ROM, for instance, contains the BASIC interpreter, the character set, operating system, and monitor. And the MicroAce 1K byte RAM (expandable to 2K on board) is roughly equivalent to 4K bytes in a conventional computer — typically storing 100 lines of BASIC. (Key words occupy only a single byte.)

The display shows 32 characters by 24 lines.

And Benchmark tests show that the MicroAce is faster than all other personal computers.

No other personal computer offers this unique combination of high capability and low price.

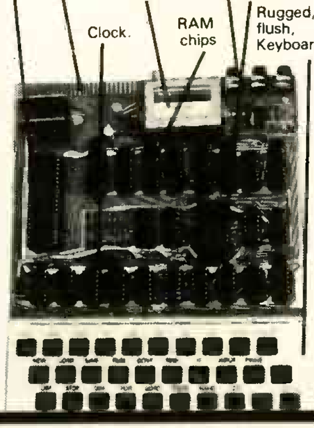
The MicroAce teach-yourself BASIC manual.

If the features of the BASIC interpreter mean little to you-don't worry. They're all explained in the specially-written book *free* with every kit! The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming-from first principles to complex programs. (Available separately-purchase price refunded if you buy a MicroAce later.)

A hardware manual is also included with every kit.

The MicroAce Kit:
$149.00 with IK COMPLETE
$169.00 with 2K

Demand for the MicroAce is very high: use the coupon to order today for the earliest possible delivery. All orders will be despatched in strict rotation. If you are unsuccessful in constructing your kit, we will repair it for a fee of $20.00, post and packing FREE. Of course, you may return your MicroAce as received within 14 days for a full refund. We want you to be satisfied beyond all doubt — and we have no doubt that you will be.



Your MicroAce kit contains...

- Printed circuit board, with IC sockets for all ICs.
- Complete components set, including all ICs-all manufactured by selected world-leading suppliers.
- New rugged keyboard, touch-sensitive, wipe-clean.
- Ready-moulded case.
- Leads and plugs for connection to domestic TV and cassette recorder. (Programs can be SAVEd and LOADed on to a portable cassette recorder.)
- Mains adaptor of 600 mA at 9VDC nominal unregulated.
- FREE course in BASIC programming and user manual.

JOIN THE REVOLUTION - DON'T GET LEFT BEHIND - ORDER YOUR MICRO ACE NOW!!

Send Check, Money Order or quote your Credit Card No. to:
MicroAce 1348 East Edinger, Santa Ana, California, Zip Code 92705.
or phone (714) 547 2526 quoting your Credit Card Number.

Quantity	Description	Unit Price	TOTAL
	MicroAce Kit 1K	$149.00	
	MicroAce Kit 2K	$169.00	
	Manual	$10.00	
	1K Upgrade Kit	$29.00	
Shipments inside California add 6% TAX		**TOTAL**	

☐ Amex
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CIRCLE 19 ON FREE INFORMATION CARD

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FIRST TO OFFER PRIME PRODUCTS TO THE HOBBYIST AT FAIR PRICES!

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1981 CATALOG AVAILABLE SOON.

Send $2.00 for your copy of the most complete catalog of computer products. A must for the serious computer user.

STATIC RAM BOARDS

Now less than 1½¢ per bit!

- **S-100 32K** (uses 2114)

ASSEMBLED		Kit	
450ns.	389.00	450ns.	339.00
250ns.	409.00	250ns.	359.00

Bare Board 39.95
Bare Board w/all parts less mem. 99.95

MODEL 2065 64K DYNAMIC RAM MODULE $600.00

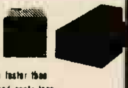
California Computer Systems

- Designed to IEEE Proposed S-100 bus standards
- Supports IMSAI-type front panels
- Operates with either an 8080 or Z-80 based S-100 system, providing processor transparent refreshes with both
- Bank select system allows system memory expansion and is compatible with Cromemco products
- Bank select port's address is jumper selectable
- Any 16K block can be made bank independent
- All 64K can be made bank-enable on power on and reset

FLOPPY DISK CONTROLLER $400.
Z80 CPU BOARD $300.

TRS80 ADD-ON

The VISTA V-80 Disk Drive System



More for Less. Speed. Capacity. Price.
The Vista V-80 mini disk system is 8 times faster than the TRS-80, 23% more storage capacity, and costs less.

Features:
- Vista offers 102K bytes to Radio Shack's 89K. That's 13K more bytes per drive for Vista.
- The V-80 operates at 12ms versus 40ms for TRS-80. Our drive can operate at 5ms, but only 50% of TRS-80 will operate at that speed, therefore Vista has purposely set the access time at 12ms.
- Totally compatible with all available disk operating systems.
- Upgraded system. Increased storage and speed. **$289.00**

VISTA DUAL V-80 includes cable **$670.00**

THE VISTA V-200 FOR EXIDY

Price: Starting as low as $1199.00

Item	Storage Capacity	Drive Configuration	Shipping Weight	Price
V200 E-20	400	2 Drive Single Head	25 lbs	1199.00
V200 E-22	800	2 Drive Double Head	25 lbs	1549.00
V200 E-30	600	3 Drive Single Head	32 lbs	1524.00
V200 E-32	1.2 MEG	3 Drive Double Head	32 lbs	1999.00

ATTENTION VIDEO HOBBYISTS!!!

★ BOX BUILDERS
★ USE AS REMOTE TUNER/TIMER
★ FULL SCHEMATICS AVAILABLE
★ FOR ONLY $5.90! – FREE W/PURCHASE

A Recent Special Purchase Allows Us To Present The Following:

NEW, UNUSED COMPONENTS

From The RCA VDT-201 Videocassette Recorder

1. UHF/VHF Tuner Subassembly with all knobs and Video Demodulator **$59.95**
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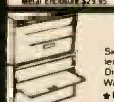
Subtotal **$123.34**

or

5. Complete Set of All The Above for Only **$74.95**

Metal Enclosure $29.95 — *Call For Volume Discounts*

LOW COST FLOPPY DISK SUBSYSTEM



Siemens FDD 120-8 (2) VISTA Floppy Controller (S-100), Case, Power Supply & Cable, CP/M Disk Operating System Assembled & Tested Walnut Wood Sides $1499.00
★ CHECK OUR FLOPPY DISK PRICING ON THIS PAGE ★
SAVE $300.00 ($1799.00 VALUE)

WATANABE MIPLOT

Max pen speed 50 mm/sec, resolution .10 mm typically .05 mm, built-in character generator sizes and 4 degrees of rotation, absolute draw, relative draw, alpha printing done with simple commands **$1195.00**

IMS STATIC RAM BOARDS

	250 ns.	450 ns.
8K Static	$209.00	$189.00
16K Static	$449.00	$399.00
32K Static	$729.00	$629.00

SALE! SD SYSTEMS BOARDS

TAKE 10% OFF!

	KIT	ASSEM
SBC 100 Single Board Computer (2MHz)	$265.00	$349.00
SBC 200 Single Board Computer (4MHz)	299.00	399.00
Z80 Starter System	319.00	449.00
VDB 8024 Video Display Board	335.00	459.00
Versa-Floppy II	325.00	429.00
Expando PROM	115.00	225.00
SD100 Computer System w/64K		6995.00
SD200 Computer System w/64K		7995.00

6800 MICROMODULE™ PRICE LIST

MODEL NO.	DESCRIPTION	PRICE
9600A	Single Board Microcomputer	$495.00
9609	Advanced Single Bd. Comp. (6809)	595.00
9601	16 Slot Mother Board	175.00
9602	Card Cage	75.00
9603	8 Slot Mother Board	100.00
9604	Power Supply	275.00
9605	DC Input Power Supply	325.00
9610	Utility Proto Board	39.00
9611	Arith. Proc/Memory Module	495.00
9612	Buffered Utility Proto Board	49.00
9616	32K EPROM/RAM Module	250.00
9617	EPROM Programming Head	250.00
9620	16 Channel Parallel I/O Module	295.00
9622	Serial-Parallel I/O Module	325.00
9627	16K Static RAM Module 470ns	395.00
9629	32K Static RAM 450ns	695.00
9629A	32K Static RAM 200ns	895.00
9630	Card Extender	68.00
9640	Multiple Programmable Timer	395.00
9650	8 Channel Duplex Serial I/O Mod	395.00
9655	Intelligent Tape Controller	550.00
96103	32/32 I/O Module	275.00
96702	Contact Closure Module	350.00

UNPOPULATED BOARDS (Also Available)

APPLE/EXIDY/EXPANDO TRS 80 16K-UPGRADE KIT

$49.95 TRS-80/APPLE $49.95

MEMORY EXPANSION KITS.
4116's, 16K (200/250 ns.)
8 pcs for $49.95
w/instructions & jumpers
Call For Volume Pricing

★ Special: TRS80 Schematic .... $ 4.95
★ Expansion Interface Schematic .. $ 4.95
★ Expansion Interface Connector 7.95

EXPANDORAM II MEMORY KITS

★ Bank Selectable ★ Uses 4116 200 ns.
★ Write Protect ★ Power 8VDC, ±16VDC
★ Phantom NEW LOW PRICES ★ Up to 4 MHz

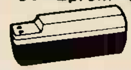
Expando 64 Kit (4116) Assem. & Tested Add $50.

16K	$249.00	48K	$435.00
32K	$289.00	64K	$505.00

PERSCI MODEL 299B DISKETTE DRIVE

3.2 Mbytes capacity (unformatted), max. seek time 100MS.
ACP Price...... **$2,199.00**

UV "Eprom" Eraser



Model UVs-11E $69.95
Holds 4 Eprom's at a time. Backed by 45 years experience
Model S-52T... $265.00
Professional Industrial Model

RAM BOARDS SPECIAL

16K Altair Mits Dynamic RAM Boards
Assem. & Tested $119.95 Untested $95.00 **16K**

CENTRONICS PRINTER

Model 737

- Centronics complete printer
- The 737 has everything. Check and compare the features
- New low price **$835.00**

The Vista V300 Printer

- 25 CPS printspeed
- Static print impact
- 136 printable columns
- 1/120 inch min char spacing
- 1/48 inch min line spacing
- 1000 msec return time
- 40 msec. line feed time
- 381mm (15") max. paper width
- Multistrike fabric black ribbon
- 96 print characters
- Standard 96 character wheel
- Standard parallel or RS232-C compatible
- 115V±10%, 50/60 Hz, 70 W power requirements

$1895.00

BASE II PRINTER

80 Column Impact Printer

- 60 Lines Per Minute
- 115/230 VAC, 50 or 60 Hz
- 72, 80, 96, 120 or 132 Char/Line
- Self-Test Switch

REG. $799.00
WITH ALL OPTIONS ACP PRICE **$699.00**

Option "M" Terminal Screen Buffer (1920 Char.) $50.00
Option "S" High Speed Paper Advance & Graphics 50.00
Option "T" Tractor Feed 50.00

Z-80/Z-80A/8080 CPU BOARD

★ On board 2708 ★ 2708 Included (450ns.)
★ Power on jump ★ Completely socketed.

- Z-80 Assembled and Tested $185.00
- Z-80 Kit $129.95
- Z-80 Bare PC Board .... $ 34.95
- For 4MHz Speed Add $15.00

8080A Kit .... $ 99.95
8080A Assembled $149.95

S-100 MOTHERBOARD SPECIAL

8 slot expandable w/9 conn.
reg $69.95 .... NOW $52.95

SIEMENS FLOPPY

- Special buy while supply lasts.
- 8" Drive with Double-Density
- 90 Day Warranty

★CHECK OUR FLOPPY DISK PRICING! ON THIS PAGE

SALE SIEMENS $429.00
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NOVATION CAT™ 0-300 Baud Bell 103 Answer, Originate **169.95**

'D' CAT MODEM NOW AVAILABLE $199.00

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Sanyo 5112CX Green Phosphor	$279.00	Sanyo VM 4509 9" B/W	169.00
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1980 IC Master $59.95
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Programming the Z80 .... 12.95
Programming the Z8000 .... 12.95
Programming the 6502 .... 12.95
6502 Applications Book 12.95
CPM Handbook 12.95

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Z8001 16 bit to 8Mb $189.00
Z8002 16 bit to 64K 149.00
Z80 .... 10.75
Z80A 14.50
F-8 (3850) 16.95
2650 .... 18.95
CD1802 .... 13.95
8080A 8.50
8080A-4MHz 19.95
SALE 8085 .... 14.95
8008-1 .... 14.95
2901 .... 9.90
2901A 14.95
2903 4-bit Superslice 29.95
TMS 9900JL 49.95
CP1600 .... 39.95
6502 .... 11.50
6502A 16.95
IM6100 .... 29.95
6800 .... 11.75
6800B 2.0 MHz 19.95
6802P 17.95
8035 .... 19.95
8755 .... 49.95
8748 .... 69.95
6809 .... 37.95
8086 .... 69.95

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AM9511 Arith. Processor 175.00
9512 Arith Processor 175.00
9513 Univ. Timing 79.95
AM9517 DMA Controller 18.95
AM9519 Universal Interrupt 18.95

Z-80 SUPPORT CHIPS

Z80-PIO	2.5 MHz	8.75
Z80A-PIO	4.0 MHz	12.95
Z80-CTC	2.5 MHz	8.75
Z80A-CTC	4.0 MHz	12.95
Z80-DMA	2.5 MHz	29.95
Z80A-DMA	4.0 MHz	38.95
Z80-SIO/0	2.5 MHz	35.95
Z80A-SIO/0	4.0 MHz	39.40
Z80-SIO/1	2.5 MHz	35.95
Z80A-SIO/1	4.0 MHz	39.40
Z80-SIO/2	2.5 MHz	35.95
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8155/8156 I/O 24.95
8755 I/O with Eprom 64.95
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8205/74S 138 Decoder 3.95
8212 8 bit I/O 2.75
8214 Priority Int. 5.25
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8224 Clock Gen 2.95
8224-4 (4MHz) 9.75
8226 Bus Driver 3.95
8T26 Bus Driver 2.95
8228 Sys. Control 5.50
8238 Sys. Cont. 5.50
8251 Prog. I/O 8.95
8253 Int. Timer 12.95
8255 Prog. I/O 6.50
8257 Prog. DMA 16.95
8259 Prog. Int 17.95
8275 CRT Controller 49.95
8279 Prog. Keyboard 15.95

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6820 PIA 5.95
6821 PIA 6.50
6828 Priority Int. 9.95
6834-1 512 x 8 Eprom 16.95
6845/HD46505 CRT Cont. 39.95
6847 Color CRT 49.95
6850 ACIA 5.95
6852 Serial Adapter 5.95
6860 Modem 10.95
6862 Modulator 11.95
6871A 1.0MHz OSC. 25.95
6875 .... 6.95
6880 Bus Driver 2.95
MC68482 .... 19.95
68047 .... 24.95

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2503V	1.49	2525	1.49
2504V	1.49	2527	1.49
2507V	1.49	2528	1.49
2517V	1.49	2529	1.49
2524V	1.49	2533	1.49

6502 SUPPORT CHIPS

6520 PIA 7.50
6522 Mult. 11.95
6530-002,003,004,005 .... 21.95
6532 .... 19.95
6551 .... 19.95

PROMS

2708 450 ns. 8.25
2708-6 650 ns. 7.50
1702A 4.95
2732 .... 74.95
2716-5V 14.95
2716-5V, 12V 19.95
2758-5V 19.95
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IM 5610 .... 3.90
SALE 8223 32 x 8 .... 2.95
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82S130 512 x 4 (OC) 6.50
82S23 .... 6.95
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NOTE: WE PROGRAM PROMS

CHARACTER GEN.

2513-001 (5V) Upper 9.50
2513-005 (5V) Lower 10.95
2513-ADM3 (5V) Lower 14.95
MCM6571 .... 11.75
MCM6571A 11.75
MCM6574 .... 14.50
MCM6575 .... 14.50

UARTS/BAUD RATE

TR1602B (5V, 12V) 3.95
AY51013 (5V, 12V) 4.95
AY51014A/1812 (5-14V) 6.95
AY51015A/1863 (5V) 6.95
TMS 6011 (5V, 12V) 5.50
IM6402 .... 7.95
IM6403 .... 8.95
2350 USRT 9.95
1671B Astros 24.95
SALE TR1472B 0.95
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4702 .... 14.95
WD1941 .... 9.95
COM 5016 .... 16.95

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AY5-2376 .... 13.75
AY5-3600 .... 13.75
HD0165 .... 9.95
74C922 .... 9.95
74C923 .... 9.95

STATIC RAMS

SALE 2102 .89

	1-24	25-99	100
21L02 450ns	1.30	1.25	.99
21L02 250ns	1.59	1.55	1.15
2111	3.75	3.65	3.55
2112-1	2.95	2.85	2.65
2101-1	2.90	2.70	2.55
2114L-250ns (4045)	6.50	5.95	5.50
2114L-450ns (4045)	5.50	5.25	4.75
4044 250 ns	8.95	7.50	6.90
4044 450ns	5.95	5.95	4.75
EMM4200A	9.75	8.75	7.95
EMM4402	7.95	7.25	6.25
AMD9140/41	10.95	10.25	9.25
AMD9130/31	12.95	11.95	10.25
1101	1.95	1.75	1.25
P2125/93425 (45ns)	9.95	8.35	8.25
6518 1K x 1 CMOS	7.95	7.95	7.25
2147 Low Power 4K Static	19.95	18.95	16.95
93415	9.95	8.95	8.50
TMS4046	11.95	10.95	10.50

DYNAMIC RAMS

416/4116 16K (16 Pin) 8.75
Set of 8 416's 49.95
4115 8K (16 Pin) 6.95
4050 4K x 1 (18 Pin) 4.95
4060 4K x 1 (22 Pin) 4.95
4096 4K x 1 (16 Pin) 3.95
2104 4K x 1 (16 Pin) 4.75
4027 4K x 1 (16 Pin) 4.95

5261	1.95	1103	1.95
5262	1.95	4008L	4.95
5270	4.95	6605	7.95
5280	4.95	6604	4.95
5290	12.45	8002	1.50

64K RAMS $159.95

SOCKETS

# Pins	Lo-Pro Soldertail	Wire Wrap 3 Level Tin	Wire Wrap 3 Level Gold
8	15	32	45
14	19	36	59
16	20	38	62
18	24	59	84
20	29	69	99
22	24	79	1.10
24	38	85	1.20
28	43	1.10	1.49
36	58	1.25	1.69
40	60	1.40	1.89

ZERO INSERTION FORCE

16 Pin $5.50 24 Pin $7.50 40 Pin $10.25

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Part No.	Size	Color	Description	Price
DL704	300	Red	Comm Cathode	99
DL707	300	Red	Comm Anode	99
FND357	357	Red	Comm Cathode	99
FND501	500	Red	Comm Cathode (+1)	99
FND503 (500)	500	Red	Comm Cathode	99
FND507 (510)	500	Red	Comm Anode	99
FND508	500	Red	Comm Anode (+1)	99
FND530	500	Green	Comm Cathode	149
FND550	500	Orange	Comm Cathode	149
FND803 (800)	800	Red	Comm Cathode	175
FND807 (810)	800	Red	Comm Anode	175
HP5082-7340	600	Red	4 x 7 Hexadecimal	20.95
HP5082-7300	600	Red	4 x 7 Sgl. Digit RHD	18.95
HP5082-7731	300	Red	Comm Anode	75
TIL305	–	Red	Array 5 x 7	7.95
TIL308	270	Red	Numerical Display	10.95
TIL309	270	Red	Numerical Display	9.95
TIL311	270	Red	4 x 7 Hexadecimal	10.95
MAN2A	320	Red	Array	5.95
MAN10A	270	Red	Alpha Numeric	8.95
XAN3061	300	Red	Comm Anode Right DP	125
XAN3062	300	Red	Comm Anode Left DP	125
XAN3063	300	Red	Overflow CA, Left DP	125
XAN3064	300	Red	Comm Cathode Right DP	125
XAN3051	300	Green	Comm Anode Right DP	199
XAN3052	300	Green	Comm Anode Left DP	199
XAN3053	300	Green	Overflow CA, Left DP	199
XAN3054	300	Green	Comm Cathode Right DP	199
XAN3081	300	Yellow	Comm Anode Right DP	210
XAN3082	300	Yellow	Comm Anode Left DP	210
XAN3083	300	Yellow	Overflow CA, Left DP	210
XAN3084	300	Yellow	Comm Cathode Right DP	210

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LF 13508 JFET Analog Multi 8 bit 8.95
ICM 7045 Precision StopWatch 23.95
CMOS LED Stopwatch/Timer 19.95
ICM 7207 Oscillator Controller 7.50
Seven Decade Counter 18.95
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ICL 7107 3½ Digit A/D (LED) 14.95
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LM 2900N Quad Amplifier 2/1.00
LM 2917N Freq. to Volt Conv. 2/1.99
AY-3-3550 4½ digit DMM 24.95
AY-5-3507 40MHz DVM 9.95
MEM 4963 Mosfet Smoke Detector 11.95
27508 32 x 8 Prom (IM 5600) 2.95
G115M 6 channel Mosfet 1.49
ULN 2003A 7 channel Driver .... .99
2101AL-4 .... 1.95
MCM 14505 64 bit Static Ram 6.95
MOC 1003 (4N28) Opto Coupler 3/1.00
SPX33 Opto Coupler 3/1.00
IH 5045 CMOS Switch DBST 4.50
VA 3045 Trans. Array 1.25
TR 1402A UART 1.95
MR 1007 Dyn. Mem. Shift Reg. 3.95
5736 Calc. Con. Circuit 2/1.99
5763 Calc. Con. Circuit 1.95
5318 TV Ch. Disp. Circuit 4.50
8080A 8 Bit CPU 4.95
82S21 32 x 2 Static RAM 2/1.99
8700 CJ 8 Bit A/D 9.95
2758 5V-2708 EPROM 12.95
MM5280/VPD 411/C2 107/TMS 4060/ 4Kx1 Dynamic 22 Pin RAM 1.75
6604/VPD 414/4027/2660/MK 4096/ 4Kx1 Dynamic 16 Pin 1.95

7520/25	.50	LM 387	1.25
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MK5014 Calc.	3/1.99	LM 4558	3/1.99
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MC1372	8.95	RC 4131	2/1.99
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LM 377	1.25	COM 5037	49.95
		DAC 100	15.95

VERBATIM DISKETTES

100% CERTIFIED ERROR-FREE!

• 35 TRACKS, DOUBLE DENSITY SINGLE-SIDED 5¼

TYPE	DESCRIPTION	PRICE BOX 10
525-01	Soft Sectored TRS 80 etc	$27.25
525-10	10 Hole Hard NS Apple etc	27.25
525-16	16 Hole Hard Micropolis	27.25

• 40 & 77 TRACK DOUBLE DENSITY – SINGLE SIDED 5¼" W/HUB REINFORCEMENT RING

577-01	Soft Sectored TRS 80 etc	$32.25
577-10	10 Hole Hard NS Apple etc	32.25
577-16	16 Hole Hard Micropolis	32.25

• 40 TRACKS DOUBLE SIDED DOUBLE DENSITY 5¼

550-01	Soft Sectored SA 450 MPI 52	$39.50
550-10	10 Hole Hard BASF WANGCO	39.50
550-16	16 Hole Hard Micro²	39.50

• 8" 100% CERTIFIED DISKETTES

FD800-01	Soft Single Density 3740	$33.50
FD800-32	32 Hard Single Density Shug	33.50
FD802-01	Soft Double Density 3740	44.80
FD850 01	Soft Double Sided Double Density 3740	49.80

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WE ALSO STOCK DYSAN-CALL

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1781 Dual Floppy 29.95
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9400 Volt to Freq. Conv. 7.25
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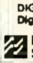

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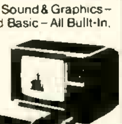

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7427	.35	74122	.39	74195	.65
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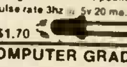

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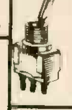

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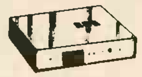

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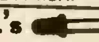

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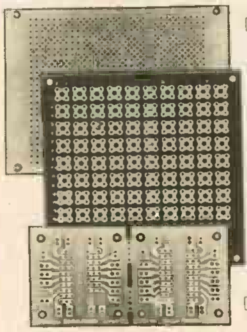

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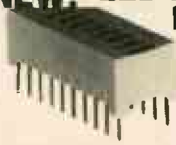

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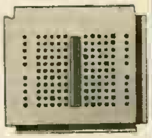

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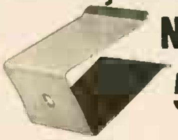

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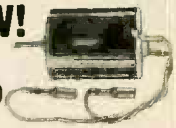

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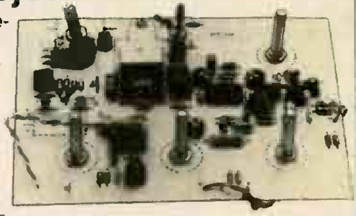

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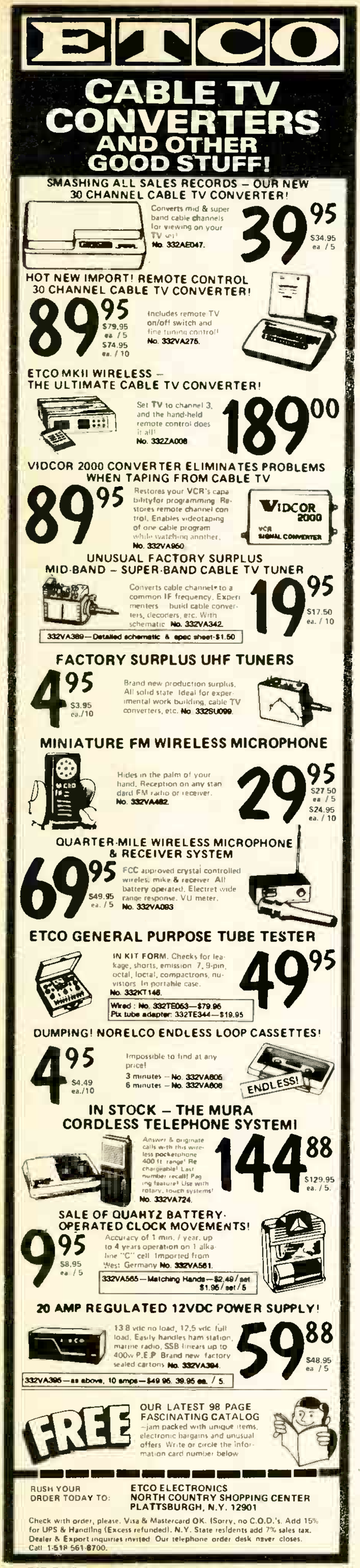

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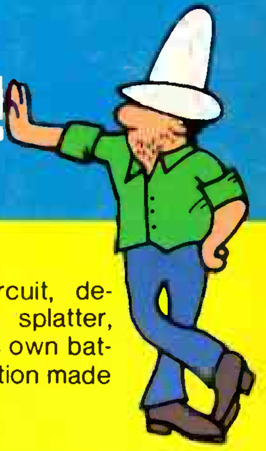

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