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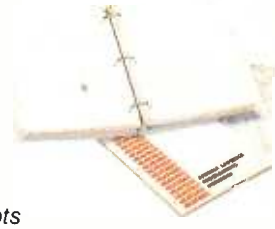

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EDITORIAL

A Bridge to Tomorrow

Tomorrow's world of consumer electronics always looks a bit clearer at this time of the year. The bridge is a series of manufacturers' press meetings and publicity news releases that, essentially, tout new models. Based on this, here's a sampling of what tomorrow's consumer electronics will be like.

- A revolutionary step anticipated next year (if you live in Japan or Europe) will be the introduction of the "Compact Disc" digital audio system promulgated by Sony and N.V. Phillips. The system's 4.7-inch disc, whose digitally encoded information is picked up by a solid-state laser, produced exemplary sound when I heard it being played on a prototype model. Look for it in '83. Price will be $800-$1000 for the player and converter, plus about $16 to $25 per record album.
- Votrax' "Type-'N-Talk" speech synthesizer is easy to use and certainly dramatizes the use of computers. When the $345 unit is connected to your computer's RS232C line, you simply type words (or even nonwords), followed by a talk command, and listen to the electronic speech playback. You should hear it pronounce typos!
- Open-reel tape enthusiasts, a diminishing group, will be cheered by the development of an open-reel tape of higher coercivity and retentivity than standard ferrics as well as machines capable of using the tape. Jointly developed by Akai, Teac, Maxell and TDK, the new tape, called EE, delivers performance at 3¾ ips that's reportedly as good as conventional tape at 7½ ips.
- It's in the record—CBS Records' CX system albums, that is. An in-the-groove coding to expand dynamic range of the playback music can be achieved with use of a fairly inexpensive decoder available from a handful of manufacturers.
- Video cassette recording enthusiasts will doubtlessly welcome new video accessories, including touch-sensor switchers, sophisticated color-TV automatic commercial eliminators, etc.
- In communications, Electra appears to have increased the range capability of cordless telephones by using 49 MHz for duplex transmission rather than 1.7 MHz for one of the links. A range of up to 1000 feet is claimed.
- There are lots of happenings coming up in the computer field, of course. Ranking among them has to be about-to-debut microcomputer systems from two corporate giants: Xerox and NEC. The latter's native language is N-BASIC by Microsoft.
- Into a miscellaneous category, might be tossed Whistler's "Fuelscan," which automatically indicates miles per gallon consumed while driving, miles to empty, and gallons in tank. All connection points are made behind the dash.

The foregoing are just a sample of what's coming up in electronic land. There is much more, naturally, including many new satellite communication systems, new video games, advanced color TV receivers, and so on. And somewhere down the pike we still anticipate a widespread viewdata TV system here. Now that 26 European countries have agreed on standards for a basic alpha-mosaic videotex, perhaps development of the system in the U.S. will be speeded up.

Art Salsberg

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LETTERS

Synchronous-Motor Speed Control

I have an important suggestion for those who build the April 1981 cover project ("Synchronous Motor Programmable Control"). In 1959, I built what I think was the first variable-frequency power source for telescope clock drives. Like the author of your article, I tried to use a standard filament transformer as an output transformer, but I found that it failed dismally because its core losses were too high.

I found that I had to rewind the transformer to have twice the original number of turns per volt. This brought the losses down from 5 watts to about 1 watt, making 4 watts of useful output power available to the motor. Hence, I suggest a transformer with a 220-volt primary rating and a 40-volt center-tapped secondary rating.

The last I heard, the MM5369 programmable counter IC was readily available in its 60-Hz output version only, and it is my understanding that programming could be done only at the time of manufacture. Where can the 100-Hz version be obtained?—*George W. Ginn, San Jose, CA.*

Readers who built the project and who are having trouble getting their motors to run below 60 Hz might want to try Mr. Ginn's suggestion. Actually, the project was designed with transformer losses in mind—that is why the author specified the Signal Transformer Company's product.

Anyone who has had trouble obtaining the National Semiconductor MM5369 EST/N integrated circuit should try Circuit Specialists, Box 3047, Scottsdale, AZ 85257. That company sells the MM5369-EST/N for $2.85 postpaid and the MM74C90N for $1.82 postpaid. —Ed.

RTTY Sources

In "RTTY Meets the Computer" (May 1981), the Directory of Manufacturers should list, as the manufacturer of Info-Tech Equipment, Digital Electronics Systems, 1633 Wisteria Ct., Englewood, FL 33533.—*G. D. Kelce, Englewood, FL.*

Telephone Accessory Circuits

Cheers for the "Electronic Ringer" in your May issue (p. 70). However, is there a more convenient power supply that would not require a connection to the 120-volt line? Would two 9-volt batteries in series to provide a ground, +9 V, and +18 V work? —*Jess Kaufman, Philadelphia.*

Yes.—Ed.

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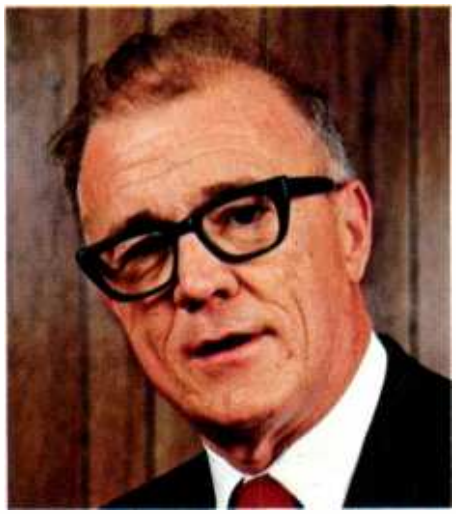

John E. Cunningham

Special Projects Director
Cleveland Institute of Electronics

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My father always told me that there were certain advantages to putting all your eggs in one basket. "John," he said, "learn to do one important thing better than anyone else, and you'll always be in demand."

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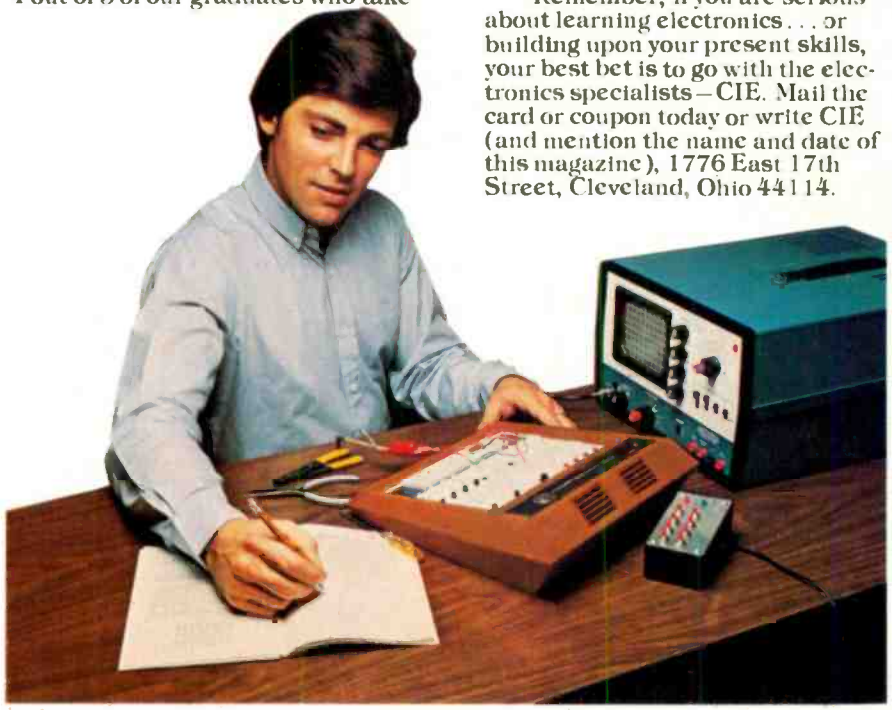

Pattern shown on oscilloscope screen is simulated.

PE-46

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NEW PRODUCTS

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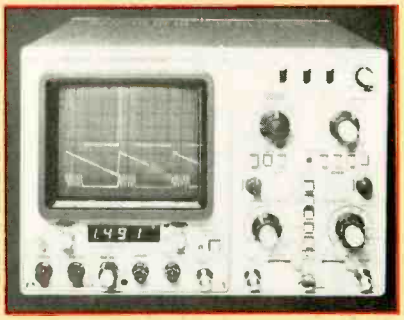
40-MHz Oscilloscope



Soltec Corporation has introduced a 40-MHz oscilloscope (Model S40M) with a built-in digital multitester. Features include a triple-trace display, a voltage-measurement circuit that provides a 3½-digit reading of the value of the waveform displayed, domed mesh CRT, single- or dual-trace X-Y capability, and vertical sensitivity of 2 mV to 10 V. The DMM display eliminates counting of CRT graticule lines and can be used independently of the CRT display. $2,265.

CIRCLE NO. 98 ON FREE INFORMATION CARD

Voice-Activated Answering Machine

The ITT Perfect Answer 2 uses microprocessor technology to eliminate the need for a beeper when accessing recorded messages from a remote location. It also contains a built-in telephone with memory redial, and can be set to answer calls on the first or fourth ring. An external speaker is provided for call monitoring. The user responds vocally to a set of five beep tones that correspond to a code. The code is preset by the user and can be changed for security. A LED alphanumeric display acts as a call counter and announcement timer, and verifies the operating functions of the unit. A dual cassette system records incoming calls from a few seconds to three minutes in length, and outgoing announcements 2 to 30 seconds long with a beep tone inserted at any point. $269.96.

CIRCLE NO. 99 ON FREE INFORMATION CARD

Battery Warning System

A device called the Battery Brain, developed by Electro Sensor Inc., uses a microprocessor to provide instant warning if there is a significant drop in voltage from a 12-volt battery or its charging system. The device, it is claimed, will sense a charging problem before the alternator light goes on. A display with two LED indicators (red and green) is connected to a vehicle's electrical system via solderless clamps to the fuse box. A green light remains on at all times, even when the vehicle is not operating, if voltage parameters are normal. A red light indicates trouble. Drain from the battery is said to be negligible. $29.95. **Address:** Electro Sensor, Inc., 10825 S. Central, Oak Lawn, IL 60453.

Video Camera

The QC-30 from Sharp weighs 3 lb and uses a battery that consumes 8.5 W. This color camera is designed to accompany Sharp's portable VHS tape recorder, the VC-2250. The QC-30 offers a see-through optical viewfinder, adjustable 2X zoom lens and automatic iris, three LED indicators (for battery alarm, VTR start, and to warn of underexposure). There is a 3-position color temperature control for adjustment to variable lighting conditions. Additional features include a 10-pin connector jack, built-in VTR start/stop remote trigger switch, built-in condenser microphone, and an accessory shoe for a lighting attachment. $599.

CIRCLE NO. 97 ON FREE INFORMATION CARD

Pioneer Stereo Receiver

Pioneer's Model SX-3400 AM/FM-stereo receiver is rated to deliver 15 watts continuous power per channel into 8 ohms from 20 to 20,000 Hz with no more than 0.08% THD. Its phono section is said to accept 140 mV at 1 kHz without overload. The power amplifier section is direct coupled, and a PLL is used in the stereo demodulator. Specifications—amplifier section: frequency response, 30 to 15,000 Hz ±0.1 dB phono, 20 to 80,000 Hz ±3 dB AUX and tape; hum and noise, 70 dB phono, input shorted. FM section: 50-dB stereo quieting sensitivity, 32.9 dBf; S/N, 70 dB stereo, distortions, 0.3% stereo; frequency response, 20 to 15,000 Hz +0.5/−1.0 dB; stereo separation, 30 dB from 30 to 15,000 Hz; alternate-channel selectivity, 60 dB; AM suppression, 50 dB. Size is 17½"W x 11½"D x 5 1/16"H, and weight is 12 lb 2 oz.

CIRCLE NO. 100 ON FREE INFORMATION CARD

Sanyo Video Disc Player

Sanyo's first video disc player, the VDR3000, is based on RCA's CED system and plays up to one hour per disc side. Visual program search is possible at either 12 or 40 times normal speed in forward and reverse. Recall without picture can be

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TI 59

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HP-67	295
HP-38C	115
HP-37E	59
HP-34C	115
HP-33C	69
HP-33E	49
HP-32E	43

*Hewlett-Packard has DISCONTINUED the System I and System II.

HP-85 COMPUTING SYSTEM

The HP-85 Personal Computing System for Professionals helps solve difficult engineering problems and simplifies financial analysis. The HP-85 is a powerful BASIC language computer with keyboard, CRT display, printer and tape drive complete in one compact unit. (HP-83 is the same as above but without the built-in printer and tape drive.)

	Mfr. Sugg. Ret.	Elek-Tek Price
HP-85 COMPUTER	$3200	$2600
HP-83 COMPUTER (as HP-85 but no Printer or Tape Drive)	2250	1800
2631B PRINTER	3650	3000
7225A PLOTTER (incl. Personality Module)	2800	2450
GRAPHICS TABLET	2050	1650
VisiCalc™ PLUS	200	180
APPLICATION PACS	95	81

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effected using an elapsed time counter that searches the program at 200 times normal speed. A stop action control allows

a near freeze-frame effect by temporarily repeating four frames—producing an almost still picture. Comb filtering is incorporated into the video circuitry, and the disc soundtrack can be played through a hi-fi system. An optional remote control is available for all player functions. $499.95.

CIRCLE NO. 96 ON FREE INFORMATION CARD

High-Performance FM Tuner

The Denon TU-900 FM tuner is said to offer a tuning precision of five significant figures rather than the usual four. Featuring a digital frequency display, the unit includes auto-lock touch tuning, two dc-coupled output circuits for direct recordings, and switchable bandwidth in the i-f section. Audio frequency response is rated at 20 to 15,000 Hz +0.2, −1.5 dB; S/N, 85 dB; THD, 0.035%; and alternate-channel selectivity, 50 dB (wide i-f) or 90 dB (narrow i-f). Capture ratio is 1.0 dB (wide), 1.5 dB (narrow). $590.

CIRCLE NO. 95 ON FREE INFORMATION CARD

Parallel-Blade Heat Gun

Eddy Products has introduced an electric heat gun (UL listed) rated for 650° to 900° F. From a standard 115-volt line, the Mark III Model EP6-UL draws 14.3 A. The housing, handle, trigger guard, and stand are Lexan 500. The unit also includes built-in circuit breaker, suspended heating element, temperature adjustment, double-jacketed nozzle and shield, and special-application accessories. $79.91. **Address:** Eddy Products, 280 S. 166th St., New Berlin, WI 53151.

Dual Power HF Transceiver

The Argosy transceiver from Ten-Tec features a switch that boosts power from 10 watts, QRP operation, to 100 watts, for SSB/CW. It provides coverage from 80 through 10 meters, operating in nine 500-kHz segments (four in the 10-meter band) with approximately 40 kHz vfo overrun on each band edge. A 100% duty cycle is tolerated for up to 20 minutes on all bands. Full break-in is offered on CW, plus PTT on SSB. A built-in sidetone has adjustable tone and volume control, with alc control on high power. Sensitivity is 0.3 μV for 10 dB S+N/N. A 2.5-kHz 4-pole crystal filter is included with 1.8-kHz, 500-Hz, and 250-Hz filters optional. A 50-dB notch filter is tunable from 200 Hz to 3.5 kHz; an i-f noise blanker is optional. The unit runs from 12-14 V dc or, optionally, from ac mains. $549.

CIRCLE NO. 94 ON FREE INFORMATION CARD

Polk Floorstanding Speakers

The RTA 12B has two trilaminate-polymer bass-midrange drivers and a "dual isophase crossover network" that holds phase shift to ±9° from 100 Hz to 10 kHz. Other drivers include one 1" moving-coil high-frequency radiator, and one 12" planar fluid-coupled subwoofer. Dimensions are 39"H × 16"W × 11⅞"D. Nominal impedance is 4 ohms, and recommended drive power is 10 to 500 W/channel. System resonance is 15 Hz; rated frequency response, 25 to 20,000 Hz, ±2 dB. $500 each.

CIRCLE NO. 93 ON FREE INFORMATION CARD

"Servo Sub-Octavator" Extends Bass Response

KM Laboratories has introduced a "black box" (2⅜"H × 14½"W × 6"D) called the SSO 300 Servo Sub-Octavator®. Said to extend the bass response of any conventional loudspeaker/amplifier system by as much as an octave without requiring internal modifications, the SSO 300 has a rated frequency response of 0.7 Hz to 200 Hz (max. gain 3 dB). Other specifications include input impedance, 20 kΩ; output impedance, 220 Ω; THD at 0.5 V, 0.001%; response time, 125 ns; and S/N, 101 dB. Bass compensation is provided in 1½-dB steps. Output impedance of the overall system with an 8-ohm speaker is negative, which is said to improve woofer transient response. Maximum output is 9 V rms (25 V peak-to-peak). $399.

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Pocket Concert Hall

PRICE SLASHED

Was $199, then $179---We cut it to only $118

NOW JUST $69

Cybernet has a problem. They built over 100,000 of these fabulous Pocket Concert Halls. They built them to be better than the Sony Walkman, but by the time they got them here, the price had already come down on the Walkman (it's now as low as $139 in some areas) and lots of cheap Hong Kong-made recorders had hit the market.

The Cybernet was built to sell for $200 and wholesale for $119. It has a very sophisticated dual flywheel tape drive system and superb electronics. The best way to test a portable is to play music and shake it. If the music wows badly, or even stops, you have a cheap unit.

Both Sony's and Cybernet's can pass this test. Not may others can. So, if you want the best sound and the most stable unit, Cybernet has 35,000 left. And at only $69 ($2.50 P&H), it's an incredible bargain. Remember this is a $200 retail unit, and the January 1981 wholesale price sheet shows dealer cost at $119.97. We'll be glad to send you a copy if you'd like to see it. Use DAK's Super Sale Order Number 9192. Of course you get DAK's 30 day risk free trial and Cybernet's one year warranty described below.

First there was silence. Then from nowhere, there explodes an awesome kaleidoscope of sound. Violins from the left, trumpets from the right, while the sounds of a vocalist seem to come from somewhere above.

You've just experienced a breathtaking experience in sound. It's better than siting in the middle of a full symphony orchestra.

As you take off the almost weightless 1½ ounce headphones and tentatively look around for the orchestra, the realization of the experience sinks in.

Now you can enjoy more beautiful sound from your cassettes while you are jogging or washing the car than when you are sitting in front of your stereo.

SOMERSAULTS AND CARTWHEELS

If you were on a diet yesterday, you probably lost more weight than the trifling 16 oz. of the Pocket Concert Hall.

The Concert Hall goes where you go with a protective leatherette case that easily hangs on your belt or rides comfortably in your pocket. It also comes with an adjustable shoulder strap.

Whether you're into gymnastics, long walks, or just mowing the lawn, you'll enjoy the unbelievably rich stereo sound of the Pocket Concert Hall. And, to prove our point, we offer you a 30 day risk free trial.

ENGINEERED FOR STRESS

Most fine stereo equipment is designed to be lovingly placed on a shelf and never moved. Obviously, this isn't a practical way to listen when you're walking your dog or riding a bike.

The Pocket Concert Hall incorporates a special dual flywheel tape movement system with a unique anti-rolling mechanism resembling a fine clock. It keeps the music smooth and stable, even when you're doing cartwheels.

The Pocket Concert Hall is specifically designed for rough treatment. Other machines are really redesigned dictation recorders. The Pocket Concert Hall is designed to provide superb stereo music while you're on the move.

You can expect years of enjoyment from this finely crafted revolutionary new sound machine.

MUSIC AT YOUR COMMAND

You won't be 'roughing it' when you leave home. You can play all your cassettes since there is an equalization switch for Metal/Chrome or standard.

The sound is crisp and clean with a frequency response of 30–14,000hz. The entire system is operated by 4 AA batteries (included).

There are convenient lock-in fast forward and rewind buttons, plus cue and review. If you want to listen to a song again, just press the review button without ever leaving play.

You can listen to the outside world by pushing the talk switch without taking off the feather-light stereophones. Dual volume controls, auto-stop and a battery condition/operation indicator light round out a full compliment of convenience features to enhance your musical enjoyment.

MULTINATIONAL GUARANTEE

Cybernet is an extremely large Japanese Company with a large presence here in the U.S. They manufacture component systems valued in the thousands of dollars and sophisticated wireless trasmission systems.

Cybernet backs the Pocket Concert Hall not with the usual limited 90 day parts and labor guarantee, but with a limited full one year guarantee.

DAK is America's largest direct selling manufacturer of magnetic products. We add our own 30 day 100% satisfaction guarantee to protect your purchase.

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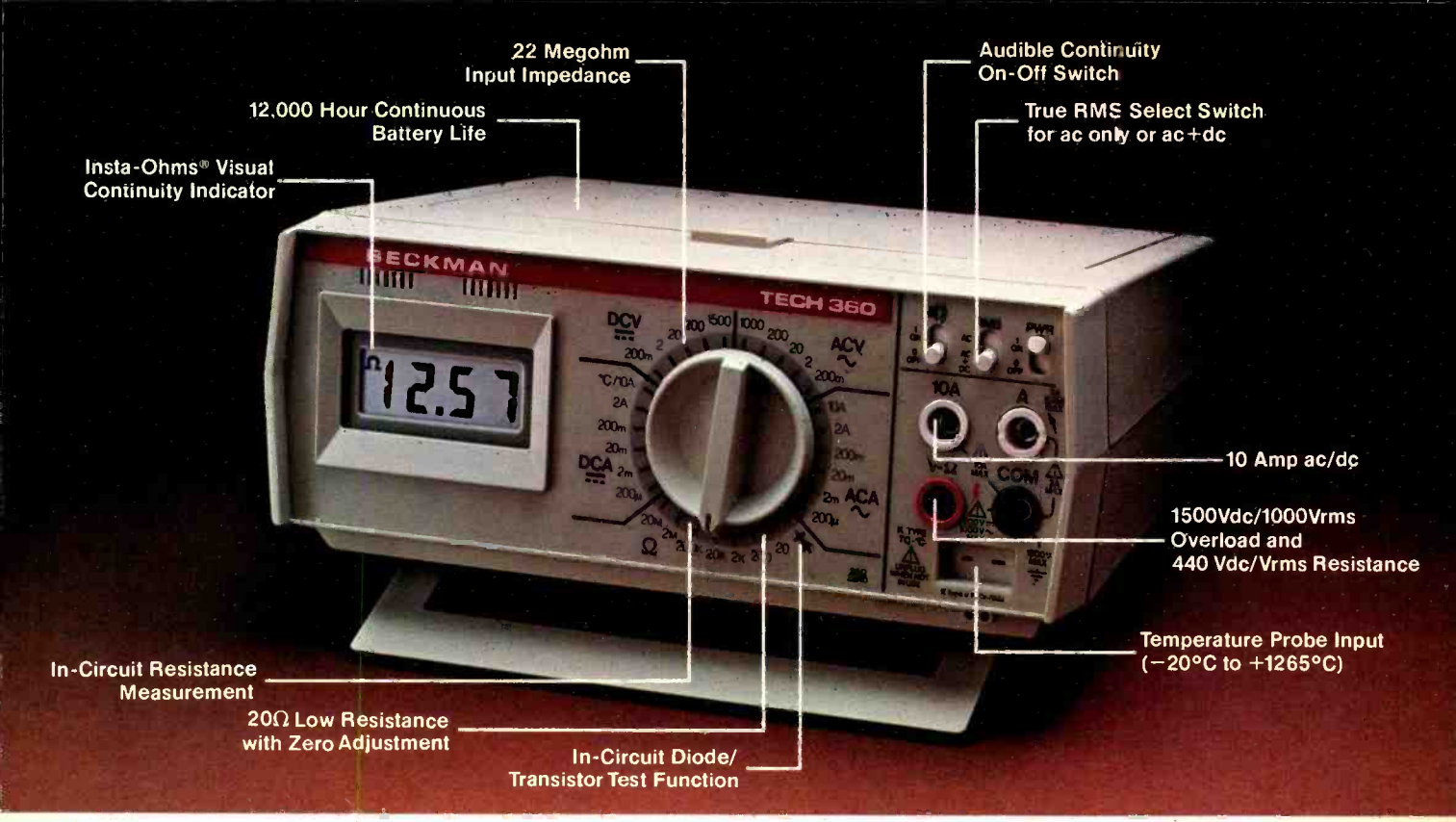

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Designed for ultimate ease of operation, the TECH 360 delivers 12,000 hours continuous service (up to 4 years of normal use) from standard heavy-duty batteries. You'll never have to search for power outlets or contend with ground loop errors. The expense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

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

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

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

BECKMAN

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Popular Electronics Tests

The Sinclair Research ZX80 Personal Computer

THE Sinclair Research model ZX80 personal computer, is a no-frills Z-80A microprocessor-based system designed to be very inexpensive and easily portable. Like many video games and low-cost computers, the ZX80 comes equipped with a TV/GAME 60-dB isolation switch that permits use with any TV receiver. For the few users that would be expected to do so, the manufacturer supplies an application note that explains how to derive direct video for use with a monitor.

The design is unique in not using a video controller for the display. Sinclair opted instead for using the refresh counter of the Z-80A to control the video display and update it about 60 times a second. When a program is running, the screen is blanked then rewritten after the process, since the Z-80A has to share its resources.

The ZX80 is housed in a nonimpact plastic case that measures 6.5 in. x 8.5 in. x 1.5 in. The case also provides the necessary shielding to enable the unit to meet FCC class-B radiation requirements. The shielding is a thin metal coating that is apparently sprayed on the inside of the case. Necessary board grounding is effected via flexible grounding straps located on the r-f modulator metal enclosure. (This arrangement, although workable to a degree, has some inherent difficulties that we will discuss later.) The plastic enclosure houses a forty-key, pressure-sensitive keyboard, built-in r-f modulator, 1K bytes of RAM, 4K bytes of system ROM, and a cassette interface.

The price of the unit is $199.95 and includes the ac adaptor, cables for a tape recorder (not supplied), and an extremely well-written and useful 130-page user's and programming guide. Since BASIC is contained in ROM, nothing else is required for operation except a TV receiver. As yet, Sinclair offers no options, however, an 8K-byte enhanced BASIC (in ROM) that reportedly will sell for $40, and a 16K-byte RAM expansion for less than $100 are in the works. Currently, software support, is available from various aftermarket sources.

General Description. The Z-80A microprocessor, operating at a 3.25-MHz clock rate, creates the screen image. The black-on-white display, which is upper-case only, is limited to 24 lines by 32 characters (768 characters per screen image) by the typical bandwidth (~ 3.5 MHz) of a typical TV receiver. The character generator also provides what Sinclair terms 24 standard graphic symbols. However, in reality, there are 10 graphic symbols and their inversions. The other four are the normal and inverse of the space character and the quote symbol. The graphic characters are formed on an 8 x 8 dot matrix that offers resolution somewhat better than that of the common 5 x 7 dot matrix though not quite the high resolution touted by Sinclair.

The integrated cassette interface operates at 250 baud. The basic tape format is frame sync information, pointers into the variable area, and compressed tokens representing both keywords and data. An interesting feature of the cassette system allows data and variable information to be saved at the same time, and restored at run time by invoking the GOTO (line no.) rather than RUN. The recorder volume setting has little or no effect on the operation of the system. The ZX80's 2K integer BASIC is limited, but it can't be considered a tiny BASIC. It is, rather, a subset of a full-scale integer BASIC with some unique attributes of its own.

(Continued on page 18)

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For all practical purposes, the typical functions found in larger implementations of BASIC are included (string operators such as MID$, LEFT$, RIGHT$, are not). Bit-wise Boolean operations are permitted using NOT, AND, or OR. The character string function CHR$ becomes a main operator in most programs, and a unique function TL$ (s) which returns the string (s) minus its first character is provided. The TL$ operator, can be employed for creating unique displays, while the function CODE returns the ASCII code for the first character of string. This latter function essentially takes the place of ASC found in most BASICs. Even PEEK and POKE are included to permit the user to get to the memory. To further support these functions, USR permits the calling of a user-written machine language routine.

Interestingly, the BASIC is well suited to the machine architecture. To enter a program, you merely tap the Q key. This executes NEW and clears the work space for a new program. Next type in a line number, depress the letter O to generate the keyword PRINT. When you do this the cursor is displayed as an inverse K to indicate a keyword. Your next entry would, in this case, be a "quote" which would generate an inverse S, indicating that a syntax problem exists (there is no "end quote" yet), and remain displayed until you have finished the line and ended it with a quote. Once you have the line typed in, you depress the key marked NEWLINE. This key acts the same as RETURN on other computers.

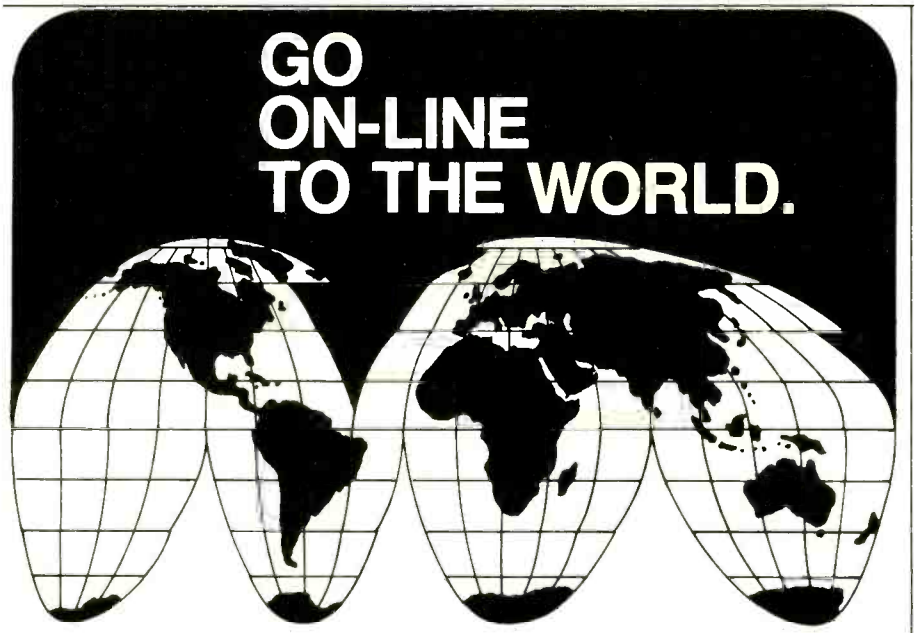
When a line is entered, all the system variables, line numbers, and pointers to the next line are stored in an area below the user RAM area. Then the program is stored, as are the working variables (A$, for example) and an indicator for end of line. Next, a working space is opened to input new lines, or for editing, then a display area that holds 24 NEWLINE characters is provided for screen updating. This is followed by a stack area that contains information for jumps and GOTOs.

Since the code is compacted, a fair amount can be input into the 1K of available RAM. Sinclair exaggerates a little in saying that you can enter 100 32-character lines (which would be 3500 bytes, assuming two bytes for a line number, 1 byte for NEWLINE terminator and 1 byte per character), but you can come close to 3000 bytes. This is fairly easily done, since all the operators are stored as tokens and in a manner to provide maximum packaging. One technique used is to drop spaces and set bits to indicate where a space should appear.

Because of the unique implementation of the BASIC, editing is fairly simple. You LIST the program (depress the letter A), and then enter the editing mode by holding the SHIFT key and depressing NEWLINE. The cursor is moved to the desired line by holding down SHIFT and depressing one of the arrowed keys, 5 for left, 6 for down, 7 for up, and 8 for right. The chosen line then is redisplayed at the bottom of the screen, and can be edited by moving the cursor over the desired area and typing over material to be changed, including the line number. This gives you a quick way of copying lines into new line numbers.

When a program is run or a new line entered, the screen is blanked. For example, if you wrote a program to draw a maze, when you RUN, the screen will blank for a few seconds and redisplay with the maze drawn. Should your program ask for an input, the same thing happens once the data is entered. This is a bit disconcerting at first, but is not a disadvantage. It can be useful for creating certain games.

Quite honestly, the 130-page, spiral-bound operating manual supplied with the ZX80 is the best we have seen so far. The authors, realistically, assumed that the buyer of this machine would be a novice and wrote accordingly. Thus, the manual explains not only how to use the ZX80 but the basics of computer operation in general. In addition, there is a



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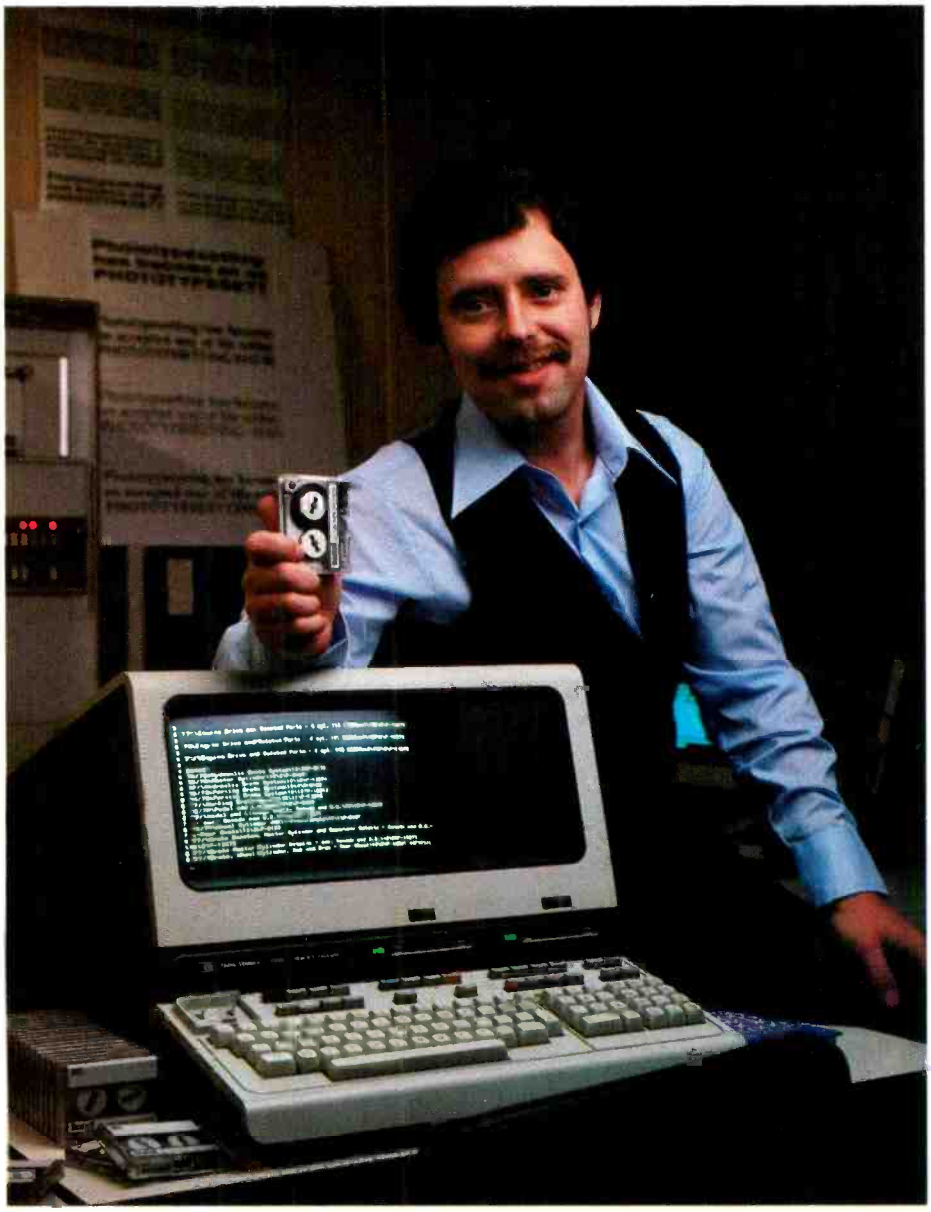

Bill Birkett, Vice President, Trade Graphics, Inc., Livonia, Michigan

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maximum of practical examples and a minimum of theory.

Evaluation. Basically, the ZX80 is easy to use—remove it from its box and plug it in. The keyboard, although small and not very well designed from a mechanical point of view, gives a good presentation of the keys. You can see at a glance what to do to get certain things to happen. For example, to print a "greater than" character (>), you would clearly have to depress the SHIFT key and the letter M. This is evident since the keys are color-coded to indicate which functions go together. Many keys "triple shift" in that one key serves three functions. For example, the Q key not only generates the letter Q, but contingent on how you handle the SHIFT key, also generates the BASIC command NEW, and a graphics symbol as well, However, this multiple use and automatic keyword feature is complicated by the diminutive keys. Adult fingers are hard-pressed for maneuvering room. Also, the touch takes some getting used to.

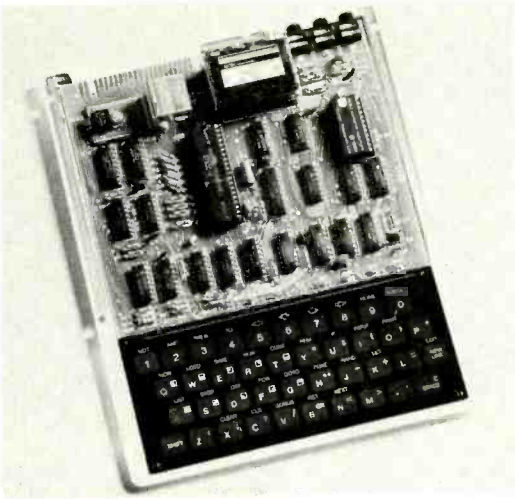

Photo of the ZX80 with its cover removed shows the compact assembly that was used to achieve its small size.

Although the display is reasonable in design, as the system is delivered it may not work properly. When we first turned the ZX80 on, we found that the display was erratic. Compressing the case in our hands improved matters, which suggested a grounding problem.

On opening the case, we found that the grounding straps, which are nothing more than strips of light metal, were not making proper contact with the case. The remedy was to bend the straps on the top of the r-f modulator can in a horseshoe, and solder a wire across the bottom straps to hold them rigid and provide a longer groundplane contact.

Still, the thin metal shielding inside the case is not really adequate. Although the ZX80 carries a notification that it has passed FCC certification for class-B operation, we found it noisy.

Another difficulty we encountered relates to the use of channel 2 as the base frequency of the r-f modulator. In the U.S., channel 2 is a major vhf channel, especially in metropolitan areas. At the fairly low level of video drive the ZX80 provides, the display is interfered with by local channel-2 TV transmissions. There are two ways the user can get around this: either offset the TV receiver slightly via the fine tuning, or wrap about 10 turns of number 14 copper wire around a small plastic tube, mount it in parallel with the coil in the modulator can, and then experiment by spreading or compressing the coils to offset the r-f frequency to some unused vhf channel in your area. Of course, you can follow the instructions in the manual for deriving direct video for a monitor.

A factor which will greatly affect the quality of the picture is the television receiver used. Specifically, if your receiver is of the so-called *hot chassis* variety, it is subject to interference from the power line.

With respect to processing speed, the unit performs much as Sinclair claims. Since the company used benchmark programs created by Tom Rugg and Phil Feldman ("BASIC Timing Comparisons," *Kilobaud*, October 1977, page 20), we did too. We found execution times that were, in most cases, within .1 sec of what was specified.

We could find no operational fault with the BASIC, and, in fact, consider it one of the better implementations available. However, like most BASICs, it has its idiosyncracies—for example, the lack of conventional control characters.

Comments. Some math applications are precluded since the integer BASIC doesn't support floating-point calculations. Nor is the machine viable as a building block for a larger system. Although it does have a 44-pin extension bus connector, no suitable peripherals are currently available.

The design philosophy of the ZX80 is sound, innovative, and commendable. Had the quality and workmanship of the hardware matched the basic design, the machine could have been spectacular. As it stands, the ZX80 may be a good choice for beginners who want to dip a toe into Computer Lake at low cost.
—*Carl Warren*

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Popular Electronics Tests

General Electric's IVHD3042W Video High Density Disc Player

THE Matsushita/JVC Video High Density (VHD) disc player is now off the drawing board and into hardware. Initial prototypes have been delivered to U.S. partner General Electric and Matsushita-owned Panasonic.

The disc itself is smooth-surfaced, 10.2" in diameter. It is made from compression-molded PVC plastic, carbon black, a lubricant, and other additives. Spinning at a constant 900 rpm, it is designed to play one hour per side. Because the force of the stylus on the disc is spread over more disc area than in the CED (Capacitance Electronic Disc) system, pressure on the surface is accordingly less. Stylus life, consequently, could amount to more than 1,000 hours, and recordings last for up to 10,000 plays. Dual audio channels can carry either full stereo or bilingual outputs.

Time-share picture and audio frames (54,000 per disc) are molded into the plastic as variable length pits of uniform depth, with tracking pits running alongside, and at right angles to them. The pickup head has only flat contact with the record, and may move freely over the disc's surface, permitting still pictures and forward and reverse slow motion at 1/2, 1/4, 1/8, and 1/16 normal speed. Similarly, forward and reverse fast picture search (with picture) is possible at 2, 3, 4, and 5 times normal speed in the forward mode, and 2 and 3 times normal in reverse.

There is chapter and *time* access, but no frame identification. This will come later—at added expense. Meanwhile, the reduced method of picture identification will locate any specific image within about 15 frames, and frame-by-frame motion control can quickly move the stylus arm into the exact position for the frame desired.

The disc player will be introduced in Japan in October of this year, in the U.S. in January of 1982, and in Britain six months after that. Here, the system is to be marketed under the General Electric, JVC, Panasonic, Sharp and Quasar brand names. Meanwhile, negotiations for first-run movies, various shows, and other entertainment and educational programs are in progress.

Operation. Since the system we investigated is still a prototype, only a block diagram (Figure 1) of the overall player was made available by General Electric. But even that is a good deal more than had been released previously.

The equipment is designed to operate in sequential steps, with lighted green indicators suggesting each succeeding step. The stylus is always in contact with the recording until play is completed, after which the player automatically moves to the unload position, and the time clock resets to zero.

Variations in capacitance (equating to frequencies from 6.1 to 7.8 MHz) are picked up from individual pits on the disc by an electrode attached to the stylus and in physical contact with the disc (Fig. 2). A 915-MHz oscillator provides a carrier for the signal, which is then peak-detected so that it contains the total video and audio information. A head amplifier receives this information and passes it to the tracking servo circuit, the dropout compensation (DOC) detector, and the video detector. Additional signal paths lead from the tracking servo circuit to the motor servo circuit, and to the stylus coils on either side of the input.

Three coils guide the stylus (Fig. 3).

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Coil B is wound around the center magnet, but is not in contact with it; and the two A coils on either side of the center magnet are in electrical phase opposition. Coil B controls the tracking error, while the A coils correct for time-base abnormalities. Thus, the stylus arm can move both transversely and longitudinally. This affords excellent stylus tracking as well as operations such as frame scan.

The video detector supplies four separate outputs: one for the sync separator; another for two audio bandpass amplifiers and their detectors; a third to the DOC switch; and a fourth directly to the luminance delay line, which delays the luminance signal so it will be properly timed with the chroma. Chroma burst (color sync) is carried conventionally on the back porch of the horizontal sync pulse and reaches the burst gate via the sync separator. Chroma information, part of composite video, having been recorded at approximately 2.56 MHz is up-converted to the NTSC standard 3.58 MHz via the 6.14 MHz voltage-

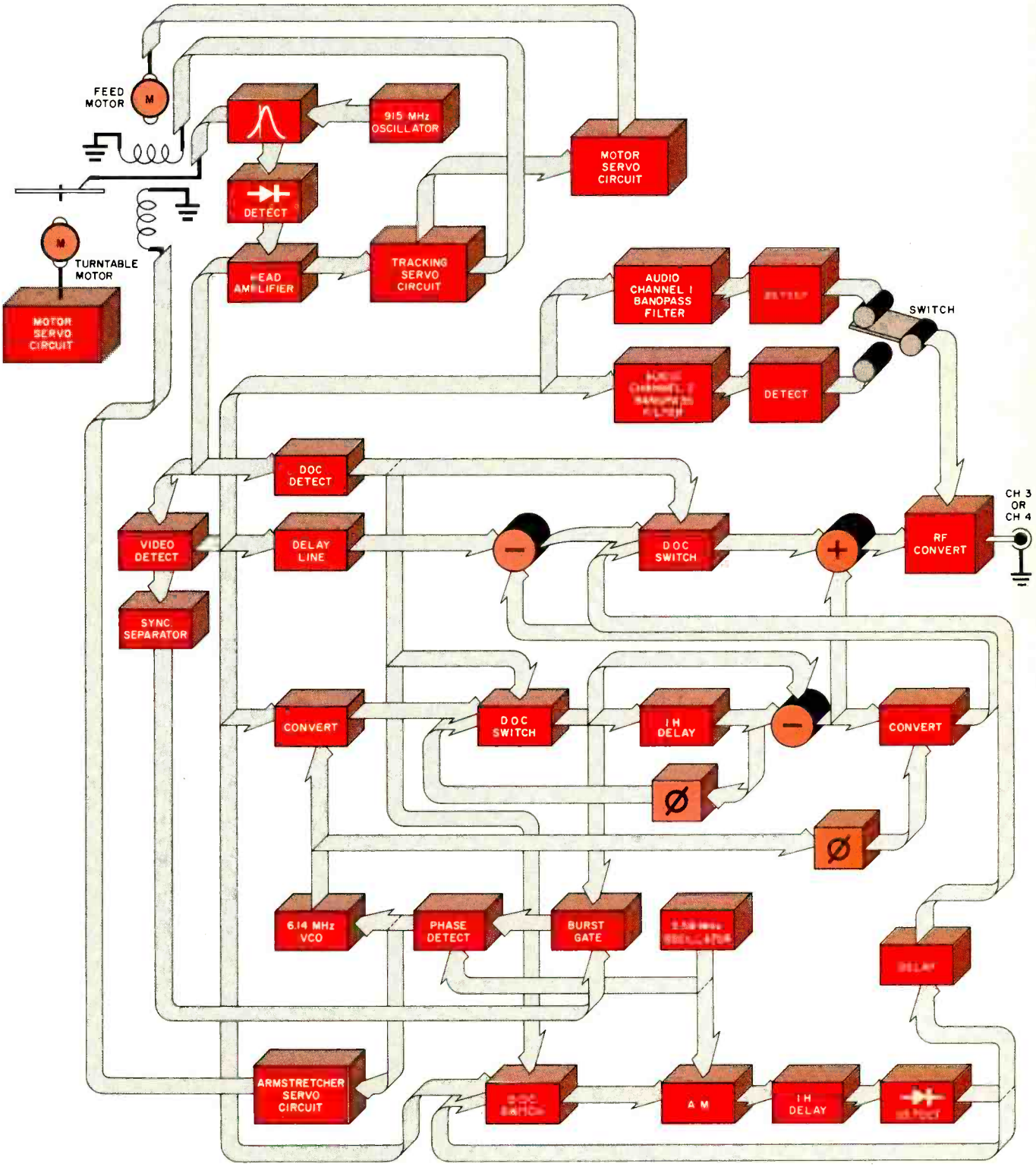

Fig. 1. Simplified block diagram of the VHD disc player.

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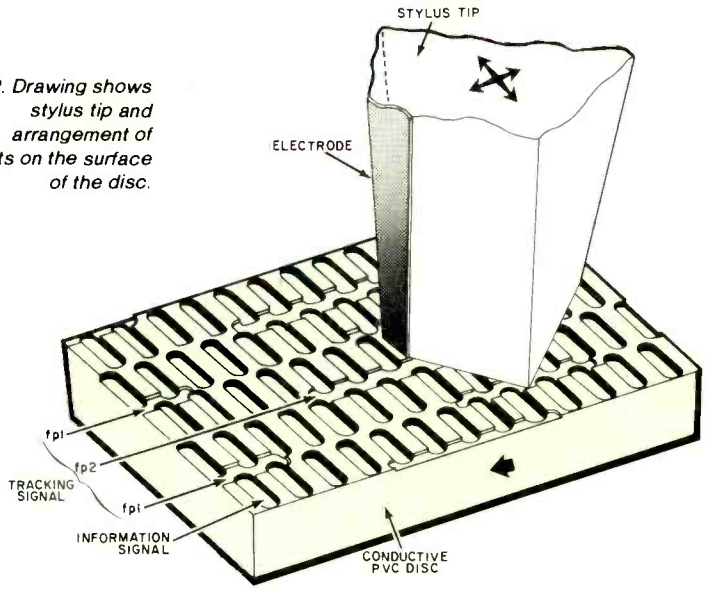


Fig. 2. Drawing shows stylus tip and arrangement of pits on the surface of the disc.

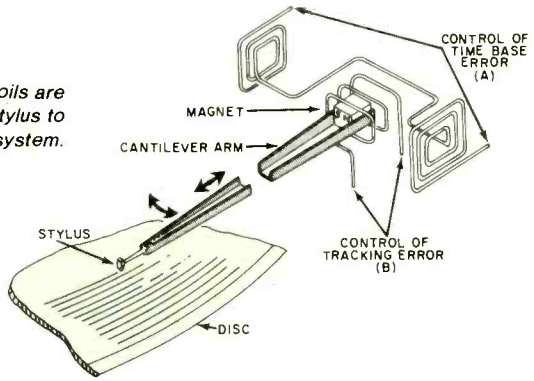


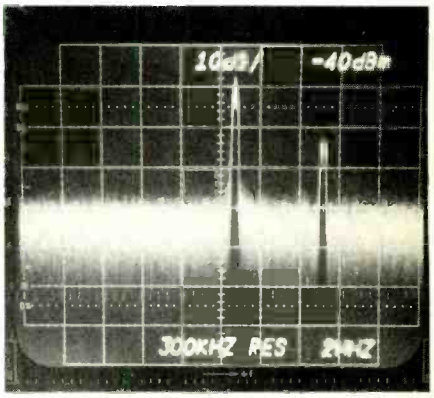
Fig. 3. Three coils are wound around the stylus to activate servo control system.

controlled oscillator. It is then passed to the dropout compensator switch, which is also supplied with feedback from the 1H (horizontal line) delay line. Should a dropout occur in a line of video information, the previous line is automatically substituted.

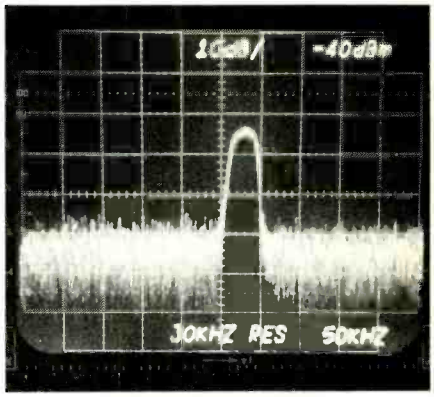
The output from the 3.58-MHz oscillator goes to a phase detector and to the AM block, where input comes via another dropout compensator switch. From that point, three-way connections lead to composite video, the DOC detector, and to a feedback circuit from a second 1H delay line and its 1H detector. This is part of a coincidence switching arrangement that permits the main DOC switch in the luminance processor to be activated just prior to final chroma addition at the r-f converter.

The armstretcher servo circuit also bears mention. Its sensing signal is derived from the 3.58-MHz oscillator's phase detector, and from the incoming chroma burst gate. A phase-locked loop corrects both the frequency of the 6.14-MHz voltage controlled oscillator and the positioning of the stylus.

Analysis. G.E.'s and Matsushita's product falls somewhere between RCA's Capacitance Electronic Disc (CED) and the Philips/Magnavox/Pioneer laser disc player. If recorded at only ½ hour per side, stop field/frame performance would theoretically be comparable to that of the laser unit. However, since each side is recorded for a full hour's play, any frozen picture occupies four fields or two frames. Where relatively still scenes are displayed, there's very little movement visible in the freeze frame, but where there is rapid motion in the picture, the jitter is rather pronounced.



Video and audio carriers show 43 and 26 dB S/N ratios.



Audio carrier has 20-kHz bandwidth at 3 dB down.

Otherwise, this versatile player does essentially everything that the ½-hour-per-side laser disc can do, with very little stylus and disc wear. Signal-to-noise ratios are much the same for Magnavox, RCA, and G.E./Matsushita at modulator outputs. There are, however, baseband ports for both audio and video in the G.E./Matsushita equipment that can reduce apparent noise through a more direct signal path. Stereo sound and bilingual channel reproduction are excellent, while picture quality probably comes very close to the 3.1-MHz design standard. Color rendition is exceptional for a player of this type.

—*Stan Prentiss.*

GENERAL ELECTRIC MODEL 1VHD3042W VIDEO DISC LABORATORY DATA

Parameter	Measurement
Designed luminance bandwidth:	3.1 MHz
Designed audio bandwidth:	20 kHz, confirmed
Video S/N:	42 dB, confirmed
Audio S/N:	60 dB claimed, 25 dB confirmed
Power drain:	30 W, confirmed
Acceptable power supply variation:	105-130 V ac, confirmed
Dimensions:	18.1″W × 15.8″D × 5.1″H
Weight (est.):	28.5 lb

NOTE: Instruments used in these measurements are: Tektronix 7L12 spectrum analyzer; Sencore PR57 variable power supply; Tektronix C-5A and Minolta XD-11 cameras.

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Audio Product of the Month

CHOSEN BY THE EDITORS OF POPULAR ELECTRONICS

KEF Electronics Model 303.2 Speaker System

THE lowest-priced speaker system in the KEF line, Model 303.2, has an 8-inch woofer operating in a sealed enclosure and a 1-inch soft-dome tweeter. Although it is the size and shape of a typical small "book-shelf" system, for best results the 303.2 should be located a few feet from any walls and from one to three feet above the floor. An optional stand is available for floor mounting.

The KEF 303.2 is 20⅝" H × 10½" W × 9" D and weighs 18 pounds. It is normally supplied with black molded plastic end caps and a black grille cloth; optionally, it can be purchased with brown ends. User-replaceable grille cloths are available in beige, blue, red, green, or grey. The optional stands, ULS40, are steel tubes based on a 13" diameter steel disc, supporting the speaker 12" above the floor. The stand is also available in brown to match the speaker. Model 303.2 sells for $450 per pair and is not available as single units. The ULS40 stands are $85 per pair.

General Description. In part, the moderate price of the 303.2 is possible because its enclosure is constructed of unfinished particle board. This is then covered on four sides by a colored "stretch cloth" sleeve and capped at both ends by molded plastic pieces. The system has no user-adjustable level or balance controls, and its insulated spring-loaded connectors are recessed into the lower rear edge. The speaker can be placed in the open without presenting an unfinished appearance from any point of view.

Sensitivity is relatively high for a sealed system, with a rating of 88-dB sound pressure level at a 1-meter distance for a 1-watt input of pink noise. Amplifiers rated at from 10 to 50 watts output into 8-ohm loads are acceptable as driving sources.

(Continued overleaf)

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(continued from previous page)

The woofer system resonates at 68 Hz with a Q of 0.7. In the horizontal plane, the output is guaranteed to be within ±2 dB of the axial response over a ±20-degree angle, up to 10,000 Hz. Vertically, in a ±5-degree angle the output is within ±2 dB of the axial response up to 20,000 Hz. The rated axial response, at a 2-meter distance, is 70 to 20,000 Hz ±3 dB (down 10 dB at 50 and 25,000 Hz).

Although the 303.2 does not have the elaborate electronic protection system featured in the costlier KEF Reference Series speakers, it can withstand an input of up to 20 volts RMS from 20 to 2,000 Hz, and to 10 volts rms between 2,500 and 20,000 Hz.

Laboratory Measurements. Close-miked woofer response of the KEF 303.2 was uniform within ±2 dB from 70 to 1,000 Hz. The averaged output from the left and right speakers, measured in the reverberant field of the room at a 10-to-15-foot distance from the speakers, was corrected for the known absorption characteristics of the room. The result was an extremely flat response at the highest frequencies (only 1 dB overall variation from 4,000 to 20,000 Hz) with only slight variations in output through the lower midrange. Splicing this curve to the woofer curve yielded a composite frequency response within ±2.5 dB from 65 to 20,000 Hz. High frequency dispersion was good, as shown by the moderate divergence in response at positions on- and off-axis.

Woofer distortion was measured with close microphone spacing at inputs of 1 watt and 10 watts (based on the rated 8-ohm impedance). At 1 watt, distortion was about 0.2% at 100 Hz, increasing to 0.8% at 70 Hz and 5% at 40 Hz. At a 10-watt input the distortion was about 0.7% at the upper bass frequencies and still less than 10% at 40 Hz. Sensitivity was exactly as rated, with a measured SPL of 88 dB at 1 meter when the speaker was driven by 2.83 volts of pink noise in an octave bandwidth centered at 1,000 Hz.

The impedance minimum was about 6 ohms at 20 Hz and between 10,000 and 15,000 Hz. Maxima were 25 ohms at 73 Hz and 50 ohms at 1,600 Hz. Over most of the audio range the impedance was between 8 and 10 ohms, justifying the 8-ohm rating.

User Comment. On a variety of program material, the KEF 303.2 demonstrated its musical and eminently listenable quality with no irritating distortions or colorations. Although the low-frequency output is limited by design and size, the speaker never lacked bass. On the contrary, it often showed a comfortably "warm" quality, probably associated with the slightly elevated output (by 2 or 3 dB) between 80 and 200 Hz.

We installed the speakers on their stands about two or three feet from any walls. Imaging was excellent, and there was no tendency to focus on the speakers themselves as sound sources. Instead, a unified sonic panorama formed across the end of the room, behind the plane of the speakers.

The 303.2 presented an attractive appearance, and the choice of colors for the grille, top and bottom plates, and stands provides numerous possibilities for making the speaker visually harmonious with its surroundings. We tried changing the grille cloths to see if it was as easy as claimed. It was, requiring only a screwdriver and a few minutes.

On the whole, the KEF 303.2 is a neatly engineered package and reasonably priced. It costs more than most "budget" speakers, but its standard of performance is appreciably higher.

—Julian D. Hirsch

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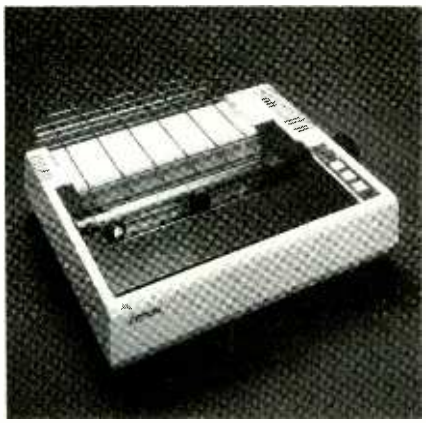

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Popular Electronics
AUGUST 1981

Word Processing

Has computer technology made the ordinary typewriter as obsolete as the quill pen?

BY LOREN WERNER

WHAT'S faster than a speeding typewriter, corrects errors in a single keystroke and produces unlimited original letters without manual intervention? Answer: a word processor.

Word processors, as the name suggests, are computer systems and/or programs that assist in the generation and handling of written text. They help achieve high levels of productivity because they allow easy, efficient editing and formatting of text. Tasks that would be very time-consuming using conventional typewriters are sped up and additional capabilities far exceeding those of the standard typewriter are offered.

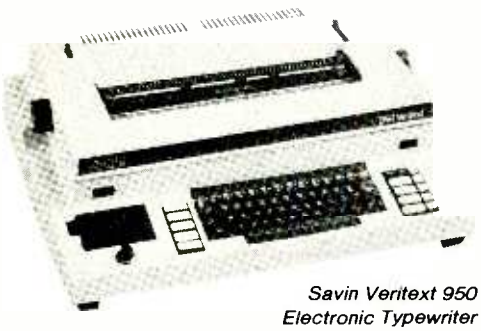
Error correction is one example of this. Usually a correction is as quick and simple as backspacing over the incorrect characters. And because nothing is printed until the user is satisfied that a document is correct, there is a saving of paper and avoidance of erasures.

Another powerful word-processing capability is inserting new material into existing text. With a typewriter, this means extensive retyping. Using a word processor, material is inserted into existing text without retyping of old material. The user indicates where the new material is to be inserted, and then types it. The word processor automatically adds this material and reformats the text as necessary.

Also valuable is the word processor's ability to rearrange text. In conjunction with the insertion facility, it is possible to move sentences or whole paragraphs from one place in the text to another.

Word processors have a number of features to facilitate text formation. These include justification, pagination, and special type faces, as well as automatic centering and margin setting. One special printing feature available on some word-processing systems is proportional spacing—which makes finished text appear as if it were typeset and printed. This is useful to businesses producing manuals and other documents.

Efficient mass mailing is a benefit that a word processor can provide to a business user. In this application, both the mailing list and the form letter are stored in the processor. These are then merged—that is, the form letter is retyped once for each entry on the mailing list, giving every letter a unique heading. The processor can also print the addresses on all of the envelopes.



Savin Veritext 950 Electronic Typewriter

How They Work. Basically, word processors are of three types. The one whose appearance most closely resembles the familiar typewriter is called the electronic typewriter. Machines of this type, made by Savin, Adler-Royal and IBM, among others, look like typewriters, but are larger. On electronic typewriters the normal keyboard is augmented by a number of special keys allowing one to perform functions such as DELETE, INSERT, FIND, and STORE. These units usually have a built-in high-speed printing system instead of the usual typewriter mechanism.

Electronic typewriters use computer memory elements to store text. Some machines have enough memory to hold one or two pages of text, while others can store up to 50 pages. Electronic typewriters increase efficiency by performing in the memory all revisions, deletions, insertions, and other changes. Text is printed when in finished form.

Besides memory, electronic typewriters also use computer-type mass storage devices. These allow one to store the contents of the memory on permanent removable media. Thus, a user can keep a library of documents on file. The documents can be read back into the electronic typewriter from the mass storage devices at any time to make more copies or further revise the documents.

Some electronic typewriters, like the one available from Savin, use a magnetic tape cartridge—very similar to a cassette tape—for mass storage. Other units, like the one from Adler-Royal, use floppy disks.

Word processing on an electronic

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typewriter has the advantage of being easy to learn. Because the design and keyboard layout are similar to a standard typewriter, most operators find it easy to adjust to an electronic one. Since each major word-processing function is performed by pressing one of the clearly-marked buttons on the keyboard, using it for word processing is easy. Electronic typewriters are also relatively compact and easy to move.

One disadvantage, however, is that their input and output are printed directly onto the paper. This means the machine must retype a whole document when you want to see the changes you have made. This is time-consuming, even with a high-speed printer.

Some word processors avoid the problem of retyping by using a video monitor instead of paper to develop and correct documents. There are two such types—dedicated word processors that, like electronic typewriters, perform only functions associated with word processing; and small business and personal computers that perform many general computing functions in addition to word processing. The first word processor to use a video monitor was a dedicated word processor developed by Lexitron, called a videotyper.

When text is entered through the keyboard into memory, it appears on the monitor, and changes in the text appear as soon as they are made. Since most video monitors display a full page of text at a time, it is possible to see fairly extensive changes—such as the moving of whole paragraphs—immediately.

Like electronic typewriters, dedicated word processors use computer technology. A microprocessor controls all important functions, memory is used for storing text, and mass storage devices are used to create permanent, removable records. Dedicated word-processing units are generally larger than electronic typewriters and have a separate printer.

Because they are designed for use in business environments with high work volumes, dedicated word processors incorporate a number of features that help to increase throughput. Many systems, for example, allow the operator to type in a new document while a completed document is being printed.

Manufacturers of dedicated word processors also strive to enhance productivity by making their systems easy to use with a minimum of training. Thus, like electronic typewriters, most dedicated word processors have additional keys to perform those functions that are used most frequently. Operators are assisted by prompts on the video monitor that ask what the user wants, and tell what commands are necessary to accomplish the task.

DIRECTORY OF SOFTWARE VENDORS

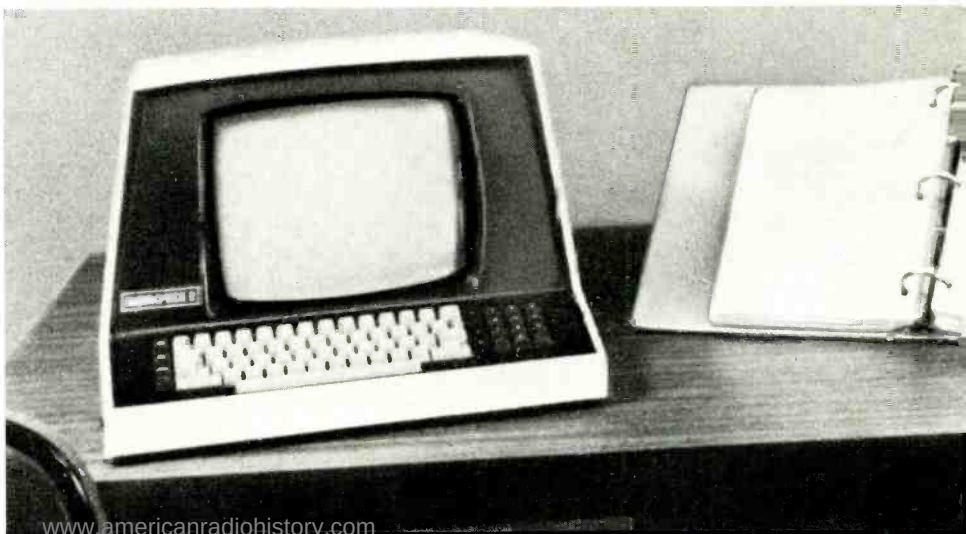
Vendor & Address	Product	Target Computers
Apple Computer, Inc. 10260 Bandley Dr. Cupertino, CA 95014	Apple Writer	Apple Computers
Atari Inc. 1265 Borregas Ave. Sunnyvale, CA 94086	Atari Word Processor	Atari 800 with disk
Commodore Business Machines, Inc. 950 Rittenhouse Road Norristown, PA 19401	WordPro 1 WordPro 2 WordPro 3	Pet Computer
Cal Data Systems Box 178446 San Diego, CA 92117	Word Magic	TRS-80
Cromemco, Inc. 280 Bernardo Ave. Mountain View, CA 94040	Cromemco Word Processing System	Cromemco Computers
Digital Research Box 579 Pacific Grove, CA 93950	TEX	Any with CP/M
Digital Marketing 2670 Cherry Lane Walnut Creek, CA 94596	Copywriter	Any with CP/M
Interactive Microware, Inc. 116 S. Pugh St. State College, PA 16801	Pro-Type	North Star
Michael Shrayer Software 1198 Los Robles Dr. Palm Springs, CA 92262	Electric Pencil Electric Pencil II	Any with CP/M
MicroPro International 1299 4th St. San Raphael, CA 94901	WordStar, WordMaster	Any with CP/M

Advantages of dedicated word-processing systems are efficiency, capacity for very high throughput, and ease of use. The disadvantages are a relatively high price and little or no general computing capability.

Many businesses that require both word-processing and general-computing capability find the most cost-effective solution in a general-purpose business computer that provides word processing through software. This is also an economical solution for owners of personal computers who want word processing. The necessary software is available for most popular personal and small business computers, including Apple, Pet, Heath, TRS-80, and Vector Graphic, among others.

When you develop a word processor

Vector Memorite Small Business System



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MicroSource 1425 W. 12th Pl. Tempe, AZ 85281	AutoScribe	North Star Computers.
Muse 330 N. Charles St. Baltimore, MD 21201	Super-Text	Apple II and Apple II Plus
North Star Computers 1440 Fourth St. Berkeley, CA 94710	North Word	North Star
Ohio Scientific Inc. 1333 S. Chillicothe Rd. Aurora, OH 44202	WP-3	OSI Systems
Radio Shack 1400 One Tandy Center Ft. Worth, TX 76102	ScripSit	TRS-80
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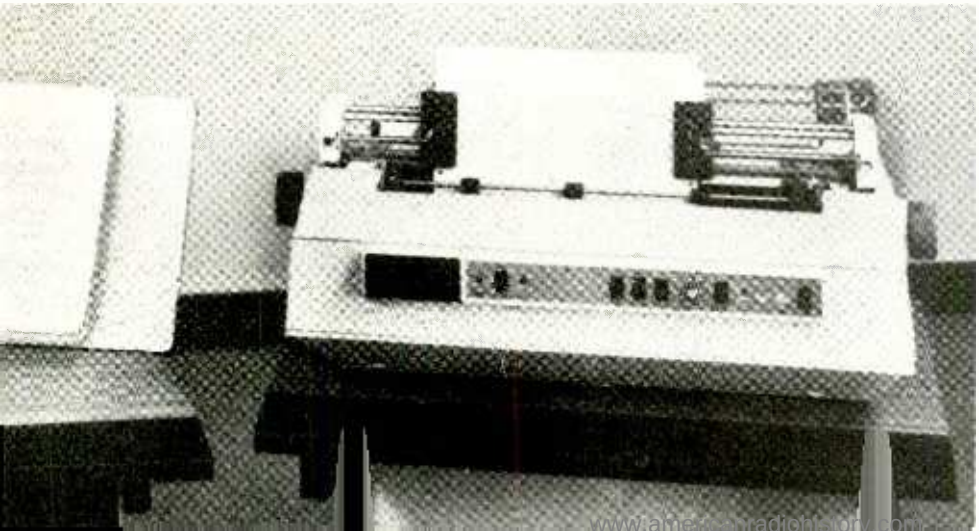
Small Business Applications 3220 Louisiana St. Suite 210 Houston, TX 77006	Magic Wand	CP/M compatible
Software Dynamics 2111 W. Crescent, Suite 9 Anaheim, CA 92801	Edit	Any based on 6800 series processors
Supersoft Assoc. Box 1628 Champaign, IL 61820	Super-M-List	CP/M compatible
Vector Graphics, Inc. 31364 Via Colinas Westlake Village, CA 91362	Memorite III	Vector Graphic computers
Zenith Data Systems Corporation 1000 Milwaukee Ave. Glenville, IL 60026	AutoScribe	Heath computers

using a general-purpose computer and commercial software, there arise a number of hardware and software considerations to examine in detail. Instead of leaving the design up to the manufacturer, as you do when buying a dedicated system or electronic typewriter, you must now decide how much memory and mass storage to include, what printer to use, and what software package provides the capabilities that most closely meet your needs.

Configuring the Hardware. In general, most small business and personal computer systems have the same basic hardware components. And most use the same type of video monitor for operator interaction. All can interface with various types of printers.



One important decision that must be made is how much memory the computer will have. For word processing, each byte of memory can store one character; and most personal and small business computers have memory capacities in the range of 4,096 (4K) to 65,536 (64K) bytes. The best results invariably come from having as much memory as you can afford.

While some systems, like the Pet and TRS-80, will function as word processors with as little as 16K of memory, most word-processing software requires a minimum of 48K, and 64K is even better if your machine will accept it.

There are several reasons for this. First, the computer's memory must hold not only the document you are typing in, but also the word-processing software and the computer's operating system. If a document is too long to fit into the computer's memory, parts of it must be saved on a mass-storage device, which slows operation considerably. Second, the large memory will increase efficiency of other computing tasks as well.

Mass storage is another important hardware feature. Most computer manufacturers offer a number of choices for mass storage, including data cartridges, standard cassette tapes, floppy disk drives, minifloppy disk drives and Winchester hard disk drives. The storage capacity, speed, and price of these devices varies greatly, and your choice will depend on your own requirements.

Data cartridges and cassettes are called serial storage devices. (This means data is written on and read from these devices sequentially.) Their main advantage is low cost. A principal disadvantage is slowness: if the data you need is at the end of a cassette you may have to rewind a large amount of tape to access that data.

There are also several types of disk storage devices available for computer-based systems. They cost more than cassettes, but provide random access to data anywhere on the disk surface. This helps to enhance overall system speed for both word processing and general computing.

Among the several types of disk storage devices are floppy and minifloppy disks—8″ and 5¼″ in diameter, respectively. Storage capacity varies from about 90K bytes for the minifloppy to about 1 million bytes for the 8″ disk. Since several disk drives can be used, it is possible to include several million bytes of mass storage in a single system.

Winchester hard disks are another type of rotating, random-access storage device. Unlike floppies, they are not removable. They do, however, offer very high storage volumes (from 5 million to about 35 million bytes) and very fast

data access. Available in 5¼", 8", and 14" diameters, their capabilities can greatly enhance overall system response. For most word processing, however, they represent costly overkill.

One of the most critical hardware components is the printer. There are two basic types used with small computer systems. In one, the dot matrix printer, characters are formed with a pattern of dots. The most common grid size for each character is 7 by 9 dots. Dot matrix printing speeds range from about 120 characters per second (cps) to about 200 cps. Costs range from about $500 to $1200.

The other type of printer common to small business systems is called a formed-character printer. Like a typewriter, it works by striking type against a ribbon. Formed-character printers are slower than dot matrix printers, usually printing between 25 cps and 55 cps. Prices for them are generally higher than for dot matrix printers, ranging from about $1800 to $3500. Their print quality, however, is superior.

Print quality in dot matrix printers is far below that of the standard office typewriter. A dot matrix printer is adequate for rough drafts, but it simply cannot produce the letter quality required for business. Formed-character printers not only provide letter quality printing, but also allow very precise control of the printing function. In many formed-character printers, the computer can move the print head in increments as fine as 1/120 of an inch horizontally and 1/48 inch vertically. This allows a system to do subscripting, superscripting, and to produce boldface printing by overstriking characters with very slight shifting of the print position. One can also perform proportional spacing of characters—giving finished documents the look of typeset printing.

For the comfort and convenience of operating personnel, the keyboard is a hardware component worth considering. Each computer manufacturer usually offers only one keyboard, and each has its own distinct feel. System efficiency depends, to a point, on operators being comfortable with the keyboard.

Choosing Software. The most crucial decision in word processing is selection of a software package. A wide variety is available from computer manufacturers and independent software sources. Word-processing packages range from relatively simple programs with only the basic functions, to more extensive packages rife with special features and capabilities.

Most makers of personal and small business computers offer word-processing packages. Apple's, for example, is called Apple Writer; Commodore has three packages called WordPros 1, 2, and 3; Heath sells the AutoScribe package under license from Zenith Data Systems Corporation; Radio Shack's TRS-80 uses a package called ScripSit; and Vector Graphic offers very comphrehensive software called Memorite III.

As indicated by the Table such packages are also available from numerous independent vendors.

When comparing word-processing software it is important to remember that any given package may perform differently on different computers. One that gives fast response on a computer with 64K of memory may run much more slowly on a computer with only 48K of memory. Likewise, a package that must make extensive use of mass storage will probably run much faster when used with a system that contains a Winchester hard disk than on a system that uses floppy disks.

Beyond Word Processing. The leading edge of word-processing technology seems to be evolving toward a new generation of software and hardware. Already, sophisticated software packages offer enhancements that extend the power of word processors. Vector Graphic's Memorite III, for example, is compatible with a computer-based dictionary that checks text for spelling at a rate of about 1,000 words per minute. The spelling-verification program reads files created by Memorite III, comparing text to a dictionary of the 30,000 most commonly-used words, plus 5,000 "spelling demons." Further, one can augment the main dictionary with custom dictionaries that recognize special words and proper names. MicroPro International reports that its word-processing package, WordStar, will soon include a spelling verification system.

Advances in software technology extend far beyond spelling verification and computer-aided instruction. As business embraces the evolving office of the future, word-processing software is continually developing to meet the challenge of integrating word processing and data processing. MicroPro, for example, offers a system of compatible software packages that perform data acquisition, data manipulation, word processing, and automated personalized mailing. Vector Graphic also offers combined word- and data-processing capability. The Memorite III software is compatible with Vector Graphic's EXECUPLAN software that allows one to perform statistical calculations, format formulas, and develop tables and charts. The files created by EXECUPLAN can be read by Memorite III, permitting their automatic merger into coherent documents.

As word processing and data processing begin to overlap, communication between word-and data-processing hardware becomes important. Many word-processing vendors are paying close attention to these requirements. Vendors are offering standard asynchronous, synchronous, and bisynchronous communications interfaces. Some vendors offer compatibility with communications networks. Lexitron's word processors, for example, can communicate on Raytheon's Raynet. Many vendors are now studying the requirements for Ethernet and other communication networks under development.

What is the potential for increased productivity and greater efficiency through integrated office systems? Vector Graphic Board Chairman Bob Harp sums it up: "Future word-processing systems will be clustered, able to share a central data base or function standalone. In a large installation with multiple systems sharing one or more common data bases, a secretary might develop a document on a word-processing system and send a message to her supervisor's video monitor saying the document is available for proofreading. The supervisor could then proofread and edit the document on the video monitor and send the edited document to the central processing unit for printing. The entire process could be conducted without using a single piece of paper until the final document is printed." ◇

Lexitron VT 1303 Word Processing System

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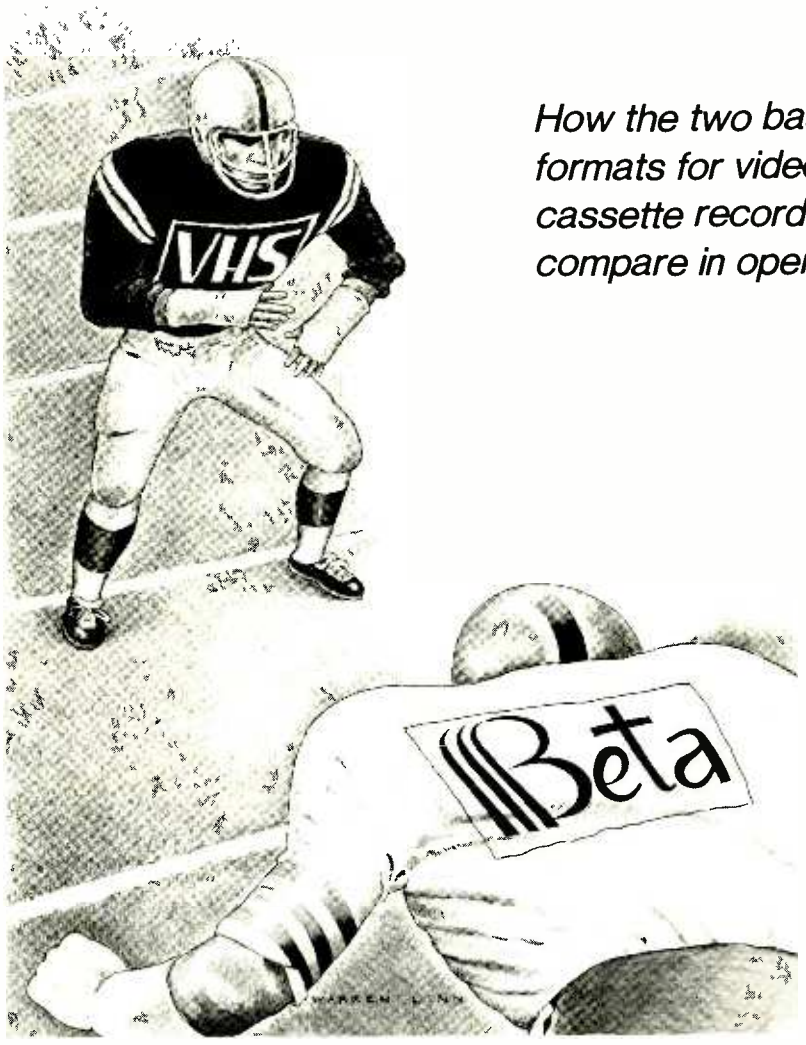
BY STAN PRENTISS

VHS MEETS BETA



How the two basic formats for video cassette recorders compare in operation

AS IS well known by now, there are two major competing VCR systems on the market today. The Zenith VR9750J Beta and the Panasonic PV-1750 VHS are representative of the newest versions of each. While the two formats are similar in many respects, VHS and Beta are different enough to be mutually incompatible.

Both systems use a rapidly rotating head cylinder to helically scan a slow-moving magnetic tape, and both offer a similar array of ancillary features—e.g., remote control, a 14-day clock timer, frame advance, etc. Their electronic underpinnings are also similar in that both change the AM of a normal television signal to FM when a program is recorded. The color signal is down-converted to 629 kHz for VHS and 688 kHz for the Beta so that the 18-octave, video frequency range (30 Hz to 4 MHz) can be relocated between 2 and 6 MHz, where it represents less than 2 octaves. Audio remains standard FM. Tapes are half-inch, and the azimuth of the record/play heads is tilted to minimize adjacent track pickup. Servo sync controls and direct-drive motors for capstan and head drives are still used. In both of the models tested, tuners are of the voltage-controlled varactor type with pushbutton controls.

Both machines are similar in overall complexity, so service costs will no doubt be comparable. Users should not be surprised to pay about $150/ year for service—heavy users, perhaps more. Those who try getting by with some of the "easy" trick head cleaners just coming onto the market could face $200 charges for new head assemblies. If you attempt to clean these recording/playback heads yourself, use only materials specifically recommended by the manufacturer. There's no reliable shortcut!

In both systems there is an approximately 3-dB signal loss between input and output, and another 1 to 5 dB loss across any 75-ohm vhf couplers and u/v signal splitters in the signal path. Those in areas of poor reception could have a problem. Thus, their equipment works best direct-coupled to an antenna.

Perhaps the most obvious difference between the two formats is the tape-transport mechanism. The VHS tape is wrapped only halfway around the head cylinder, and is completely removed from head contact when the tape is

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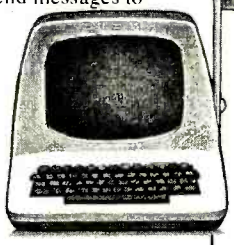

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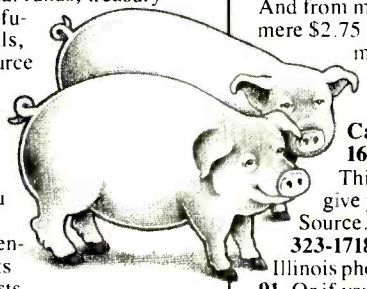

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stopped. Beta uses a 360° full-head wrap which is in constant contact with the head cylinder. Tape wear for both systems, however, is about the same.

Cassette sizes are also different. VHS is slightly larger and holds more tape. Thus, the maximum playing time for VHS is six hours, compared to five hours for the Beta format.

Zenith/Betamax. The Zenith VR 9750J player/recorder has a number of features in common with last year's VR9700. These include "feather touch" external 14-channel tuning control; five hour maximum recording and playback during manual or programmed operation; speed-search forward and reverse at 7x for Beta II and 10x for Beta III; still picture in the stop (or pause) mode, with automatic release after five minutes to prevent undue tape or head wear; improved audio bandwidth; and a remote control for the tape transport.

The VR9750J, however, has additional features. Instead of two recording heads, it has three. As in the VR9700, the two prime heads are spaced 180 degrees apart and positioned at +7° and −7° azimuth. The third head is next to one of the other two, but with reversed azimuth. It is used only in stop action and slow motion. This arrangement makes possible dual scanning of a single field to make a two-field frame. This reduces extraneous movement. VHS, in contrast, scans both fields, allowing motion in the stop action frame.

Also, Zenith claims there is less noise in the new Beta machines. Since the heads are 27 micrometers wide and the tracks measure only 19 micrometers, there is sufficient overlap to cover the entire track without loss of picture. Further, the new model has additional integrated circuits for slow-motion control, as well as more delay lines.There are comb filters for both chroma and luminance, which should further clean up any color-video crosstalk and, theoretically, widen the luminance passband. Head life, we are told, should be at least 2,000 hours, even with heavy use, and some heads are known to have lasted as long as 8,000 hours. An external thumbwheel potentiometer is now included to augment two internal adjustments: one for Beta II and the other for Beta III. Identified as the BRIGHTNESS BALANCE control, it is used only in the stop-field mode to minimize picture flicker. Zenith recommends setting up for minimum flicker in the display's center, rather than along the edges.

There is also a vertical sync lock control directly above the 75 - ohm video output on the unit's rear terminal board. During still mode, frame advance and slow motion, an internally generated vertical drive pulse appears with the video signal. This sync control adjusts the phase of the pulse to prevent the picture from rolling or flipping when there is noise in the vertical interval.

Two additional features are worth noting: slow motion tracking and automatic tape rewind. Normal tracking controls the phase (and therefore rpm) of the capstan motor in Beta II. Since capstan speed is 50 percent slower in Beta III, a separate thumbwheel control

LABORATORY DATA
PANASONIC PV-1750

Parameter	Measurement
SP baseband (monitor) playback response:	3.5 MHz
SLP baseband (monitor) playback response:	3 MHz
SP TV playback through modulator:	3.5 MHz
SLP TV playback through modulator:	3 MHz
SP/SLP TV chroma response through modulator:	4.08 MHz/6 dB down
Tuner/system input sensitivity (before snow):	vhf: −4.5 dBmV uhf: −0.5 dBmV
S/N at modulator output (Ch. 3):	SP: video: 49 dB SLP: video: 45 dB
S/N at modulator output (Ch. 3):	SP: audio: 30 dB SLP: audio: 28 dB
System signal loss, input to output: (Ch. 3 is recorder output)	vhf (Ch.6) in: −4.5 dBmV (Ch.6) out: −10 dBmV vhf (Ch. 6) in: −4.5 dBmV (Ch. 3) out: −9 dBmV uhf (Ch. 30) in: −0.5 dBmV (Ch. 30) out: −11.5 dBmV uhf (Ch. 30) in: −0.5 dBmV (Ch. 3) out: −9 dBmV
Wow/flutter:	Not discernible
Audio via TV receiver speaker and modulator (ballpark, but not a precise measurement at 3 dB down):	SP: 200 Hz to 3.5 kHz SLP: 300 Hz to 3 kHz
Power requirement (ac varied from 105 to 130 V):	62 W

LABORATORY DATA
ZENITH VR9750J

Parameter	Measurement
Beta II, III baseband (monitor) playback response:	3 MHz/10 dB down
Beta II, III TV playback through modulator:	3 MHz/10 dB down
Beta II, III baseband (monitor) chroma response in playback:	4.08 MHz/3 dB down
Beta II, III TV chroma response through modulator:	4.08 MHz/6 dB down
Tuner/system input sensitivity (before snow):	vhf: −6 dBmV uhf: −3 dBmV
S/N at modulator output (Ch.3):	Video: 49 dB Audio: 36 dB
System signal loss input to output:	vhf (Ch. 6) in: −6 dBmV (Ch. 6) out : −10.5 dBmV vhf (Ch. 6) in: −6 dBmV (Ch. 3) out: −8.5 dBmV uhf (Ch. 30) in: −3 dBmV (Ch. 30) out: −13 dBmV uhf (Ch. 30) in: −3 dBmV (Ch. 3) out: −8.5 dBmV
Wow/flutter:	Not discernible
Audio via TV receiver speaker and modulator (ballpark, but not a precise measurement for both Beta II and III at 3 dB down):	200 Hz to 3.9 kHz
Power requirement (ac varied from 105 to 130 V):	55 W

Zenith VR9750J Beta

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MANUFACTURER'S SPECIFICATIONS PANASONIC PV-1750

Recording system: Two heads record; four heads playback; one pair for SP; one pair for LP/SLP
Programmed timer: Microprocessor controlled for 14-day, 8-program timer, including one daily repeat
S/N for video: >40 dB
S/N for audio: >40 dB (avg.)
Video/baseband input: 1 V/75 Ω
Audio input: RCA type: 100 kΩ; −20 dB
Microphone jack: 4 kΩ, −70 dB
Video output: RCA type: 1 V/75 Ω
Audio output: RCA type: −6 dB, 600 Ω
Tape speed: SP: 3.335 cm/s
LP: 1.667 cm/s
SLP: 1.112 cm/s
Play time: Up to 6 hours with NV-T120 cassette
Speed search: 9 times normal speed
Audio frequency response:
SP: 100 to 8000 Hz
LP: 100 to 6000 Hz
SLP: 150 to 5000 Hz (10 dB down)
Dimensions: 18 15/16"W x 6 3/8"H x 14 5/8"D
Power requirement: 62 W
Weight: 33 lb

MANUFACTURER'S SPECIFICATIONS ZENITH VR9750J

Recording system: Two heads record; three heads playback; for stop mode and slow motion
Programmed timer: Microprocessor controlled for 4 separate programs daily over 14 days, plus daily or weekly repeats.
S/N for video: >45 dB
S/N for audio: >40 dB
Video/baseband input: +1 V to −0.5 V/75 Ω sync negative
Audio input: Mini jack: 100 kΩ; −10 dB
Microphone: 600 Ω, −60 dB
Video output: 1 V/75 Ω sync. negative
Audio output: <10 kΩ; −5 dB
Tape speed: Beta II: 2 cm/s
Beta III: 1.33 cm/s
Play time: Up to 5 hours with L830 cassette
Speed search: 7 times normal speed in Beta II 10 times normal speed in Beta III
Audio frequency response:
Beta II: 50 to 10,000 Hz
Beta III: 50 to 7000 Hz
Dimensions: 19 1/2"W x 7 1/2"H x 15 1/4"D
Power requirement: 60 W
Weight: 36.5 lb

has been added so that the tape will be scanned correctly in playback, without unnecessary noise and streaking.

In play, fast forward, or record, the VR9750J offers an automatic rewind when the cassette tape is exhausted. A sensor detects the metal leader at the tape's end and activates a solenoid. After 5 seconds, the tape starts rewinding.

The PV-1750 VHS Panasonic. This is the newest and most elaborate Matsushita cassette product available. Like its competitors, this machine builds upon older technology. It is a four-head programmable VCR that plays for 2, 4, or 6 hours. Visual cue and revue are accomplished at 9x normal speed, and there is variable slow motion, double speed, and still (stop) frame with picture and frame by frame advance. According to Panasonic, it will record seven mixed programs per day and another one per week during a 14-day period. It has "soft touch" control and direct drive for the head cylinder, capstan and two additional heads.

The PV-1750 automatically unloads when it is in the pause mode for five minutes. At reel's end, the machine will automatically rewind its tape. The one-hour timer has memory, and backup in case of power failure. Head widths are 70 and 90 micrometers for standard play (SP), and 26 and 31 micrometers for long play (LP) and super long (SLP). The usual input and output video and audio connections are provided.

Remote control is considerably more extensive than in the Beta format, comprising CHANNEL, CHANGE, REWIND, STOP, RECORD/PLAY, PAUSE, DOUBLE SPEED (x2), and FRAME ADVANCE, in addition to SEARCH and SLOW/FAST speed-variable control. The counter and memory are much the same as Zenith's, and the usual audio dub is available in both machines. There is also a "dew" light to warn of excess moisture or temporary equipment lockup.

Panasonic PV-1750 VHS

Analysis. Our favorite technique for evaluating the performance of a VCR is to put multiburst and swept chroma through its baseband camera input and monitor the output. We also monitored the r-f modulators that feed the TV antenna terminals. Conventionally, the test signals come from NTSC video generators, which are supposed to produce more exotic and precise waveforms than their sidelock counterparts, but, in this instance, we found the swept multiburst and chroma functions to be more suitable since they easily cover most of the luminance, linearity response and chroma between 0.75 and 4.08 MHz. In the displays that follow, the top trace is always the reference. The lower traces are actual baseband and r-f responses —the latter being processed through a high-quality Zenith television receiver with a 4-MHz video bandpass.

Figure 1 illustrates both staircase and multiburst between 0.75 and 3.5 MHz in the record mode of the Zenith/Beta equipment. You can see 3 MHz in the lower trace at about 6 dB down, while the staircase is reasonably linear with only minor overshoots. In Fig. 2, still during record, chroma passes nicely and there is good burst response on the back porch of the horizontal sync pulse.

In Beta II playback (Fig. 3), however, the 3-MHz baseband response drops sharply, and overshoots are even more pronounced. Beta III results (Fig. 4) are quite similar. Still in baseband, the Beta II waveform in chroma playback (Fig. 5) shows loss of amplitude in both the 3.08- and 4.08-MHz portions, and Fig. 6 for Beta III principally indicates additional noise riding on the chroma response. There is, of course, some amplitude modulation apparent on the chroma displays in both Fig. 5 and Fig. 6.

For most VCR users, Figs. 7 and 8 are, by far, the most important, since they are taken at a receiver's video detector. As you see in Fig. 7, there is only a faint suggestion of 3-MHz multiburst showing, followed by an odd rise in the wave form, and then both symmetrical preshoots and overshoots on the staircase (which, by the way, are actually designed into the receiver's i-f's for accentuated light-to-dark transitions). Throughout Fig. 8 there is additional fuzziness in the swept-chroma information, and the 4.08-MHz portion is well down in amplitude compared to what it should be.

In Fig. 9, you see the marvelous detail produced by our Tektronix 7L12 spectrum analyzer. At 300-kHz resolution,

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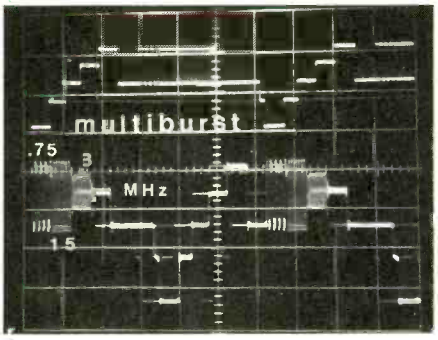

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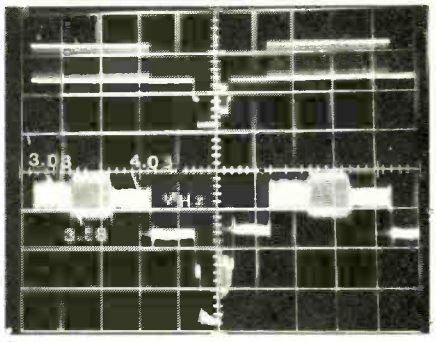

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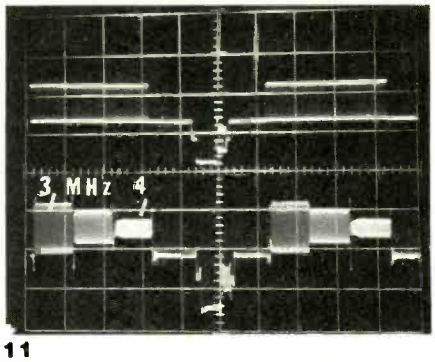

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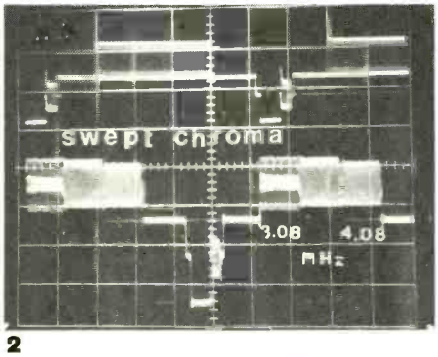

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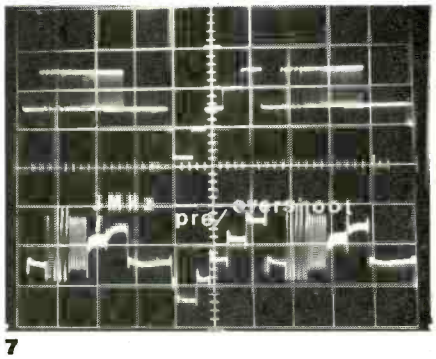

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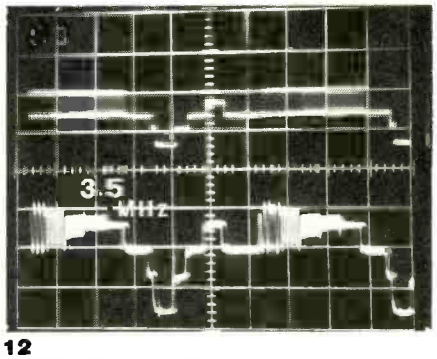

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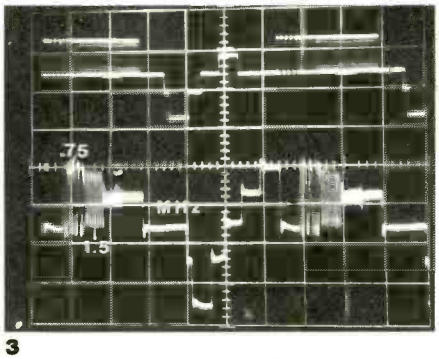

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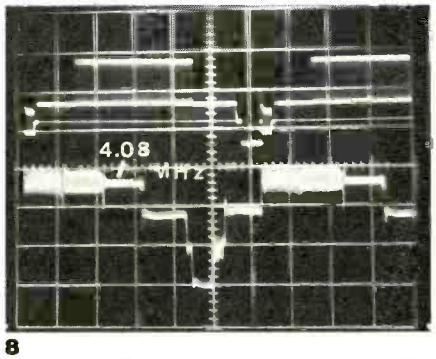

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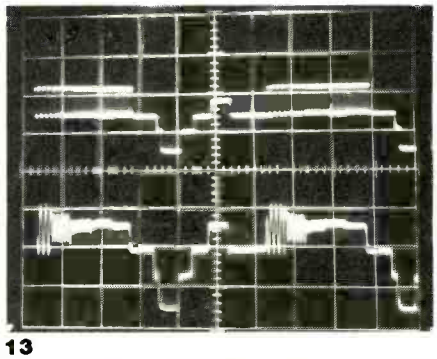
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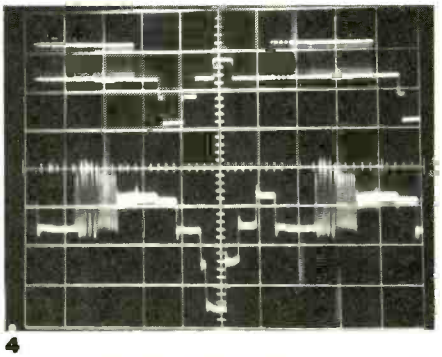
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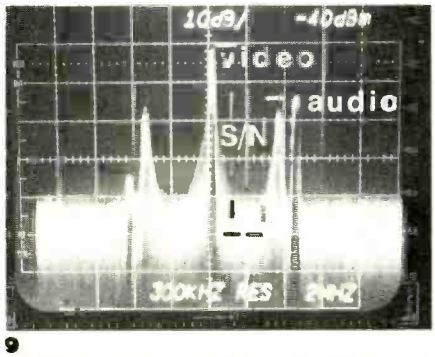

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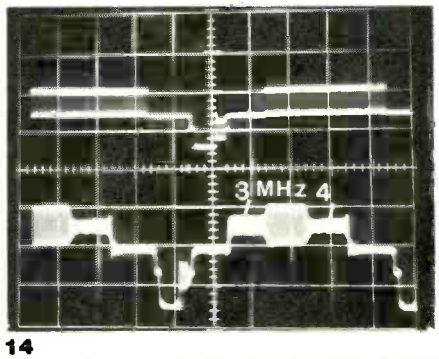

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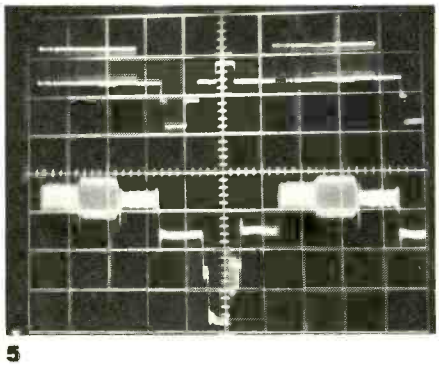
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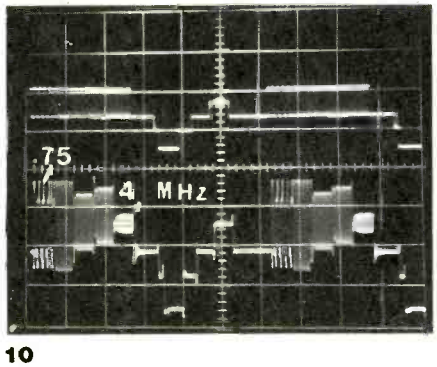

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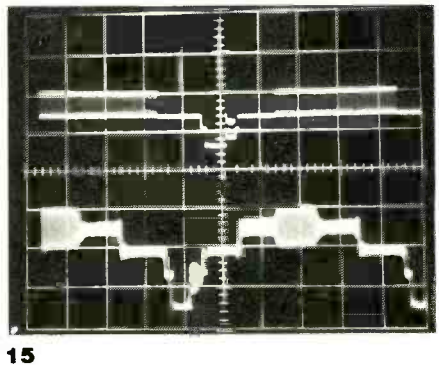
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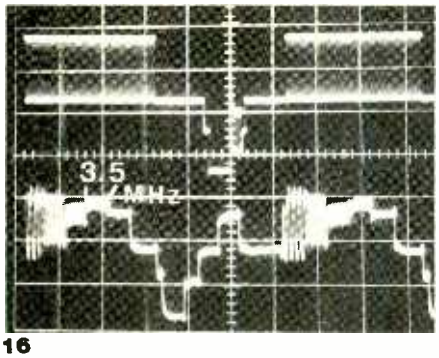

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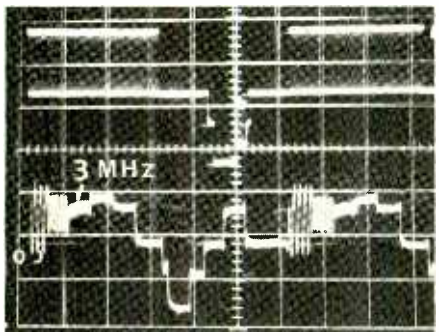

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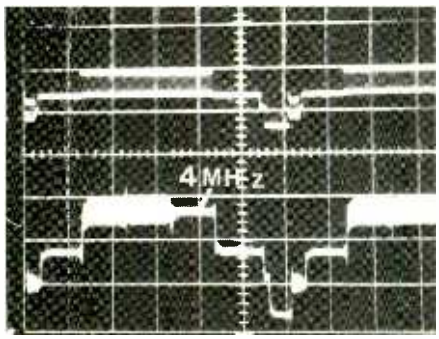

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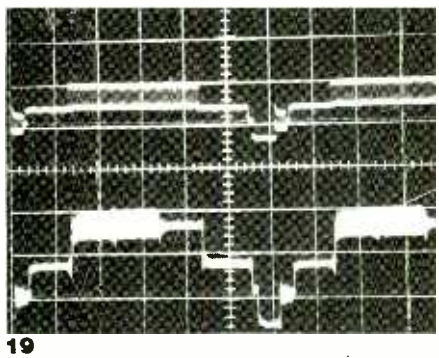

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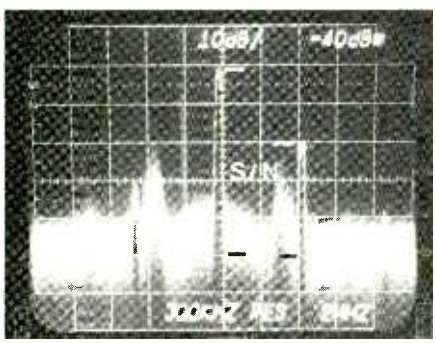

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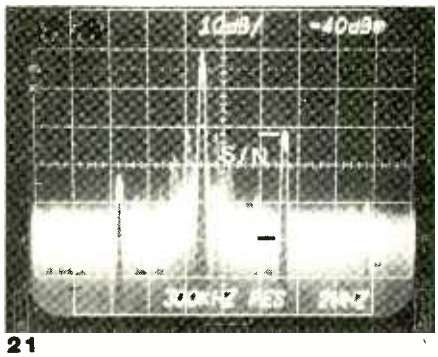

21

Figures 1 through 9 on the opposite page are performance characteristics for the Zenith/Beta system. Figure 1 is multiburst response during record; Fig. 2 still during record is swept chroma. Multiburst baseband response during playback for Beta II and Beta III are in Figs. 3 and 4; with similar chroma playback baseband in Fig. 5 (Beta II) and Fig. 6 (Beta III). Beta II/Beta III multiburst playback through the modulator is shown in Fig. 7 with swept chroma response in Fig. 8. Figure 9 is a spectrum analyzer display of the Beta's audio and video carriers at antenna terminals. Figures 10 through 21 are for the Pansonic PV-1750. Figures 10 and 11 are responses in luminance and chroma in record mode and SP. Baseband for SP and SLP are in Figs. 12 and 13, with swept chroma in Figs. 14 and 15. Figures 16 and 17 are responses through the r-f modulator for SP and SLP, while Figs. 18 and 19 are the same for swept chroma. Figures 20 and 21 are spectrum analyzer displays for the SP and SLP modes.

2-MHz per horizontal division and 10-dB per vertical division, and −40+(+5.72) dBm down, you see the video carrier and its two sidebands and the unmodulated audio carrier on the right. With the noise center as reference, the video carrier has a S/N ratio of 49 dB, while the audio carrier shows 36 dB.

The Panasonic PV-1750 waveforms, Figs. 10 through 16, precisely match those for Beta. However, since there are some additional differences between SP and SLP that require illustrating, the Panasonic group continues to Fig. 21.

Figures 10 and 11 show good responses in luminance and chroma out to 4 MHz with the player in record mode in the SP position. As you can see, most of these are exceptional. Figures 12 and 13 are SP and SLP, respectively, with 3.5 MHz plainly visible in SP, and only about 3 MHz in SLP at baseband via camera and video input/output. Figures 14 and 15 show relatively little difference in swept chroma, except that the 4.08 MHz seems to be down a bit more. In Figs. 16 and 17, responses through the r-f modulator into the TV receiver are exceptional for a VCR, as are the other parameters, including a slightly distorted (rounding) staircase. Figures 18 and 19 show swept chroma passing through the modulator, with the 4-MHz portion, well down, as is to be expected. Figures 20 and 21 are spectrum-analyzer displays for the SP and SLP modes. Observe that the S/N ratio is 49 dB for SP video and 30 dB for audio. In SLP, video drops to about 45 dB, and audio drops to 28 dB.

Conclusions. Both units represent an improvement over their respective predecessors. Images are more distinct, noise is reduced, control flexibility and range are enhanced, and record/play times are considerably longer than they were a few years ago.

But between the formats there are real differences. Beta has an audio S/N ratio about 5 or 6 dB better than VHS, and a frequency response extending to about 10 kHz. VHS, on the other hand, has a wider video bandpass, a video S/N ratio comparable with that of Beta, more program selections, and many more remote-control functions. VHS also plays an hour longer in extended play and has a lighted moisture (dew) sensor. Of course, if your receiver bandpass is too limited, the extra bandwidth of the Panasonic VHS player is of no practical consequence.

The absolute contest between the two systems would be a hookup with your own TV. Both units tested here are of superior quality. The decision as to which type of player is more suitable for you is yours alone. ◇

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BY THOMAS R. FOX

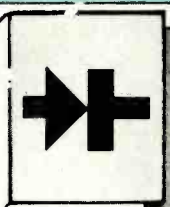
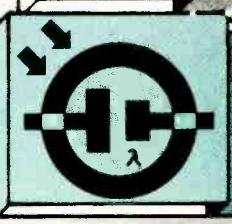
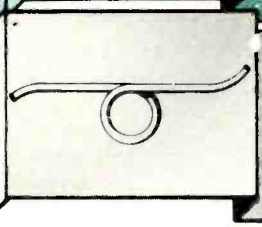
SOME LIKE IT HOT...

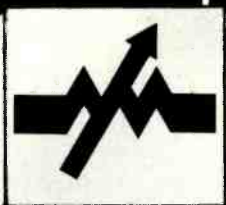
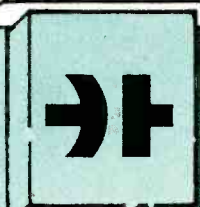
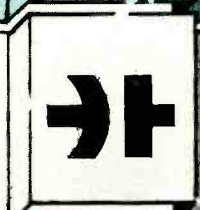
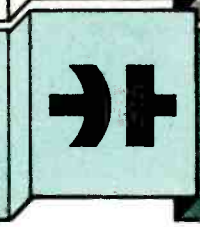
But which ones?
Test your knowledge of
how circuit components respond
to temperature.

SOME electronic components, especially semiconductors, are extremely sensitive to temperature changes. Even passive components (resistors and capacitors, for example), which are normally insensitive to temperature variations, can undergo parameter changes that are sometimes sufficient to influence circuit behavior.

Here is a quiz that will check your knowledge of how the parameters of some common electrical components (as well as a few rare ones) change with temperature. The quiz gives you the common name and electrical symbol or pictorial representation of the components and the parameters of interest under temperature change (resistance, voltage, etc.).

Your task is to answer the following questions about each component: (A) Does the parameter of interest increase or decrease as the component's temperature increases from 68°F (20°C) to 95°F (35°C)? (B) Is the component frequently used in temperature measuring, control, or compensation circuits? As an example, for component No. 1, the thermistor, the answers are: (A) Decrease; (B) Yes. Answers for the rest are on the third page of the quiz. If you get 35 correct answers out of the total 50, you have done very well indeed.

Component	Symbol	Parameter of interest
1 Thermistor		Resistance
2 Silicon diode		Forward voltage drop
3 Silicon photovoltaic cell (Solar cell)		Power output
4 Copper wire		Resistance

Component	Symbol	Parameter of interest
5 Platinum wire		Resistance
6 Electrolytic capacitor (A1)		Capacitance
7 Polystyrene capacitor		Capacitance
8 NPO-type capacitor		Capacitance

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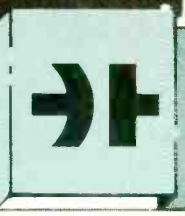
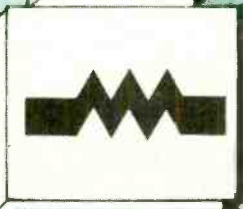
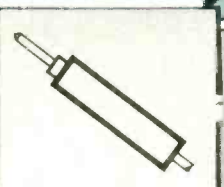
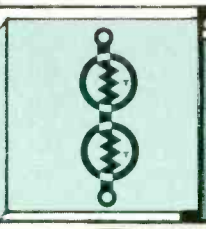
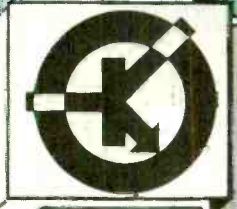
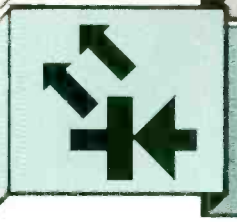
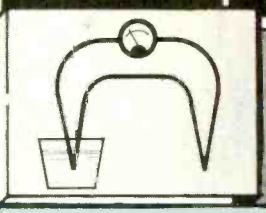
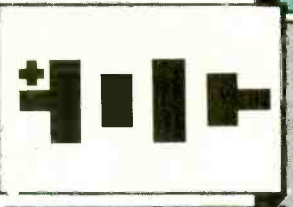
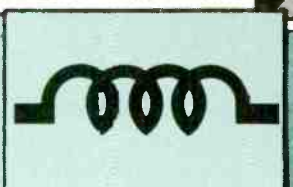
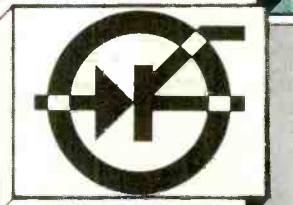
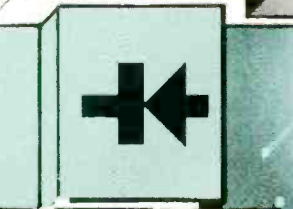
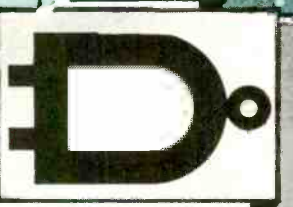
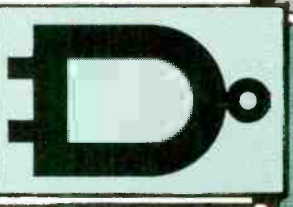
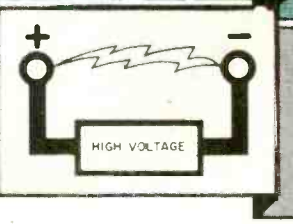
	Component	Symbol	Parameter of interest
9	Class I ceramic capacitor		Capacitance
10	Carbon composition resistor		Resistance
11	Positive temp. coef. silicon resistor		Resistance
12	Insulated test lead		Insulation resistance
13	Thermistor (TC = −1000 ppm/°C) Sensitor TC = +1000 ppm/°C) (Pos temp. coef.)		Resistance between points A and B (Assume perfect linearity)
14	NPN silicon transistor		DC Beta (current gain)
15	Germanium diode		Reverse leakage current
16	Red LED		Radiant power (light output)
17	Red LED		Wavelength of light (Red = long wave Violet = short wave)

	Component	Symbol	Parameter of interest
18	Copper-iron thermocouple		Current when temp. of test junction rises
19	Lead-acid storage battery		Capacity
20	Typical primary battery (Zn/C, for example)		Storage life
21	Inductor		Inductance
22	Silicon controlled rectifier		Minimum trigger voltage
23	Passivated alloy silicon diode		Reference voltage
24	7400 TTL gate		Threshold voltage
25	CMOS gate		Transfer voltage
26	Spark gap		Minimum spark voltage

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QUIZ ANSWERS

1. See introduction.

2. (A) Decrease; (B) Yes. **Note:** The silicon diode has a relatively linear forward voltage vs. temperature characteristic. It is also low-cost and readily available. However, it is comparatively insensitive.

3. (A) Decrease; (B) No. **Note:** Keeping the cell cool raises efficiency.

4. (A) Increase; (B) No. **Note:** Except possibly at high temperatures, copper's variation of resistance is seldom taken into account in designs.

5. (A) Increase; (B) Yes. **Note:** Platinum makes probably the best of the metallic type of temperature probe. Its advantages are: it can be highly refined; it resists contamination; it is electrically and chemically stable; its resistance characteristic is quite linear; and its drift and error with age are negligible.

6. (A) Increase; (B) No. **Note:** Seldom used in critical circuits.

7. (A) Slight decrease; (B) No. **Note:** The capacitance of polystyrene units varies little with temperature.

8. (A) Almost no change; (B) No. **Note:** NPO (Negative-Positive-Zero) is a temperature compensating dielectric that has an ultrastable temperature characteristic. Used in certain types of ceramic capacitors.

9. (A) Most decrease (B) Yes. **Note:** Some types of Class I ceramic capacitors, which are usually made of titanium dioxide, are frequently used in compensation circuits.

10. (A) Increase; (B) No. **Note:** This workhorse of the resistor world has quite a high temperature coefficient and thus isn't used frequently in critical circuits that must be temperature stable. Carbon-film, metal-film, or wire-wound resistors are better choices for application in critical circuits.

11. (A) Increase; (B) Yes. **Note:** Because of its fairly linear resistance/temperature characteristic (especially with a properly chosen fixed resistor in parallel) this component has possible use in simple digital thermometers.

12. (A) Decrease; (B) No. **Note:** Keep this in mind when testing high-voltage circuits.

13. (A) None; (B) No. **Note:** The thermistor resistance decreases by 0.1% for every degree Celsius increase in temperature (remember, 1000 ppm/°C = 0.1%) and the Sensitor resistance increases by an identical amount. Thus, the overall effect is zero.

14. (A) Increase; (B) Yes. **Note:** This effect has been used in inexpensive electronic thermometers. Also, it must be compensated for when designing a transistor circuit so that the transistor's operating point doesn't change significantly with temperature.

15. (A) Increase; (B) Yes. **Note:** A simple electronic thermometer can be constructed from a reverse-connected germanium diode, a battery, and a microammeter. The relatively high, temperature-dependent reverse leakage currents of germanium diodes make the silicon diode, whose leakage is far smaller, preferable in some applications.

16. (A) Decrease; (B) No. **Note:** Keep LEDs cool for increased brightness.

17. (A) Increase; (B) No.

18. (A) Decrease; (B) Yes. **Note:** Does this surprise you? Well, this is sort of a trick question. One normally thinks of a thermocouple's output as increasing with an increase in temperature. The fact is, a thermocouple's output increases with an increase in the *difference* in temperature between its standard junction and the test junction. Since the standard junction shown is at a constant 120°F, the thermocouple's output *decreases* until the test junction reaches 120°F, at which point the output is zero. For test junction temperatures above 120°F, the output increases with further increase in temperature. Since we are limited to a maximum temperature of 95°F, the output is said to *decrease* with increasing temperature.

19. (A) Increase; (B) No. **Note:** This answer is obvious to anyone who had no trouble starting his car on a relatively mild winter afternoon, but early the following morning, when it was bitter cold, had to jumper the battery to start the car. (Of course, thickening oil exacerbates the problem.)

20. (A) Decrease; (B) No. **Note:** This effect is more important than most people realize. One answer is to store batteries in as cool an area as possible. A standard battery will retain nearly all its original capacity for as long as two years if stored at 32°F. This same battery, if stored at 160°F (say in an attic), will have only about 15% of its original capacity after only 1 month of storage!

21. (A) Increase; (B) No.

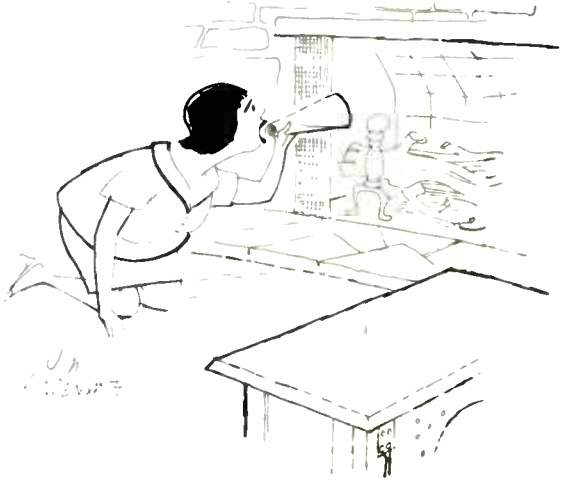
22. (A) Decrease; (B) No. **Note:** A substantial increase in temperature can trigger a false alarm. (Although the author has never seen it done, he speculates that a simple fire alarm can be constructed using an SCR with its gate clamped to a constant voltage just below the minimum trigger point (at room temperature).

23. (A) Almost none; (B) No. **Note:** This diode provides a reference voltage whose stability compares with that of standard cells.

24. (A) Decrease; (B) No. **Note:** Here is one reason why commercial-quality TTLs should be used only between 0°C and 70°C.

25. (A) Slight decrease; (B) No. **Note:** CMOS devices are less sensitive to temperature than TTLs. Plastic-cased CMOS are guaranteed to operate satisfactorily from −40°F to 185°F (−40°C to 85°C).

26. (A) Decrease; (B) No. **Note:** Spark gaps are frequently used to measure extremely high voltages. While this method may seem crude, it is accurate.◇



"I said, I think maybe the ghosts seem sharper now!"

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CIRCLE 46 ON READER SERVICE CARD

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HIGH-SPEED **ELECTRONIC FUSE**

"Blows" within microseconds to protect sensitive components

BY CHARLES M. LENNY AND CHESTER DAVENPORT

FUSES, in many cases, blow too slowly to prevent damage in solid-state circuits. Power transistors, which are prone to thermal runaway when passing excessive currents, are especially vulnerable to slow-opening fuses. The electronic "fuse" shown in the schematic is a basic crow-bar circuit that operates in a hundred microseconds or so—more than fast enough to save low-power transistors—and can safely handle load currents up to 60 amperes.

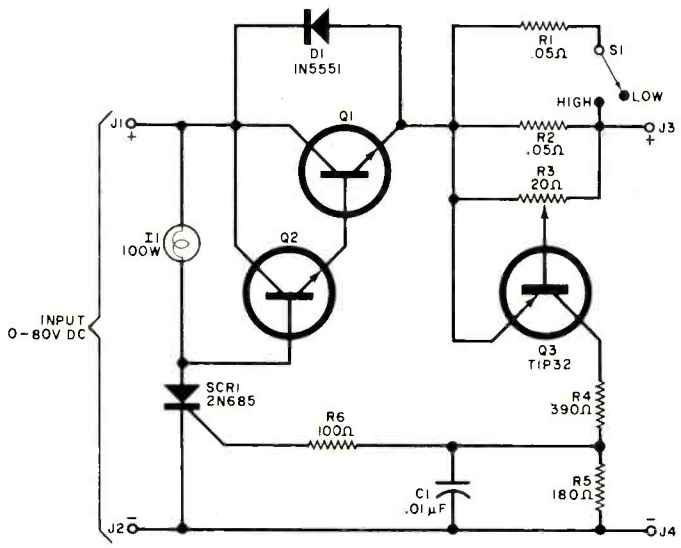
How It Works. When an overcurrent triggers *SCR1* into conduction, base drive is diverted from series-pass transistors *Q1* and *Q2*, which cut off and stop the flow of current to the load. Incandescent lamp *I1* has about a 10-ohm resistance when cold, and drops very little voltage. When *SCR1* fires, the lamp glows, and the filament resistance increases to about 100 ohms, minimizing the load on *SCR1* and acting as an indicator to show that the circuit has tripped.

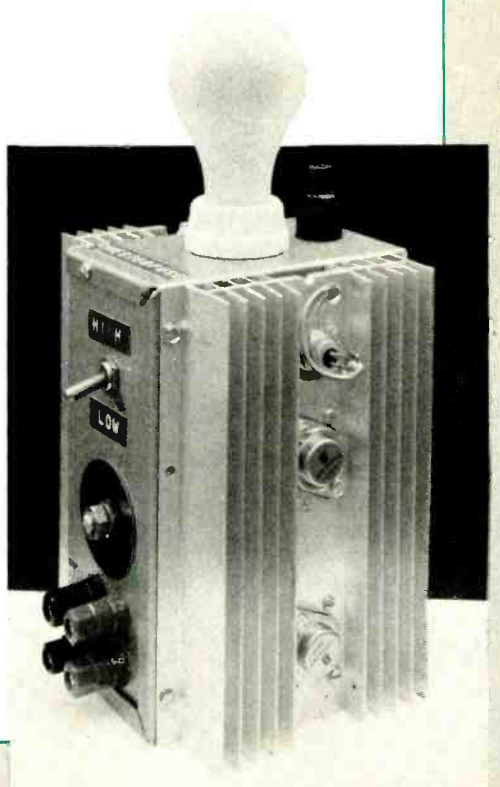
Potentiometer *R3* establishes the desired trip current. When the current passing through *R2* (and *R1* when *S1* is set to HI), exceeds the desired limit, transistor *Q3* turns on. The resulting positive voltage generated across *R5* turns on *SCR1*. Resistor *R6* limits the SCR gate current to a safe value. Diode *D1* permits operating the electronic fuse with an inductive load, removing any probability of punch-through of *Q1* or *Q2*.

Construction. At 60 amperes, resistors *R1* and *R2* can dissipate 45 watts each and should be provided with suitable heat sinking. A similar heat sink should be used for *Q1*, *Q2* and *SCR1*. These two heat sinks should be mounted on two exterior sides of the selected chassis. A socket for *I1* can be mounted on top of the chassis. Input and output power connectors *S1*, and *R3* can be mounted on an empty side as desired. The Solitron SDT96306 can handle 70 amperes at 325 volts. A 2N3055 that can handle 15 amperes at 60 volts is an acceptable substitute.

Calibration of *R3* is performed by using various resistive loads to draw specific currents, with *R3* adjusted so that the lamp glows when the specific current is reached. A dial plate on *R3* is used to identify the calibration points. Remember that the trip current must be within the pass transistor's rating.

Since the SCR is powered by dc, once it fires it will remain in the conductive state until the applied dc voltage is removed. This can be done either by installing a series switch in either of the supply leads or by turning off the driving power supply. ◇





PARTS LIST

C1—0.01-μF disc capacitor
D1—1N5551 diode
J1 through J4—5-way binding post, color coded
I1—100-W incandescent lamp
Q1, Q2—SDT96306 (70 amperes) or 2N3055 (15 amperes)
Q3—TIP32 or any silicon transistor
R1, R2—0.05-Ω, 50-W resistor
R3—20-Ω, 5-W potentiometer
R4—390-Ω, 10-W resistor
R5—180-Ω, 1-W resistor
R6—100-Ω, ½-W resistor
S1—Spst switch
SCR1—2N685 or similar SCR
Misc.—Suitable heat sinks (2), socket for I1, enclosure, terminal strips, mounting hardware.

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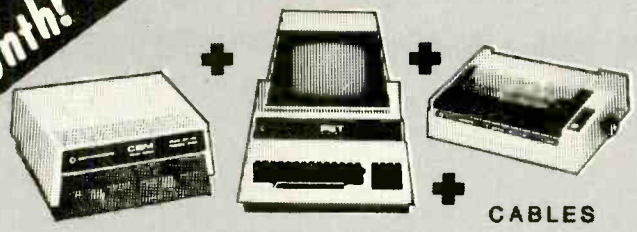

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ENTERTAINMENT ELECTRONICS

By Ivan Berger

Stylus Replacements—Original and Brand "X"

WHEN YOUR stylus wears down, three choices are open: replace the cartridge, replace the stylus with one from the original manufacturer, or buy a lower-cost replacement by someone else. Odd though it may seem, an original replacement stylus will often cost nearly as much as a new cartridge. Even though the suggested retail price of a replacement stylus is only about half that of a new cartridge, its cost to the dealer is usually close to the cost of the cartridge. But considering what goes into making a stylus, that is not as unreasonable as it may seem.

Compare a modern stylus assembly with one from even five years back: the cantilever is far thinner and more difficult to fabricate, and the stylus diamonds are ground into more complex shapes. The elliptical shape is largely giving way to new, line-contact "hyperelliptical", "Shibata", "Van Den Huls", "Pramanik", and other shapes that are harder to grind.

Mounting those new shapes is another problem: where a spherical-tipped stylus can be simply inserted into a round hole, the other shapes must be precisely oriented. Audio-Technica, for example, uses lasers to "drill" precisely shaped and oriented holes in fragile, beryllium cantilevers for the square-shanked, linear-contact styli in its premium cartridges. Sonus bends a square shank and inserts its square-topped diamond into the end. Others use less exotic, but equally exacting methods.

That beryllium cantilever is just one example of the exotic—and hard-to-fabricate—materials used in many modern styli: Sony and Dynavector, for example, have cantilevers of diamond itself, Dynavector also has a ruby, and Bang & Olufsen uses a sapphire shaft to mount its diamond. (It took a year to find the right adhesive.) Shure's top styli are more exotic in construction than in materials, with stepped shafts that look like telescopes under a magnifier. Add in the careful design and selection of the stylus suspension and damping materials, and you can see that a stylus replacement involves some exacting manufacture.

Because the stylus accounts for most of the cartridge's cost to the manufacturer, he has to charge the dealer accordingly. Cartridge manufacturers are coy about the fact that they put unrealistically low retail prices on their styli (or unrealistically high ones on their cartridges, depending how you look at it), but I suspect it's because buyers would be pained at hearing that the "replacement part" costs nearly as much as the whole cartridge. But since it costs the dealer a lot, it will cost you a lot, too, regardless of the difference in list prices. That's why there is a market for lower-priced replacement styli. The question is: Are such "second-source" replacements as good as the originals?

The cartridge manufacturers say "No." And though they're obviously interested parties, their arguments make sense. Shure, for example, points out that only the cartridge's original manufacturer knows all the original design criteria, including its materials, dimensions and their tolerances, and "the delicate relationship of parts"; only the original manufacturer has the tools and assembly experience. The original manufacturer has a bigger stake in quality, too—if your new Brand "X" stylus makes your Shure, Stanton, Empire or whatever sound worse than the competition, it's likely to be the cartridge you should blame.

Shure, for example (and they're hardly alone), runs samples of all its products through a series of "conformance" tests to make sure they perform within spec—then puts them through environmental tortures for a while, and tests them over again. The tests are now computerized (with a Commodore Pet, incidentally—not all "home" computers stay home), both to simplify the job (it even recalibrates itself for wear on the test disc) and so that production trends can be identified and isolated from the background noise of sample-to-sample variations. That lets the quality-assurance engineer find where production's going wrong before defective parts start coming off the line.

Shure recently purchased 244 styli made by other companies to fit Shure cartridges, and ran them through its conformance tests: only about 2 percent passed, leaving too few for meaningful environmental tests. Though it may well be possible to get off-brand styli as good as the original, the odds, obviously, are not good.

Getting original replacement styli isn't always easy, though. Many dealers don't stock them, both because customers complain about their prices and because supporting older cartridges as well as current models can mean carrying a lot of slow-moving inventory. Most cartridge manufacturers will help, though: Audio-Technica, for example, has a toll-free number (800-221-0906, or in New York State, 212-871-3303) for information on where to buy replacement styli.

If manufacturers say it's best to replace styli only with those from the original source, there are others who say you shouldn't replace them yourself, at all. "If you replace the stylus, you change the response," says Len Chase, of New York's Electronic Workshop. "Many of the cartridges I sell come with individual frequency-response graphs, and there are always minute variations between even those with consecutive serial numbers. The variations between original-replacement styli may be no greater than those between cartridges—but at least with the cartridge, you can see what you're getting."

Many moving-coil cartridges must be returned to the factory for stylus replacement, which ensures that only original-replacement styli will be used. The same is even true of a few nonmoving-coil designs, such as those made by Bang & Olufsen. B&O doesn't sell replacement styli at all, pointing out that "the tolerances are so close that it's difficult to take out part of the system, like a stylus assembly, and replace it at random. When our stylus assemblies are connected to the stylus body, they are adjusted with a tool which has a micrometer control, to get the gap right, and then sealed as an integrated unit.

"Each cartridge is supplied complete and checked, at a price marginally higher than a replaceable stylus for other cartridges of similar quality. With today's technology, it is no longer a case of 50% of the cartridge cost being in the stylus assembly and 50% in the body; the body represents only a small fraction of the total. When we first introduced our integrated cartridges, in 1973, all we did was admit these facts."

Shure disagrees on that point. When asked if noninterchangeable styli might not be better, Shure's engineers replied: "If noninterchangeable styli became the vogue, our engineers have determined that we'd still build them the way we do now, but cement them together." (Osawa and a few others, incidentally, come close to this approach, with styli that are held in place by set-screws, for rigidity.)

As so often happens in audio, there are logical arguments on both sides of the question of whether to replace styli at all. But if you do, it probably does make sense to use an original replacement unless your dealer will let you make an A-B comparison of how a given cartridge sounds with both original-brand and other-brand styli—and I doubt any will. Otherwise, as Shure says, "with an imitation stylus, it's no longer our cartridge, as far as we're concerned—it's Brand 'X'." ◇

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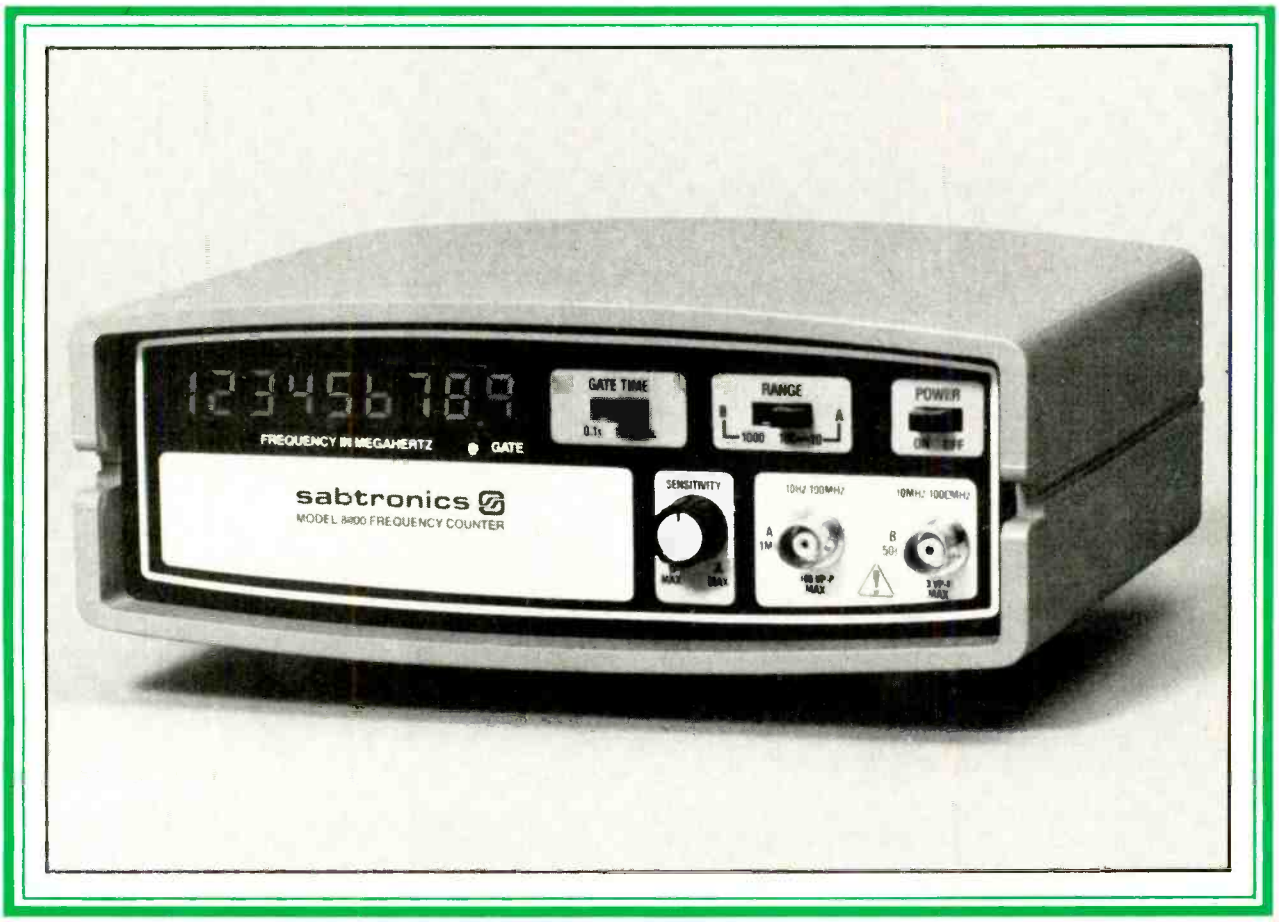
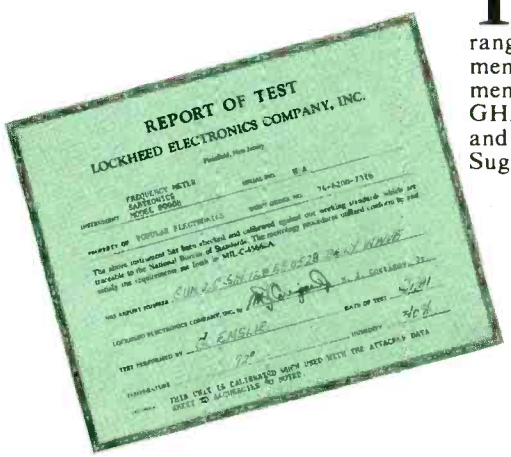
Popular Electronics Tests

The Sabtronics Model 8000B Frequency Counter




REPORT OF TEST

LOCKHEED ELECTRONICS COMPANY, INC.

THE Sabtronics Model 8000B Frequency Counter is a low-cost, wide-range battery- or line-powered instrument capable of frequency measurements between 10 Hz and 1000 MHz (1 GHz). It measures 8"W x 6.5"D x 3"H and weighs 1.3 lb without the batteries. Suggested retail price is $239.

General Description. The front panel, which holds a mini-digit readout of seven-segment red LEDs, is surrounded by a half-inch deep rim that protects against damage if the instrument is accidentally dropped on its front surface. Controls include the GATE TIME switch that allows selection of 0.1-, 1-, or 10-second counting periods, a RANGE switch that provides a choice of 10, 100, or 1000 MHz full scale, a POWER ON/OFF switch, and a SENSITIVITY control. Two BNC connectors are provided, with one used between 10 Hz and 100 MHz and having a 1-megohm input impedance and the other used for the 10- to 1000-MHz range, having a 50-ohm input impedance. A single red LED visible just below the display is used to indicate gate operation.

(Continued overleaf)

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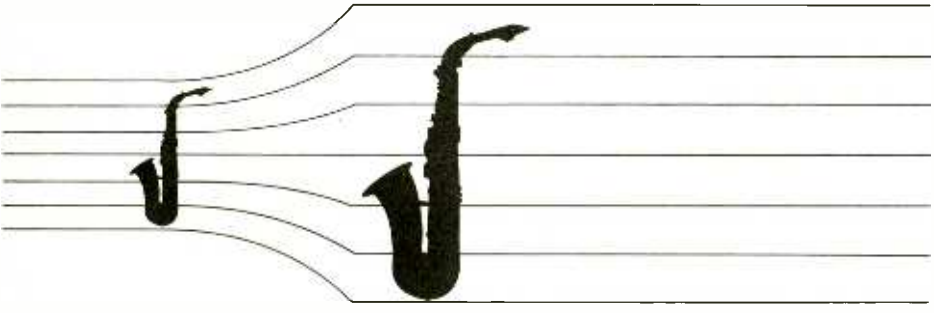

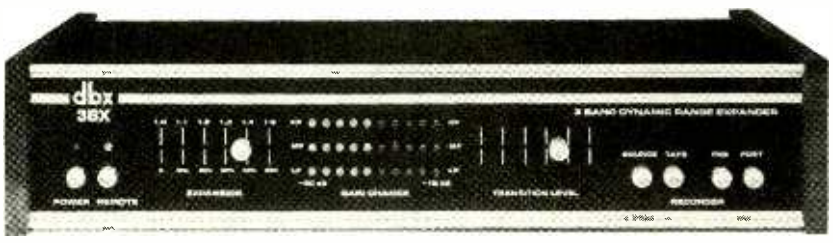

test equipment

The unit is provided with four large plastic feet with a two-position tilt stand affixed to the front pair. The external wall-mounted ac adapter connects to the EXTERNAL INPUT receptacle on the rear apron, which also contains the cover for the battery compartment.

Rated sensitivity is: < 20 mV, 10 Hz to 100 MHz; < 30 mV, 100 to 600 MHz; <40 mV, 600 to 1000 MHz. The input is protected against 400 volts peak-to-peak at 10 Hz; protection declines with frequency to 3 volts peak-to-peak at 1000 MHz. Maximum rated resolution is 0.1 Hz on the 10-MHz range, 1 Hz on the 100-MHz range, and 10 Hz on the 600-to-1000-MHz range, all using the 10-second gate time. The internal time base operates at 10 MHz with a claimed temperature stability of ±1 ppm between 0 and 40°C, an adjustability of ±2 ppm, and an aging rate of less than 5 ppm/year. Rated accuracy is 1 Hz + 1 digit + timebase error. The power requirement is 4.8 to 6.5 volts dc at 300 mA from four C cells, or the optional ac adapter/charger.

Comments. The Model 8000B was checked by the Lockheed Electronics Instrumentation Measurements Laboratory, Plainfield, NJ, against standards traceable to the National Bureau of Standards. It met or exceeded its specifications in all respects but two. First, since there are only 9 digits in the readout, the upper limit on the frequency display is 999.999999 MHz. This by itself is minor, but it precluded checking the resolution using the 10-second gate. Second, since there was no access to the time base, its long-term stability could not be determined. Short-term stability can be inferred from the accuracy with which the standard frequencies were displayed. In fact, time-base error appears to be ±3 ppm.

We used the counter to make a number of frequency measurements over a few weeks, and found it to be of great value. When used in conjunction with a low-cost audio generator, we found the combination allowed a far better "fine tuning" of frequency than the relatively rough dial of the generator alone. This was also true when using the 8000B with the r-f generators used for radio and TV alignment. It is always nice to know that the frequency being injected is correct.

A small, multiturn air coil was connected to the end of the scope probe we were using as the signal probe to allow us to probe some r-f circuits of a couple of CB and ham rigs we were aligning. This combination also worked well with some border-line microwave (about 800 MHz) gear we were installing.

With its relatively low price, optional battery operation, and extremely wide frequency range, the Model 8000B is an excellent and handy instrument. It is easy to use and comfortably exceeds the accuracy need for CB, ham, and audio applications.—*Leslie Solomon.*

CIRCLE NO. 104 ON FREE INFORMATION CARD

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Two Projects for Summer:

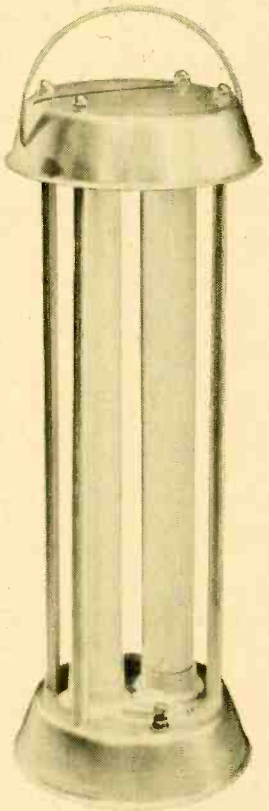
A BATTERY-OPERATED FLUORESCENT LAMP

Portable, high-efficiency light source draws current from a vehicle's 12-volt storage battery, but leaves plenty of charge for engine starting.

BY LAWRENCE M. WALDEN

THE recreational vehicle is becoming more and more popular with campers who want a "home away from home." In such cases, the vehicle's 12-volt battery supply provides a convenient source of power for lighting around the camp. This is very handy, of course; but, for the amount of light they deliver, 12-volt incandescent lamps waste a lot of valuable battery power. Fluorescent lamps, on the other hand, produce good lighting at high efficiency. Unfortunately, they require a dc-to-ac converter.

The low-cost circuit described here not only performs the dc-to-ac conversion, it also provides automatic shut-



down when the battery reaches some predetermined voltage level, thus preventing a complete discharge. A LED indicator glows when the turnoff point is reached. Once turned off, the system draws only a few milliamperes.

Circuit Operation. When the 12-volt supply (Fig. 1) is applied to the circuit through fuse *F1*, switch *S1*, and the protective diode, *D1*, multivibrator *IC1* starts to oscillate at a frequency determined by the setting of *R2*. This is approximately 10 kHz. At this time, *Q1* is cut off to allow *IC1* to oscillate.

As the +12 volts are applied to the *R18*/zener diode *D2* network, 7.6 volts are applied to the emitters of *Q3* and *Q4*. At this time, the base of *Q4* is at zero voltage, thus turning this transistor fully on and developing approximately 7 volts across its collector resistor (*R12*). This voltage, applied via *R13* to the base of series-pass transistor *Q5*, turns the transistor on and allows the output of *IC1* to pass through *R7* to driver transistor *Q6*. The latter, in turn, drives power transistor *Q7* to its maximum output.

The collector load of *Q7* is formed by the 6.3-volt winding of transformer *T1*. Thus, as *IC1* oscillates, a high alternating voltage is developed across the 120-volt winding of *T1* and applied to the two series-connected fluorescent lamps (*L1* and *L2*), and across current-sensing resistor *R17*.

At lamp turnon, the voltage developed across *R17* is rectified and filtered by *D3* and *C5* and applied across lamp-current-adjust potentiometer *R16*. A preselected portion of this voltage is applied to the *R15*/*C4* network and to the base of *Q4*. When this voltage approximates the 7.6-volt emitter reference, *Q4* starts to reduce its conductance, thus lowering the voltage developed across collector resistor *R12*. This action lowers the bias on series-pass transistor *Q5*, reducing the drive to *Q6*/*Q7* to lower the lamp drive and reduce the voltage across *R17*. The circuit stabilizes lamp current preset by *R16*.

At initial lamp turnon, approximately 1.3 amperes will flow through *Q7* until the fluorescent lamps fire. This ensures lamp start even in cold weather. Once the lamps strike, the current will range from about 0.9 ampere at 13.2 volts to about 1.1 amperes when the battery voltage drops to near 10.6 volts.

Low battery protection is provided by potentiometer *R6*. The selected voltage is applied via *R8* to the base of *Q3*. In normal operation, *Q3* is cut off since its base voltage is higher than the 7.6 volts applied to its emitter. If the battery voltage drops so that the base of *Q3* goes below the emitter voltage, *Q3* starts to conduct and its collector current flows through *R10* to the base of *Q2*. When *Q2* starts to conduct, the base drive of *Q3* is further reduced until both *Q2* and *Q3* are latched fully on. Once latched on, the collector of *Q3* will be approximately 6 volts, which are applied through *R11*, causing *LED1*—the low-voltage indicator—to glow. This voltage is also applied via *R5* to the base of *Q1* to bias this transistor fully on. When this occurs, pins 2 and 3 of *IC1* become fully positive, thus disabling the multivibrator. At this point, battery consumption drops to about 50 mA, since *Q1*, *Q2*, and *Q3* are the only active elements. Operating power should now be removed via *S1*.

Capacitor *C4* at the base of *Q4* is a high value to prevent oscillation, while *C3* at the base of *Q2* allows the circuit to stabilize before low voltage levels can be detected. Once the circuit is

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working, it responds very rapidly to voltage drops.

Construction. Since there is nothing critical about the circuit, it can be constructed on a small piece of perf board using point-to-point wiring and sockets for *IC1* and the seven transistors. Transistor *Q7*, transformer *T1*, power on/off switch *S1*, fuse *F1*, and the two fluorescent lamp sockets are mounted on the enclosure.

Select an enclosure that can support the circuit board, the transformer, a heat sink for power transistor *Q7*, and the sockets for the two fluorescent lamps. The two lamps can be mounted vertically on top of the enclosure, and provided with some form of transparent weather protection such as a plastic sleeve. If a metal enclosure is used, it can serve as the *Q7* heat sink when a suitable insulator is used. Connection to the +12 volts can be made with a length of conventional two-conductor lamp cord having a cigarette lighter plug at one end. The author used 33 feet of lamp cord.

• Since the secondary of transformer *T1* can develop as much as 1500 volts peak-to-peak across the output, and as much as 225 volts when the lamps are lit, suitable insulation must be used at these points. Also, keep these voltages in mind when performing the adjustments on the circuit.

Adjustments. Before applying power, remove the connection between low-voltage-adjust potentiometer *R6* rotor to the +12-volt end. Then set lamp-current-adjust potentiometer *R16* so that the rotor is at the ground end. Frequency-adjust potentiometer *R2* should be set to the *R1* side (highest resistance).

To make a complete test, use an adjustable power supply between 10 and 14 volts, with a capacity of at least 2 amperes. Connect an ammeter (about 2 amperes) in series with the positive battery connection, and a voltmeter (20-volt range) from the cathode side of *D1* to ground. Connect the power source.

When *S1* is turned on, the lamps may not fire due to the low frequency of the multivibrator, and about 0.3 to 0.4 ampere will be drawn. Transformer *T1* may also make sounds due to lamination movement, which indicates an operating circuit.

Slowly rotate frequency-adjust potentiometer *R2* and note that the ammeter current increases and the lamps start to glow. Continue to increase the frequency very slowly until the lamps come to full brightness at a current of about 0.6 ampere. At this point, the supply current will suddenly jump to about 1.2 to 1.3 amperes. Advance the frequency for an additional 0.2 ampere, but not higher, as both output voltage and efficiency will drop.

If desired, the multivibrator can be "fine tuned" using an oscilloscope. To do this, turn the power off, set the controls as described above, remove the lamps and replace them with four 100-kΩ, ½-W resistors connected in series. Connect the scope leads across *R17*, and set the scope vertical to 5 volts/division. Turn the power on and

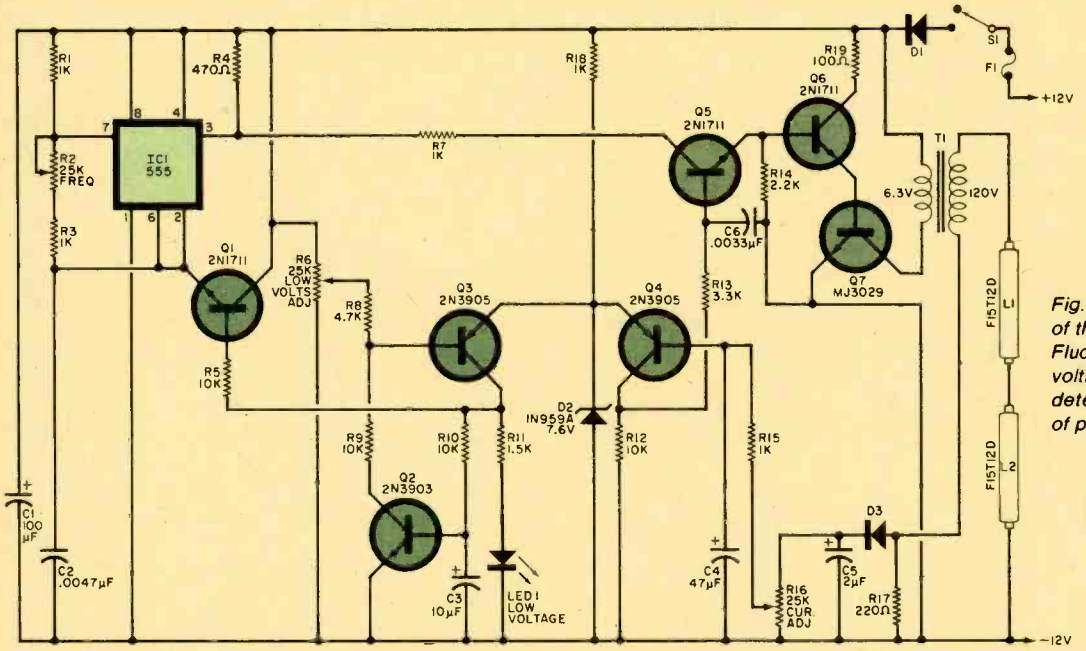

Fig. 1. Schematic diagram of the Battery-Operated Fluorescent Lamp. The low-voltage cutoff point is determined by the setting of potentionmeter R6.

PARTS LIST

C1—100-µF, 25-V electrolytic
C2—0.0047-µF, film capacitor
C3—10-µF, 60-V electrolytic
C4—47-µF, 50-V electrolytic
C5—2-µF, 50-V electrolytic
C6—0.0033-µF, 100-V film capacitor
D1,D3—2-ampere rectifier diode
D2—1N959A, 7.6-V zener diode
F1—4-A fuse and holder
IC1—555 timer
L1,L2—15-watt daylight fluorescent lamps (F15T12D or similar)
LED1—Red LED
Q1,Q5,Q6—2N1711 or similar npn silicon transistor
Q2—2N3903 or similar npn silicon transistor
Q3,Q4—2N3905 pnp or similar transistor
Q7—MJ3029 npn power transistor
R1,R3,R7,R15—1-kΩ, ¼-W resistor
R2,R6,R16—25-kΩ, pc potentiometer
R4—470-Ω, ½-W resistor
R5,R9,R10,R12—10-kΩ, ¼-resistor
R8—4.7-kΩ, ¼-W resistor
R11—1.5-kΩ, ½-W resistor
R13—3.3-kΩ, ¼-W resistor
R14—2.2-kΩ, ¼-W resistor
R17—220-Ω, 2-W resistor
R18—1-kΩ, ½-W resistor
R19—100-Ω, 1-W resistor
S1—Spst switch
T1—6.3-V, 1.2-A transformer (Radio Shack 273-0050 or similar)
Misc.—Perf board, sockets for *IC1* and transistors, heat sink and thermal insulator for *Q7*, sockets (4) for fluorescent lamps, suitable enclosure, length of conventional lamp cord, automotive cigarette plug, transparent weather shield for lamps, adhesives, mounting hardware, etc.

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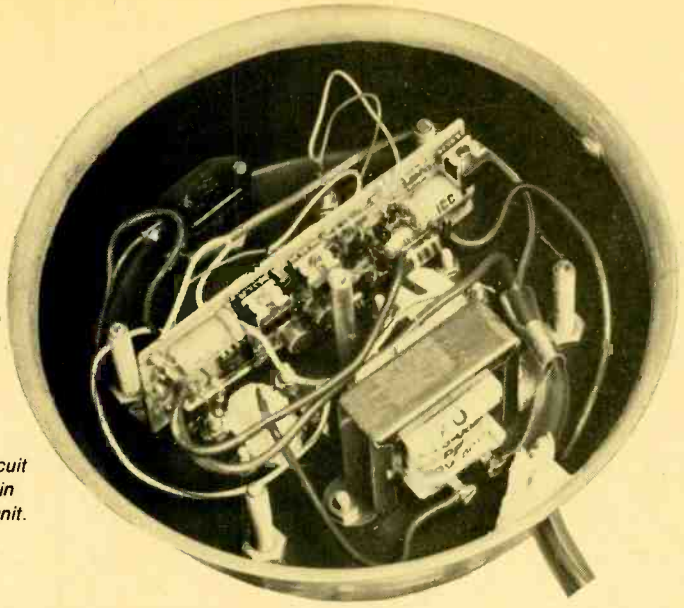

Lamp circuit mounted in base of unit.

note that about 0.5 ampere flows and a 3-to-4-volt waveform appears on the scope. Slowly increase the frequency (via *R2*) until the scope trace peaks at about 15 volts peak-to-peak. The supply current should reach about 1 ampere at this point. Do not adjust the frequency higher than this, or the efficiency will be reduced. Turn the power off, remove the resistors, and replace the lamps.

To adjust the lamp current regulator with the lamps glowing, slowly rotate current-adjust potentiometer *R16* until the current approaches 0.8 ampere and there is a decrease in light output. Then slowly adjust *R16* until the current reaches 1 ampere. Lower the power supply to 10.6 volts, then re-adjust *R16* for 1.1 amperes current flow. This becomes the maximum current drain at the lowest operating voltage.

Increase the supply voltage from 10.6 to 13.2 volts and note that the light output remains constant as the current decreases. With 12 volts applied, about 1 ampere will flow, and with a 13.2-volt supply, the current drops to about 0.9 ampere.

To adjust the low-voltage cutoff, reconnect *R6* to the +12-volt line. and with the voltmeter still in the circuit, allow a 5-minute lamp warm-up. Reduce the power supply to 10.6 volts (or other desired low-voltage point) and slowly rotate *R6* until the lamps go off and *LED1* glows. Recheck this point several times. If, during operation, the lamps go out, the presence of glowing *LED1* indicates that the low battery voltage has been reached, and the circuit has not been accidentally removed from the power source. ◇

"COINSHOOTER" METAL DETECTOR

Advanced circuit reacts to coins and other precious metal objects while ignoring chunks of iron and steel

BY WILLIAM LAHR

SEARCHING FOR coins and other lost articles along beaches and in parks can be both profitable and fun. The Coinshooter, a novel and inexpensive electronic metal detector, can make such outings more productive. Employing a sophisticated, vlf induction-balance detection system that responds only to the proximity of nonferrous metallic objects, it ignores items containing iron. Moreover, the project can be adjusted to compensate for the soil's mineral content, thus minimizing false indications.

The Coinshooter can detect a dime at an air gap of four inches or a half-dollar at nine inches. It cannot detect coins buried deep in the ground, but will yield excellent results if the coins are at depths of from 1 to 3 inches. Unlike detectors that employ conventional beat-frequency oscillator circuits, the Coinshooter does not require the user to monitor the pitch of a continuous tone. Rather, it alerts the user to the proximity of nonferrous metal by generating one or more beeps. Also, it is lightweight (about 2 lb) and well balanced. Total construction cost is approximately $35, and less if salvaged parts are used.

About the Circuit. The Coinshooter appears schematically in Figure 1. Coplanar search coils are formed by placing a receiving coil (*L3*) over a folded-loop transmitting coil (*L1* and *L2*) so that there is little if any coupling between them unless there is metal present in the search field. A Colpitts oscillator comprising *Q1* and its associated passive components generates a 6.2-kHz signal that drives the transmitting coil. Transistors *Q2* and *Q3* amplify the low-level signal induced across receiving coil *L3* when no metal objects are present in the search field so that a 1-volt p-p signal appears at the collector of *Q3*.

Capacitor *C7* couples this signal to the noninverting input of voltage comparator *IC1A*. The input circuit of the comparator rectifies the ac signal, resulting in the generation of a slightly

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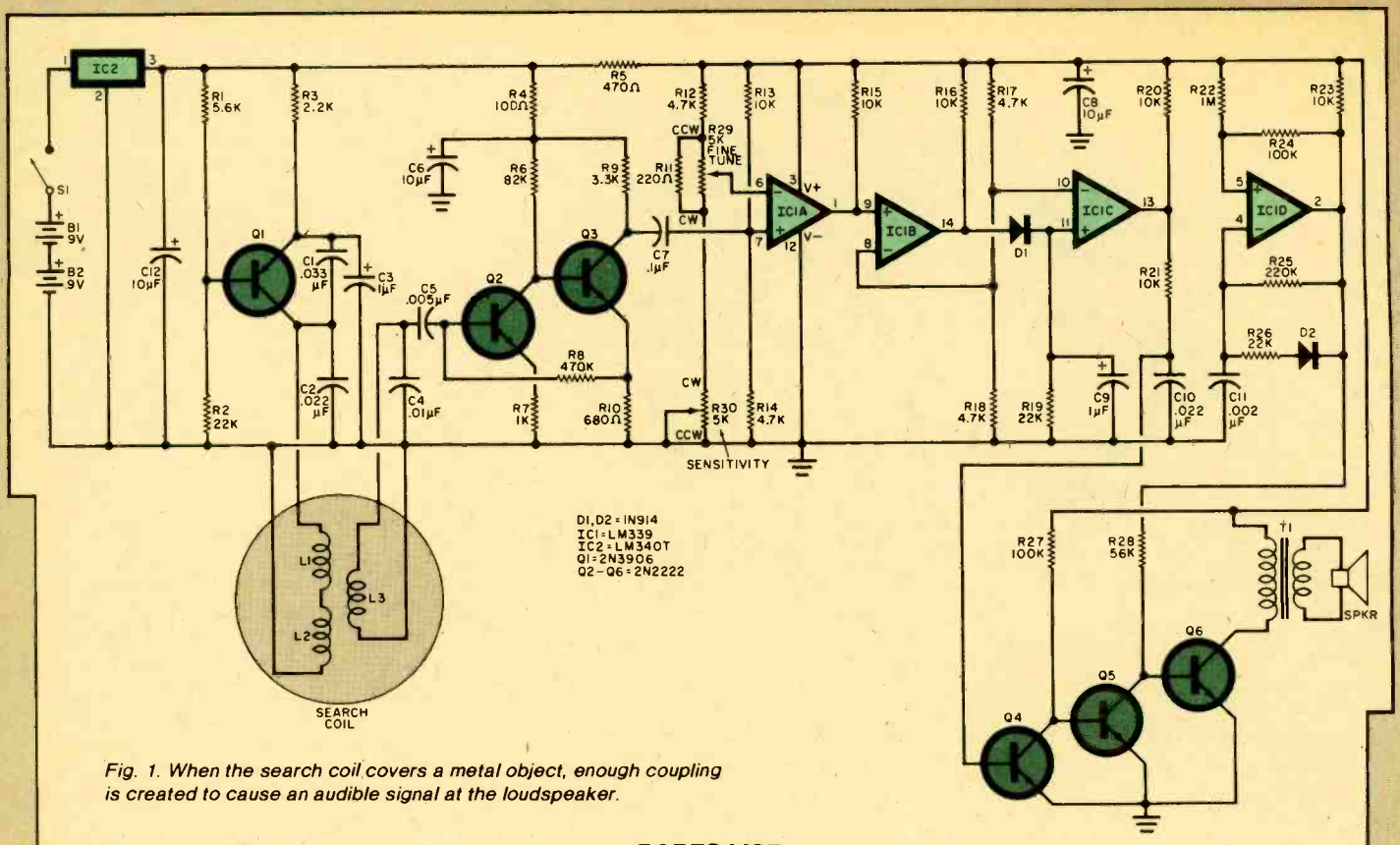

Fig. 1. When the search coil covers a metal object, enough coupling is created to cause an audible signal at the loudspeaker.

PARTS LIST

B1,B2—9-V alkaline battery
C1—0.033-μF, 50-V Mylar capacitor
C2, C10—0.022-μF, 50-V Mylar capacitor
C3, C9—1-μF, 16-V tantalum capacitor
C4—0.01-μF, 50-V disc ceramic capacitor
C5—0.005-μF, 50-V disc ceramic capacitor
C6, C8, C12—10-μF, 16-V aluminum electrolytic capacitor
C7—0.1-μF, 50-V Mylar capacitor
C11—0.002-μF, 50-V disc ceramic capacitor
D1, D2—1N914 silicon switching diode
IC1—LM339 quad voltage comparator
IC2—LM340T-8 +8-V regulator
L1, L2—Air-core inductor: 175 turns of No. 30 wire wound 9½ inches in diameter (see text)
L3—Air-core inductor: 550 turns of No. 38 enamelled wire on 3½" diam.
Q1—2N3906 or similar pnp silicon switching transistor
Q2 through Q6—2N2222 or similar npn silicon switching transistor

The following, unless otherwise specified, are ¼-watt, 5%-tolerance, carbon-composition fixed resistors.
R1—5.6 kΩ
R2, R19, R26—22 kΩ
R3—2.2 kΩ
R4—100 Ω
R5—470 Ω
R6—82 kΩ
R7—1 kΩ
R8—470 kΩ
R9—3.3 kΩ
R10—680 Ω
R11—220 Ω
R12, R14, R17, R18—4.7 kΩ
R13, R15, R16, R20, R21, R23—10 kΩ
R22—1 MΩ
R24, R27—100 kΩ
R25—220 kΩ
R28—56 kΩ
R29—5-kΩ, linear-taper potentiometer
R30—5-kΩ, linear-taper potentiometer with shaft-actuated spst switch

S1—Spst switch (part of R30)
SPKR—2¼-inch, 8-Ω dynamic speaker
T1—1kΩ:8Ω miniature audio output transformer
Misc.—Suitable enclosure, perforated or printed-circuit board, single-conductor shielded cable, hookup wire, No. 30 and No. 38 enamelled copper (magnet) wire, battery clips, battery holders, circuit-board standoffs, grommets or other suitable strain reliefs for shielded cable, PVC electrical tape or silicone cement or other suitable insulating material, 12-inch-by-12-inch sheet of ¼-inch plywood, monofilament fishing line, ¾-inch masking tape, epoxy, hot-melt, and PVC glues, 4 feet of ½-inch O.D., schedule 125 PVC pipe, 2 feet of ½-inch, schedule 40 PVC pipe, 90° elbow PVC pipe joint, 135° elbow PVC pipe joint, tee PVC pipe joint, PVC pipe cap, bicycle steering-bar handgrip, lead buckshot, resin sealant, white paint, solder, hardware, aluminum foil etc.

negative voltage that subtracts from the positive bias voltage supplied by divider *R13R14*. Potentiometers *R29* and *R30* determine the magnitude of the reference voltage applied to the inverting input of *IC1A* and hence the detector circuit's sensitivity. They are adjusted so that the voltages at the two inputs are practically equal.

When the voltage at the noninverting input of the comparator becomes more positive than that at the inverting input, the output terminal (pin 1) switches to the positive supply voltage. This positive pulse toggles comparators *IC1B* and *IC1C*, which are connected in cascade and whose inverting inputs are biased to one-half the positive supply voltage. The charging of *C9* via *D1* and the discharging of *C9* through *R19* stretches the pulse. Transistor *Q4* is triggered into conduction by the elongated pulse that appears at the output of *IC1C*, cutting off *Q5*.

When *Q5* is cut off, *Q6* amplifies the tone produced by the audio oscillator comprising *IC1D* and its associated passive components. The current flowing through the primary of audio-output transformer *T1* and transistor *Q6* increases the voltage drop across *R5*, and this upsets the

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bias applied to the inverting input of *IC1A*. As a result, the outputs of *IC1A*, *IC1B*, and *IC1C* go low, transistor *Q4* cuts off, and transistor *Q5* saturates, shunting the base drive of *Q6* to ground and cutting that transistor off. This silences the loudspeaker and allows *C8* to charge again to the full positive supply voltage. The higher voltage across the capacitor allows *IC1A* to change state again if the nonferrous metal object is still within the search field.

Iron objects or mineralized ground within the search field will produce an increase in the amplitude of the signal at the collector of *Q3* and thus a less positive bias at the noninverting input of *IC1A*. In contrast, the presence of coins or other nonferrous metal objects within the search field will cause a smaller signal to appear at the collector of *Q3* and a more positive bias at the noninverting input of the first voltage comparator. This allows the Coinshooter to locate coins and other items of interest while ignoring nails, bottle caps, and other junk pieces of iron and steel.

When a small nonferrous item quickly enters and exits the search field, the loudspeaker will generate a single beep. If the object enters and remains in the search field, a series of beeps will be produced. Its rate of repetition will vary with the settings of potentiometers *R29* and *R30*, the size of the object, and the distance between the object and the search coil. The pitch of the beep is determined by the values of *C11* and the resistances in the feedback loop, as well as by the supply voltage. Its frequency is nominally 1.3 kHz.

Power for the Coinshooter circuit is supplied by two series-connected nine-volt batteries. An IC voltage regulator provides a constant supply potential to the rest of the circuit until the batteries are nearly exhausted. Quiescent current demand is approximately 10 mA, so battery replacement should be infrequent if alkaline cells are used. If desired, the Coinshooter can be powered by a single nine-volt battery and the regulator IC omitted. However, the circuit is sensitive to changes in supply voltage, and this alternative is not recommended. But, if this approach is taken, an alkaline battery must be used.

Construction. Procure a circular form 9½" in diameter on which you can wind the transmitting coil. In assembling the prototype, a hamper lid was used, but a mixing bowl or cardboard cylinder would be suitable.

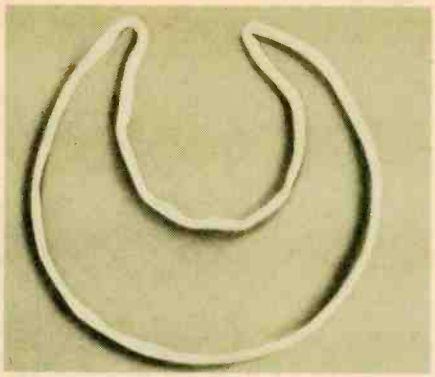

Fig. 2. Transmitting coil has been shaped to form L1 and L2.

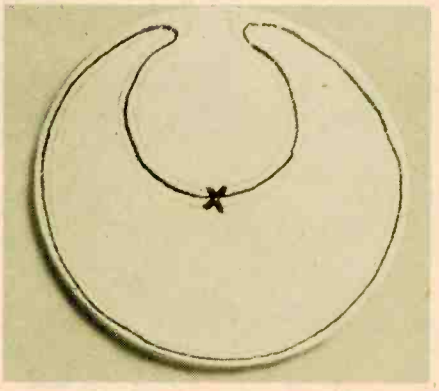

Fig. 3. Positions of L1 and L2 are marked on a plywood disc.

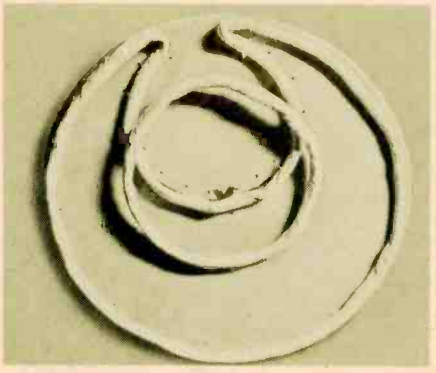

Fig. 4. The disc is shown with L1 and L2 tied in place and L3 on top.

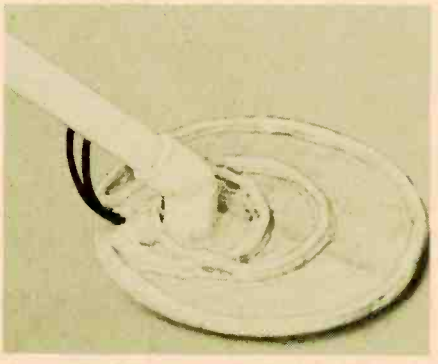

Fig. 5. The search-coil assembly with handle in place.

Wind a layer of masking tape ¾-inch wide around the form so that the adhesive side is exposed. The tape will hold the wire and make winding the coil much easier. Wind a total of 175 turns of No. 30 enamelled copper wire around the form, keeping the wire as close to the center of the tape as possible. The last turn should exit the coil at a point on the circumference 10 inches before the starting point is reached. Fold the tape around the coil and remove it from the form. Spiral-wrap the coil tightly with masking tape. Then shape the coil assembly as shown in Fig. 2 to form the transmitting coil. (*L1* is the large-diameter portion and *L2* is the small-diameter section.) The coils must be shielded so spiral wrap them (starting with *L1* opposite the lead wires) with 1" wide strips of aluminum foil. Cover the coils completely except for a ¼" gap between start and finish of the foil layer. Strip a 6" piece of hookup wire and lay it on the foil so that 2" exits next to one of the lead wires. Then spiral wrap the coils tightly with masking tape, covering the foil completely.

Next, cut a disc seven inches in diameter from a sheet of ¼-inch plywood. Lay the shaped coil assembly on the disc and trace pencil lines around the inside of *L1* and both sides of *L2* (see Fig. 3). Remove the coil assembly and drill a series of 1/16-inch holes spaced ½ inch apart along the pencil lines. Then place the shaped coil assembly back on the disc and tie it down with monofilament fishing line, looping the line through the series of holes.

Obtain a circular form 3½ inches in diameter on which you can wind the receiving coil. In assembling the prototype, a glass ashtray was used, but a cardboard cylinder would also be acceptable. The form should have a slight taper to facilitate removal of the coil after it has been wound. Apply masking tape to the form as was done in winding the transmitting coil, and wind 550 turns of No. 38 enamelled copper wire, keeping the windings as close to the center of the tape as possible. When the coil has been wound, fold the tape around the windings and remove the coil from the form. Spiral-wrap the coil tightly with masking tape. Wrap the coil with foil and another layer of tape as on *L1* and *L2* being sure to cover the foil completely. If the two foil shields are allowed to touch when the coils are positioned, the detector will not function.

Now assemble the circuit of the Coinshooter. In the construction of the prototype, a small (5 inches by 1-

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3/4 inches) perforated board and point-to-point wiring were used. Printed-circuit assembly techniques are also acceptable. Because the circuit operates at very low frequencies, parts layout is not especially critical. Use an IC socket or Molex Soldercons for *IC1* rather than soldering the chip's pins directly to the circuit board.

Potentiometers *R29* and *R30* and the loudspeaker are not mounted on the board. Rather, they should be affixed to the enclosure housing the circuit board. Resistor *R11* can be soldered directly across the outer lugs of potentiometer *R29*. A total of four holes (two 3/8 inch in diameter spaced 2 inches apart, and two 1/8 inch in diameter spaced 1/2 inch above and below the larger holes) should be drilled in the bottom of the project enclosure so that two shielded cables can exit the enclosure and self-tapping screws can provide mechanical support. Additional holes might have to be drilled for circuit-board standoffs.

Prepare the inner conductor and shield at one end of each of two 48-inch lengths of single-conductor shielded cable. Color-code both ends of one of the cables with a dab of enamel paint or nail polish. Connect the shields of the prepared ends of both cables to circuit ground. The inner conductor of the color-coded cable should be connected to the node *C1*, *C2*, and collector of *Q1*; the inner conductor of the other cable should be connected to the node *C4*, *C5*. These cables should exit the enclosure housing the circuit board through the two 3/8-inch holes previously drilled through its bottom. Be sure to outfit these holes with grommets or similar bushings that prevent chafing of their outer plastic jackets and that provide strain relief.

When the circuit board has been assembled and mounted in the enclosure along with the other components, place the transmitting-coil assembly and the receiving coil on a desk or on the floor away from any metal. Prepare the free ends of the two shielded cables and tin their inner conductors and shields. Using clip leads, connect the color-coded cable's conductors to the transmitting coil, and the other cable's conductors to the receiving coil. Connect the coil shields to the outer cable conductors. Apply power to the circuit and connect an oscilloscope probe between *Q3*'s collector and circuit ground.

Referring to Fig. 4, position the receiving coil near the center of the plywood disc on which the transmitting coil has been mounted. Adjust the position of the receiving coil for the minimum signal level at the collector of *Q3* as indicated by the scope beam's vertical deflection. Trace a pencil line on each side of the receiving coil after the null position has been determined, and then remove the receiving coil from the disc. Drill a series of 1/16-inch holes, spaced 1/2 inch apart, along the pencil lines. Reposition the receiving coil on the disc and tie it down with monofilament fishing line, looping the line through the small holes.

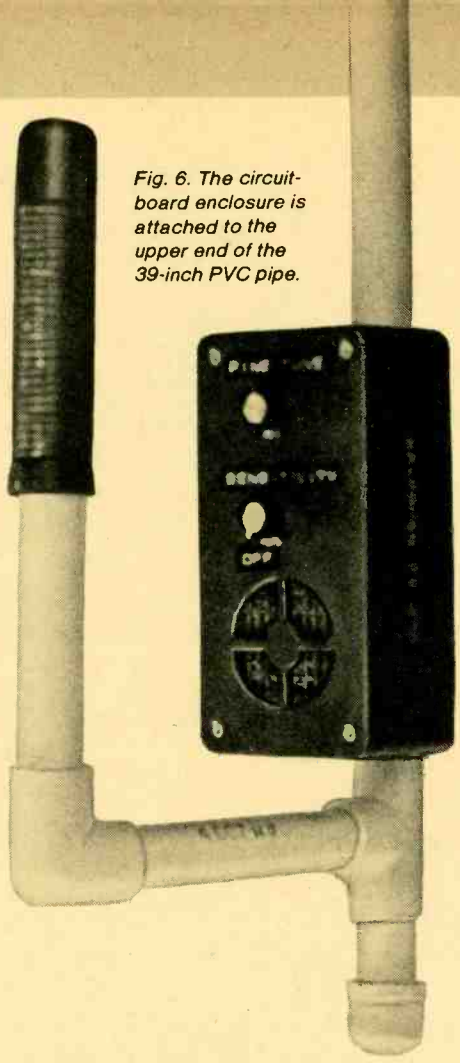

Fig. 6. The circuit-board enclosure is attached to the upper end of the 39-inch PVC pipe.

Using hot-melt or epoxy glue, cement a 135° elbow PVC pipe joint in the area between *L2* and *L3* so that its open end points toward the gap in *L1*. (See Fig. 5.) Cut a 39-inch length of 1/2-inch O.D., schedule 125 PVC pipe, and drill four 1/4-inch holes in it, one above the other, approximately 2 inches in from each end. The two holes at one end of the pipe section should be 2 inches apart from each other, but the holes at the other end can be closer. Also drill two 1/8-inch holes spaced 1/2 inch above and below the two holes spaced 2 inches apart.

Slip the free ends of the shielded cables exiting the circuit-board enclosure through the 1/4-inch holes that are bracketed by the smaller holes and pass the cables through the pipe until they protrude from the far end. Run a bead of hot-melt or epoxy glue on the pipe and attach the bottom of the project enclosure to the pipe. Added mechanical support can be introduced by driving self-tapping screws through the two small holes in the bottom of the enclosure and into the matching holes that were drilled into the pipe section.

Feed the free ends of the shielded cables through the two holes at the other end of the pipe. Insert that end of the pipe into the elbow joint attached to the plywood disc so that the circuit enclosure faces away from the coil assembly. Then glue the pipe to the elbow joint using PVC cement, maintaining the orientation of the enclosure with respect to the coil assembly. (Note that PVC cement sets quickly.) Solder the conductors of the color-coded cable to the transmitting coil and the conductors of the other cable to the receiving coil. The polarities of these connections are unimportant. Connect the coil shield leads to the outer cable conductors. Insulate the solder joints using PVC electrical tape, silicone cement, or some other suitable material. Then cement the cables to the plywood disc in the area between *L3* and the gap in *L1* using hot-melt or epoxy glue.

Cut 6- and 9-inch lengths of 1/2-inch O.D., schedule 40 PVC pipe. Referring to Fig. 6, assemble a handle using the lengths of pipe, a 90° elbow PVC pipe joint, a tee PVC pipe joint, a bicycle steering-bar handgrip and PVC cement. The handgrip is glued to the 9-inch section of pipe, and one of the two collinear openings of the tee should be glued to the 39-inch pipe section to which the circuit-board enclosure and the search coil assembly are attached. PVC cement is fast-setting, so work quickly and orient the handle with respect to the circuit-board enclosure as it is in Fig. 6. The remaining end of the tee will be left open until the detector is balanced.

Apply power to the circuit and reconnect the oscilloscope probe between the collector of *Q3* and circuit ground. Suspend the search coil in the air away from any metal and rotate the shaft of *R29* to its minimum-sensitivity setting. Monitor the scope trace and, if necessary, slightly adjust the position of *L3* so that a 1-volt p-p signal appears at the collector of *Q3*. Pass a pair of pliers approximately three inches under the search-coil assembly while monitoring the scope trace. If the signal level decreases, shift *L3* through the null point and repeat the test. The signal must in-

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crease in amplitude when the pliers are brought near the search-coil assembly, or the detector will ignore coins and respond to the proximity of ferrous objects. Receiving coil *L3* should be positioned as close to the null point as possible yet still provide an increase in signal amplitude when iron or steel is brought near the search-coil assembly.

Next, pass a dime about three inches under the search coil and note the slight increase in signal level as displayed on the oscilloscope. Carefully fix the positions of the coils by bonding them to the plywood disc with quick-setting epoxy cement. When the epoxy has cured, remove the scope probe and button up the circuit-board enclosure. Advance the setting of the SENSITIVITY control until the speaker begins to beep. Then adjust the FINE TUNE control to silence the speaker. Pass a pair of pliers three inches below the search coil and note that the speaker remains silent. Then pass a dime three inches under the coil and note that the speaker starts to beep. The most sensitive area of the search coil is near its center.

The search-coil assembly can be coated with two thin applications of resin to seal it, and then it can be painted white so that it matches the PVC pipe. The coils must be bonded securely to the disc before the application of sealant and paint. To minimize the possibility of displacing the coils, use spray-on resin and paint.

If the coils have shifted position before the resin has cured, a compensating piece of iron or steel can be added to the search-coil assembly. Determine whether this has in fact happened by removing the top of the circuit-board enclosure and reconnecting the oscilloscope probe between the collector of *Q3* and circuit ground. Pass a ferrous object three inches below the search coil and monitor the scope trace. If the proximity of iron or steel causes a decrease in signal level, position a small steel washer on or near receiving coil *L3* to correct for the misalignment. Locate the required position by repeating the test for iron sensitivity and shifting the location of the washer until the correct response is obtained. Then fix the washer in place with epoxy cement.

Final Assembly and Use. Grasp the Coinshooter by its handgrip and check it for proper balance. The search-coil assembly should be parallel with and approximately 2 inches above the floor. Cut a 3-inch piece of ½-inch O.D., schedule 125 PVC pipe, and glue one end of it to a PVC pipe cap. Fill the pipe section with lead buckshot and tape its open end closed with PVC electrical tape. Then tape the shot-laden pipe section to the open end of the tee PVC pipe joint and recheck the balance of the project.

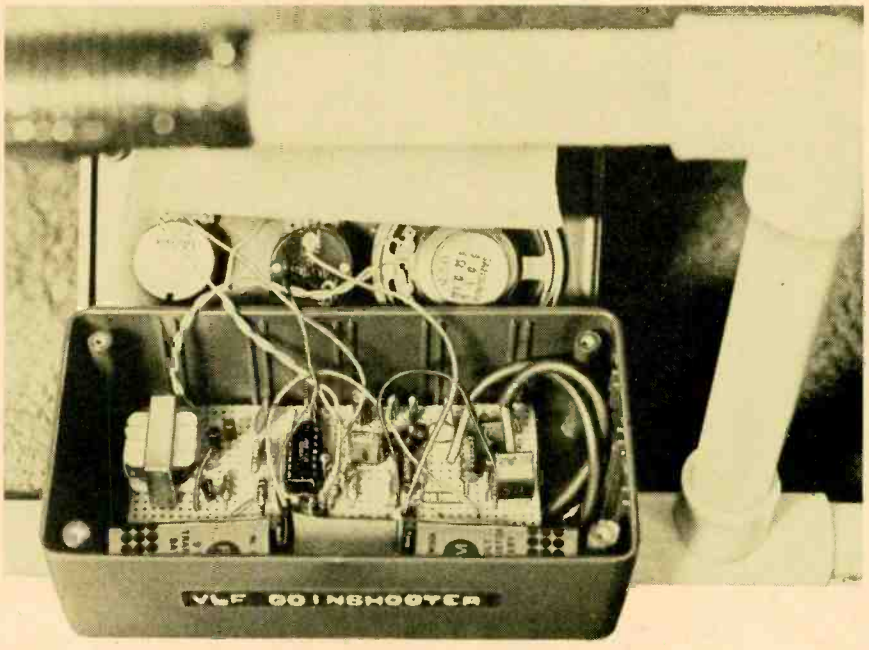
If it is unbalanced, untape the shot-laden pipe section, remove a little shot, tape the section closed again and reattach it to the tee PVC pipe joint. Recheck the balance of the Coinshooter. If necessary, repeat this procedure until the Coinshooter is properly balanced and feels comfortable to the hand. When the correct amount of shot has been determined, remove the pipe section from the tee PVC pipe joint, seal the shot in the pipe section with epoxy, and cement the section to the tee after the epoxy has cured. This completes assembly.

Take the finished project outdoors and hold the search coil 4 to 6 inches above the ground. Apply power to the project and adjust its controls so that the speaker emits a slow series of beeps. Lower the search coil until it is approximately 2 inches above the ground. The beeping should stop. This occurs because most soil is mineralized and affects the Coinshooter much like ferrous objects do.

The detector is now at maximum sensitivity and will detect coins at depths of from 1 to 3 inches, depending on their sizes and positions. Ferrous objects will not trigger the circuit unless they are very large or very close to the search coil or both. The Coinshooter will detect aluminum cans, caps and pull tabs, but it responds best to coins. Raise the search coil from time to time to check for the slow beeps that indicate maximum detector sensitivity. Although the circuit is very stable, the FINE TUNE control might have to be adjusted occasionally to compensate for changes in ground mineralization, temperature, and, if an unregulated power supply is used, battery voltage.

Always hold the Coinshooter so that the search-coil assembly is 1 to 2 inches above and parallel to the ground. Try to keep the search coil at a constant height above the ground. Swing the loop back and forth in front of you, making overlapping arcs. It is best to search slowly, but a coin will usually be detected even if the search coil passes over it quickly. For best results, operate the circuit as close to its switching threshold as possible.

When an object has been detected, move the search-coil assembly over it from front to back and from side to side to pinpoint its location. Keep in mind that the center of the search-coil assembly is its most sensitive point. Probe for the object with a small screwdriver or similar digging tool. If you search for coins in parks and woodlands, do so without disturbing the landscape. Always fill any holes that you make with your digging tool and place any turf that has been disturbed back in its original position. ◇



Photograph shows the circuit-board enclosure mounted on the PVC pipe. The top has been unfastened and laid aside.

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A SIGNAL-PROCESSOR PATCH BOX

Simple switching facility allows easy rearrangement of outboard audio gear

BY MICHAEL N. STOSICH

A WIDE variety of outboard signal processors is available for connection to home audio systems, but using them is often a problem—particularly if several are in tandem and one wishes to make a tape of the processed signal. The problem, simply, is that preamps, integrated amplifiers, and receivers don't have enough connection facilities to conveniently accommodate all the extra "black boxes" one might need.

Let's say, for example, that you want to prepare a tape of a 78-rpm disc that is scratched, noisy, and lacking in bass. You would probably use something like an SAE 5000 impulse noise reducer to de-click it, then feed the signal to a Burwen 1201 to de-hiss it, and finally, run the signal through a graphic equalizer to boost the bass.

It is possible to hook all these up in tandem via the TAPE MONITOR on your control center—be it a receiver, integrated amp, or preamp—and bypass each with its own TAPE MONITOR when its use is not desired. However, you'll still have a problem dubbing tapes without reconnection, unless your system can handle two or more recorders and has dubbing facilities. Even then, you'll only be able to dub in one direction—if you want to use the signal-processing facilities. There is a better way: a switching panel that can arrange and vary the interconnection of components via switching. A schematic is shown below.

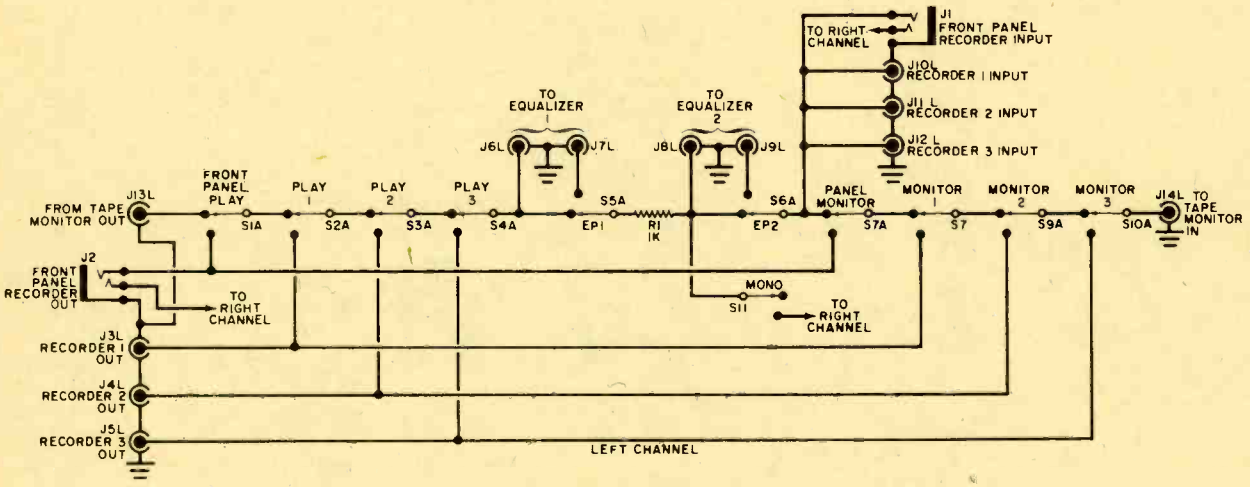
The Panel. The switch box accommodates three recorders with provisions for a fourth one connected to a front-panel jack. You can listen to any phono, tuner, aux, or tape recorder with or without processing, and if desired, record that signal. You can also dub between any of the recorders while processing the signal and still use the other preamp functions. A MONO switch is located in the circuit, to allow output summation after the pop/scratch filter. The second external loop exists for the rare instance when you have a single-channel processing device. In that case, the sum of the two channels is fed to the single-channel device via the MONO switch. When the EP_2 switch is operated, a *Y*-connector is fed out to both tape feeds. Normal stereo processors can also be added to the EP_2 loop.

Construction. If you want to give your switch box a raw metallic look, use an aluminum rack panel. If you want to paint it, use a pre-painted panel of any color, and spray paint it as desired. You can also purchase an anodized panel for a professional look.

Use an aluminum box that fits the panel which holds the 24 RCA jacks. Mount those jacks on the rear of the box and the 1/4-inch stereo jacks on the front. It is also possible to use another sheet of metal to mount the RCA jacks, and then mount the entire unit to the rear of the front panel, using 1- to 2-inch spacers. Shielded cable should be used wherever practicable, to minimize crosscoupling.

Operation. Connect the switch panel's amplifier jacks to the TAPE and MONITOR jacks of the preamp or receiver. When the preamp's MONITOR switch is on, it is extended to the switch panel. Then you can leave that switch depressed. Now connect your tape recorders and external processing devices to the panel.

To play a record or tuner with signal processing, simply play it as usual with the appropriate EQ switch. Thus, you can record the signal just as it sounds from the speakers. To hear the sound as it is being recorded, use the MONITOR. Signal processing will also work for any or all of the recorders in this scheme. When dubbing from one deck to another, it is possible to listen to the radio or phonograph by deactivating the MONITOR. ◇



PARTS LIST

J1, J2 — 1/4" stereo phone jack
J3L through J14L, J3R through J14R — RCA phono jack
R1,R2 — 1 kΩ, 1/2-W resistor
S1 through S10 — Dpdt switch
S11 — Spdt switch

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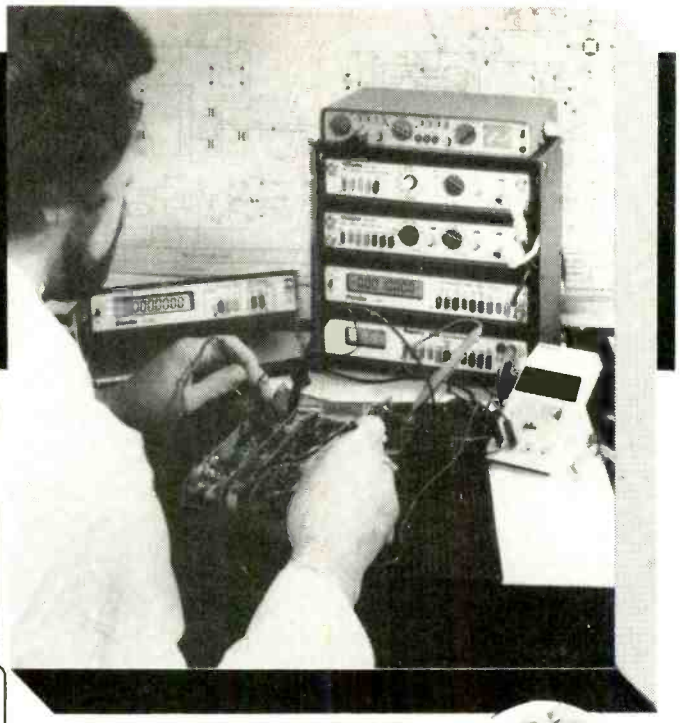
THANDAR'S COMPLETE PORTABLE TEST BENCH



LCD HAND HELD MULTIMETER

$79.95

TM354 3½ Digit

● DC Volts 1mV to 1000V ● AC Volts : 1V to 500V AC rms ● DC current : 1μA to 2A ● Resistance : 1Ω to 2MΩ ● Diode Check ● Basic accuracy : ± (0.75% of reading + 1 digit) ● Battery life : Typically 2000 hours

2000 hrs BATTERY LIFE

LCD BENCH MULTIMETERS

4000 hrs BATTERY LIFE

$199 inc.batts

TM351 3½ Digit

● DC and AC Volts : 100μV to 1000V (750V AC rms) ● DC and AC current : 100nA to 10A (20A for 10 secs) ● Resistance : 100mΩ to 20MΩ ● Diode check ● Basic accuracy : ± (0.1% of reading + 1 digit) ● Battery life : up to 4000 hours

TM353 3½ Digit

● DC and AC Volts : 100μV to 1000V (750V AC rms) ● DC and AC current : 100nA to 2A ● Resistance : 1Ω to 20MΩ ● Diode check ● Basic accuracy : ± (0.25% of reading + 1 digit) ● Battery life : Typically >3000 hours ● $159 (inc. batts).

LED MULTIMETERS

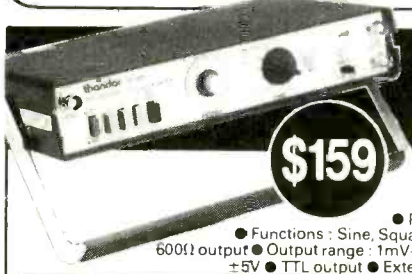
$99.95

DM350 3½ Digit; 34 ranges; 0.1% basic accuracy;

DM235 3½ Digit; 21 ranges; 0.5% basic accuracy; $69.95

PDM35 3½ Digit; Hand held; 16 ranges; 1% basic accuracy; $39.95

PULSE & FUNCTION GENERATORS



$159

TG100 100kHz Function Generator

● Frequency range : 0.1Hz to 100kHz ● Functions : Sine, Square, Triangle and DC from variable 600Ω output ● Output range : 1mV-10V peak-peak ● DC offset range : ±5V ● TTL output ● External sweep : ≥300:1 linear range

STOP PRESS TG102 2MHz Function Generator $299

TG105 5MHz Pulse Generator

● Period : 200nsec to 200ms (5MHz to 5Hz) ● Pulse width : 100nsec to 100ms ● 50Ω output range : 0.1V-10V ● TTL output ● Sync. output ● Operating modes: run, external trigger, external gate, manual 1-shot or gate ● Complement and square wave ● $199

GOLD MEDAL WINNER

$259

SC110 SINGLE TRACE LOW POWER 2" OSCILLOSCOPE

This truly portable oscilloscope, the only British product to win a Gold Medal at the 1980 Brno Trade Fair, boasts the following specification: ● Bandwith : DC to 10MHz ● Sensitivity : 10mV/div to 50V/div ● Sweep Speeds : 0.1μsecs/div to 0.5 secs/div ● Power Requirements : 4 to 10V DC from 4 'C' cells or AC adaptor ● Size and weight : 255 × 150 × 40mm; 800gms excl. batteries

FREQUENCY METERS

$199 inc.batts

TF040 8-Digit LCD

● Frequency Range : 10Hz-40MHz (to 400MHz with TP600) ● Sensitivity : 40mV rms ● Timebase accuracy : better than 0.5 ppm ● Battery life : Typically 80 hours

TF200 8-Digit LCD

● Frequency Range : 10Hz-200MHz (to 600MHz with TP600) ● Sensitivity : 10mV rms 20Hz-100MHz, 30mV rms 10Hz-20Hz, 100MHz-200MHz ● Timebase accuracy : better than 0.3 ppm ● Battery life : Typically 200 hours ● $299 (inc. batts).

PFM200 8-Digit LED Hand Held Meter

● Frequency Range : 20Hz-200MHz (to 600MHz with TP600) ● Sensitivity : Typically 10mV ● Timebase accuracy : better than 2 ppm ● Battery life : Typically 10 hours ● $99.95

TP600 600MHz Prescaler

● Frequency Range : 40MHz to 600MHz ● Sensitivity : 10mV ● Output : Typically 500mV peak-peak ● $79

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COMPUTER BITS

By Carl Warren

This Is the Year of Software.

A STRIKING difference between the sixth annual West Coast Computer Faire this past April and previous shows was the large number of software vendors in attendance. And this time, the software being shown was of great value and indicated the power possessed by microcomputers.

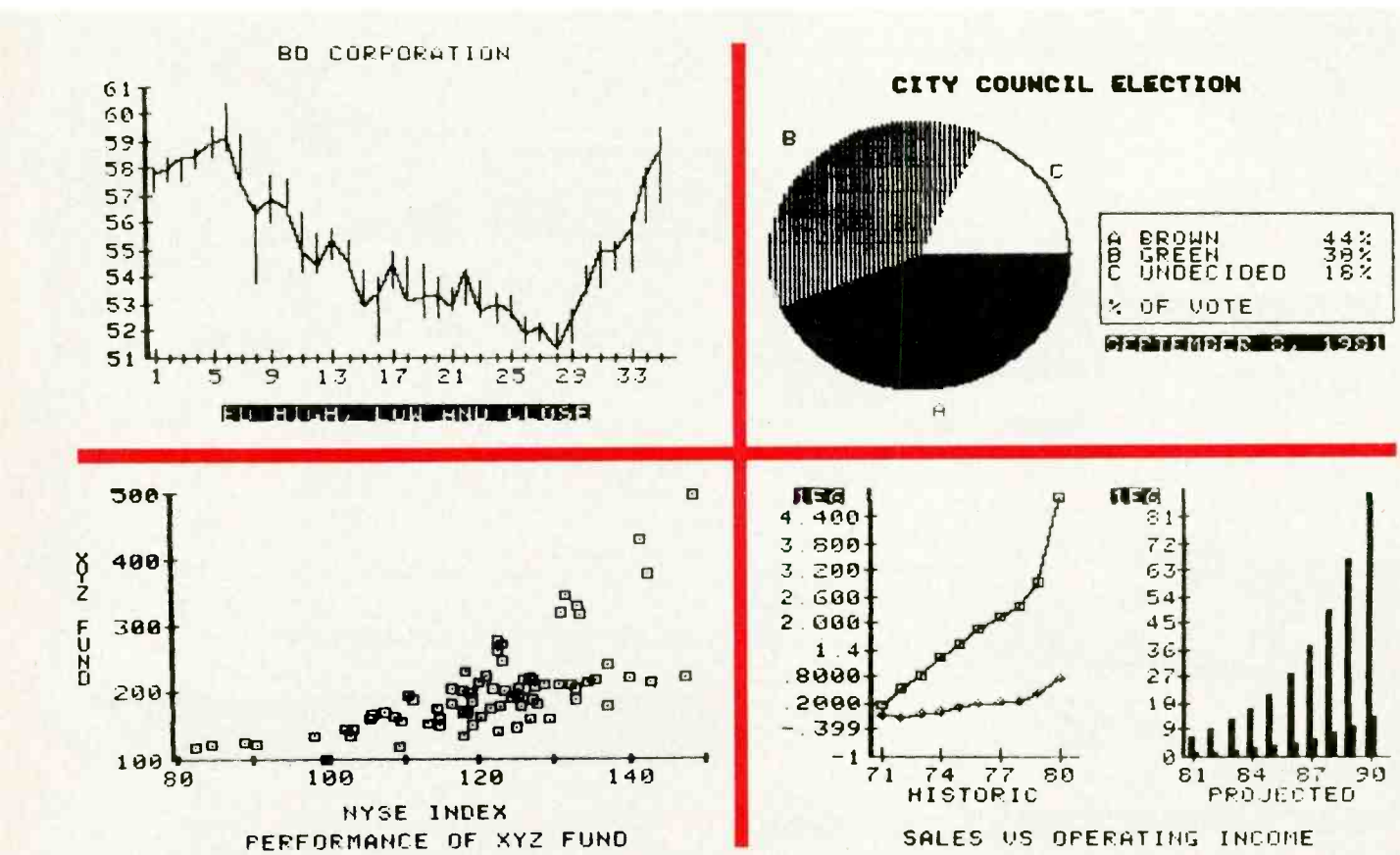
Sorcim for example, showed its latest piece of magic, called "Supercalc." This isn't just another electronic worksheet patterned off Personal Software's "Visicalc"; it's a powerful information-handling tool that happens to create spread sheets. The package lists for $295 and works with the CP/M operating system. Data entry is facilitated by using single keystroke inputs for commands and menu selections. Somewhat similar to Supercalc is Ashton-Tate's dBase II. This comes in two flavors: a $700 package for large CP/M systems that support anything from 5.25-in. floppies to 10M byte Winchesters, and a $350 package for the Apple II. The latter version has some unusual hooks in it, requiring a Microsoft Z80 Softcard, and Apple CP/M. To ensure proper operation of the package, and to prevent it from being loaded to larger machines, the Apple version uses part of the 6502 instruction set for certain mathematical functions.

The dBase II package is delivered as a demo diskette and a system diskette. The demo diskette lets you do everything you can do with dBase II, up to a maximum of 15 records in any one database. The purpose is twofold: first, to let you decide if this is really the package for you; and, second, to let you configure the database(s) the way you want them before committing yourself to the full package. If you decide it's for you—open the sealed and coded package.

I have been able to use dBase in a variety of ways. To make sure I fully understood the package (the documentation is good, but still needs refinement), George Tate, of Ashton-Tate, spent a day going over it with me.

One unique feature of dBase II is its built-in language. This nameless language was designed to permit the building of command files that will work on an automatic basis and require no operator intervention. However, the language is so powerful, using constructs very much like Pascal and Fortran, that you can create specialized applications.

Still on the information retrieval side, are four packages from Personal Software. Created to turn a personal com-



Sample printouts from the VisiPlot and VisiTrend/VisiPlot programs. Producible graphs include bar chart, scatter, pie, line, and high-low.

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puter into a powerful intelligent worksheet, four generic software packages dubbed Visiplot, Visitrend, Visidex, and Visiterm provide powerful general capabilities. These include calculations, data plotting, and financial or statistical analysis. Moreover, the packages exhibit great flexibility. Currently designed to operate on the Apple computer, they are visually oriented, and require no special programming skill. Additionally, all the programs have a mutually consistent command structure. Visiplot, for $179.95, produces high-resolution graphs and charts in six different formats and colors, without programming intervention on the part of the user. It can use numerical data entered directly or data generated by the popular Visicalc.

Visiplot's repertoire of "plots" includes bar graphs (cumulative and side-by-side), time-series-one plots, hi-lo charts, and scatter grams. A total of 645 data points is held in memory at one time and up to 150 data points can be plotted on a single graph. As an added feature, plots may be printed to either the Apple Silentype thermal printer, or the Integral Data Paper Tiger Models 440 and 445. Daisy wheel printers with graphics capability can also be used.

Combining the power of Visiplot with a forecasting program is Visitrend/Visiplot at $259.95. This package speeds time-consuming statistical calculations. Among the many types of trend analysis that can be performed are: descriptive statistical analysis, multiple linear regression, trend-like forecasting, data transformations, cumulatively total data values, generation of fitted and residual series, moving average, smoothing—line of best fit—and lead/lag and percent change. Since Visitrend works in tandem with Visiplot, the results of the calculations can be displayed graphically. And, like Visiplot, it can accept data either from direct keyboard input or from Visicalc files.

The third program in the series, Visidex, stores and provides rapid retrieval of unrelated information. Priced at $199.95, it permits information to be entered on the screen in free-form fashion in user-defined formats. Applications can include; tickler files, mail lists, to-do lists, memos, and virtually anything you now do on paper. Up to 36 six-letter keywords can be defined for any record, thus permitting access via multiple avenues. Also included in Visidex is a built-in calendar that facilitates retrieving information by date or, if your Apple is equipped with an onboard clock, automatically purge information on a given date or time or generate a reminder for you. This data can be sorted by keyword, numeric order, or by date and set for later print out.

The final package in the series, Visiterm, at $149.95, permits the transfer of disk file information over the phone. It is designed to work with files created by the other information packages and includes such features as single-key macro definitions, a configuration feature to match host systems, scrolling, and entry of information in upper or lower case.

All these packages are available now from Apple and Personal Software dealers on 16-sector formatted diskettes. Although there has been controvery over the command structure used in Personal Software packages, I have found them easy to learn. Personal Software supplies very informative manuals with its products. Of course, they won't do you any good if you don't read them.

That North Star Book. Many of you have written requesting more information on North Star BASIC, and where to get that book I thought had been written. The book is entitled: "A User's Guide to North Star BASIC" by Robert R. Rogers. About 100 copies of the first edition are still available at $14.95 plus $2.50 UPS charges. You can order by contacting Robert Rogers at Scott Randolph Labs, 5924 Allday, Houston, TX 77036. Phone: 713-975-1807. The author is currently working on a new edition that might be available before year's end.

Let's Communicate. I know that many of you are looking for a method of getting onto MicroNet or setting up your own system. Here's how. Contact Microperipheral Corp. (2643 151st, NE, Redmond, WA 98052; 206-881-7544) and order the Microconnection for your favorite system. The modem is priced at $199.50 with a terminal program; add another $79.95 for the autodial/autoanswer module. With this in hand, you can set up your own network.

A question that has been asked about the Microperipheral modem is: why does it use a separate power supply, rather than deriving the power from the phone line? The answer, according to Microperipheral's Don Stoner, is that telephone line voltages tend to vary too much around the country, and, should a line spike occur, damage to the modem would be likely.

There seems to be a growing mass of evidence to support this design decision. A number of users on MNet have reported difficulties with modems powered from the phone line and have found it necessary to add pull-up resistors to force a higher voltage or add a power supply of their own. Pat McMullen, a technician with whom I do a great deal of work, and I ran a number of tests with various modems to determine whether or not they could work under a wide range of conditions. Our purpose was to choose a modem that could be implemented in a message network, of which we will divulge the number before the end of the year. We decided that the Microconnection met all our needs, and have it installed on the TRS-80, Heath H-89, and an S-100 bus system. Later, we will use it with the Apple II. So far, after two months, no problems. ◇

NEW!!! THE *
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for S100, Elf II, Apple, TRS-80 Level II*

From $99.95 kit

Now — teach your computer to talk, dramatically increasing the interaction between you and your machine.

That's right: the ELECTRIC MOUTH actually lets your computer talk! Installed and on-line in just minutes, it's ready for spoken-language use in office, business, industrial and commercial applications, in games, special projects, R&D, education, security devices — there's no end to the ELECTRIC MOUTH's usefulness. Look at these features:

- ★ Supplied with 143 words/letters/ phonemes/ numbers, capable of producing hundreds of words and phrases.
- ★ Expandable on-board up to thousands of words and phrases (just add additional speech ROMs as they become available).
- ★ Four models, which plug directly into S100, Apple, Elf II and TRS-80 Level II computers.
- ★ Get it to talk by using either Basic or machine language (very easy to use, complete instructions with examples included).
- ★ Uses National Semiconductor's "Digitalker" system.
- ★ Includes on-board audio amplifier and speaker, with provisions for external speakers and amplifier.
- ★ Adds a new dimension and excitement to programming: lets you modify existing programs and games to add spoken announcements of results, warnings, etc.
- ★ Installs in just minutes.

Principle of Operation: The ELECTRIC MOUTH stores words in their digital equivalents in ROMs. When words, phrases, and phonemes are desired, they are simply called for by your program and then synthesized into speech. The ELECTRIC MOUTH system requires none of your valuable memory space except for a few addresses if used in memory mapped mode. In most cases, output ports (user selectable) are used.

Spoken Material Included

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two	nineteen	cancel	down	is	of	second	d	u
three	twenty	case	equal	it	off	set	e	v
four	thirty	cent	error	kilo	on	space	f	w
five	forty	400hertz tone	feet	left	out	speed	g	x
six	fifty	80hertz tone	flow	less	over	star	h	y
seven	sixty	20ms silence	fuel	lesser	parenthesis	start	i	z
eight	seventy	40ms silence	gallon	limit	percent	stop	j	
nine	eighty	80ms silence	go	low	please	than	k	
ten	ninety	160ms silence	gram	lower	plus	the	l	
eleven	hundred	320ms silence	great	mark	point	time	m	
twelve	thousand	certi	greater	meter	pound	try	n	
thirteen	million	check	have	mile	pulses	up	o	
fourteen	zero	comma	high	milli	rate	volt	p	
fifteen	again	control	higher	minus	re	weight	q	
sixteen	ampere	danger	hour	minute	ready	a	r	
seventeen	and	degree	in	near	right	b	s	

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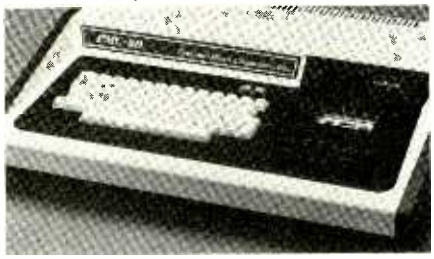
COMPUTER SOURCES

By Leslie Solomon
Senior Technical Editor

Hardware

New Computer. The PMC-80 is designed to fill the niche left by Radio Shack's withdrawal of the TRS-80 Model I. It is fully compatible with the TRS-80 in software and operations. It features a high-speed cassette port, interfaces for disk, printer, RS232B, and an S-100 bus. The basic "Stripper" version that requires an external r-f modulator and TV receiver is $675 and includes 16K and built-in level-2 BASIC, while the "Startup" version that includes a video monitor is $834. **Address:** Personal Micro Computers, Inc., 475 Ellis St., Mt. View, CA 94043 (Tel: 415-962-0220).



SS50 Multifloppies. The DMA Disk Controller uses DMA (direct memory access) for data transfer and can support any combination of 8", 5", single/double track (48/96 tpi), single/double density, and up to four drives total. It can be used with 6809 systems ($548.68). The Double Density PIO Controller supports up to four 5" single/double headed, single/double track, single/double density drives (6809 version $348.28). The 5/8 Disk Controller can be used with 6800/6809 systems and supports any combination of 8" or 5", single/double headed, single/double track, and up to four drives total. In 6800 systems only 5" drives can be used. This board is a replacement for the SWTP DC-1, -2, or -3 controller ($226.58). Available software includes 6809 FLEX DOS, OS-9 for all three controllers, and UniFLEX for the DMA controller. **Address:** GIMIX Inc., 1337 West 37th Place, Chicago, IL 60609 (Tel: 312-927-5510).

TRS-80 Printer. Printer V for the TRS-80 is designed for business use and features a bidirectional, logic-seeking, 7x9 dot-matrix upper- and lower-case characters with descenders, and 132 columns. It has software-selectable 5, 7.5, 10, or 15 characters/inch, 26 European characters, and 30 graphics patterns. Print speed is 160 characters per second, 60 lines per minute. The tractor feed handles fanfold paper up to 15" wide and up to 5 sheets, and is adjustable in 1/8-line increments. It has a full set of indicators, controls, and self test. $1860. Sold in Radio Shack Computer Centers and stores.

S-100 Video Board. The VB3 Video Board for S-100 systems features 48, 80-character lines, upper/lower case, and true descenders. A second RAM block contains "attribute" bytes for user programming, low intensity, reverse video, underscore, strike through, thin line, or dot graphics. Bank switching occupies memory only when activated. It generates both US and European TV rates. Software includes CP/M-compatible driver and terminal simulator. Software controlled options include timing loop, top and bottom margins, horizontal position, inverted video, (2×4) graphic character, one level of gray, blinking character, underline, blankout character, and cursor. $654 assembled/tested. A 24-line by 80-character version is $565. **Address:** SSM Microcomputer Products Inc., 2190 Paragon Drive, San Jose, CA 95131 (Tel: 408-946-7400).

4 Winchesters on one OSI C3-C. OSI C3-C (CD-23) users can now have up to four SA4008 (CD-23) hard disk systems on one computer. The board has a built in power supply, and the only connections to be made are the controller-to-interface cables, the ac power, and one 50-conductor cable to each drive. $845. **Address:** Terry Electronic Assembly Co., Inc., Box E, 2117 Ohio St., Michigan City, IN 46360 (Tel: 219-874-6234).

H-89 Double Density. This new controller supports up to four 8" and four 5" disk drives. A 5" double-sided, 96-tpi drive holds 700K bytes, and an 8" double-sided drive holds over 1.2M bytes. Four drives give the user 7.6M bytes. The controller can handle any combination of 8" and 5" 40- or 80-track drives in either single- or double-sided versions. It is compatible with the Corvus 10 and 20M byte Winchesters, and Cameo 5+5 Cartridge Disk subsystem. Includes CP/M 2.2. $595. **Address:** Magnolia Microsystems Inc., 2812 Thorndyke Ave., West, Seattle, WA 98199 (Tel: 800-426-2841).

Atari Upgrade. The MagiCard plug-in module for the Atari contains 1K bytes of RAM and a 2K ROM monitor that converts the system into a hobby computer. Commands include exam and fill memory, disassembly, and running user-written programs. Subroutines to display text or memory-mapped color graphics are also provided. Sample pro-

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grams and a cassette interface program further extends the use. $49.88. **Address:** Computer Magic Inc., Box 3383P, Fox Valley Center, Aurora, IL 60505.

PET Disk. The PEDISK II comes as 5" or 8" with a small disk controller board that fits inside the machine and contains the PDOS in ROM. Up to three drives can be controlled. The 5" size offers 143K bytes ($595), and the dual 5" quad density system provides 572K bytes ($1195). It is compatible

with all Commodore disk systems and can be used simultaneously. The PDOS II software package includes BASIC commands such as OPEN, CLOSE, INPUT, and PRINT, all used for file handling. The DOS also contains diagnostic and utility functions. **Address:** CGRS Microtech, Inc., Box 102, Langhorne, PA 19047 (Tel: 215-757-0284).

Low-Cost Printer. The Bytewriter-1 is an 80-column, 7 × 7 dot-matrix printer that accepts single sheet or roll paper up to 8½" wide and prints at 60 lines per minute. The interface is similar, but not identical, to a Centronics parallel interface and has been designed to operate with the Apple II, Atari 400/800, and all models of the TRS-80. $299 (interface cable slightly extra). **Address:** Microtek, Inc., 9514 Chesapeake Dr., San Diego, CA 92123 (Tel: 714-278-0633).

Software

ZX80/Microace Games. The Chest of Classics is a cassette containing four games for the Sinclair ZX80 and the Microace computers. The games are Life (machine language that allows 1000 generations per minute), Lunar Lander, Mindmaster, and K-Trek, a variation of Star Trek. Complete BASIC listings are provided as well as a color keyboard overlay. $9.95. A free catalog and ZX80 coding sheets are available. **Address:** Lamo-Lem Laboratories, Box 2382, La Jolla, CA 92038 (Tel: 714-262-5681).

Data Abstraction Language. DATABS, a data abstraction language for the 8080 runs under CP/M and was inspired by the MIT developed CLU language. Types include boolean, character, single- and double-byte integer, and string. It allows user-defined types with dynamic storage mechanism. It supports UNIX+ style command line arguments and I/O redirection. Stream abstraction allows terminal and disk I/O. Requires 40K. Diskette includes the compiler, type and run-time support library, stream abstraction, and command line processor. $49.95. **Address:** Softronics, 36 Homestead Lane, Roosevelt, NJ 08555.

TRS-80 Game. The Everest Explorer is a simulation game for the TRS-80. In it, the user needs to select manpower, food, fuel, shelter and oxygen to support the climb. Other factors include weather, climber condition, and morale. Uses Model I, Level II, and 16K. Cassette is $14.95. A 32K disk version is $20.95. **Address:** Acorn Software Products, 634 North Carolina Ave., SE, Washington, DC 20003 (Tel: 202-544-4259).

6809 UniFLEX. Written in 6809 assembler language, the UniFLEX operating system is a full disk, sort/merge package for easy operator interface and fast sorts. Any size or type file may be sorted with parameters supplied as part of the command line through the use of a parameter editor, or in an existing parameter file. It can also merge on previously sorted files. Other features include any size fixed or variable-length input records, fixed or variable-length fields, up to 250 input/output keys, key length up to 250 characters, supports ascending or descending and right or left justified keys, user-definable sorting sequence, run-time messages, and record select/exclude. License is $100. **Address:** Technical Systems Consultants, Inc., Box 2570, West Lafayette, IN 47906 (Tel: 317-463-2502).

C Language. The C programming language is available for Cromemco Z-80A based, S-100 systems operating under multi/user, multi/tasking CROMIX operating system. It produces relocatable code that can be linked with FORTRAN, COBOL, and assembly language, or called from BASIC. This powerful language is effective for writing operating systems, languages, utilities and I/O drivers, communication software, database management systems, file management software, and fast graphics software. Available on 5" (CCC-S), or 8" (CCC-L) diskettes. $595. **Address:** Cromemco, Inc., 280 Bernardo Ave., Mountain View, CA 94043 (Tel: 415-964-7400).

Stock Analysis. The STOCKPAK System for the TRS-80 is a Standard & Poor stock analysis and portfolio management package. It provides evaluation and management of a stock portfolio of up to 100 securities with as many as 30 transactions on each issue. It also allows analysis of 900 NY and American exchange and over-the-counter common stocks, and generates reports to guide

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investment decisions. It records buy and sell transactions, price and dividend information, and splits. It is designed for Model I or Model III 32K business systems and includes four diskettes. Optional monthly updating is available from Standard & Poor. $49.95. Sold at Radio Shack Computer Centers or stores.

Educational Programs. A series of programs written for an Apple II with 16K and disk, and especially designed as childrens teaching aids include hand/eye coordination programs such as Cooperation Maze, Write In Color, Make A Tune, and Computer Palette. Also counting programs such as Count to 10, Counting Fun, Counting Numbers Less Than 101, and Counting By *; and a series of programs in arithmetic, vocabulary, synonyms and antonyms, hard/soft consonants, syllables, word breakup, basic reading skills, etc. **Address:** Edutek Corp., 415 Cambridge #14, Palo Alto, CA 94306 (Tel: 415-325-9965).

Apple Word Processor. Using a 48K Apple II with disk and Applesoft in ROM, WRITE-ON!-I and II allows personalized letters, mailing labels, bills, checks, and the creation and maintenance of data files, merging, etc. Version II can preformat often-used text for faster printing. No computer training is required to use either version. Version I does not have data file merge. $99.50 for version I, $150 for II. **Address:** Rainbow Computing Inc., 9719 Resada Blvd., Northridge, CA 91324 (Tel: 213-349-5560).

PASCAL Utilities. Screen Handler is compatible with a variety of terminals making CRT data input simple. Extensive error checking and an easy-to-use system for storing and changing user prompts without reprogramming are provided ($75). Output Formatter makes reports easy to design and program. It includes tab, automatic page and line counter during program execution, and top of form routine ($37.50). Forms Generator includes an output formatter and additional software that allows an end user to redesign reports without programming ($49.50). **Address:** HDP Inc., 222 E. Anapamu St., Santa Barbara, CA 93101 (Tel: 805-965-4477).

Music and Animation. The Rainbow Writer is a graphics, text, music, and animation program for the Apple II. The program creates special effects using color, animation, alphabetics, shapes and sounds. It uses a simple menu-driven selection. Special character fonts can be created, or a selection can be made between nine sizes and 18 different colors of upper- and lower-case English or Greek letters. In the music mode, six chromatic octaves and special tonal effects can be produced. $39.95. **Address:** Personal Software Inc., 1330 Bordeaux Drive, Sunnyvale, CA 94086 (Tel: 408-745-7841). ◇

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SOLID-STATE DEVELOPMENTS

By Forrest M. Mims

Solid-State Speech

BY NOW, you have probably heard samples of solid-state speech produced by such devices as the Speak & Spell® educational trainer manufactured by Texas Instruments or the Voice Challenger® chess game by Fidelity Electronics. If not, you are in for a treat—amazing progress has been made in the field of digital speech generation.

My first exposure to solid-state speech occurred in 1975, when two companies demonstrated talking calculators at a conference on electronic aids for the blind. Both machines produced intelligible spoken renditions of the symbols and numbers marked on their keys as well as visual displays.

The speech quality of Speak & Spell is at least as good as that of the talking calculators. This is true even though Speak & Spell requires considerably less memory per spoken word. This is the result of highly sophisticated circuits that model the human vocal tract.

The latest speech-generation circuits are highly complex. The need for this complexity is explained by the nature of the human vocal tract. An in-depth discussion of the mechanism that converts streams of exhaled air into intelligence-bearing sounds is beyond the scope of this column. Suffice it to say that speech is generated by intricate cooperation of the diaphragm, lungs, vocal cords, air passages, resonant cavities (both fixed and adjustable ones), and the lips, tongue and teeth.

Generating Solid-State Speech. There are three major methods of generating solid-state speech. The first is the equivalent of the magnetic tape recorder. Spoken words are digitized by an analog-to-digital converter (ADC) and stored directly in memory. Solid-state speech is produced when the contents of the memory are clocked out of the mem-

(Continued on page 72)

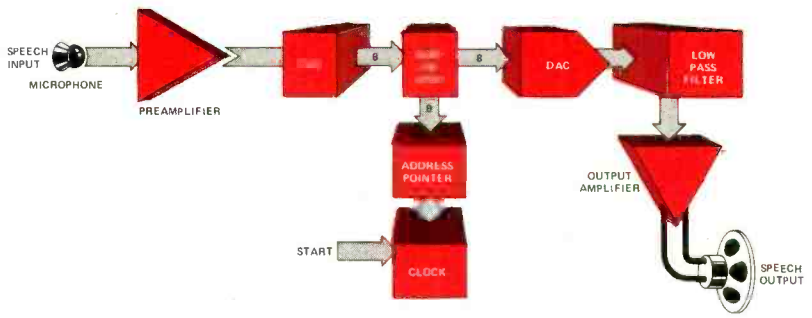

Fig. 1. Direct storage of speech in solid-state memory.

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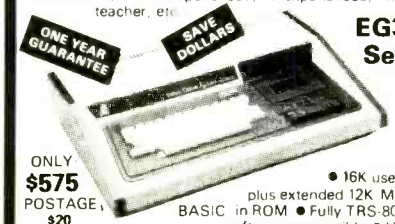

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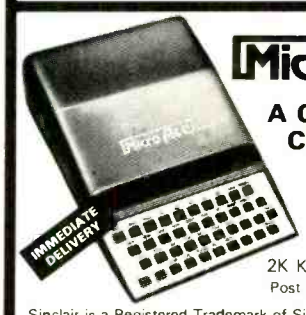

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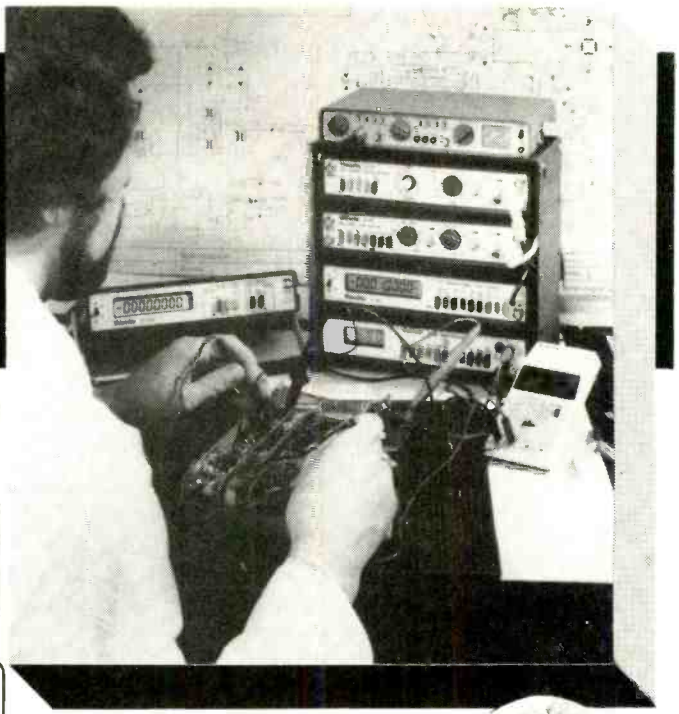

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COMPUTER BITS

By Carl Warren

This Is the Year of Software.

A STRIKING difference between the sixth annual West Coast Computer Faire this past April and previous shows was the large number of software vendors in attendance. And this time, the software being shown was of great value and indicated the power possessed by microcomputers.

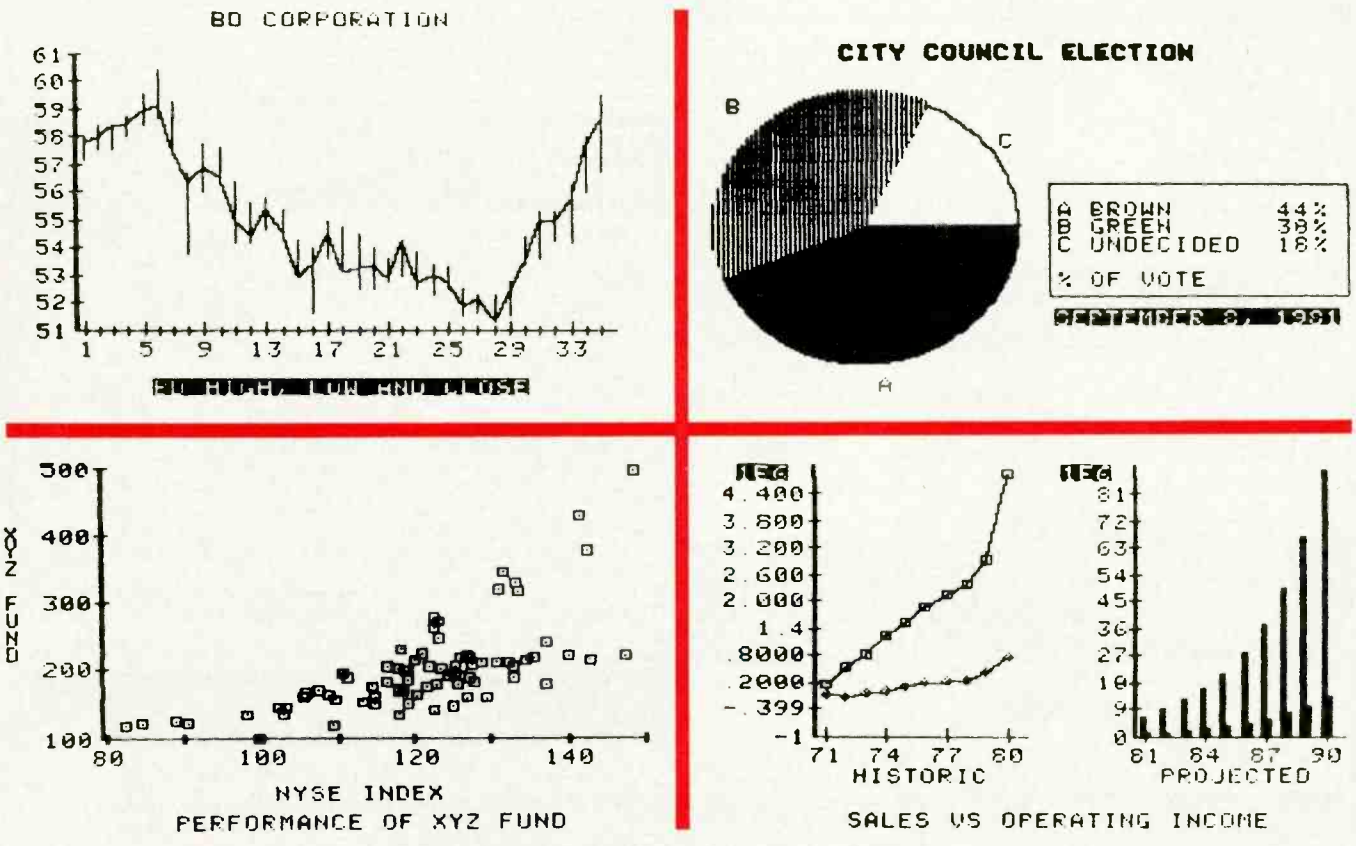
Sorcim for example, showed its latest piece of magic, called "Supercalc." This isn't just another electronic worksheet patterned off Personal Software's "Visicalc"; it's a powerful information-handling tool that happens to create spread sheets. The package lists for $295 and works with the CP/M operating system. Data entry is facilitated by using single keystroke inputs for commands and menu selections. Somewhat similar to Supercalc is Ashton-Tate's dBase II. This comes in two flavors: a $700 package for large CP/M systems that support anything from 5.25-in. floppies to 10M byte Winchesters, and a $350 package for the Apple II. The latter version has some unusual hooks in it, requiring a Microsoft Z80 Softcard, and Apple CP/M. To ensure proper operation of the package, and to prevent it from being loaded to larger machines, the Apple version uses part of the 6502 instruction set for certain mathematical functions.

The dBase II package is delivered as a demo diskette and a system diskette. The demo diskette lets you do everything you can do with dBase II, up to a maximum of 15 records in any one database. The purpose is twofold: first, to let you decide if this is really the package for you; and, second, to let you configure the database(s) the way you want them before committing yourself to the full package. If you decide it's for you—open the sealed and coded package.

I have been able to use dBase in a variety of ways. To make sure I fully understood the package (the documentation is good, but still needs refinement), George Tate, of Ashton-Tate, spent a day going over it with me.

One unique feature of dBase II is its built-in language. This nameless language was designed to permit the building of command files that will work on an automatic basis and require no operator intervention. However, the language is so powerful, using constructs very much like Pascal and Fortran, that you can create specialized applications.

Still on the information retrieval side, are four packages from Personal Software. Created to turn a personal com-



Sample printouts from the VisiPlot and VisiTrend/VisiPlot programs. Producible graphs include bar chart, scatter, pie, line, and high-low.

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puter into a powerful intelligent worksheet, four generic software packages dubbed Visiplot, Visitrend, Visidex, and Visiterm provide powerful general capabilities. These include calculations, data plotting, and financial or statistical analysis. Moreover, the packages exhibit great flexibility. Currently designed to operate on the Apple computer, they are visually oriented, and require no special programming skill. Additionally, all the programs have a mutually consistent command structure. Visiplot, for $179.95, produces high-resolution graphs and charts in six different formats and colors, without programming intervention on the part of the user. It can use numerical data entered directly or data generated by the popular Visicalc.

Visiplot's repertoire of "plots" includes bar graphs (cumulative and side-by-side), time-series-one plots, hi-lo charts, and scatter grams. A total of 645 data points is held in memory at one time and up to 150 data points can be plotted on a single graph. As an added feature, plots may be printed to either the Apple Silentype thermal printer, or the Integral Data Paper Tiger Models 440 and 445. Daisy wheel printers with graphics capability can also be used.

Combining the power of Visiplot with a forecasting program is Visitrend/Visiplot at $259.95. This package speeds time-consuming statistical calculations. Among the many types of trend analysis that can be performed are: descriptive statistical analysis, multiple linear regression, trend-like forecasting, data transformations, cumulatively total data values, generation of fitted and residual series, moving average, smoothing—line of best fit—and lead/lag and percent change. Since Visitrend works in tandem with Visiplot, the results of the calculations can be displayed graphically. And, like Visiplot, it can accept data either from direct keyboard input or from Visicalc files.

The third program in the series, Visidex, stores and provides rapid retrieval of unrelated information. Priced at $199.95, it permits information to be entered on the screen in free-form fashion in user-defined formats. Applications can include: tickler files, mail lists, to-do lists, memos, and virtually anything you now do on paper. Up to 36 six-letter keywords can be defined for any record, thus permitting access via multiple avenues. Also included in Visidex is a built-in calendar that facilitates retrieving information by date or, if your Apple is equipped with an onboard clock, automatically purge information on a given date or time or generate a reminder for you. This data can be sorted by keyword, numeric order, or by date and set for later print out.

The final package in the series, Visiterm, at $149.95, permits the transfer of disk file information over the phone. It is designed to work with files created by the other information packages and includes such features as single-key macro definitions, a configuration feature to match host systems, scrolling, and entry of information in upper or lower case.

All these packages are available now from Apple and Personal Software dealers on 16-sector formatted diskettes. Although there has been controvery over the command structure used in Personal Software packages, I have found them easy to learn. Personal Software supplies very informative manuals with its products. Of course, they won't do you any good if you don't read them.

That North Star Book. Many of you have written requesting more information on North Star BASIC, and where to get that book I thought had been written. The book is entitled: "A User's Guide to North Star BASIC" by Robert R. Rogers. About 100 copies of the first edition are still available at $14.95 plus $2.50 UPS charges. You can order by contacting Robert Rogers at Scott Randolph Labs, 5924 Allday, Houston, TX 77036. Phone: 713-975-1807. The author is currently working on a new edition that might be available before year's end.

Let's Communicate. I know that many of you are looking for a method of getting onto MicroNet or setting up your own system. Here's how. Contact Microperipheral Corp. (2643 151st, NE, Redmond, WA 98052; 206-881-7544) and order the Microconnection for your favorite system. The modem is priced at $199.50 with a terminal program; add another $79.95 for the autodial/autoanswer module. With this in hand, you can set up your own network.

A question that has been asked about the Microperipheral modem is: why does it use a separate power supply, rather than deriving the power from the phone line? The answer, according to Microperipheral's Don Stoner, is that telephone line voltages tend to vary too much around the country, and, should a line spike occur, damage to the modem would be likely.

There seems to be a growing mass of evidence to support this design decision. A number of users on MNet have reported difficulties with modems powered from the phone line and have found it necessary to add pull-up resistors to force a higher voltage or add a power supply of their own. Pat McMullen, a technician with whom I do a great deal of work, and I ran a number of tests with various modems to determine whether or not they could work under a wide range of conditions. Our purpose was to choose a modem that could be implemented in a message network, of which we will divulge the number before the end of the year. We decided that the Microconnection met all our needs, and have it installed on the TRS-80, Heath H-89, and an S-100 bus system. Later, we will use it with the Apple II. So far, after two months, no problems. ◇

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five	forty	400hertz tone	feet	left	out	speed	g
six	fifty	80hertz tone	flow	less	over	star	h
seven	sixty	20ms silence	fuel	lesser	parenthesis	start	i
eight	seventy	40ms silence	gallon	limit	percent	stop	j
nine	eighty	80ms silence	go	low	please	than	k
ten	ninety	160ms silence	gram	lower	plus	the	l
eleven	hundred	320ms silence	great	mark	point	time	m
twelve	thousand	centi	greater	meter	pound	try	n
thirteen	million	check	have	mile	pulses	up	o
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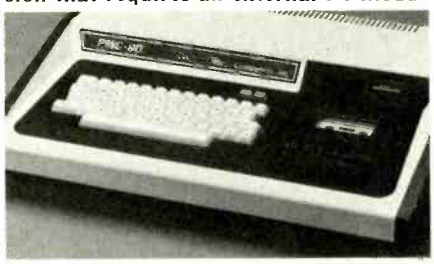
COMPUTER SOURCES

By Leslie Solomon
Senior Technical Editor

Hardware

New Computer. The PMC-80 is designed to fill the niche left by Radio Shack's withdrawal of the TRS-80 Model I. It is fully compatible with the TRS-80 in software and operations. It features a high-speed cassette port, interfaces for disk, printer, RS232B, and an S-100 bus. The basic "Stripper" version that requires an external r-f modulator and TV receiver is $675 and includes 16K and built-in level-2 BASIC, while the "Startup" version that includes a video monitor is $834. **Address:** Personal Micro Computers, Inc., 475 Ellis St., Mt. View, CA 94043 (Tel: 415-962-0220).



SS50 Multifloppies. The DMA Disk Controller uses DMA (direct memory access) for data transfer and can support any combination of 8", 5", single/double track (48/96 tpi), single/double density, and up to four drives total. It can be used with 6809 systems ($548.68). The Double Density PIO Controller supports up to four 5" single/double headed, single/double track, single/double density drives (6809 version $348.28). The 5/8 Disk Controller can be used with 6800/6809 systems and supports any combination of 8" or 5", single/double headed, single/double track, and up to four drives total. In 6800 systems only 5" drives can be used. This board is a replacement for the SWTP DC-1, -2, or -3 controller ($226.58). Available software includes 6809 FLEX DOS, OS-9 for all three controllers, and UniFLEX for the DMA controller. **Address:** GIMIX Inc., 1337 West 37th Place, Chicago, IL 60609 (Tel: 312-927-5510).

TRS-80 Printer. Printer V for the TRS-80 is designed for business use and features a bidirectional, logic-seeking, 7x9 dot-matrix upper- and lower-case characters with descenders, and 132 columns. It has software-selectable 5, 7.5, 10, or 15 characters/inch, 26 European characters, and 30 graphics patterns. Print speed is 160 characters per second, 60 lines per minute. The tractor feed handles fanfold paper up to 15" wide and up to 5 sheets, and is adjustable in 1/8-line increments. It has a full set of indicators, controls, and self test. $1860. Sold in Radio Shack Computer Centers and stores.

S-100 Video Board. The VB3 Video Board for S-100 systems features 48, 80-character lines, upper/lower case, and true descenders. A second RAM block contains "attribute" bytes for user programming, low intensity, reverse video, underscore, strike through, thin line, or dot graphics. Bank switching occupies memory only when activated. It generates both US and European TV rates. Software includes CP/M-compatible driver and terminal simulator. Software controlled options include timing loop, top and bottom margins, horizontal position, inverted video, (2×4) graphic character, one level of gray, blinking character, underline, blankout character, and cursor. $654 assembled/tested. A 24-line by 80-character version is $565. **Address:** SSM Microcomputer Products Inc., 2190 Paragon Drive, San Jose, CA 95131 (Tel: 408-946-7400).

4 Winchesters on one OSI C3-C. OSI C3-C (CD-23) users can now have up to four SA4008 (CD-23) hard disk systems on one computer. The board has a built in power supply, and the only connections to be made are the controller-to-interface cables, the ac power, and one 50-conductor cable to each drive. $845. **Address:** Terry Electronic Assembly Co., Inc., Box E, 2117 Ohio St., Michigan City, IN 46360 (Tel: 219-874-6234).

H-89 Double Density. This new controller supports up to four 8" and four 5" disk drives. A 5" double-sided, 96-tpi drive holds 700K bytes, and an 8" double-sided drive holds over 1.2M bytes. Four drives give the user 7.6M bytes. The controller can handle any combination of 8" and 5" 40- or 80-track drives in either single- or double-sided versions. It is compatible with the Corvus 10 and 20M byte Winchesters, and Cameo 5+5 Cartridge Disk subsystem. Includes CP/M 2.2. $595. **Address:** Magnolia Microsystems Inc., 2812 Thorndyke Ave., West, Seattle, WA 98199 (Tel: 800-426-2841).

Atari Upgrade. The MagiCard plug-in module for the Atari contains 1K bytes of RAM and a 2K ROM monitor that converts the system into a hobby computer. Commands include exam and fill memory, disassembly, and running user-written programs. Subroutines to display text or memory-mapped color graphics are also provided. Sample pro-

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grams and a cassette interface program further extends the use. $49.88. **Address:** Computer Magic Inc., Box 3383P, Fox Valley Center, Aurora, IL 60505.

PET Disk. The PEDISK II comes as 5" or 8" with a small disk controller board that fits inside the machine and contains the PDOS in ROM. Up to three drives can be controlled. The 5" size offers 143K bytes ($595), and the dual 5" quad density system provides 572K bytes ($1195). It is compatible

with all Commodore disk systems and can be used simultaneously. The PDOS II software package includes BASIC commands such as OPEN, CLOSE, INPUT, and PRINT, all used for file handling. The DOS also contains diagnostic and utility functions. **Address:** CGRS Microtech, Inc., Box 102, Langhorne, PA 19047 (Tel: 215-757-0284).

Low-Cost Printer. The Bytewriter-1 is an 80-column, 7 × 7 dot-matrix printer that accepts single sheet or roll paper up to 8½" wide and prints at 60 lines per minute. The interface is similar, but not identical, to a Centronics parallel interface and has been designed to operate with the Apple II, Atari 400/800, and all models of the TRS-80. $299 (interface cable slightly extra). **Address:** Microtek, Inc., 9514 Chesapeake Dr., San Diego, CA 92123 (Tel: 714-278-0633).

Software

ZX80/Microace Games. The Chest of Classics is a cassette containing four games for the Sinclair ZX80 and the Microace computers. The games are Life (machine language that allows 1000 generations per minute), Lunar Lander, Mindmaster, and K-Trek, a variation of Star Trek. Complete BASIC listings are provided as well as a color keyboard overlay. $9.95. A free catalog and ZX80 coding sheets are available. **Address:** Lamo-Lem Laboratories, Box 2382, La Jolla, CA 92038 (Tel: 714-262-5681).

Data Abstraction Language. DATABS, a data abstraction language for the 8080 runs under CP/M and was inspired by the MIT developed CLU language. Types include boolean, character, single- and double-byte integer, and string. It allows user-defined types with dynamic storage mechanism. It supports UNIX+ style command line arguments and I/O redirection. Stream abstraction allows terminal and disk I/O. Requires 40K. Diskette includes the compiler, type and run-time support library, stream abstraction, and command line processor. $49.95. **Address:** Softronics, 36 Homestead Lane, Roosevelt, NJ 08555.

TRS-80 Game. The Everest Explorer is a simulation game for the TRS-80. In it, the user needs to select manpower, food, fuel, shelter and oxygen to support the climb. Other factors include weather, climber condition, and morale. Uses Model I, Level II, and 16K. Cassette is $14.95. A 32K disk version is $20.95. **Address:** Acorn Software Products, 634 North Carolina Ave., SE, Washington, DC 20003 (Tel: 202-544-4259).

6809 UniFLEX. Written in 6809 assembler language, the UniFLEX operating system is a full disk, sort/merge package for easy operator interface and fast sorts. Any size or type file may be sorted with parameters supplied as part of the command line through the use of a parameter editor, or in an existing parameter file. It can also merge on previously sorted files. Other features include any size fixed or variable-length input records, fixed or variable-length fields, up to 250 input/output keys, key length up to 250 characters, supports ascending or descending and right or left justified keys, user-definable sorting sequence, run-time messages, and record select/exclude. License is $100. **Address:** Technical Systems Consultants, Inc., Box 2570, West Lafayette, IN 47906 (Tel: 317-463-2502).

C Language. The C programming language is available for Cromemco Z-80A based, S-100 systems operating under multi/user, multi/tasking CROMIX operating system. It produces relocatable code that can be linked with FORTRAN, COBOL, and assembly language, or called from BASIC. This powerful language is effective for writing operating systems, languages, utilities and I/O drivers, communication software, database management systems, file management software, and fast graphics software. Available on 5" (CCC-S), or 8" (CCC-L) diskettes. $595. **Address:** Cromemco, Inc., 280 Bernardo Ave., Mountain View, CA 94043 (Tel: 415-964-7400).

Stock Analysis. The STOCKPAK System for the TRS-80 is a Standard & Poor stock analysis and portfolio management package. It provides evaluation and management of a stock portfolio of up to 100 securities with as many as 30 transactions on each issue. It also allows analysis of 900 NY and American exchange and over-the-counter common stocks, and generates reports to guide

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investment decisions. It records buy and sell transactions, price and dividend information, and splits. It is designed for Model I or Model III 32K business systems and includes four diskettes. Optional monthly updating is available from Standard & Poor. $49.95. Sold at Radio Shack Computer Centers or stores.

Educational Programs. A series of programs written for an Apple II with 16K and disk, and especially designed as childrens teaching aids include hand/eye coordination programs such as Cooperation Maze, Write In Color, Make A Tune, and Computer Palette. Also counting programs such as Count to 10, Counting Fun, Counting Numbers Less Than 101, and Counting By *; and a series of programs in arithmetic, vocabulary, synonyms and antonyms, hard/soft consonants, syllables, word breakup, basic reading skills, etc. **Address:** Edutek Corp., 415 Cambridge #14, Palo Alto, CA 94306 (Tel: 415-325-9965).

Apple Word Processor. Using a 48K Apple II with disk and Applesoft in ROM, WRITE-ON!-I and II allows personalized letters, mailing labels, bills, checks, and the creation and maintenance of data files, merging, etc. Version II can preformat often-used text for faster printing. No computer training is required to use either version. Version I does not have data file merge. $99.50 for version I, $150 for II. **Address:** Rainbow Computing Inc., 9719 Resada Blvd., Northridge, CA 91324 (Tel: 213-349-5560).

PASCAL Utilities. Screen Handler is compatible with a variety of terminals making CRT data input simple. Extensive error checking and an easy-to-use system for storing and changing user prompts without reprogramming are provided ($75). Output Formatter makes reports easy to design and program. It includes tab, automatic page and line counter during program execution, and top of form routine ($37.50). Forms Generator includes an output formatter and additional software that allows an end user to redesign reports without programming ($49.50). **Address:** HDP Inc., 222 E. Anapamu St., Santa Barbara, CA 93101 (Tel: 805-965-4477).

Music and Animation. The Rainbow Writer is a graphics, text, music, and animation program for the Apple II. The program creates special effects using color, animation, alphabetics, shapes and sounds. It uses a simple menu-driven selection. Special character fonts can be created, or a selection can be made between nine sizes and 18 different colors of upper- and lower-case English or Greek letters. In the music mode, six chromatic octaves and special tonal effects can be produced. $39.95. **Address:** Personal Software Inc., 1330 Bordeaux Drive, Sunnyvale, CA 94086 (Tel: 408-745-7841). ◇

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SOLID-STATE DEVELOPMENTS

By Forrest M. Mims

Solid-State Speech

BY NOW, you have probably heard samples of solid-state speech produced by such devices as the Speak & Spell® educational trainer manufactured by Texas Instruments or the Voice Challenger® chess game by Fidelity Electronics. If not, you are in for a treat—amazing progress has been made in the field of digital speech generation.

My first exposure to solid-state speech occurred in 1975, when two companies demonstrated talking calculators at a conference on electronic aids for the blind. Both machines produced intelligible spoken renditions of the symbols and numbers marked on their keys as well as visual displays.

The speech quality of Speak & Spell is at least as good as that of the talking calculators. This is true even though Speak & Spell requires considerably less memory per spoken word. This is the result of highly sophisticated circuits that model the human vocal tract.

The latest speech-generation circuits are highly complex. The need for this complexity is explained by the nature of the human vocal tract. An in-depth discussion of the mechanism that converts streams of exhaled air into intelligence-bearing sounds is beyond the scope of this column. Suffice it to say that speech is generated by intricate cooperation of the diaphragm, lungs, vocal cords, air passages, resonant cavities (both fixed and adjustable ones), and the lips, tongue and teeth.

Generating Solid-State Speech. There are three major methods of generating solid-state speech. The first is the equivalent of the magnetic tape recorder. Spoken words are digitized by an analog-to-digital converter (ADC) and stored directly in memory. Solid-state speech is produced when the contents of the memory are clocked out of the mem-

(Continued on page 72)

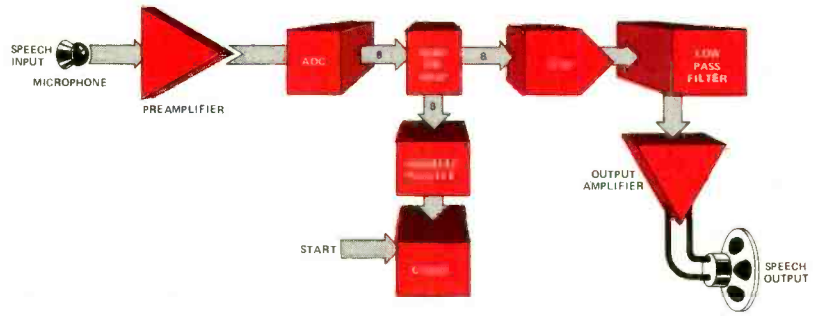

Fig. 1. Direct storage of speech in solid-state memory.

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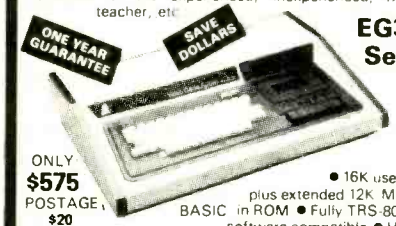

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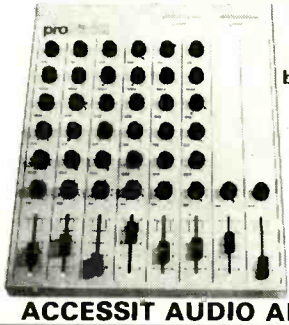

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ory, processed by a digital-to-analog converter (DAC) and then smoothed by a low-pass filter and amplified. A block diagram of this appears in Fig. 1.

This direct-storage method was used very effectively in the first talking calculators. Unfortunately, however, considerable memory space is required for even small amounts of speech. For example, a system of this type might store speech in 8-bit samples loaded into memory at a clock rate of 8 kilohertz. One second of speech, therefore, would require 64,000 bits of memory.

The required amount of memory can be considerably reduced by storing only the relatively small number of basic speech sounds or *phonemes* required to produce any spoken word. This is what is done in the second major form of speech generation. Stored phonemes are electronically combined to produce any desired word in any language.

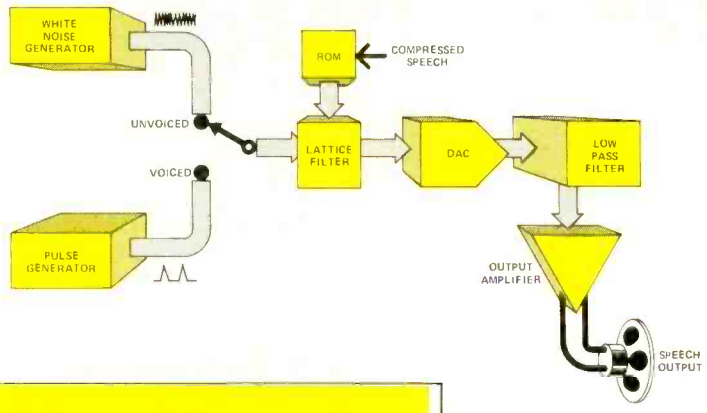

Fig. 2. The linear predictive coding method of speech synthesis.

Unlike the method in which entire words are stored, the phoneme storage and reconstruction method provides truly synthesized speech. It also provides a virtually unlimited vocabulary. Unfortunately, as computer enthusiasts who have tried this method have found, stringing together phonemes produces unnatural, "robotic" sounding speech.

The third method of speech generation is also a form of synthesis. In this method, words are analyzed for distinguishing features that are quantized and stored in digital form. The compressed words are then reconstructed by sophisticated electronic processing.

Individual words consist of a small number of frequency and amplitude variations followed by intervals of redundant signal. By extracting the key frequency and amplitude variations and the time intervals between them and ignoring inconsequential signal, a word can be electronically dissected and compressed. Speech processed in this way can be loaded into much less memory than otherwise would be required. The procedure used for compression and conversion is called *parametric speech analysis* and requires sophisticated computer techniques and a good deal of human effort.

Two of the methods used to recreate compressed speech are *linear predictive coding* (LPC) and *adaptive predictive coding* (APC). The former, LPC, is the method used by Texas Instruments in its Speak & Spell, Speak & Read® and Speak & Math® learning aids. It is also used by General Instrument in its *Orator* SP-0250 speech processor chip.

An LPC synthesizer circuit (Fig. 2) is an electronic analog of the human vocal tract. In operation, a periodic train of pulses or a white-noise signal is applied to a sophisticated, digital lattice filter which, under the control of the compressed-speech data stored in the memory, reproduces the original speech pattern. A digital-to-analog converter transforms the digital output of the fil-

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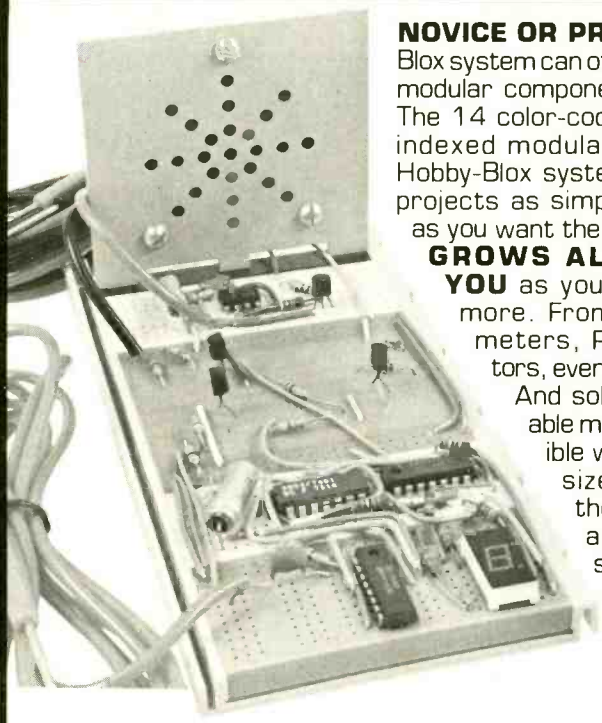

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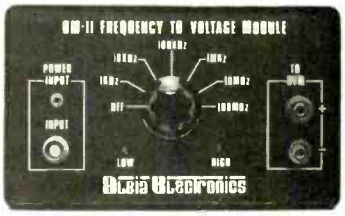

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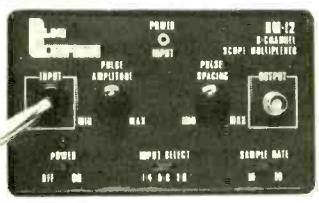

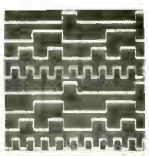

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ter into an analog signal, which is then smoothed by a low-pass filter and used to drive a speaker.

The LPC method synthesizes speech at rates from 1200 to 2400 bits per second. Texas Instruments implements LPC with a three-chip set consisting of a TMC 0280 synthesizer, a TMC 0350 16,384 x 8-bit ROM and a TMC 0270 microprocessor-controller.

National Semiconductor has recently introduced a speech-synthesizer chip set that uses a somewhat simpler approach. Words are compressed and stored in a standard 16K, 32K or 64K ROM and reconstructed by a special-purpose, speech-processor chip. The latter contains a programmable frequency generator and a variable-gain DAC.

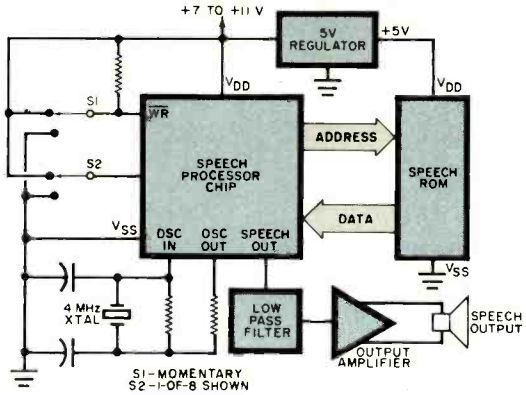

Fig. 3. National Semiconductor's speech processing system.

National's speech-processor chip can directly address up to 256 words or expressions stored in up to 128K of ROM. Much larger vocabularies can be obtained by cascading additional ROMs.

A simplified circuit diagram of a complete synthesizer made from National's speech-processor chip and an external ROM is shown in Fig. 3. This chip is available with a custom-encoded ROM or preassembled into National's DT1000 DIGITALKER®.

The DT1000 comes on a single circuit board complete with a speech-processor chip, a ROM, a microprocessor, and an output amplifier. It can generate any of 144 preprogrammed words, selected by a self-contained keyboard.

The DT1000 sells for $495. If that seems high, consider the fact that National charges $599 to custom encode just *one* word of male speech. Female speech requires a higher data rate, and the cost is $700 per word! The customer supplies a high-quality tape recording of the desired words or phrases, and National compresses and loads the digitized version in the ROM. The synthesized output preserves the original inflection, emphasis, and timbre of the speaker's voice.

Summing Up. If you have yet to hear a sample of solid-state speech, be sure to visit a store that sells Speak & Spell or similar talking products. For a sample of National's very realistic-sounding synthesized speech, dial 408-737-3939 (a toll call). You'll hear an assortment of common phrases such as "Please call your office;" "Going up;" "The temperature is . . .;" and others in male, female and children's voices.

Soon, it seems, electronic speech will be a common part of everyday life. You can already buy talking clocks, calculators, toys and games. Next will come talking vending machines, elevators, appliances, test equipment, aids for the blind, automobiles and many other devices which now convey information to their users via analog or digital meters, readouts or gauges.

For More Information. If you are interested in solid-state speech, rather than directing your inquiries to this column, it would be better to contact di-

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rectly the companies that produce various kinds of electronic-speech generators. These devices employ sophisticated hardware and software, and some of the firms that make them have prepared information and specification sheets explaining their products in detail.

Some of the manufacturers of solid-state speech modules and chips are:

Texas Instruments
M/S 308
Box 225012
Dallas, TX 75265

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2900 Semiconductor Dr.
Santa Clara, CA 95051

Microelectronics Div.
General Instrument Corp.
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Hicksville, NY 11802

Telesensory Systems, Inc.
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Palo Alto, CA 94304

Stynetic Systems, Inc.
Flowerfield Buildings 1
Saint James, NY 11780

Votrax Division
Federal Screw Works
Troy, MI

Other firms are also involved with or preparing to enter the speech-synthesis business. As developments occur, they will be described here.

New Products. Datel-Intersil (11 Cabot Blvd., Mansfield, MA 02048) has introduced a miniature 3½-digit LED digital panel meter that sells for $38.50 in single-unit quantities. The new meter, designated the DM-31, measures only 3.5" × 2.0" × 0.5" and utilizes large (0.56" high) digits. It reads from 0 to ±1.999 volts dc. Write to the company for additional specifications.

National Semiconductor (2900 Semiconductor Dr., Santa Clara, CA 95051) has introduced a new voltage-regulator chip, the LM330, that it claims has a lower minimum input-to-output differential voltage than any other fixed-output regulator—0.32 volt at 150 milliamperes. Conventional 5-volt regulators require an input of at least 7 volts. The LM330, however, will provide a 5-volt output even if the input voltage falls to 5.32 volts.

The LM330 offers the possibility of longer operating intervals between cell replacement or recharging in battery-powered equipment. It also makes it possible to power such equipment with a 6-volt battery.

The automotive version of the LM330 is the LM2930. Both these new chips are made using a new, deep-diffusion process. They are protected against reverse-polarity connection and will be available for under a dollar. Write to National for additional information. ◇

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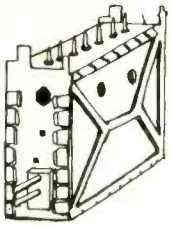

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By Forrest M. Mims

Remote Sensing—Part 2

LAST month, we discussed the basics of remote sensing. We also assembled a dual-wavelength green-leaf detector which relies upon the unique *reflectance signature* of green vegetation.

Leaves, as you might recall, reflect red light poorly but reflect near-infrared radiation very well. This generates a characteristic reflectance signature which makes it possible to use a red LED and a near-infrared LED as a pair of narrow-band radiation *detectors*. This is done in the leaf-detector circuit described last month in Part 1 of this series.

NASA's Image Classification Circuit. An expanded version of the leaf-detector circuit has been developed for NASA's Langley Research Center by Roland L. Hulstrom, Roger T. Schappell and John C. Tietz of the Martin Marietta Corporation. Like the circuit I described, NASA's circuit also teams a red sensor and a separate near-infrared sensor to detect green vegetation. Moreover, these two detectors also permit the detection of water, bare land, clouds and snow.

Figure 1 is the schematic for this new circuit as given in a recent NASA Tech Brief. The circuit, an expanded version of which is slated to be flight-tested aboard one or more Space Shuttle missions, is designed to automatically reduce the quantity of unwanted imagery transmitted to earth from camera-carrying earth satellites.

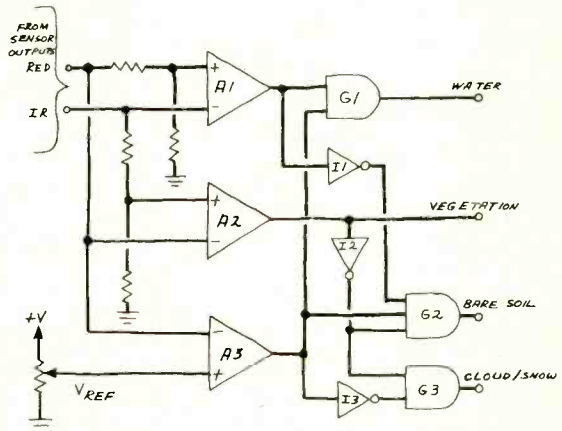

Fig. 1. Earth satellite picture classification circuit.

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NASA explains the objective behind the design of the new circuit as follows. Earth-observation satellites generally do not make decisions about the usefulness of the data being sent to earth. As a result, a significant amount of time and money is spent in sorting out the useful data. A great saving could be realized if circuits aboard the satellite could recognize useless imagery or actually look for specific features. The circuits do not have to be very smart to be useful. For example, about 70% of the earth's surface is water. Of the 30% that is not water, about one-third to one-half will be obscured by clouds at any given time.

This means that a satellite might get one clear picture of land out of perhaps five or six observations. The amount of unwanted, more or less useless data that is stored, processed and indexed could, therefore, be greatly reduced by a circuit that simply blocked transmission of the 80% of the images that is of water and clouds.

A simple circuit has been developed to classify picture elements by spectral signature alone. No pattern recognition is required. Computer simulations and field measurements have confirmed that the four basic features—vegetation, bare land, water and clouds or snow—can be separated by radiance measurements at two discrete wavelengths: 650 and 850 nm.

It's very significant that the reflectance signatures of four key topographic features can be classified by examining only two wavelengths of their reflected radiation. From last month, you already know that green vegetation has a very low reflectance at 650 nanometers—typically less than 5 percent. At 850 nanometers in the near infrared, the reflectance of vegetation is typically from 45 to 55 percent.

Soil usually has a higher reflectance at near-infrared wavelengths than in the visible portion of the spectrum. The transition between low and high reflectance is more gradual than for vegetation, and occurs in the visible region. This means that the difference in soil reflectance at 650 and 850 nanometers is not as dramatic as it is for green leaves.

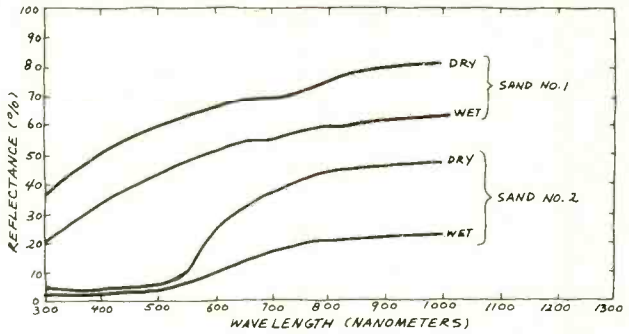

Fig. 2. Spectral reflectance of two different sands.

Figure 2 shows the reflectance curves of two highly reflective soils (actually, sands). Sand number 1 is white beach sand from Ft. Walton Beach, Florida. Sand number 2 is a darker sand from Monument Valley, Utah. Note that both sands, like all other soils, reflect less light when they are wet. These reflectance curves, and many others, can be found in "The Spectral Reflectance of American Soils" by H. R. Condit (*Photogrammetric Engineering*, Sept. 1979).

Water's reflectance at 650 and 850 nanometers is the reverse of that of leaves, because water reflects red light but absorbs near-infrared wavelengths. Clouds and snow have much higher reflectances than soil, but the differences in reflectance at 650 and 850 nanometers are similar to that of some soils.

Remarkably, the two wavelengths selected by NASA for its Image Classification Circuit are very close to the optimal detection regions of the GaAsP LED (650 nanometers) and the new (AlGa)As "super" LED (880 nanometers). A practical version of NASA's circuit can be made by using two such

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experimenter's corner

LEDs as detectors. The green-leaf detector circuit described last month shows how LEDs can be coupled to a circuit like the one shown in Fig. 1.

A detailed report on NASA's image-classification circuit is available for $6.00 (paid in advance) from the National Technical Information Service, Springfield, VA 22161. The report is entitled "Experimental and Simulation Study Results for Video Landmark Acquisition and Tracking Technology" (NASA CR-158997). Request the publication by name and by the identification number LAR-12589.

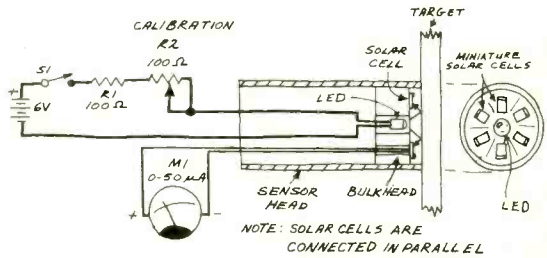

Fig. 3. Construction of a simple, low-cost reflectometer.

An Inexpensive Narrow-Band Reflectometer. Sometimes, it is important to know the reflectance of an object at only one wavelength. Since 1970, I have measured the reflectance at 940 nanometers of scores of different objects. These measurements make possible the accurate prediction of the detection range of various infrared travel aids for the blind.

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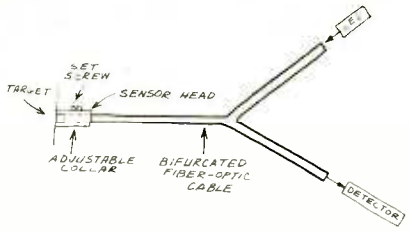

Fig. 4. How to build a fiber-optic reflectometer.

To make a reflectance reading, the sensor head is first placed against a Kodak photographic test card or a similar target with a known reflectance. The CALIBRATION potentiometer is adjusted until the reference target's reflectance is indicated on the meter. If, for example, the reference target has a reflectance of 90 percent (as does the Kodak test card), the CALIBRATION control should be adjusted for a meter reading of 45 μA.

You need not duplicate exactly the arrangement shown in Fig. 3 to make a working reflectometer. To reduce erroneous readings to a minimum, the solar cells should be mounted in a ring around the source LED. It is important that ambient light be kept away from both the target and the solar cells when measurements are being taken.

When making a measurement, place the sensor head firmly against the target. The output of the LED will fluctuate with changes in temperature and battery voltage, so the circuit should be recalibrated just before each reading is taken.

L. A. Lott and D. L. Cash have described a more sophisticated reflectometer in a paper entitled "Spectral Reflectivity Measurements Using Fiber Optics," which appeared in the April 1973 issue of *Applied Optics* (pp. 837-840). In their device, one branch of a "Y"-configured, *bifurcated* fiber-

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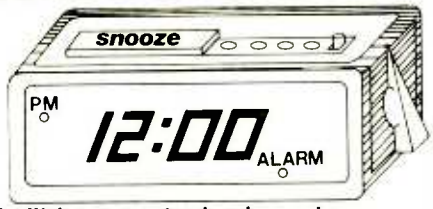

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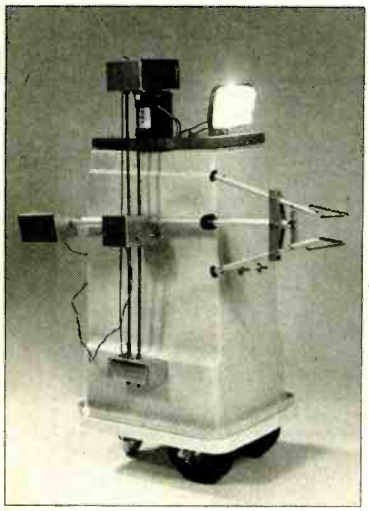

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93	.42	.95	.48	-
95	.59	.95	.65	-
96	.59	-	.99	-
107	.32	1.25	.39	1.50
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156	.69	-	.95	1.10
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165	.75	1.25	.99	-
174	.79	1.10	.95	1.35
175	.79	1.10	.95	1.35
188	-	-	3.50	3.50
189	-	-	3.50	3.50
193	.75	1.50	.99	-
195	.62	1.50	.89	1.50
221	1.10	2.10	1.10	2.00
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optic cable carries light to the target. The reflected light is carried through the second branch of the cable to a detector. The low light levels involved necessitate the use of a detector amplifier.

I've assembled such a fiber-optic reflectometer, and it works quite well. The small size of the sensor head means that the reflectance of very small objects, or different parts of the same object, can easily be measured. Figure 4 is a simplified diagram of such a device. See Lott and Cash's paper for more detailed information.

Remote Sensing of Water Vapor. If you read the "Solid-State Developments" in the February 1981 issue of this magazine, you may recall that 940-nanometer radiation is strongly absorbed by water vapor in the atmosphere, but that absorption at 880 nanometers is negligible. This provides a characteristic signature which permits the remote sensing of water vapor by dual-wavelength *transmission spectroscopy*.

Figure 5 is a simple circuit I've designed to demonstrate this method of detecting water vapor. It is a dual-wavelength transmission spectrometer with an audio output.

In operation, a GaAs:Si 940-nanometer emitter and an (AlGa)As 880-nanometer emitter are both pointed at a silicon phototransistor that drives an amplifier. The two LEDs are alternately driven by pulses with a duty cycle of 50 percent that are generated by an astable multivibrator made from two of the four NAND gates in a 7400.

Initially, the receiver will generate a tone coinciding with the pulse rate at which the LEDs are driven. The position of the silicon detector is then adjusted to null out the tone.

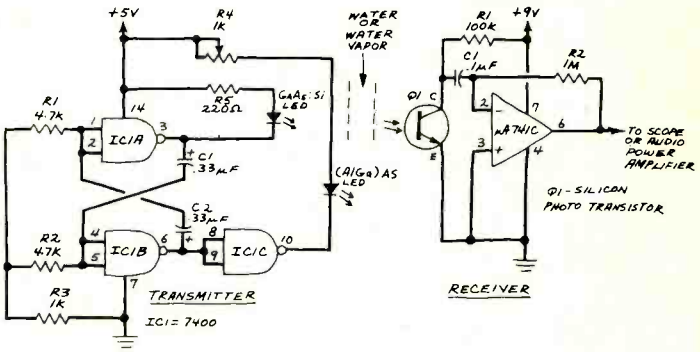

Fig. 5. Dual-wavelength water-vapor detector.

Operation of the circuit can be demonstrated by placing a small, transparent container between the two LEDs and the detector. If necessary, align the detector to cancel any tone output from the receiver. When water is poured into the container, radiation from the 940-nanometer LED will be suppressed, but that from the 880-nanometer emitter will be largely unaffected. Consequently, the null condition will be disturbed and a tone will be emitted by the receiver.

This simple circuit proves that an 880-nanometer LED can be teamed up with a 940-nanometer LED to detect water. Detecting water *vapor* is more difficult, but it can be done. One way to demonstrate the detection of water vapor is to allow steam to pass between the two LEDs and the silicon detector. More sophisticated versions of this dual-wavelength circuit are possible, but I will leave their design to those of you interested in remote sensing.

Summing Up. In this two-part series, we have only touched upon the field of remote sensing. Although you might not derive much practical benefit from the circuits with which we have experimented, you should now have a better appreciation of how some remote-sensing devices operate.

Remote sensing is an excellent subject for science-fair projects and low-cost research. Many good articles and some books on the subject have been published. For more information, visit a good technical library. Perhaps you will be able to design a simple remote sensor for detecting soil moisture or crop diseases. ◇

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DX LISTENING

By Glenn Hauser

Science & Technology Programs

YOU can keep up with scientific developments by listening to several weekly programs available on shortwave radio. All times and days given are in GMT. An asterisk means the program time will change to one hour later when the station ceases observing DST. Frequencies may change too so check future listings in the magazine.

AFRTS. *CBS Radio* has a weekly "Science Editor", produced at UCLA, which has been running for many years, but unfortunately is cleared by only a few affiliates (since it is noncommercial) and then at inconvenient times. It is, however, heard easily via *AFRTS* shortwave, Thursday at 0430-0444* on 17765, 15330, 11790 and 6030 kHz; repeated at 0930* on 9590, 9530 and 6030. A shorter version has been appearing on the widely-heard *WBBM*, 780, Chicago, Monday at 0522*.

Radio Australia. This station has several science series, headed by the excellent "Australian Inventor", produced by Keith Smith, whose enthusiasm for seeking out new and unusual ideas is quite obvious. He also invites listener contact by offering free plans for a solar hot water heater and other items. Saturday 1240 on 9580 and 17795; Sunday 0340 on 17795. "The Body Program" (about human physiology, medicine, etc.) airs Sunday at 0540 on 21680, 17890, 17870 and 15160; better at 1140 on 9580, 17795, 5995. These two eclipse a more traditional "This Week in Science," Saturday 0140 on 21740 and 17795; 0740 on 15115, 11740 and 9570; Sunday 1440 on 17795, 11705, 9770, 9710, 6060.

BBC World Service. Two major weekly science series are perhaps the best on the air: "Science in Action", Friday at 1615 on 21710, 17830, 15260; Sunday at 2209 on 21690, 15420, 15260, 9590; and "Discovery", described as "advanced developments in science," which is on its usual summer vacation. It had been scheduled for Wednesday at 0330 on 15070, 9410, 6175, 5975; Thursday at 1430 on 15070, 21710, but the times could change in October. "Nature Notebook" (10 minutes) is paired with "Farming World" (19), which has broader appeal than you might think, Wednesday at 1215 on 25650, 21710, 11775, 9510; Thursday at 0630 on 15070, 9510, 9410, 6175. "New Ideas" is the BBC's invention programme, Saturday at 0530 on 15070, 9510, 9410, 6175; 1115 on 21710, 11775, 9510; 2230 on 21690, 15420, 9590; and Monday at 1725 on 21710. Furthermore, *BBC* documentary programs frequently have scientific subjects, in blocks on Monday at 1345 on 15070, 21710; Wednesday at 0230 on 9410, 7325, 6175 and 5975. Dates and programs are: July 20-22, "Medical Hypnosis"; July 27-29, "The Modern Nurse"; August 3-5, "Vaccination;" August 17-19, "Is Medicine Necessary?"; August 24-26, "The Psychology of Prejudice."

Radio Canada International puts a "Spotlight on Science," Sunday around 1830-1845 on 17820 and 15260. "As It Happens" has a regular science news segment, "Eureka," on Thursdays sometime during its sesquihour, at 2130* on 17875 and 15325; 2230* on 9755 and 5960 (also on *CBC* domestic Radio starting at 6:30 p.m. local). "Morningside" has a "World of Science" segment on Tuesdays sometime between 9:13 a.m. and noon local time (also carried on *CBC Northern Quebec Shortwave Service* at 1313-1459* on 11720, 9625). "Quirks & Quarks" hosted by Jay Ingram is *CBC*'s major science show, always striving to entertain as well as inform, Saturdays at 12:05-12:59 p.m. local (also on *CBCNQSWS* at 1605* on 11720, 9625). Also very well done is "The Food Show" with a strong consumer angle, Sundays at 8:30 a.m. local (also on *CBCNQSWS* at 1230* on 9625, 6065).

Radio Moscow. "Science & Engineering is a long-running series (also available free on request to U.S. stations by tape), broadcast in the North American Service, Thursdays at 2315*; Fridays 0115*, 0415*, 0615* (often starting 10-15 minutes later) on up to 16 frequencies at once.

Voice of America. "Space & Man" ranges far more widely than the title implies. It's on Wednesday at 1215 on 9565; 1812 on 15410, 21485, 26040; Thursday at 0015 on 17860, 15205, 11740, 9650, 6130, 5995. "New Horizons" airs Sunday at 1115 on 9565; 1912 on 15140; Monday at 0115 on 17860, 15205, 11740, 9650, 6130, 5995. "New Products USA" is also on Sunday at 1307 on 9565, 2108 on 15410; Monday at 0109 on 17730, 15205, 11740, 9650, 6130, 5995. "Science in Africa" presents some interesting, though rather padded and slow-paced interviews with African scientists, Sunday at 1734 & 2034 on 26040, 21485, 15410.

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is called "Spectrum," Monday at 2010 on 21495, 17645, 15582, 15415; Tuesday at 0015 & 0215 on 15583, 11637, 9815.

Radio RSA (South Africa). "Science World" is scheduled at approximately: Wednesday at 2145 on 11900, 9585; Thursday at 0245 on 9585, 9615, 5980 and 3980; 1337 on 25790, 21535, 15220.

Radio Japan. "Science & Industry" is on Thursday at 1215 on 9505; 1915 on 17755; 2315 on 17755; Friday at 0005 on 17825, 15430; 0150 on 21640, 17825, 17725, 15235.

All India Radio General Overseas Service airs "Science Today", on the 3rd Wednesday of the month at 1400 on 15335, 11810; 1820 and 2220 on 11620. Reception is spotty in North America; best around the equinoxes.

HCJB increased its popular science programming last year; religious messages may be included too. "World of Science" is on Sunday at 0130 on 17885, 15360, 9745; 0600 on 11915, 9745, 6095; 0915 on 6130; 1945 on 26020, 21480, 17790; Tuesday at 2330 on 15180; Thursday at 0345 on 15360 and 9745. And, "Nature Trail," Friday at 0700 on 11900, 9745, 6130; Saturday at 0615 on 15235, 11835 and at 1215 on 15115, 11740.

Radio Deutsche Welle broadcasts a "Science Journal" to areas other than North America, but we can sometimes hear it, Saturdays 0455 on 11765, 9765, 9565, 7225, 7150; 1224 on 21600, 17875, 17765, 15410. Here only, we go into programs not in English since reception is so much better during German transmissions, for "Wissenschaft und Forschung", Wednesday at 2325-2340 on 21560, 15410, 11765, 9735, 9700, 6075; Thursday at 0325-0340 on 11795, 9735, 6145, 6100, 6085, 3995.

Radio Bucharest gives a Romanian "Science Magazine" Saturday at 0420 on 11940, 11840, 9690, 9570 (usually best), 9510, 5990. Several other stations have such a token feature.

National Public Radio has several science shows available to its 200+ member stations, which are free to air them later (or not at all) than these network feed times: "Radio Smithsonian" Mondays 2230-2259*, Wednesdays 1900-1929*. Ira Flatow, perhaps best known for a poster showing him interviewing penguins in "Antarctica", contributes "Science Modules" Thursdays 1715-1744*, Saturdays 1500-1529.* "Science World," a reading service for the blind, Friday at 1930 to 1959.* "The Nature of Things", brief popular science talks from Vermont, fed Fridays 1730* but meant to be played back one at a time. "New Dimensions", hour-long conversations from the San Francisco foundation of the same name (check with your local *NPR* station for time). And, not least, *NPR* carries "BBC Science Magazine", a melding of programs mentioned under *BBC* above, including a "Frontiers of Knowledge" segment, Wednesday at 2330-2359* and Thursday at 1905-1934*. ◇

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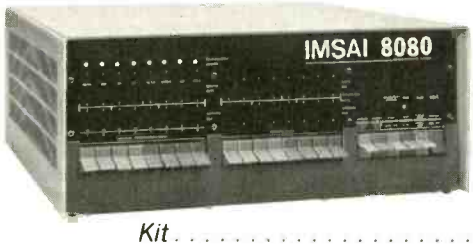

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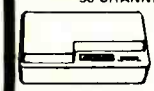

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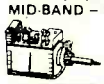

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Hewlett-Packard model 206A audio signal generator. Need schematic and service manual. P. Young, 16W761 White Pines, Bensenville, IL 60106.

Grunow model 833 AM radio. Need schematic. H.L. Schultz, 610 Young Rd, Erie, PA 16509.

Hoffman model W7304A color TV. Need service manual and schematic. William C. LeDuc, 3 House Ave, Troy, NY 12180.

Micronta tachometer model #22-914. Need operating manual. Carl McCormick, 6723 Old Morringsport Rd., Shreveport, LA 71107.

Heathkit HR-10-B receiver. Need any information available. David Weisenthal, 29 Northview Ave., Montclair, NJ 07043.

Beckman model 6121 frequency counter. Need manual, schematic or any available information. Charles Patterson, 723 S. Broadway, Tarrytown, NY 10591.

Systems Electronics model 57 scope. Need schematic and manual. Ken Dolan, Electronic Services, 286 S. Seymour St., Napa, CA 94558.

Accurate Instrument Co., model 152 VTVM. Need operating manual, calibration procedures and schematic. Wayne Cox, 558 East Northern Ave., Springfield, OH 45503.

Audimation Corporation model SRA-100 power amplifier. Need schematic or any information available. Jonathan Kalfus, 98-19 64th Avenue, Rego Park, NY 11374.

Xetex Electronics model OS-15 scope. Need schematic and service manual. Walter S. Jackson, 281 Irish Road, Berwyn, PA 19213.

Hickok 288X signal generator. Need meter transformer and schematic. Bill Springer, 923 Nelda, Houston, TX 77088.

Video Brain model 101 computer. Need manuals and information on cartridge availability. Jim Porta, 8709 Gainsborough Dr., Louisville, KY 40291.

Hammarlund HQ145-X receiver. Need owner's manual, alignment data and schematic. F. Scoville, Box 243, Sewell St., Lake George, NY 12845.

Clough-Brengle model 23AA ac capacity ratio bridge. Need owners operation manual. H.B. Claremont, Box 581, Dolan Springs, AZ 86441.

Polarad spectrum analyzer, model SA-84WA. Need technical manual. Russell S. Watson, c/o Howard McAuliffe Inc., 15 Industrial Park Place, Middletown, CT 06457.

Uher model 7000D tape recorder. Need schematic diagram or service manual. James O. Mosher, 3031 Dunham Dr., Wichita, KS 67216.

Roberts 1040A tape recorder. Need schematic and parts list. Joseph Wright, 518 W. Santa Fe, Olathe, KS 66061.

RCA model WO-870A oscilloscope. Need replacement power transformer. Emil Huddy, 54451 Road 200, North Folk, CA 93643.

Eric Electronics model ST-100 tuner and 40P amplifier.

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Waterman S-11-A scope. Need schematic. Kenneth G. Vandivar, Rte. 4, Box 412, Cleveland, OH 30528.

Chicago Industrial Instruments Co., model 504 VTVM. Need schematic and source for transformer #482. Harold Cressin, 7511 Patapsco Dr., Sykesville, MD 21784.

Hammarlund HQ-140-X receiver. Need case or address of dealer. George Kelm, Box 160, Yap Island, Guam 96943.

Belden model BC-388 shortwave receiver. Need schematic and owner's manuals. S.H. Hwang, Kangseoku Youmchang Dong 95-3, Seoul, Korea.

Hallicrafters S-38D receiver. Need schematic or any information available. Mike Cranston, 2411 Donovan, Bellingham, WA 98225.

Relax Acizor model #16 exercise machine. Need schematic. Jack W. Gallarda, 1171 Ort Lane, Merbin, OR 97532.

Tektronix model 545 oscilloscope. Need service manuals. Ed Petro, RR1, Box B-1, Flat Rick, IN 47234.

Calbest FM stereo generator model MX 625SG and Ballantine model 300 or 300L / 18 voltmeter. Need operating manuals, service manuals and schematics. Luis E. Gelardi, 2123 Aaron St., Los Angeles, CA 90026.

Westinghouse TV chassis V-2483-1. Need power transformer 410V066C01 or source. William J. Wayland, 670 Andrews St., Southington, CT 06489.

Sylvania Electric oscilloscope type 403, signal generator 216, and voltage calibrator type 304. Need schematics and manuals. Stan Heide, R4-6320 7th St., Kenosha, WI 53142.

Knight model KG-686 generator. Need schematic and manuals. John Schneider, 1501 West Jean Circle, Lincoln, NB 68522.

RCA model 117, serial #015511 radio. Need schematic and source for replacement speakers and components. H. Minshall, 20 New Dutch Lane, Fairfield, NJ 07006.

Hammarlund model HQ-120 receiver. Need schematic, tube diagram and operating manual. Jeffrey Boutin, P.O. Drawer E, Lanesborough, MA 01237.

Hallicrafter Skyrider SX 24. Need copy of original circuit and component layout. Ron Lucking, 62 Ember Farm Way, East Molesey, Surrey, London, England.

Weston model 547, no. 2432 radio tester. Need any information available and adapters. W.A. Kernaghan, Box 2065, Sierra Vista, AZ 85635.

Concertone 803A tape recorder. Need schematic and operation manual. Wray Jay Sheen, 3511 Marshfield Ave., Park City, IL 60085.

RCA aircraft direction finder model DZ MI 8814. Need manual and schematic. E.C. Ozag, 823 N. Marion St., Oak Park, IL 60302.

Hallicrafters model SX-101A receiver and RCA WO-88A oscilloscope. Need schematics, operation and alignment manuals. Bob Roy, 3054 E. El Moro, Mesa, AZ 85204.

Harvey Wells model MTR-25 radio telephone. Need schematics, parts list and operating manuals. Patrick Meyer, 6320 S.E. Jennings, Portland, OR 97222.

Howard Radio Corp., model 450, serial 450-211 receiver. Need schematic, parts list or any information available. Henry Nimitzek, 226 S. 4th St., Millville, NJ 08332.

Raytronic Laboratories, model CB-54A CRT analyzer. Need schematic and operating manual. Picarella TV, 306 Bailey Road, Crystal City, MO.

Sandborn model B1 chart recorder. Need instruction manual and recording tape. Frank A. Wojcik, 5417 E. 17th St., Indianapolis, IN 46218.

Century model FC-2 tube tester. Tube chart needed. L.D. Barr, 36646 Riviera Dr., Fremont, CA 94536.

Carol Electronics Corp., model OS-8E/U oscilloscope. Need schematic and operating manual. George Windolph, Box 3305, 1901 N. 18th St., Quincy, IL 62301.

Conar model 600 TV. Need instruction manual and trouble-shooting guide. Paul Slopak Jr., 2206 N. Sheridan Rd., Peoria, IL 61604.

Tennele MS-2 memory scan. Need schematic and service information. Alan A. Griffin, Box 18012, Wichita, KS 67218.

Measurements model 65-B signal generator. Need dial drive belt part #H-6469 or H-5334. K.M. Schurak, 2842 N. Linder Ave., Chicago, IL 60641.

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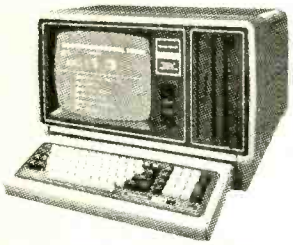

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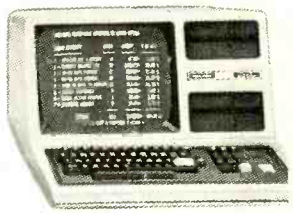

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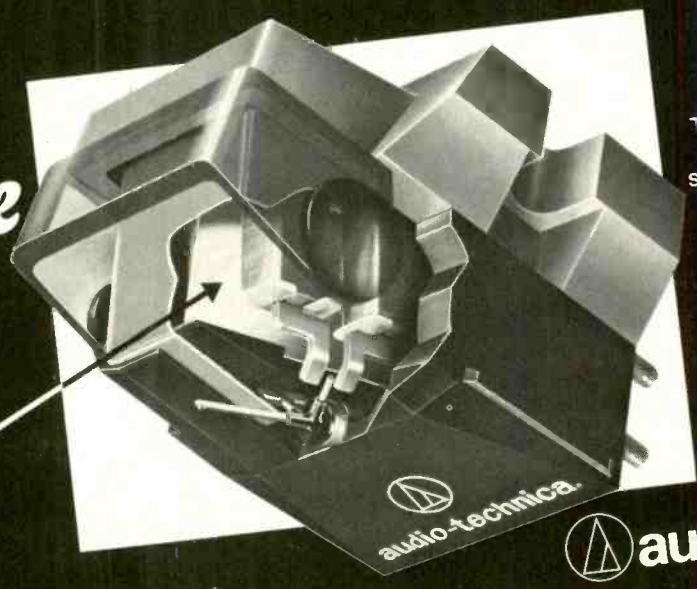

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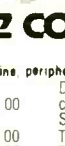

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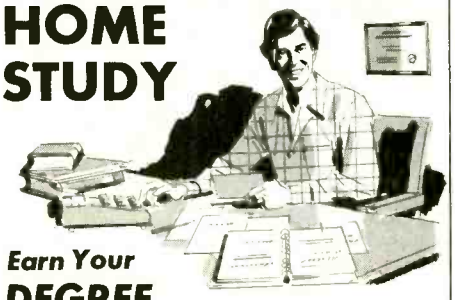

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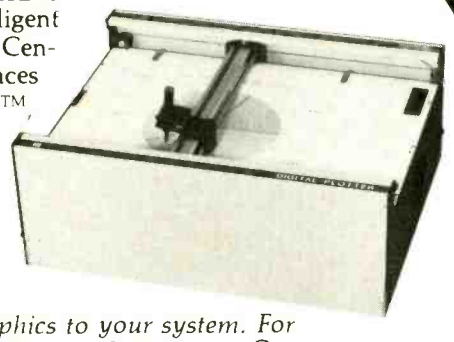

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Need schematics or any information available. Alex Boyce, 109 South Irving St., Ridgewood, NJ 07450.

Wyle Computer Products, Inc. model 8220 CRT/keyboard terminal. Need schematic, parts list and any information available. Pete Zboinski, 75A East 2nd Street, Dugway, UT 84022.

Candle micro TV, model MT-510. Need schematic and service manual. Paul Hanke, 12 Buckingham Pkwy., Maplewood, NJ 07040.

Metropolitan Electric Inst., model 999 signal generator. Need schematic. Al Hillard, 2202 Pleasant St., Miles City, MT 59301.

Honeywell model 500 Digi-test tester. Need schematic or service manual. Paul Hockey, Box 220, Welaka, FL 32093.

Standard model SR606SU receiver. Need schematic or manual. Rudolph N. Claffer, 1990 Ellis Avenue, Bronx, NY 10472.

Compucorp model 122/125 calculator. Need schematic and information on logic structure and signals. **Electrolab,** model 100 voltmeter. Need schematic. Wendell Caley, 17 Canton Rd., Quincy, MA 02171.

R-390A/URR military radio receiver. Need two complete i-f. strips. G. Lindquist, Box 391, Madison, WI 53705.

Crown model CSC-640 SW 4-band radio cassette. Need schematic and transistor D355-6YD2. Eduardo Krapivka, Rivadavia 8481-7C, Buenos Aires, Argentina 1407.

Johnson Viking Messenger. Need operation manual and schematic. John Pat Sanders, Box 26, Spivey, KS 67142.

Hallicrafters model S-120 receiver. Need schematic diagram, operating manual and alignment data. W.E. Schroedter, 6108 N. Sherman Blvd., Milwaukee, WI 53209.

Wolensak model T1600 tape recorder and **The Voice of Music** tape recorder. Need schematics and parts information. Tony Meyer, Box 206, Thoreau, NM 87323.

B&K model 1076 TV analyst. Need schematic. Larry Mills, 2858 S.E. Harrison St., Portland, OR 97214.

Hewlett-Packard model 608C signal generator. Need schematic. Daniel F. Lill, Box 2043, Cheyenne, WY 82001.

Hammarlund PS600 shortwave receiver. Need operating manual, schematic and service manual. B. Berg, 1619 Elizabeth Lane, Alamogordo, NM 88310.

Sony TC105 tape recorder. Need schematic and assembly data. B.R. Lipscombe, 6520 Selma, #266, Los Angeles, CA 90028.

Estey model 432 guitar amplifier. Need schematic or power output tube number. W.L. Weinand, 4 Friendship Court, Troy, MO 63379.

Marantz model 4230 receiver. Need owners manual and schematic. Oliver Croley, 972 Wellington #4, Memphis, TN 38126.

Philips model 4422 tape recorder. Need schematic and parts list. A. Drogowski, Box 80, Hahnville, LA 70057.

Knight Kit Star Roamer shortwave radio. Need schematic or assembly manual. Dale L. Schneider, 4416 S. 112th., E. Ave., Tulsa, OK 74145.

Globe Star model 8677-2 transceiver. Need schematic and service manual. Gerald V. Pike, 42 East Earle St., Cumberland, RI 02864.

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Takachiho model AT-R2 E4-E7 telephone answering machine. Need schematic and instruction manual. G. Cook, Box 14E, Centerville, MO 63633.

Precision Radiation Instruments, Inc., model 107B geiger counter. Need manual, schematic or any other information available. Brandt Springman, 2042 Lakewinds Dr., Reston, VA 22091.

Philco model 7008-C generator. Need operating instructions. D.J. Kelley, 38373 S.E. Coupland Rd., Estacada, OR 97023.

RCA model AR598 radiola. Need schematic. E.F. Comwell, W8BGR, Box 23, Maylene, AL 35114. ◇

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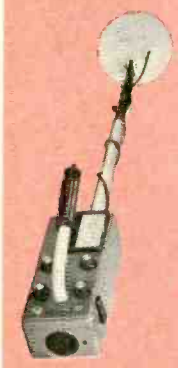
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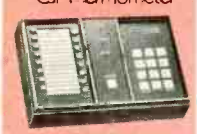
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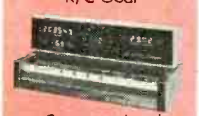
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CIRCLE NO. 4 ON FREE INFORMATION CARD

PROJECT OF THE MONTH

By Forrest M. Mims

Simple BCD Keyboard Encoder

THE November 1978 "Project of the Month" was a hexadecimal keyboard encoder assembled from four TTL chips (a 7400, a 74173 and a 74193). Many circuits require only one decade of decimal entry (0 through 9). The circuit in Fig. 1 implements this function with only three readily available CMOS chips. Because this new circuit is a CMOS design, its power consumption is considerably less than the TTL circuit presented earlier.

In operation, an astable oscillator made from two cross-coupled inverters (*IC1A* and *IC1B*) supplies clock pulses to *IC2*, a 4017 decade counter/decoder, and to *IC3*, a 4518 dual BCD counter. Initially, both counters are disabled by the application of appropriate logic levels to their respective enable inputs (a logic 1 at pin 13 of *IC2* and a low at pin 10 of *IC3*). The LED readout, therefore, displays the status of the outputs of *IC3* immediately after power is applied.

The keyboard is activated by closing any of the ten input switches *S0* through *S9* and then toggling RESET switch *S10* from ground to $+V_{DD}$ and back to ground. If desired, the BCD output can be cleared to 0000 (all LEDs glowing) by toggling RESET switch *S10* prior to selecting a data input switch.

Assume *S3* is closed. All inactive outputs of the 4017 are *low*, so the keyboard (*S0* through *S9*) bus goes low and enables both *IC2* and, via *IC1C*, *IC3*. Both counters then begin a synchronized count of the pulses, applied to their CLOCK inputs.

When the fourth clock pulse has been counted, pin 7 of *IC2* goes to logic 1 and, via closed switch *S3*, disables *both* counters. The LEDs then display the BCD equivalent of the selected switch: 0100. Counter *IC3* stores and presents at its outputs the BCD equivalent of the selected switch, even if the selected switch is opened and another is closed. Only after *S10* has been momentarily toggled will a new switch closure be detected and indicated by the output LEDs.

What happens if two or more input switches are closed when *S10* is toggled? The first closed to be scanned by the 4017 is selected. This is a form of *priority encoding*. The October 1978 "Experimenter's Corner" described the operation and use of the 74147 priority encoder. This TTL chip accepts up to ten inputs and presents at its outputs the BCD equivalent of the highest priority or most significant input while ignoring all others.

Going Further. The output LEDs shown in Fig. 1 are optional. They permit the operation of the circuit to be verified but are unnecessary in many practical applications. Of course, they can be retained. Alternatively, the outputs can be decoded by a BCD-to-seven-segment decoder/driver such as the 4511 or 4543 for display on a LED or liquid-crystal readout.

The basic circuit shown in Fig. 1 can also be modified for different applications. For example, recall that the 4518 contains *two* BCD counters, only one of which is used. The second counter can be clocked in parallel with the first (and the 4017) to provide a storage register which can remember a previous keystroke.

Other modifications may require the addition of one or more chips. For example, a 4066 quad bilaterial switch can be connected to the outputs of the second counter to provide a 3-state output. ◇

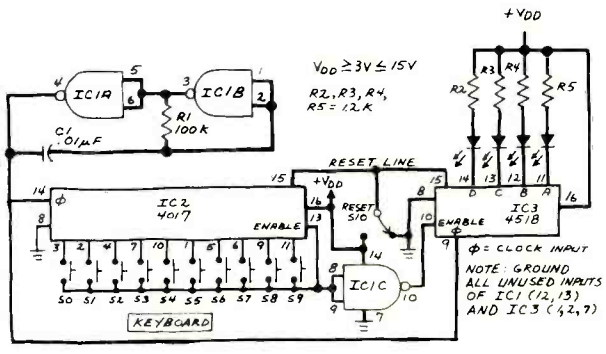

Fig. 1. A BCD keyboard encoder circuit using CMOS chips for low power consumption.

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NEW LITERATURE

VCR and Disc Player Accessories

Video connectors of various styles and sizes, video adaptors, cables, and other accessories for video cassette recorders and disc players are described in a catalog issued by RMS Electronics. Also described is a switch to convert a TV receiver to operate with Atari and Mattel video games and computers. The connectors and adaptors are all UL approved. Address: RMS Electronics, Inc., 50 Antin Pl., Bronx, NY 10462.

Satellite Communications

The Satellite Communications Div. of Digital Communications Corp. is offering a new Satellite Capabilities Brochure. The 12-page publication provides an overview of products such as PSK modems and earth stations. Address: Digital Communications Corp., 11717 Exploration Ln., Germantown, MD 20767.

Tool Kit Catalog

Catalog No. 25 from Techni-Tool describes, in 240 pages, 10,000 products from 800 manufacturers for electromechanical assembly, maintenance, and laboratory work. A "Design-a-Kit" form provides an efficient way to design one's own custom tool kit from off-the-shelf items. Address: Techni-Tool, Inc., 5 Apollo Rd., Plymouth Meeting, PA 19462.

Scanners and Receivers Catalog

A variety of radio scanner receivers used by professional law enforcement agencies, governmental authorities, and ham radio operators is described in a new catalog from Communications Electronics. It also features computer products, cordless telephones, wireless intercoms, and scanner receiving antennas. Address: Dept. A38, Communications Electronics, Box 1002, Ann Arbor, MI 48106.

Inorganic Electrolyte Batteries

Four sizes (½AA, AA, C, and D) of Tadiran lithium thionyl chloride (inorganic electrolyte) batteries are described in a new 6-page catalog. Used as power sources for CMOS circuits, memories, and other instrumentation requiring high reliability, the batteries are said to provide long life, high energy density and wide operating temperatures. Each cell's nominal working voltage is 3.4 V. At room temperature, shelf life is said to be greater than 10 years. Address: Plainview Electronics Corp., 28 Cain Dr., Plainview, NY 11803.

Sound Systems

Catalog #210-K, in 16 pages, describes the Bogen line of sound equipment for PA systems. Included are 10/20/35/60/100-watt integral amplifiers as well as 60/125/250-watt power models. Also covered are: telephone paging amplifiers, mixer-preamplifiers, tuners, receivers, equalizers, speakers, microphones, stands, and accessories. Address: Bogen Div., Box 500, Paramus, NJ 07652.

Video Training Tape Catalog

A guide to Sony's Training Tape Library is available in a catalog covering three categories of tapes. The first, Basic Fundamentals, describes courses on a wide variety of video-related subjects. The second category, Technical Training, explains Sony tapes dealing with specific video products, covering subjects such as operation for the nontechnician to detailed technical information. The last section covers Special Programs, which describe new equipment for dealers. Address: Sony Video Communications, Tape Production Dept., 700 W. Artesia Blvd., Compton, CA 90220.

Equipment Rental Catalog

A 32-page catalog lists 47 separate categories of electronic equipment available for short-term rental from Genstar Rental Electronics. Equipment includes analyzers, meters, computers, PROM programmers, tape recorders, and data terminals. All items are described and the 30-day rental price is given. Used equipment sales facilities are also listed. Address: Genstar Rental Electronics, Inc., 19527 Business Center Dr., Northridge, CA 91324.

RFI Shielded Cases

A line of blank, standard-size, and custom RFI shielded cases and accessories is described in a catalog from Compac. Cases are effective from 60 to over 100 dB at 100 MHz and are available with an optional nickel-plate finish. Various configurations and outlines are shown. Accessories described include coaxial attenuators, terminations, filters and feedthroughs, r-f connectors, mounting bars, etc. Address: Compac, 279 Skidmore Rd., Deer Park, NY 11729.

IC Hardware Catalog

The Cambion IC Packaging Hardware Catalog 131 contains 52 pages of information on four sizes of general-purpose "Cambi-Cards for dual in-line wrapost sockets, pin-jack assemblies for breadboarding changes, and high-density cards for discrete mounting. Also described and listed are buttable socket cards, extenders, card files with hardware and accesories, pins, cord kits, plugs, and jacks. Address: Cambion, 445 Concord Ave., Cambridge, MA 02238.

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74C30	.35	74C907	1.00	4025	.35	4502	.95
74C32	.50	74C908	2.00	4026	1.65	4503	.65
74C42	1.75	74C909	2.75	4027	.65	4508	1.95
74C48	2.10	74C910	9.95	4028	.80	4510	.95
74C73	.65	74C911	10.00	4029	.95	4511	.95
74C74	.85	74C912	10.00	4030	.45	4512	.95
74C76	.80	74C914	1.95	4034	2.95	4514	1.25
74C83	1.95	74C915	2.00	4035	.85	4515	2.25
74C85	1.95	74C918	2.75	4040	.95	4516	1.55
74C86	.95	74C920	17.95	4041	1.25	4518	1.25
74C89	4.50	74C921	15.95	4042	.75	4519	1.25
74C90	1.75	74C922	5.95	4043	.85	4520	1.25
74C93	1.75	74C923	5.95	4044	.85	4522	1.25
74C95	1.75	74C925	6.75	4046	.95	4526	1.25
74C107	1.00	74C926	7.95	4047	.95	4527	1.95
74C150	5.75	74C927	7.95	4049	.55	4528	1.25
74C151	2.25	74C928	7.95	4050	.55	4531	.95
74C154	3.25	74C929	19.95	4051	.95	4532	1.95
74C157	1.75	74C930	19.95	4053	.95	4538	1.95
74C160	2.00	4000	.35	4060	1.45	4539	1.95
74C161	2.00	4001	.35	4066	.75	4543	2.70
74C162	2.00	4002	.25	4068	.40	4555	.95
74C163	2.00	4006	.95	4069	.35	4556	.95
74C164	2.00	4007	.29	4070	.35	4581	1.95
74C165	2.00	4008	.95	4071	.30	4582	1.95
74C173	2.00	4009	.45	4072	.30	4584	.95
74C174	2.25	4010	.45	4073	.30	4585	.95
74C175	2.25	4011	.35	4075	.30	4702	12.95
74C192	2.25	4012	.25	4076	.95	4724	1.50
74C193	2.25	4013	.45	4078	.30	80C07	.95
74C195	2.25	4014	.95	4081	.30	80C95	.85
74C200	5.75	4015	.95	4082	.30	80C96	.95
74C221	2.25	4016	.45	4085	.95	80C97	.95
		4017	1.15	4086	.95	80C98	1.20

DIP SWITCHES

4 position	.85
5 position	.90
6 position	.90
7 position	.95
8 position	.95

CONNECTORS

RS232 MALE	3.25
RS232 FEMALE	3.75
RS232 HOOD	1.25
S-100 ST	3.95
S-100 WW	4.95

TRANSISTORS

PN2222	10/1.00	100/8.99
2N3904	10/1.00	100/8.99
2N3906	10/1.00	100/8.99
2N3055	.79	10/6.99
IN4148		25/1.00
IN4004		10/1.00

LINEAR

LM301V	.34	LM741V	.29
LM308V	.98	LM747	.79
LM309K	1.49	LM748V	.59
LM311	.64	LM1310	2.90
LM317T	1.95	MC1330	1.89
LM317K	3.95	MC1350	1.29
LM318	1.49	MC1358	1.79
LM323K	4.95	LM1414	1.59
LM324	.59	LM1458V	.69
LM337K	3.95	LM1488	1.39
LM339	.99	LM1489	1.39
LM377	2.29	LM1800	2.99
LM380	1.29	LM1889	2.49
LM386V	1.50	LM3900	.59
LM555V	.39	LM3909V	.98
LM556	.69	LM3914	3.95
LM565	.99	LM3915	3.95
LM566V	1.49	LM3916	3.95
LM567V	1.29	75451V	.39
LM723	.49	75452V	.39
LM733	.98	75453V	.39

T=TO-220 V=8 PIN K=TO-3

74S00 SERIES

74S00	.44	74S74	.69	74S163	3.75	74S258	1.49
74S02	.48	74S85	2.39	74S168	4.65	74S260	1.83
74S03	.48	74S86	1.44	74S169	5.44	74S274	19.95
74S04	.79	74S112	1.59	74S174	1.09	74S275	19.95
74S05	.79	74S113	1.98	74S175	1.09	74S280	2.90
74S08	.48	74S114	1.50	74S181	4.47	74S287	4.75
74S09	.98	74S124	2.77	74S182	2.95	74S288	4.45
74S10	.69	74S132	1.24	74S188	3.95	74S289	6.98
74S11	.88	74S133	.98	74S189	14.95	74S301	6.95
74S15	.70	74S134	.69	74S194	2.95	74S373	3.45
74S20	.68	74S135	1.48	74S195	1.89	74S374	3.45
74S22	.98	74S138	1.08	74S196	4.90	74S381	7.95
74S30	.48	74S139	1.25	74S197	4.25	74S387	5.75
74S32	.98	74S140	1.45	74S201	14.95	74S412	2.98
74S37	1.87	74S151	1.19	74S225	8.95	74S471	9.95
74S38	1.68	74S153	1.19	74S240	3.98	74S472	16.85
74S40	.44	74S157	1.19	74S241	3.75	74S474	17.85
74S51	.78	74S158	1.45	74S251	1.90	74S482	15.60
74S64	.79	74S161	2.85	74S253	7.45	74S570	7.80
74S65	1.25	74S162	3.70	74S257	1.39	74S571	7.80

VOLTAGE REG'S

7805T	.89	7905T	.99
7808T	.99	7912T	.99
7812T	.89	7915T	1.19
7815T	.99	7924T	1.19
7824T	.99		
7805K	1.39	7905K	1.49
7812K	1.39	7912K	1.49
7815K	1.39		
78L05	.69	79L05	.79
78L12	.69	79L12	.79
78L15	.69	79L15	.79
LM309K	1.49	LM323K	4.95
LM317T	1.95	LM337K	3.95
LM317K	3.95		

T = TO-220 K = TO-3 L = TO-92

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4K STATIC RAMS 8/18.95

2114 LOW POWER 450ns

ALL MERCHANDISE 100% GUARANTEED **CALL US FOR VOLUME QUOTES**

8200

8202	45.00
8205	3.50
8212	1.95
8214	3.90
8216	1.85
8224	2.50
8226	1.85
8228	4.95
8237	19.95
8238	4.95
8243	4.50
8250	14.95
8251	5.50
8253	9.85
8253-5	9.85
8255	5.25
8255-5	5.25
8257	9.00
8259	7.00
8272	39.95
8275	29.95
8279	10.50
8279-5	10.50
8282	6.65
8283	6.65
8284	5.80
8286	6.65
8287	6.65
8288	25.00
8289	49.95

6800

6800	6.95
6802	11.95
6809	37.95
6810	4.60
6820	4.95
6821	4.95
6828	9.95
6834	16.95
6840	14.95
6843	42.95
6844	44.95
6845	29.95
6847	15.95
6850	4.75
6852	5.75
6860	10.95
6862	11.95
6871	25.95
6875	6.95
6880	2.95

Z80

Z80	8.95
Z80A	9.95
Z80B	19.95
Z80-PIO	6.50
Z80A-PIO	8.60
Z80-CTC	6.50
Z80A-CTC	8.65
Z80-DART	15.25
Z80A-DART	18.75
Z80-DMA	17.50
Z80A-DMA	27.50
Z80-SIO/0	23.95
Z80A-SIO/0	28.95
Z80-SIO/1	23.95
Z80A-SIO/1	28.95
Z80-SIO/2	23.95
Z80A-SIO/2	28.95
Z80-SIO/9	17.95
Z80A-SIO/9	22.95

6502

6502	6.95
6502A	12.95
6504	6.95
6505	8.95
6520	4.95
6522	9.95
6532	14.95
6551	14.95

MPU'S

8035	16.95
8039	19.95
8080A	3.95
8085	12.95
8086	99.95
8088	39.95
8155	11.95
8156	11.95
8185	29.95
8185-2	39.95
8741	39.95
8748	69.95
8755	49.95

IC SOCKETS

	1-100	100pcs
8 pin ST	.13	.11
14 pin ST	.15	.12
16 pin ST	.17	.13
18 pin ST	.20	.18
20 pin ST	.29	.27
22 pin ST	.30	.27
24 pin ST	.30	.27
28 pin ST	.40	.32
40 pin ST	.49	.39
ST = SOLDERTAIL		
8 pin WW	.59	.49
14 pin WW	.69	.52
16 pin WW	.69	.58
18 pin WW	.99	.90
20 pin WW	1.09	.98
22 pin WW	1.39	1.28
24 pin WW	1.49	1.35
28 pin WW	1.69	1.49
40 pin WW	1.99	1.80
WW = WIREWRAP		

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SUPER RAM•II

- PLUG IN SLOT Ø
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- INCLUDES 5 JUMPER OPTIONS
- INCLUDES 5 RAM-ROM OPTIONS
- ENJOY THE BEST OF BOTH WORLDS
- 16K RAM (RANDOM ACCESS MEMORY)
- THIS IS SOPHISTICATED FIRMWARE
- EXPANDS YOUR 48K APPLE TO 64K OF PROGRAMMABLE MEMORY
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- ALLOWS YOU TO RUN APPLE'S NEW FORTRAN PACKAGE ALSO PASCAL AND PILOT
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- THE SOFTWARE DEVELOPED BY VARIOUS VENDORS FOR YOUR (64K) SHOULD NOW WORK AS THEY ADVERTISED
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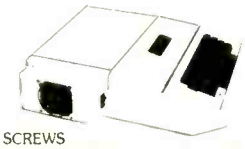
"COOL-IT"



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- SAVE DOWN TIME
- LONG LIFE MOTOR
- LOW NOISE IS A MUST
- SAVE REPAIR CHARGES
- INCREASES RELIABILITY
- CLIPS ON—NO HOLES OR SCREWS
- MINIMUM QUIETNESS IS DUE TO THE DRAW EFFECT OF AIR THROUGH YOUR COMPUTER AND A SPECIAL FAN AND MOTOR DESIGN
- THOSE EXTRA PLUG-IN CARDS CAN CAUSE EXTRA HEAT

HOW TO HOOK IT UP

1. Clip it on your APPLE
2. Unplug your 120V cable (you won't need it)
3. Plug short 120V cable from Super Fan II to the back of your computer
4. Plug the supply cable from Super Fan II to your 120V power source
5. Turn on the rocker switch and a built-in red ready light comes on
6. You are all set *"COOL IT"*

UNIQUE 1 YEAR WARRANTEE!! $69.00

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Jumbo Red	10/1.00
Jumbo Green	6/1.00
Jumbo Yellow	6/1.00
5082-7760 .43'CC	.79
MAN74 .3'CC	.99
MAN72 .3'CA	.99

DYNAMIC RAMS

			100pcs
4027	(250ns)	2.50	2.00
4116-150	(150ns)	8/21.95	2.65
4116-200	(200ns)	8/19.95	2.35
4116-300	(300ns)	8/16.95	2.00
4164	(200ns)	CALL	CALL

EPROMS

				8pcs
1702	256 × 8	(1us)	4.95	4.50
2708	1024 × 8	(450ns)	3.95	3.50
2716	(5v) 2048 × 8	(450ns)	6.95	5.95
2758	(5v) 1024 × 8	(450ns)	9.95	8.95
2716-1	(5v) 2048 × 8	(350ns)	12.95	11.95
TMS2716	2048 × 8	(450ns)	9.95	8.95
TMS2532	(5v) 4096 × 8	(450ns)	21.95	19.95
2732	(5v) 4096 × 8	(450ns)	17.95	16.95

STATIC RAMS

			100pcs
2101	(450ns)	1.95	1.85
2102-1	(450ns)	.89	.85
21L02-1	(LP) (450ns)	1.29	1.15
2111	(450ns)	2.99	2.49
2112	(450ns)	2.99	2.79
2114	(450ns)	8/18.95	2.25
2114L-2	(LP) (200ns)	8/22.95	2.45
2114L-3	(300ns)	8/21.95	2.45
2113L-4	(LP) (450ns)	8/18.95	2.25
4044-4	(450ns)	3.49	3.25
4044-3	(300ns)	3.99	3.75
TMM2016	(200ns)	CALL	CALL
MB6116	(200ns)	CALL	CALL

LP = LOW POWER

PROMS

74S188	(82S23)	OC	32 × 8	3.95
74S287	(82S129)	TS	256 × 4	4.75
74S288	(82S123)	TS	32 × 8	4.45
74S387	(82S126)	OC	256 × 4	5.75
74S471		TS	256 × 8	9.95
74S472	(82S147)	TS	512 × 8	16.85
74S474	(82S141)	TS	512 × 8	17.85
74S570	(82S130)	OC	512 × 4	7.80
74S571	(82S131)	TS	512 × 4	7.80

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7400

SN7400N	.25	SN7472N	.29	SN74156N	.79
SN7401N	.20	SN7473N	.35	SN74157N	.69
SN7402N	.25	SN7474N	.35	SN74160N	.89
SN7403N	.25	SN7475N	.49	SN74161N	.89
SN7404N	.25	SN7476N	.35	SN74162N	.89
SN7405N	.29	SN7479N	5.00	SN74163N	.89
SN7406N	.35	SN7480N	.50	SN74164N	.89
SN7407N	.35	SN7482N	.99	SN74165N	.89
SN7408N	.29	SN7483N	.69	SN74166N	1.25
SN7409N	.29	SN7485N	.89	SN74167N	2.79
SN7410N	.25	SN7486N	.35	SN74170N	1.95
SN7411N	.29	SN7489N	1.75	SN74172N	4.95
SN7412N	.35	SN7490N	.49	SN74173N	1.39
SN7413N	.40	SN7491N	.59	SN74174N	.99
SN7414N	.69	SN7492N	.45	SN74175N	.89
SN7416N	.29	SN7493N	.45	SN74176N	.79
SN7417N	.29	SN7494N	.69	SN74177N	.79
SN7420N	.29	SN7495N	.69	SN74179N	1.49
SN7421N	.29	SN7496N	.69	SN74180N	.79
SN7422N	.45	SN7497N	3.00	SN74181N	2.25
SN7423N	.29	SN74100N	1.49	SN74182N	.79
SN7425N	.29	SN74104	.89	SN74184N	2.49
SN7426N	.29	SN74105	.89	SN74185N	2.49
SN7427N	.25	SN74107N	.35	SN74190N	1.25
SN7428N	.49	SN74109N	.39	SN74191N	1.25
SN7430N	.25	SN74116N	1.95	SN74192N	.89
SN7432N	.29	SN74121N	.39	SN74193N	.89
SN7437N	.25	SN74122N	.55	SN74194N	.89
SN7438N	.40	SN74123N	.59	SN74195N	.69
SN7439N	.25	SN74125N	.49	SN74196N	.89
SN7440N	.20	SN74126N	.49	SN74197N	.89
SN7441N	.89	SN74132N	.75	SN74198N	1.49
SN7442N	.59	SN74136N	.75	SN74199N	1.49
SN7443N	1.10	SN74141N	.99	SN74221N	1.25
SN7444N	1.10	SN74142N	3.25	SN74251N	.99
SN7445N	.89	SN74143N	3.49	SN74276N	1.95
SN7446N	.79	SN74144N	3.49	SN74279N	.79
SN7447N	.69	SN74145N	.79	SN74283N	1.49
SN7448N	.79	SN74147N	1.95	SN74284N	3.95
SN7450N	.20	SN74148N	1.29	SN74285N	3.95
SN7451N	.20	SN74150N	1.25	SN74365N	.69
SN7453N	.20	SN74151N	.69	SN74366N	.69
SN7454N	.20	SN74152N	.69	SN74367N	.69
SN7459A	.25	SN74153N	.79	SN74368N	.69
SN7460N	.20	SN74154N	1.25	SN74390N	1.49
SN7470N	.29	SN74155N	.79	SN74393N	1.49

74LS

74LS00	.29	74LS92	.75	74LS192	1.15
74LS01	.29	74LS93	.75	74LS193	1.15
74LS02	.29	74LS95	.99	74LS194	1.15
74LS03	.29	74LS96	1.15	74LS195	1.15
74LS04	.35	74LS107	.45	74LS197	1.19
74LS05	.35	74LS109	.45	74LS221	1.19
74LS08	.29	74LS112	.45	74LS240	1.95
74LS09	.35	74LS113	.49	74LS241	1.95
74LS10	.29	74LS114	.49	74LS242	1.95
74LS11	.35	74LS122	.89	74LS243	1.95
74LS12	.35	74LS123	1.25	74LS244	1.95
74LS13	.59	74LS125	.89	74LS245	2.95
74LS14	.99	74LS126	.89	74LS247	1.19
74LS15	.35	74LS132	.99	74LS248	1.19
74LS20	.29	74LS133	.89	74LS249	1.19
74LS21	.35	74LS136	.49	74LS251	1.49
74LS22	.35	74LS138	.89	74LS253	.99
74LS26	.35	74LS139	.89	74LS257	.89
74LS27	.35	74LS151	.89	74LS258	.99
74LS28	.35	74LS153	.89	74LS260	.69
74LS30	.29	74LS154	1.75	74LS266	.69
74LS32	.35	74LS155	1.19	74LS273	1.95
74LS33	.59	74LS156	1.19	74LS279	.75
74LS37	.45	74LS157	.89	74LS283	1.09
74LS38	.49	74LS158	.99	74LS290	.99
74LS40	.35	74LS160	1.15	74LS293	.99
74LS42	.89	74LS161	1.15	74LS298	1.25
74LS47	.89	74LS162	1.15	74LS352	1.29
74LS48	1.15	74LS163	1.15	74LS353	1.29
74LS49	1.15	74LS164	1.25	74LS365	.75
74LS51	.29	74LS165	1.25	74LS366	.75
74LS54	.29	74LS168	1.19	74LS367	.75
74LS55	.29	74LS169	1.19	74LS368	.75
74LS73	.45	74LS170	2.49	74LS373	1.95
74LS74	.45	74LS173	1.39	74LS374	1.95
74LS75	.59	74LS174	.99	74LS375	.89
74LS76	.45	74LS175	.99	74LS386	.69
74LS78	.49	74LS181	2.95	74LS393	2.49
74LS83	.89	74LS190	1.25	74LS399	2.49
74LS85	1.25	74LS191	1.25	74LS670	2.49
74LS86	.45			81LS95	1.95
74LS90	.59			81LS97	1.95

74S

74S00	.50	74S124	2.49	74S243	3.25
74S02	.50	74S133	.55	74S244	3.25
74S03	.50	74S134	.69	74S251	1.45
74S04	.55	74S135	1.19	74S253	1.45
74S05	.55	74S136	1.75	74S257	1.35
74S08	.55	74S138	1.35	74S258	1.35
74S09	.50	74S139	1.35	74S260	.79
74S10	.50	74S140	1.15	74S280	2.95
74S11	.50	74S151	1.35	74S287	4.95
74S15	.50	74S153	1.35	74S288	4.95
74S20	.50	74S157	1.35	74S373	3.49
74S22	.50	74S158	1.35	74S374	3.49
74S30	.50	74S160	1.95	74S387	5.95
74S32	.55	74S174	1.59	74S471	19.95
74S38	.69	74S175	1.59	74S472	19.95
74S40	.55	74S188	4.95	74S473	19.95
74S51	.50	74S194	1.95	74S474	21.95
74S64	.50	74S195	1.95	74S475	21.95
74S65	.50	74S196	3.95	74S570	7.95
74S74	.79	74S240	2.95	74S571	7.95
74S86	.79	74S241	2.95	74S572	19.95
74S112	.79	74S242	3.25	74S573	19.95
74S113	.79			74S940	3.15
74S114	.79			74S941	3.15

CA—LINEAR

CA3010H	1.07	CA3060N	3.25	CA3089N	3.75
CA3013H	2.15	CA3080H	1.25	CA3096N	3.95
CA3023H	3.25	CA3081N	2.00	CA3130H	1.39
CA3035H	2.48	CA3082N	2.00	CA3140H	1.25
CA3039H	1.35	CA3083N	1.60	CA3160H	1.25
CA3046N	1.30	CA3086N	.85	CA3401N	.59
CA3059N	3.25			CA3600N	3.50

CD—CMOS

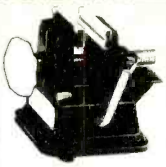
CD4000	.39	CD4041	1.49	CD4098	2.49
CD4001	.39	CD4042	.99	CD4506	.75
CD4002	.39	CD4043	.89	CD4507	.99
CD4006	1.19	CD4044	.89	CD4508	3.95
CD4007	.25	CD4046	1.79	CD4510	1.39
CD4009	.49	CD4047	2.50	CD4511	1.29
CD4010	.49	CD4048	1.35	CD4512	1.49
CD4011	.39	CD4049	.49	CD4514	3.95
CD4012	.25	CD4050	.69	CD4515	2.95
CD4013	.49	CD4051	1.19	CD4516	1.49
CD4014	1.39	CD4052	1.19	CD4518	1.79
CD4015	1.19	CD4053	1.19	CD4519	.89
CD4016	.59	CD4056	2.95	CD4520	1.29
CD4017	1.19	CD4059	9.95	CD4526	1.79
CD4018	.99	CD4060	1.49	CD4528	1.79
CD4019	.49	CD4066	.79	CD4529	1.95
CD4020	1.19	CD4068	.39	CD4543	2.79
CD4021	1.39	CD4069	.45	CD4562	11.95
CD4022	1.19	CD4070	.55	CD4566	2.79
CD4023	.29	CD4071	.49	CD4583	2.49
CD4024	.79	CD4072	.49	CD4584	.75
CD4025	.23	CD4073	.39	CD4723	1.95
CD4026	2.95	CD4075	.39	CD4724	1.95
CD4027	.69	CD4076	1.39	MC14409	14.95
CD4028	.89	CD4078	.55	MC14410	14.95
CD4029	1.49	CD4081	.39	MC14411	14.95
CD4030	.49	CD4082	.39	MC14412	11.95
CD4034	3.49	CD4093	.99	MC14419	4.95
CD4035	.99			MC14433	13.95
CD4040	1.49			MC14538	2.49
				MC14541	1.95

ok®

DIP/IC INSERTION TOOL WITH PIN STRAIGHTENER

Inserts both 14 and 18 pin packages. Narrow profile permits work on closely spaced items. Pin straightener built into handle.

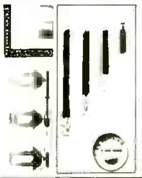
Part No.	Function	Price
INS-1416	14 16 pin	$3.49
MOS-1416	14 16 pin CMOS safe	7.95
MOS-2428	24 28 pin CMOS safe	7.95
MOS-40	36 40 pin CMOS safe	7.95



Vacuum Vise

Vacuum-based light-duty vise for small components and assemblies. ABS construction. 1½" jaws, 1¼" travel. Can be permanently installed.

VV-1 . . . . $3.49



Wire Wrapping Kit WK-2

Contains WSU-30 wrap tool, 50 feet of Kynar 30 AWG white wire, 50 pieces each pre-stripped wire in 1", 2" 3" and 4" lengths, stripped 1" both ends.

WK-2 . . . . $12.95

DISCRETE LEDS

XC556R	.200"	red	5/$1	MV50	.085"	red	6/$1
XC556G	.200"	green	4/$1	XC209R	.125"	red	5/$1
XC556Y	.200"	yellow	4/$1	XC209G	.125"	green	4/$1
XC556C	.200"	clear	4/$1	XC209Y	.125"	yellow	4/$1
XC22R	.200"	red	5/$1	XC526R	.185"	red	5/$1
XC22G	.200"	green	4/$1	XC526G	.185"	green	4/$1
XC22Y	.200"	yellow	4/$1	XC526Y	.185"	yellow	4/$1
MV10B	.170"	red	4/$1	XC526C	.185"	clear	4/$1

6 VOLT MINI LAMP — INCANDESCENT —

800-147 Clear w/5" leads 8/$1
80620 Red w/10" leads 9/$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	Type	Polarity	Ht	Price
MAN 1	C.A.—red	.270	2.95	DLG507	C.A.—green	.500	1.25
MAN 2	5x7 D.M.—red	.300	4.95	DL704	C.C.—red	.300	1.25
MAN 3	C.C.—red	.125	.25	DL707	C.A.—red	.300	1.25
MAN 52	C.A.—green	.300	1.25	DL728	C.C.—red	.500	1.49
MAN 54	C.C.—green	.300	1.25	DL741	C.A.—red	.600	1.25
MAN 71	C.A.—red	.300	.75	DL746	C.A.—red ± 1	.630	1.49
MAN 72	C.A.—red	.300	.75	DL747	C.A.—red	.600	1.49
MAN 74	C.C.—red	.300	1.25	DL750	C.C.—red	.600	1.49
MAN 82	C.A.—yellow	.300	.49	DLO847	C.A.—orange	.800	1.49
MAN 84	C.C.—yellow	.300	.99	DLO850	C.C.—orange	.800	1.49
MAN 3620	C.A.—orange	.300	.49	DL338	C.C.—red	.110	.35
MAN 3630	C.A.—orange ± 1	.300	.99	FND358	C.C. ± 1	.357	.99
MAN 3640	C.C.—orange	.300	.99	FND359	C.C.	.357	.75
MAN 4610	C.A.—orange	.400	.99	FND503	C.C. (FND500)	.500	.99
MAN 6610	C.A.—orange—DD	.560	.99	FND507	C.A. (FND510)	.500	.99
MAN 6630	C.A.—orange ± 1	.560	.99	HDSP-3401	C.A.—red	.800	1.50
MAN 6640	C.C.—orange—DD	.560	.99	HDSP-3403	C.C.—red	.800	1.50
MAN 6650	C.C.—orange ± 1	.560	.99	5082-7751	C.A., R.H.D.—red	.430	1.25
MAN 6660	C.A.—orange	.560	.99	5082-7760	C.C., R.H.D.—red	.430	1.75
MAN 6710	C.A.—red—DD	.560	.99	5082-7300	4x7 sgl. dig. RHD	.600	22.00
MAN 6750	C.C.—red ± 1	.560	.99	5082-7302	4x7 sgl. dig. LHD	.600	22.00
MAN 6780	C.C.—red	.560	.99	5082-7304	Overnge. char. (±1)	.600	19.95
DLO304	C.C.—orange	.300	1.25	4N28	Photo Xsistor Opto-Isol.		.99
DLO307	C.A.—orange	.300	1.25	LIT-1	Photo Xsistor Opto-Isol.		.69
DLG500	C.C.—green	.500	1.25	MOC3010	Optically Isol. Triac Driver		1.25

SOCKETS — RECEPTACLES

Test TEXTOOL Sockets

ZERO INSERTION FORCE

* Nickel Boron Plating
* G.F. PSF Plastic Body
* For testing IC's

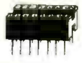
Part No.	Pins	Price	Part No.	Pins	Price
214-3339	14 pin	5.95	222-3343	22 pin	9.95
216-3340	16 pin	6.49	224-3344	24 pin	9.75
218-3341	18 pin	7.95	228-3345	28 pin	11.95
220-3342	20 pin	8.95	240-3346	40 pin	12.95

* Nickel Boron Plating
* G.F. PSF Plastic Body
* Wire Wrap Contacts

Part No.	Pins	Price	Part No.	Pins	Price
214-3592	14 pin	9.75	222-3596	22 pin	12.95
216-3593	16 pin	9.95	224-3597	24 pin	12.75
218-3594	18 pin	10.95	228-3598	28 pin	13.95
220-3595	20 pin	11.95	240-3599	40 pin	15.95

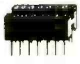
LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100
8 pin LP	.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61



SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100
14 pin ST	.27	.25	.24
16 pin ST	.30	.27	.25
18 pin ST	.35	.32	.30
24 pin ST	.49	.45	.42
28 pin ST	.99	.90	.81
36 pin ST	1.39	1.26	1.15
40 pin ST	1.59	1.45	1.30



SOLDERTAIL (GOLD) STANDARD

	1-24	25-49	50-100
8 pin SG	.39	.35	.31
14 pin SG	.49	.45	.41
16 pin SG	.54	.49	.44
18 pin SG	.59	.53	.48
24 pin SG	.79	.75	.69
28 pin SG	1.10	1.00	.90
36 pin SG	1.65	1.40	1.26
40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100
8 pin WW	.59	.54	.49
10 pin WW	.69	.63	.58
14 pin WW	.79	.73	.67
16 pin WW	.85	.77	.70
18 pin WW	.99	.90	.81
20 pin WW	1.19	1.08	.99
22 pin WW	1.49	1.35	1.23
24 pin WW	1.39	1.26	1.14
28 pin WW	1.69	1.53	1.38
36 pin WW	2.19	1.99	1.79
40 pin WW	2.29	2.09	1.89

1/4 WATT RESISTOR ASSORTMENTS – 5%

ASST. 1	5 ea.	10 Ohm 12 Ohm 15 Ohm 18 Ohm 22 Ohm 27 Ohm 33 Ohm 39 Ohm 47 Ohm 56 Ohm	50 pcs.	$1.95
ASST. 2	5 ea.	68 Ohm 82 Ohm 100 Ohm 120 Ohm 150 Ohm 180 Ohm 220 Ohm 270 Ohm 330 Ohm 390 Ohm	50 pcs.	$1.95
ASST. 3	5 ea.	470 Ohm 560 Ohm 680 Ohm 820 Ohm 1K 1.2K 1.5K 1.8K 2.2K 2.7K	50 pcs.	$1.95
ASST. 4	5 ea.	3.3K 3.9K 4.7K 5.6K 6.8K 8.2K 10K 12K 15K 18K	50 pcs.	$1.95
ASST. 5	5 ea.	22K 27K 33K 39K 47K 56K 68K 82K 100K 120K	50 pcs.	$1.95
ASST. 6	5 ea.	150K 180K 220K 270K 330K 390K 470K 560K 680K 820K	50 pcs.	$1.95
ASST. 7	5 ea.	1M 1.2M 1.5M 1.8M 2.2M 2.7M 3.3M 3.9M 4.7M 5.6M	50 pcs.	$1.95
ASST. 8R		Includes Resistor Assts. 1-7 (350 pcs.)		$10.95 ea.

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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
8038CCPD	Waveform Generator	4.95
8048CCPE	Monolithic Logarithmic Amp	21.60
8069CCQ	50ppm Band—GAP Volt Ref. Diode	2.50
8211CPA	Volt Ref/Indicator	2.50
8212CPA	Volt Ref/Indicator	2.50

74C

74C00	.39	74C95	1.59	74C221	1.95
74C02	.39	74C107	1.89	74C240	2.25
74C04	.39	74C151	2.95	74C244	2.25
74C08	.39	74C154	3.95	74C373	2.49
74C10	.39	74C157	2.25	74C374	2.59
74C14	.75	74C160	1.69	74C901	.89
74C20	.39	74C161	1.60	74C903	1.15
74C30	.39	74C162	1.49	74C911	10.95
74C42	1.39	74C163	1.69	74C912	10.95
74C48	1.95	74C164	1.59	74C915	1.69
74C73	.79	74C173	1.39	74C917	10.95
74C74	.79	74C174	1.39	74C922	5.49
74C85	1.95	74C175	1.39	74C923	5.75
74C86	.99	74C192	1.69	74C925	7.50
74C89	6.95	74C193	1.69	74C926	7.50
74C90	1.29	74C195	1.59	80C95	.79
74C93	1.29			80C97	.79

LINEAR

LH0002CN	6.85	LM340T-5	1.25	LM702H	.79
LM10CLH	4.50	LM340T-12	1.25	LM703CN	.89
LM11CLH	4.75	LM340T-15	1.25	LM709N	.49
LH0070-OH	6.05	LM341P-5	.75	LM710N	.79
TL071CP	.79	LM341P-12	.75	LM711N	.79
TL072CP	1.39	LM341P-15	.75	LM723N	.69
TL074CN	2.49	LM342P-5	.69	LM733N/H	1.00
LH0082CD	35.80	LM342P-12	.69	LM739N	1.19
TL082CP	1.19	LM342P-15	.69	LM741CN	.35
TL084CN	2.19	LM348N	1.25	MC1741SCG	3.00
LH0094CD	36.80	LM350K	5.75	LM747N/H	.79
LM300H	.99	LF351N	.60	LM748N/H	.59
LM301CN/H	.35	LF353N	1.00	LM1014N	2.75
LM302H	1.95	LF355N	1.10	LM1310N	1.95
LM304H	1.95	LF356N	1.10	LM1458CN	.59
LM305H	.99	LM358N	1.00	LM1488N	1.25
LM307CN/H	.45	LM359N	1.79	LM1489N	1.25
LM308CN/H	1.00	LM370N	4.49	LM1496N	1.95
LM309H	1.95	LM373N	3.25	LM1556V	1.75
LM309K	1.25	LM377N	2.95	LM1800N	2.95
LM310CN	1.75	LM380N	1.25	LM1877N-9	3.25
LM311H/CN	.90	LM381N	1.95	LM1889N	3.20
LM312H	2.49	LM382N	1.79	LM1896N	1.75
LM317MP	1.15	LM384N	1.95	LM2002T	1.49
LM317T	1.75	LM386N-3	1.29	LM2877P	2.05
LM317K	3.95	LM387N	1.45	LM2878P	2.25
LM318CN/H	1.95	LM389N	1.35	LM2896P-1	2.25
LM319N	1.95	LM392N	.69	LM3189N	2.95
LM320K-5	1.35	LF398N	4.00	LM3900N	.69
LM320K-12	1.35	LM399H	5.00	LM3905CN	1.25
LM320K-15	1.35	TL494CN	4.49	LM3909N	1.15
LM320T-5	1.25	TL496CP	1.75	LM3914N	3.95
LM320T-12	1.25	NE510A	6.00	LM3915N	3.95
LM320T-15	1.25	NE529A	4.95	LM3916N	3.95
LM323K-5	5.95	NE531H	3.95	RC4136N	1.25
LM324N	.99	NE536H	6.00	RC4151NB	3.95
LM329DZ	.65	NE540H	6.00	RC4194TK	5.95
LM331N	3.95	NE544N	4.95	RC4195TK	5.49
LM334Z	1.30	NE550A	1.30	KB4428	4.25
LM335Z	1.40	NE555V	.39	KB4429	5.95
LM336Z	1.75	LM556N	.99	LM4500A	3.25
LM337T	1.95	NE564N	3.95	ICL8038B	4.95
LM337MP	1.15	LM565N	1.25	LM13080N	1.29
LM338K	6.95	LM566CN	1.95	LM13600N	1.49
LM339N	.99	LM567V	1.25	75138N	1.95
LM340K-5	1.35	NE570N	4.95	75450N	.89
LM340K-12	1.35			75451CN	.39
LM340K-15	1.35			75492	.89

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50 VOLT CERAMIC DISC CAPACITORS

Value	1-9	10-99	100+	Value	1-9	10-99	100+
10 pf	.08	.06	.05	.001µF	.08	.06	.05
22 pf	.08	.06	.05	.0047µF	.08	.06	.05
47 pf	.08	.06	.05	.01µF	.08	.06	.05
100 pf	.08	.06	.05	.022µF	.09	.07	.06
220 pf	.08	.06	.05	.047µF	.09	.07	.06
470 pf	.08	.06	.05	.1µF	.15	.12	.10

100 VOLT MYLAR FILM CAPACITORS

.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022mf	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (Solid) CAPACITORS

.1/35V	.39	.34	.29	1.5/35V	.41	.37	.29
.15/35V	.39	.34	.29	2.2/35V	.51	.45	.34
.22/35V	.39	.34	.29	3.3/25V	.53	.47	.37
.33/35V	.39	.34	.29	4.7/25V	.63	.56	.45
.47/35V	.39	.34	.29	6.8/25V	.79	.69	.55
.68/35V	.39	.34	.29	15/25V	1.39	1.25	.95
1.0/35V	.39	.34	.29	22/6V	.79	.69	.55

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Axial	1-99	100-499	500+	Radial	1-99	100-499	500+
.47/50V	.16	.14	.10	.47/25V	.15	.13	.12
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3.3/50V	.17	.15	.11	1.0/16V	.15	.13	.12
4.7/25V	.18	.15	.11	1.0/25V	.16	.14	.13
10/25V	.18	.15	.11	1.0/50V	.17	.15	.14
10/50V	.19	.16	.12	4.7/16V	.15	.13	.12
22/25V	.19	.16	.12	4.7/25V	.16	.14	.13
22/50V	.24	.20	.18	4.7/50V	.17	.15	.14
47/25V	.25	.21	.19	10/16V	.15	.13	.12
47/50V	.29	.25	.23	10/25V	.16	.14	.13
100/25V	.28	.24	.22	10/50V	.17	.15	.14
100/50V	.41	.37	.34	47/50V	.25	.21	.19
220/25V	.39	.34	.33	100/16V	.21	.17	.14
220/50V	.49	.45	.41	100/25V	.25	.23	.21
470/25V	.54	.49	.45	100/50V	.37	.34	.31
1000/16V	.79	.69	.61	220/16V	.25	.21	.19
2200/16V	.89	.79	.69	470/25V	.35	.31	.27

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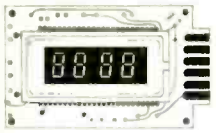
National Semiconductor Clock Modules



12VDC AUTOMOTIVE/ INSTRUMENT CLOCK

APPLICATIONS:
- In-dash autoclocks
- After-market auto/ RV clocks
- Aircraft-marine clks.
- 12VDC oper. instru.
- Portable/battery powered instruments.

Features: Bright 0.3" green display. Internal crystal time-base. ± 0.5 sec./day accur. Auto. display brightness control logic. Display color filterable to blue, blue-green, green & yellow. Complete – just add switches and lens.

MA1003 Module $16.95

CLOCK MODULES

MA1023	.7" Low Cost Digital LED Clock Module	8.95
MA1026	.7" Dig. LED Alarm Clock/Thermometer	18.95
MA5036	.3" Low Cost Digital LED Clock/Timer	6.95
MA1002	.5" LED Display Dig. Clock & Xformer	9.95

TRANSFORMERS

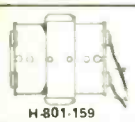
102-P20	Xformer for MA1023 Clock Modules	3.49
102-P22	Xformer for MA1026 Clock Modules	3.49
102-P20	Xformer for MA5036 Clock Modules	3.49

A0201

8 OHM SPEAKER

2¼" – 8 Ohm – .25 watt

$1.25 ea. 2/$1.95 ea. 10/$7.95 ea.

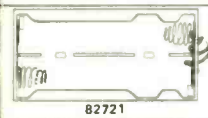


H-801-159

BATTERY HOLDER

- Holds 2 ea. C cells
- Aluminum Case
- 5" leads

$ .45 each 10/$3.95



82721

BATTERY HOLDER

- Holds 4 ea. C cells
- Plastic case
- 9" leads

$ .49 ea. 10/$4.25

EPROM Erasing Lamp

- Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.
- Erases up to 4 chips within 20 minutes.
- Maintains constant exposure distance of one inch.
- Special conductive foam liner eliminates static build-up.
- Built-in safety lock to prevent UV exposure.
- Compact – only 7-5/8" x 2-7/8" x 2"
- Complete with holding tray for 4 chips.

UVS-11E $79.95

JOYSTICKS

JS-5K

JVC-40

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

6-Digit Clock Kit

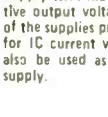
- Bright .300 ht. comm. cathode display
- Uses MM5314 clock chip
- Switches for hours, minutes and hold modes
- Hrs. easily viewable to 20 ft.
- Simulated walnut case
- 115 VAC operation
- 12 or 24 hr. operation
- Incl. all components, case & wall transformer
- Size: 6¼" x 3-1/8" x 1¾"

JE701 . . . . . $19.95

NEW! JE215 Adjustable Dual Power Supply

General Description: The JE215 is a Dual Power Supply with independent adjustable positive and negative output voltages. A separate adjustment for each of the supplies provides the user unlimited applications for IC current voltage requirements. The supply can also be used as a general all-purpose variable power supply.

FEATURES:
- Adjustable regulated power supplies, pos. and neg. 1.2VDC to 15VDC
- Power Output (each supply): 5VDC @ 500mA, 10VDC @ 750mA, 12VDC @ 500mA, and 15VDC @ 175mA
- Two, 3-terminal adj. IC regulators with thermal overload protection.
- Heat sink regulator cooling
- LED "on" indicator
- Printed Board Construction
- 120VAC input
- Size: 3-1/2" w x 5-1/16" L x 2" H



JE215 Adj. Dual Power Supply Kit (as shown) . . $24.95

(Picture not shown but similar in construction to above)

JE200 Reg. Power Supply Kit (5VDC, 1 amp) . . $14.95
JE205 Adapter Brd. (to JE200) +5, -9 & +12V. $12.95
JE210 Var. Pwr. Sply. Kit, 5-15VDC, to 1.5amp. $19.95

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES

INS8080A	CPU	6.50
DP8212	8-Bit Input/Output	3.25
DP8214	Priority Interrupt Control	5.95
DP8216	Bi-Directional Bus Driver	3.49
DP8224	Clock Generator/Driver	3.95
DP8226	Bus Driver	3.49
DP8228	System Controller/Bus Driver	4.95
DP8238	System Controller	5.95
INS8243	I/O Expander for 48 Series	8.95
INS8250	Asynchronous Comm. Element	16.95
DP8251	Prog. Comm. I/O (USART)	7.95
DP8253	Prog. Interval Timer	14.95
DP8255	Prog. Peripheral I/O (PPI)	9.95
DP8257	Prog. DMA Control	19.95
DP8259	Prog. Interrupt Control	14.95
DP8275	Prog. CRT Controller	99.95
DP8279	Prog. Keyboard/Display Interface	19.95
DP8300	Octal Bus Receiver	6.95
DP8303	System Timing Element	6.95
DP8304	8-Bit Bi-Directional Receiver	3.95
DP8307	8-Bit Bi-Directional Receiver	3.95
DP8308	8-Bit Bi-Directional Receiver	3.95

6800/6800 SUPPORT DEVICES

MC6800	MPU	14.95
MC6802CP	MPU with Clock and RAM	19.95
MC6810API	128-8 Static RAM	4.95
MC6821	Peripheral Inter. Adapt (MC6820)	7.49
MC6828	Priority Interrupt Controller	19.95
MC6830L8	1024-8 Bit ROM (MC6830-8)	14.95
MC6850	Asynchronous Comm. Adapter	6.95
MC6852	Synchronous Serial Data Adapter	6.95
MC6860	0-600bps Digital MODEM	10.95
MC6862	2400bps Modulator	12.95
MC6880A	Quad 3-State Bus Trans. (MC8T26)	2.25

MICROPROCESSOR CHIPS

Z80 (780C)	CPU (MK3880N) (2MHz)	13.95
Z80A (780-1)	CPU (MK3880N-4) (4MHz)	15.95
COP1802	CPU	19.95
7650	MPU	19.95
IOM2901ADC	CPU 4-Bit Slice (Com. Temp. Grade)	19.95
MCS6502	MPU w/Clock (6K Bytes Memory)	11.95
INS8035N-4	MPU 8-Bit (64MHz)	16.95
INS8039N-4	CPU Sgl. Chip 8-Bit (128 bytes RAM)	19.95
INS8040N-4	CPU (256 Bytes RAM)	24.95
INS8070N	CPU-64 Bytes RAM	24.95
INS8073N	CPU w/Basic Micro Interpreter	29.95
P8085	CPU	19.95
INS8900	CPU-16-Bit	29.95
TMS9900JL	MPU-16 Bit	99.95

SHIFT REGISTERS

MM5002+	Dual 25-Bit Dynamic	.50
MM5013+	Dual 50-Bit Dynamic	.50
MM5016+	Dual 100-Bit Static	.50
MM5010+	Dual 64-Bit Accumulator	.50
MM1402	256-Bit Dynamic	3.95
MM5013	1024-Bit Dynamic/Accumulator	1.95
MM5016H	500/512-Bit Dynamic	.89
MM5034N	Octal 80-Bit	9.95
MM5035N	Octal 80-Bit	9.95
2504V (1404A)	1024-Bit Dynamic	3.95
2518V	Hex 32-Bit Static	4.95
2532V	Dual 132-Bit Static	2.95
2534V	512-Bit Dynamic	.99
2535V	1024-Bit Dynamic	2.95
2537V	Dual 256-Bit Static	2.95
2538V	Dual 250-Bit Static	4.00
2539V	Dual 240-Bit Static	4.00
2540V	Quad 80-Bit Static	2.95
2MPC	Fifo (Dual 80)	6.95

DATA ACQUISITION

AF100-1CN	Universal Active Filter 2.5%	5.95
AF121-1CJ	Touch Tone Low Pass Filter	19.95
AF322-1CJ	Touch Tone Low Pass Filter	19.95
LM308AH	Super Gain Op Amp	1.00
LM334Z	Constant Current Source	1.30
LM335Z	Temperature Transducer	1.40
LF356N	JFET Input Op Amp	1.10
LF398N	Sample & Hold Amplifiers	3.95
LM399H	Temp. Comp. Ref. (.2ppm/C°)	4.95
ADC0804LCN	8-Bit A/D Converter (1 LSB)	4.95
DAC0808LCN	8-Bit D/A Converter (0.78% Lin.)	2.25

DATA ACQUISITION (CONTINUED)

ADC0809CCN	8-Bit A/D Converter (8-Ch. Multi.)	5.25
ADC0811CCN	8-Bit A/D Converter (16-Ch. Multi.)	10.95
DAC1008LCN	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	80K BAUD UART	5.95

RAM'S

1101	256-1 Static	1.49
1103	1024-1 Dynamic	.99
2101 (8101)	256-4 Static	3.95
2102	1024-1 Static	1.75
2111-02	1024-4 Static	1.95
2111 (8111)	256-4 Static	3.95
2112	256-4 Static MOS	4.95
2114	1024-4 Static 450ns	5.95
2114L	1024-4 Static 450ns Low Power	6.95
2114-3	1024-4 Static 300ns	7.95
2114L-3	1024-4 Static 300ns Low Power	7.95
2117	16,384-1 Dynamic 350ns (housemarked)	6.95
4116 (N-4) UPD416	16K Dynamic 250ns (MM5290-4)	3.95
4164	64K Dynamic 250ns	99.95
MM2147Q	4096-1 Fast 70ns	19.95
5101	256-4 Static	7.95
MM5261	1024-1 Dynamic Fully Decoded	.99
MM5262	2K-1 Dynamic	.75
2114L	1024-4 Static 450ns Low Power	6.95
MM5280/2102	1024-1 Dynamic	6.95
MM5290N-2 (4116)	16K Dynamic 150ns (UPD416C-3)	5.25
MM5298U-3A	8K Dyn. 200ns (lower vg of MM5290)	4.95
MM5299NAA/N	Controller Oriented Processor	9.95
UPD414/MK4027	4K Dynamic 16-Pin	4.95
TMS4044-45NL	4K Static	16.95
TMS4045	1024-4 Static	14.95

PROMS/EPROMS

1702A	2K UV Erasable PROM	5.95
2708	8K EPROM	5.95
TMS2716	16K EPROM (5V, +5V, -12V)	19.95
2716(Intel/2516JT1)	16K EPROM (Single +5V)	10.95
2732(Intel/2532)T1	32K EPROM	19.95
2758	8K EPROM (450ns) (5/single +5V)	7.95
5203	2048 PROM	14.95
82S23(74S188)	32-8 PROM (Open Collector)	4.95
82S115	4096-8 Bipolar PROM	19.95
82S123(74S288)	32-8 Tri-State Bipolar PROM	4.95
82S185	8K PROM	29.95

ROM'S

2513(2140)	Character Generator (Upper Case)	9.95
2513(2021)	Character Generator (Lower Case)	9.95
2316N	Character Generator	10.95
MM5230N	2048-Bit Read Only Memory	1.95

NMOS READ ONLY MEMORIES

MCM6670P	128-9x7 ASCII Shifted w/Greek	13.50
MCM6676P	128-8x7 Math Symbol & Pictures	13.50
MCM6675P	128-9x7 Alpha, Control Char. Gen.	13.50

MICROPROCESSOR MANUALS

M-780	User Manual	7.50
MCDP1802	User Manual	7.50
M-7650	User Manual	5.00

SPECIAL FUNCTION

DS0025CN	Dual MOS Clock Driver (SMZ)	3.50
DS0026CN	Dual MOS Clock Driver (SMZ)	1.95
INS1771N-1	Floppy Disc Controller	24.95
INS2651N	Communication Chip	19.95
MM5837N	Microprocessor Real Time Clock	11.95
MM5841N	Microprocessor Compatible Clock	11.95
COP402N	Microcontroller with 4K-Digit RAM and Direct LED Drive	6.95
COP802MN	Microcontroller with 64-Digit RAM & Direct LED Drive w/N Bus Int.	1.49
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 (64 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
MM53200N	Push Button Pulse Dialer	7.95
MM5299N	96/104-Key Serial Keyboard Encoder	8.95

ELECTRONIC TOY MOTORS

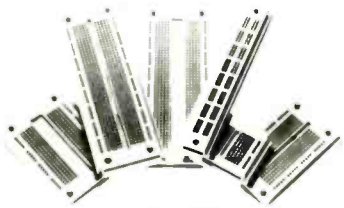
Taper Power Source	Operating Voltage Range	TYPICAL CHARACTERISTICS NO LOAD Voltage	Speed RPM	Current AMP	AT MAXIMUM EFFICIENCY Speed RPM	Current AMP	Torque OZ. IN.	Output W	Eff %	STALL TORQUE OZ. IN.
Dry Cells	1.5 6.0	3.0	9,200	0.20	6,750	0.90	0.260	1.30	57.0	0.97

937 O.D. X 1.201 Length

MABUCHI RE280 $.99 each . . . 10/$7.50 . . . 100/$50.00

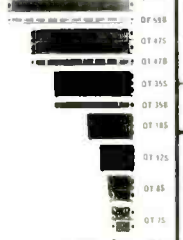
GLOBAL SPECIALTIES

EXPERIMENTOR SOCKETS



Model	Length	Width	Center Channel	5 Tie Point Terminals	Bus Strips	Price
EXP48	6.0"	1.0"	n/a	n/a	4(1601	$ 4.75
EXP300	6.0"	2.1"	.3"	94(470)	2(80)	$12.00
EXP325	1.8"	2.1"	.3"	22(110)	2(20)	$ 3.50
EXP350	3.6"	2.1"	.3"	46(230)	2(40)	$ 6.75
EXP600	6.0"	2.4"	.6"	94(470)	2(80)	$14.75
EXP650	3.6"	2.4"	.6"	46(230)	2(40)	$ 8.75

Quick Test Sockets & Bus Strips



	Length	Hole Centers	Terminals	Price
QT 595	6.5"	6.2"	110	$12.25
QT 595	6.5"	6.2"	70	$ 7.75
QT 475	5.2"	5.0"	94	$ 8.25
QT 470	5.2"	5.0"	16	$ 2.50
QT 355	4.1"	3.8"	70	$ 7.25
QT 350	4.1"	3.8"	12	$ 2.20
QT 185	2.4"	2.1"	35	$ 4.50
QT 125	1.8"	1.5"	24	$ 3.75
QT 85	1.6"	1.3"	15	$ 3.00
QT 75	1.3"	1.0"	10	$ 2.75

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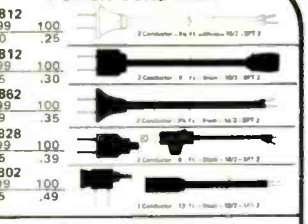
1-9	362-812 10-99	100	
.39	.35	.30	
1-9	473-862 10-99	100	
.45	.39	.35	
1-9	468-828 10-99	100	
.49	.45	.39	
1-9	435-802 10-99	100	
.59	.55	.49	



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

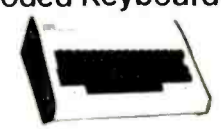
DB25P	D-Subminiature Plug	$2.95
DB25S	D-Subminiature Socket	$3.50
DB51226	Cover for DB25P/S	$1.75
22/44SE	P.C. Edge (22/44 Pin)	$2.95
UG88/U	BNC Plug	$1.79
UG89/U	BNC Jack	$3.79
UG175/U	UHF Adapter	$ .49
SO239	UHF Panel Recp.	$1.29
PL258	UHF Adapter	$1.60
PL259	UHF Plug	$1.60
UG260/U	BNC Plug	$1.79
UG1094/U	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 *150 NS $39.95
TRS-16K4 *250 NS $29.95

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 8¼"D

JE610/DTE-AK (After assembled as pictured above) . . . **$124.95**

JE610 Kit 62-Key Keyboard, PC Board, & Components (no case). . . . **$ 79.95**
K62 62-Key Keyboard (Keyboard only) . . . **$ 34.95**
DTE-AK (case only – 3¼"Hx11"Wx8¼"D) **$ 49.95**

NEW! JE212 – Negative 12VDC Adapter Board Kit for JE610 ASCII KEYBOARD KIT Kit/ Provides -12VDC from incoming 5VDC . . . $9.95

JE600 Hexadecimal Encoder Kit

FULL 8-BIT LATCHED OUTPUT 19-KEY KEYBOARD

The JE600 Encoder Keyboard Kit provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8-bit microprocessor or 8-bit memory circuits. Three additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with 9 LED readouts. Also included is key entry strobe. Features: Full 8-bit latched output for microprocessor use. Three user-define keys with one being bistable operation. Debounce circuit provided for all 19 keys. 9 LED readouts to verify entries. Easy interfacing with standard 16-pin IC connector. Only +5VDC required for operation. Size: 3½"H x 8¼"W x 8¾"D

JE600/DTE-HK (After assembled as pictured above) . . . **$99.95**

JE600 Kit 19-Key Hexadec. Keyboard, PC Board & Cmpnts. (no case) . . . **$59.95**
K19 19-Key Keyboard (Keyboard only) **$14.95**
DTE-HK (case only – 3½"Hx8¼"Wx8¾"D) **$44.95**

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DIGI-KEY CORPORATION 800-346-5144

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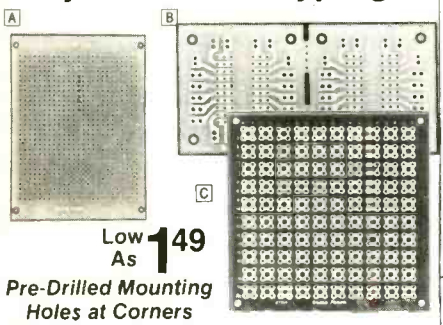

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A IC-Grid Breadboard. Has .100x.100 centers for DIP ICs, sockets, and headers. Labeled on both sides for faster layouts and easier pin identification. 750 contact points. 2¾x3¾". **276-158** 1.95

B Dual IC Board. Accepts two 14 to 20-pin, or four 6 or 8-pin DIP devices. Provides four contact points for each device pin. 1¾x3⅜". **276-159** 1.49

C Component Board. 100 pads, each with 4 contact points. 5/32" spacing for discrete devices. Indexed with letters and numbers. 3½x3½". **276-160** 1.95

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5.99 *Was 6.99 in 1981 Catalog*

SN76488. This IC, a handful of parts, and your imagination will create an almost infinite variety of sounds. Includes analog and digital circuitry—microprocessor compatible. Built-in 125 mW audio amp. 28-pin DIP with data. **276-1766** ..... Now 5.99

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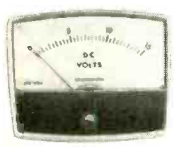

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25 per type	.025
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(Continued from page 91)

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Microcomputer Book Catalog

A new catalog from dilithium Press lists over 65 books for teaching and general purposes in the microcomputer field. Books of special interest to computer enthusiasts in other fields are also included as well as software for the TRS-80 Level II and the 8K Pet. Address: dilithium Press, 30 NW 23rd Pl., Portland, OR 97201.

IEC Video Recorder Standard

The International Electrotechnical Commission has issued Publication 602: "Type B Helical Video Recorders" to define the electrical and mechanical parameters for the professional "Segmented Field" video recording system on one inch tape. The recording format is known commercially as the BCN-Recording System and has been accepted by IEC member countries. The video signal is recorded in segments of 52 lines, which leads to 6 segments for each of both video heads for composing a complete frame in pal and SECAM. For NTSC, only 5 segments are needed. The 29-page standard is 33 Swiss francs from: Information Officer, IEC, 1, Rue de Varembe, 1211 Geneva 20, Switzerland.

Display System Brochure

A four-page brochure, "Display Design Ideas," tells how to build your own electronic display assembly using Beckman's SM-810-001 display system. Three types of assembly interfaces are described: Keyboard, Host Computer, and Keyboard & Computer. The 40-character displays require eight data lines and six control lines and are TTL compatible. Address: Beckman Instruments, Inc., 350 N. Hayden Rd., Scottsdale, AZ 85257. □

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ELECTRONIC PARTS, semiconductors, kits. FREE FLYER. Large catalog $1.00 deposit. BIGELOW ELECTRONICS, Bluffton, Ohio 45817.

RADIO—T.V. Tubes—49 cents each. Send for free catalog. Cornell, 4213 University, San Diego, Calif. 92105.

SAVE UP TO 50% on name brand test equipment. Free catalog and price list. Salen Electronics, Box 82, Skokie, IL 60077.

TELETYPE EQUIPMENT: Copy Military, Press, Weather, Amateur, Commercial Transmissions. Catalog $1.00. WEATHER-MAP RECORDERS: Copy Satellite Photographs, National-Local Weather Maps. Learn How! $1.00. Atlantic Sales, 3730 Nautilus Ave., Brooklyn, NY 11224. Phone: (212) 372-0349.

SOUND SYNTHESIZER KITS—Surf $19.95, Wind $19.95, Wind Chimes $24.95, Musical Accessories, many more. Catalog free. PAIA Electronics, Box J14359, Oklahoma City, OK 73114.

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UNSCRAMBLERS, seven models available to decode police, ambulance, and fire coded transmissions. Other scanner devices. Tone encoders/decoders. Telephone accessories, etc. Free Catalog. KRYSTAL KITS, Box 445, Bentonville, AR 72712. (501) 273-5340.

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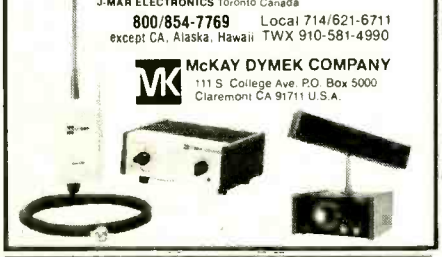

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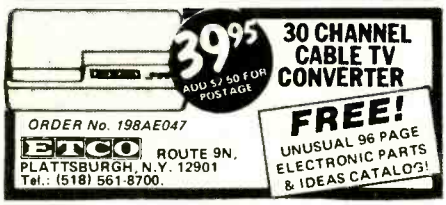

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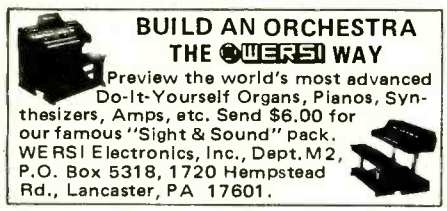

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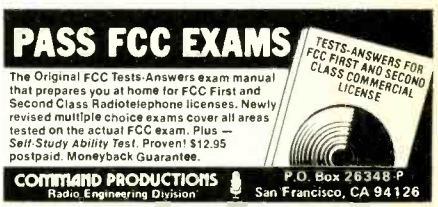

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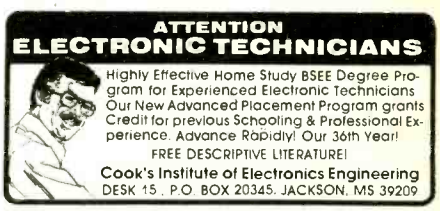

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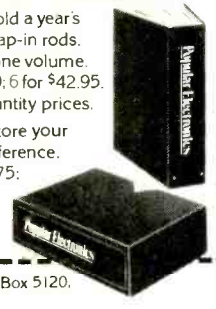

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STANDARDS FOR TELETEXT IN THE U.S. are called for in a petition filed with the Federal Communications Commission by the National Association of Broadcasters. Though filed in support of a similar petition by the United Kingdom teletext industry urging adoption of its Ceefax system, the NAB action does not endorse any specific system. Rather, it asks that standards be set as soon as possible. Opposition to the establishment of teletext standards comes from the cable industry, which claims that because of the currently fluid technology such action would be premature. Under supervision of the FCC's broadcast bureau, the cable industry has been participating in trials of video text systems similar to teletext.

SATELLITE EARTH STATIONS IN KIT FORM will be added to the Heathkit line this year. The antenna and other items of essential hardware will be manufactured by Scientific-Atlanta of Atlanta, Georgia, but, according to a company spokesman, "Heath will add significant value to the system in styling and design of the in-home receiver console and convenience features like Zenith 'Space Command' remote control which are not presently available in other home satellite receivers."

A NATIONWIDE ELECTRONIC MAIL NETWORK connecting New York and a group of other cities including Los Angeles, San Francisco, Chicago, Boston, Washington, and Hartford is now a reality. "Q Mail," as the system is called, can transmit a standard-sized letter across the country in 45 seconds and can handle legal-sized documents, charts, diagrams, and hand-written material as well, using Rapicom 1000 digital facsimile transceivers. The system has started with 12 service locations and is expected to expand to 60 by the end of 1981.

WIRETAPPING IS A MAJOR CONCERN of business executives says Sharper Image, which retails a $49 phone attachment that detects wiretaps and other forms of telephone eavesdropping. The San Francisco company sold 1000 Phone Guards in the first 11 days that the device was offered in its catalog. A random survey of buyers revealed that 47% were concerned about wiretapping by business rivals; 40% were fearful of eavesdropping by company operators, supervisors, and others where they work; 12% wanted extension privacy at home; and 1% were trying to shield their private recreational activities from law-enforcement officials.

DIGITAL SOUND FOR THE HOME came one small step closer as Philips and Sony demonstrated working prototypes of their jointly developed Compact Disc system late in May. Based on the technology used in the laser video disc, the 120-mm (4¾") diameter disc is 1.2 mm (0.05") thick and plays in stereo for one hour per side. Rated frequency response is flat 20 to 20,000 Hz with S/N, dynamic range, and channel separation all in excess of 90 dB. Harmonic distortion is said to be less than 0.05%, and wow and flutter are unmeasurable.

Unlike the prototype shown by Philips in 1979, the current Compact Disc uses a 16-bit, linear quantization; sampling frequency is 44.1 kHz. The error-correcting system is capable of handling error bursts up to 4000 bits long, and, when this figure is exceeded, can conceal errors up to 14,000 bits long.

Compact Disc players should be available from Sony late in 1982, with those from Philips following in 1983. Introductory prices, say the manufacturers, will be competitive with those of high-quality phonograph playback equipment. The discs themselves are slated to retail for about 30% more than conventional discs of premium quality.

CONFERENCES BY TELEVISION are the goal of an application filed by AT&T with the FCC requesting permission to construct and operate facilities for an initial 11-city video teleconferencing service. Both satellite and terrestrial digital transmission facilities will be used to provide "Picturephone" with audio-visual communications between conference rooms that may be either public rooms or private rooms constructed on a customer's premises. Facilities will include a graphics display unit, a hard copy machine, and video tape recording capability. Initially, the service is scheduled to be in operation in December 1981 between New York and Washington, DC with 39 other cities to be added in two years.

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