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- Bridging Analog & Digital Circuits with Voltage Comparators
- Enhance Telephone Answer Machines with Voice Synthesis

Tandy Model 1000 IBM-compatible computer (p. 30)

TCC voice-operated "Hearoid" robot (p. 22)

Sony Model EV-20XBR color TV receiver/monitor (p. 14)

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Plus: ● Testing Sony's New Color TV Receiver/Monitor and AT&T's Intelligent Modem ● Don Lancaster's "Hardware Hacker" Q&A ● Evaluating Skill-Building Software ● New Electronic Products ● Latest Electronic/Computer News

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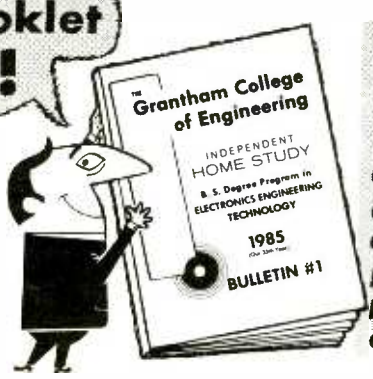

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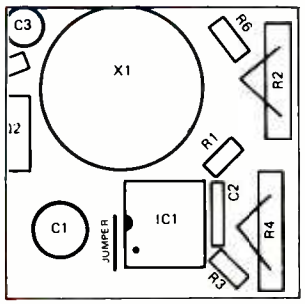

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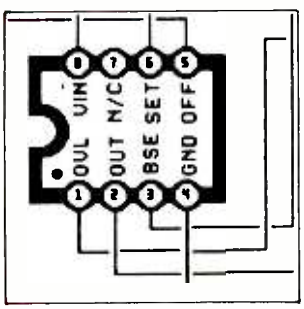

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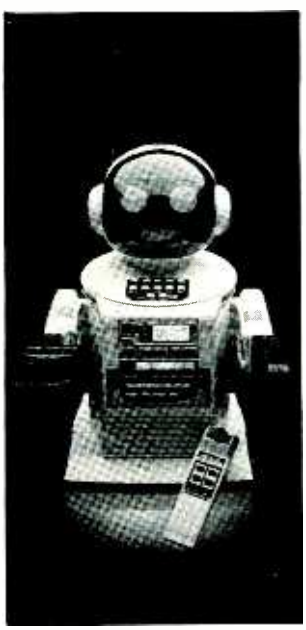
22

FEATURES

PRODUCT EVALUATIONS

DEPARTMENTS

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2.2k	271-1325
3.3k	271-1328
4.7k	271-1330
6.8k	271-1333

Ohms	Cat. No.
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EDITORIAL

Ruminating

It was sad to learn that the magazine I edited for so many years before launching *Modern Electronics* last October—*Computers & Electronics,* formerly *Popular Electronics*—is gone. Its April issue was the last one in a line that stretched back to October 1954.

Not many publications live more than thirty years, of course. Nevertheless, its demise underscores what could happen when loyal readers are deserted for what seems to be fairer ground: only computers. In a brief 2½ years as C&E, less than 10% of its former electronics-oriented readers were left.

Along the way some very fine people nurtured the magazine, some of whom are doing the same for *Modern Electronics* (Forrest Mims, Don Lancaster, Stan Prentiss, Glenn Hauser, Len Feldman, Charles Rubenstein, and Al Burawa, among them). Others never lived to see this day (Perry Ferrell, who preceded me at PE; Bill Scherer, who tested our communications gear; John Frye, who wrote a "Carl and Jerry" column), and wherever you are, Lou Garner, whom Forrest Mims succeeded about eight or nine years ago. And who can forget staffer Les Solomon, who, after some two decades of creative tech editorial work, missed the final curtain, too.

In a way, its destiny was foreordained. The top honchos in its giant publishing company never empathized with the publication. They viewed its readership as less-than-classy. The "dirty fingernail" crowd, they felt (and expressed). Never mind that their educational attainment level was higher on average than most magazines in its stable that they admired; that their average household income was also higher; that its subscription renewal rate was the highest among their many magazines (until it changed its editorial thrust, that is).

"Schematics are ugly!" they said. Soldering irons and test instruments: "Ugh!" What they really wanted was a "coffee-table" publication. Something their wives and railroad buddies could, perhaps, understand. It was an orphan magazine among a horde of glitzy ones. It was a magazine that was refused "membership" in the company's magazine group division due to its (in their eyes) blue-collar appeal . . . even though more than 12% of subscribers had Ph.D.s or some graduate school credits.

As a result, there was continual pressure to change its focus, diminishing projects until, it was hoped, they would go away. At one point, just before I joined the company, they pressed to make it into an "audio"-oriented magazine. After all, audio advertising was blossoming and even *Playboy* was going after the ad Grail. Then it was glittering, imaginative color illustrations and photographs, taking away pages of technical matter to make room for them. Then it was computers for the masses with the promise of not diminishing electronic content . . . by the same honcho who pushed for audio years before. Finally, it was a generalized business-computer-oriented thrust that did them in.

We promise you that all this won't happen here. Our charter is to cater to your active electronics (including computer) interests; there'll always be something for everyone with technical inclinations, whatever specialized area, in *Modern Electronics*. The publishing house that M-E is in, which also produces electronic-hardware magazines—*CQ/The Radio Amateur's Journal* and *Popular Communications*—identifies itself with our goals.

Art Salsberg

LETTERS

Automotive Security Devices

• The new magazine looks great. I'm certainly glad to see that the electronics hobbyist will be able to persue non-computer interests.

I would like to point out that the automotive security article in the February issue failed to mention Radio Shack as a source. We sell a complete line of automotive security products and, unlike many suppliers mentioned, our products are available in more than 6500 retail stores in the U.S.

Radio Shack, A Division of Tandy Corp.
Robert B. Miller
Vice President Merchandising
Ft. Worth, TX

• Having been a designer of automotive alarms, I'm very familiar with the requirements of a good system. After reading descriptions of the other "10 best" in your February "Automotive Anti-Theft Alarm" article it was plain to see that the "cat" was clearly outclassed in both features and price by several, especially the Cal Custom Model 982. Not only does the 982 have all the features of the "cat," but it also has additional features at almost half the price.

You may have already guessed that I am an owner of one of these and also very happy with it. I wanted to write to make sure your readers check features vs. price very closely, for there are a great deal of low-tech, over-priced systems on the market.

Jeff Riggs
Huntington Beach, CA

Article Index

• Do you have a cumulative article index available? Also, can I get reprints of articles published?

J.E. Korneluk
W. Palm Beach, FL

We'll publish an article index in a while, probably when we hit one-year old. No reprint service yet, but we sell back issues, starting with the October 1984, our first, for $2.50 each—Ed.

PC Board-Minded

• An article I haven't seen in a few years is about making printed-circuit boards. I'd like info on photo etching.

Paul Boman
Newport News, VA

We'll keep this in mind. Meanwhile, our March issue had an article on making pc boards with adhesive-backed foil material—Ed.

Likes Color-TV Evaluations

• Appreciated your January article on selection of the latest color-TV receivers. As a consumer I find your evaluations very complete. Only wish you would recommend a best selection.

W. Blackman
Los Angeles, CA

Digital Design Enjoyable

• Congratulations on your magazine. One reading of "Circuit Design From Scratch" by Jules Gilder and I was amazed at how enjoyable digital design techniques are.

Robert Johnson
Old Bridge, NJ

MODERN ELECTRONICS NEWS

NEW ENGLAND INVENTOR OF YEAR. Henry Kloss, long-time audio/video inventor, was named the 1985 New England Inventor of the Year by an awards committee from MIT, Boston Patent Law Association, and Boston Museum of Science. Kloss joins previous honorees An Wang, who founded Wang Laboratories and Edwin Land, Polaroid Land camera inventor. He was a founder of Acoustic Research and KLH (the "K" was for Kloss) before developing the first projection TV system at Advent Corp., which he formed, and is now pursuing projection TV improvements at Kloss Video Corp.

MICROPROCESSOR COPYRIGHT APPLICATIONS. The first microprocessor to be registered in the U.S. under the Semiconductor Chip Protection Act of 1984 was Motorola's MC68020 on January 7, 1985, says Motorola. At the same time, Intel claims it was first with registration of its 27C256 CMOS EPROM chip. Who's on first? The new law permits protection of mask works in integrated-circuits.

GE ENTERS COMPUTER PERIPHERALS. General Electric introduced a bevy of computer peripheral products for home computers as an extension of its consumer electronics business. The company is aiming at compatibility with Atari, Commodore and IBM PCjr computers. Leading with a 13" switchable monitor/TV set and a 12" black-and-white one, GE's line now includes a letter-quality printer with interface modules, a phone modem that's both direct-connect and acoustic, and a cassette recorder.

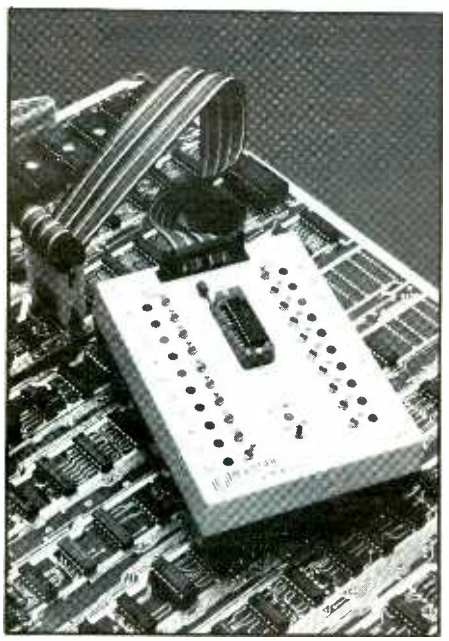
JBL TOPS RECORDING-STUDIO SURVEY. Once again, JBL Incorporated topped Billboard magazine's 1984-1985 brand-use survey among recording and mastering studios in the U.S. JBL speakers were found to be in 68.5% of these studios, based on a sampling of 453 companies. The runner-up hit 59.6%.

VIDEOCASSETTE NEWS. More and more home entertainment electronic companies are adding VCRs to their product lines. The latest is Goldstar Electronics, a burgeoning South Korean company in the TV receiver field. Its initial line includes a play-only leader model, the top-loading VCP-400M, which carries a suggested retail price of $349.95, discounted to ....The compact (13" W x 5.1" H x 13.8" D) machine is targeted to people who mostly rent video tape films rather than recording or for those wish to have a second VCR to only dub by....In another area, service-data pioneer Howard W. Sams & Co., Inc. has repackaged its VCR servicing information, adding it to the publisher's regular line of PHOTOFACT® consumer electronic service data. Such information was previously sold in a 100-page+ book for as much as $29.95. Now it's to be issued quarterly as a set of folders placed in a file jacket for $9.95....The EIA reports that VCR sales continued to boom in January, topping 638,000 units bought by dealers the first month of '85, a 64% rise over last year's figure.

CAD EDUCATION. Computer-aided drafting and design gets a boost from the Heath Company, which introduced a complete CAD system to teach how to use the burgeoning new-technology system. It includes a general-purpose program for use with its Heath/Zenith Z-100 Series Computers to create a variety of drawings with the assistance of on-screen menus and instruction maunals. Among its features is a bidirectional zoom. Eight colors and unlimited number of layers allows drawings to be selectively viewed or plotted.

NEW PRODUCTS

For more information on products described, please circle the appropriate number on the Free Information Card bound into this issue or write to the manufacturer.



Logic Comparator

The Bugtrap Model 2074A logic comparator from Jensen Tools is claimed to offer a 300% increase in testing capability compared to conventional logic comparators. It tests the full line of 14-, 16-, 18- and 20-pin TTL ICs, including tri-state, bidirectional and open-collector devices, as well as 5-volt TTL RAMs and bipolar ROMs. It handles ICs previously considered to be untestable, picking up errors usually missed by oscilloscopes. Tests are conducted dynamically, in-circuit, at system speed and under actual operating conditions. No interpretation of digital activity is required. A malfunctioning IC causes one or more LEDs (one LED is assigned to each pin of the socket on the Bugtrap) to light and latch on, exposing faulty lines. Setup and testing require only a known good IC of the same type being tested and the flip of a single switch to route V_{CC} and ground as required. The product features a ribbon cable terminated with a glomper clip that connects to the IC being tested and a ZIF (zero-insertion-force) socket into which the known good IC plugs.

CIRCLE 58 ON FREE INFORMATION CARD

Digital Programmable Music Synthesizer

Casio breaks the $500 barrier in digital music synthesizers with its Model CZ-101 49-key programmable. Utilizing Casio's unique phase-distortion method of sound generation, the synthesizer is said to offer natural and rich tone qualities. Though digital in design, the CZ-101 is laid out like an analog instrument, making it easy to program.

Two modes of operation are available: eight-note polyphonic when using a single line of sound controllers and four-note polyphonic when combining two lines for richer three-dimensional sound. The synthesizer can store 32 programs internally but can be optionally equipped with a RAM cartridge to store 16 more programs. Also, a MIDI interface allows the CZ-101 to communicate with any other MIDI keyboard, drum machine, sequencer or computer software and will read four MIDI channels simultaneously, allowing for multiple-timbre performance from one keyboard.

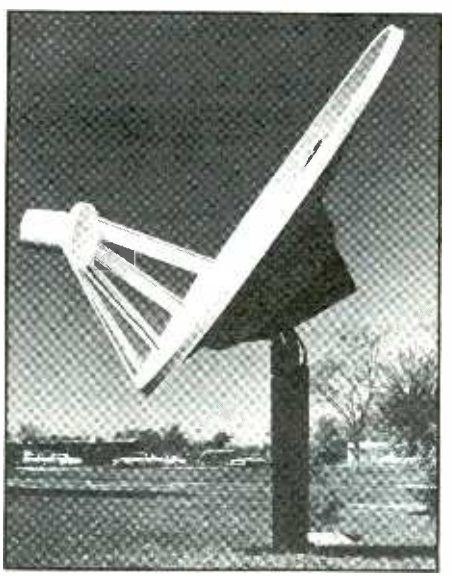
Other features of the CZ-101 include: six eight-stage variable envelope generators that control pitch, tone color and volume; pitch blend; polyphonic portamento; ring modulation; tone mixing; key transposition; and an LCD display. D-size cells power the synthesizer for portable operation. $499.

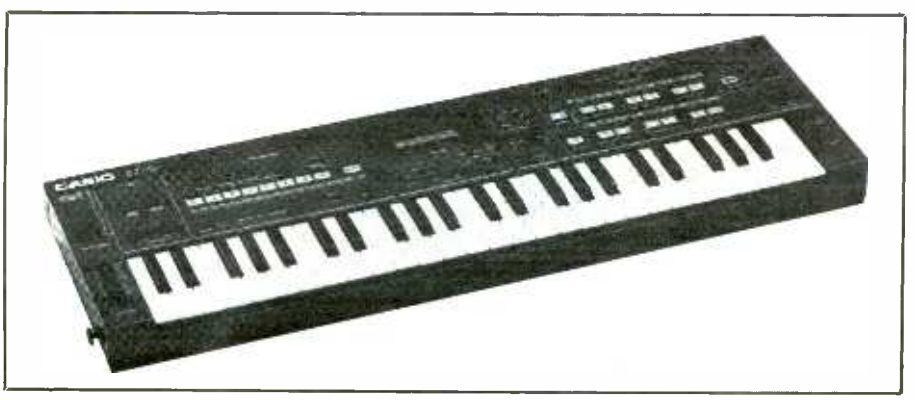
CIRCLE 59 ON FREE INFORMATION CARD

Satellite-TV Receiving Antenna

Its elliptical shape is what prompted manufacturer Birdview to name its new satellite-TV receiving antenna the "Spoon." The 7-foot (2.13-meter) antenna is constructed from 0.05" stretched steel with a zinc-phosphatized finish overcoated with a polyester-based paint final coat to protect it from the elements. The antenna sits atop a single-pier, below-ground polar mount with 5.5° offset. (An optional above-ground tripod

(Continued on page 12)





Learn robotics and you build this robot

New NRI home training prepares you for a rewarding career in America's newest high-technology field.

The wave of the future is here. Already, advanced robotic systems are producing everything from precision electronic circuits to automobiles and giant locomotives. By 1990, over 100,000 "smart" robots will be in use.

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Keeping this robot army running calls for well-trained technicians . . . people who understand advanced systems and controls. By the end of the decade, conservative estimates call for more than 25,000 new technical jobs. These are the kind of careers that pay $25,000 to $35,000 a year right now. And as demand continues to grow, salaries have no place to go but up!

Build Your Own Robot As You Train at Home

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You need no experience, no special education. NRI starts you at the beginning, takes you in easy-to-follow, bite-size lessons from basic electronics right on through key subjects like instrumentation, digital and computer controls, servomotors and feedback systems, fluidics, lasers, and optoelectronics. And it's all reinforced with practical, hands-on experience to give you a priceless confidence as you build a programmable, mobile robot.

You get and keep Hero 1 robot with gripper arm and speech synthesizer, NRI Discovery Lab for electronic experimentation, professional multimeter with 3½-digit LCD readout, 51 fast-track training lessons.

Program Arm and Body Movement, Even Speech

Designed expecially for training, your robot duplicates all the key elements of industrial robotics. You learn to operate, program, service, and troubleshoot using the same techniques you'll use in the field. It's on-the-job training at home!

industrial control as

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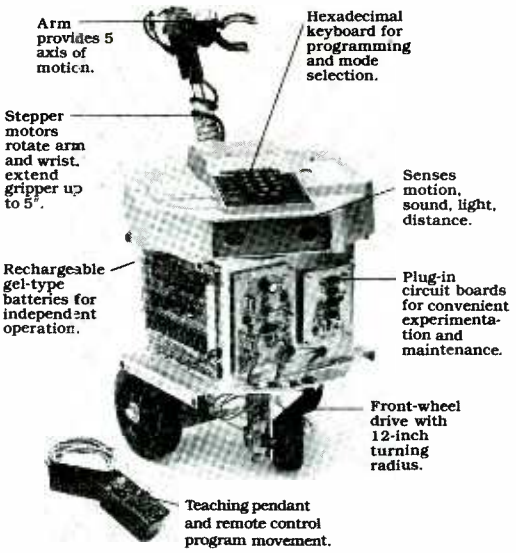

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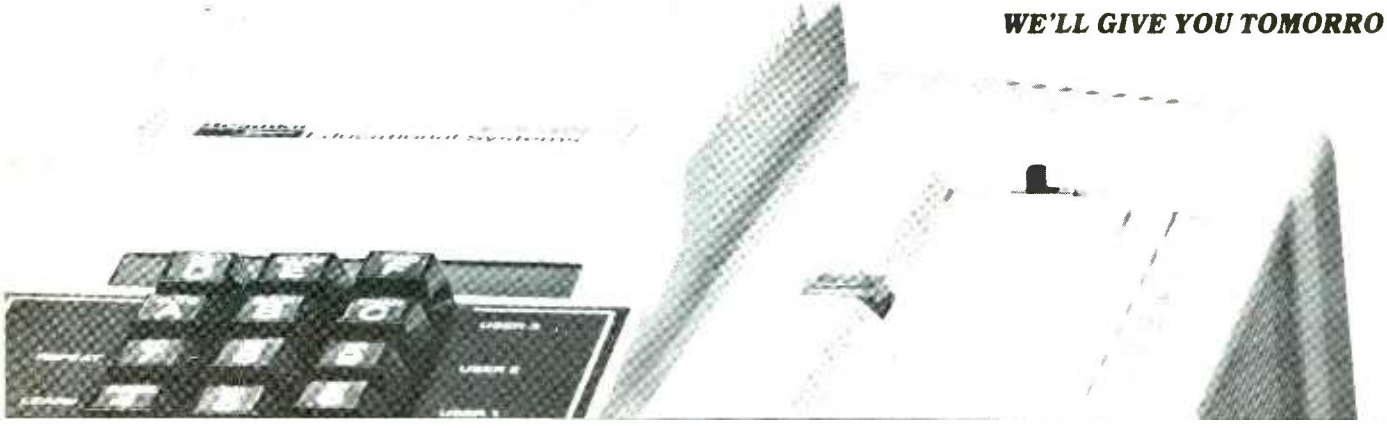

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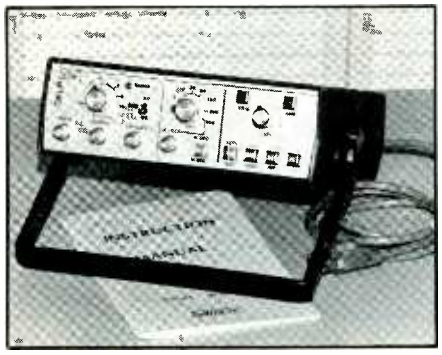
mount is also available.) The offset-feed Spoon is designed to remain operational in winds up to 60 mph and to survive winds up to 100 mph.

Antenna feed is through a corrugated conical horn. Rated gain is 37.7 dB, with aperture efficiency of 76%. Half-angle beamwidth at 3 dB is 1.3°; the first sidelobe is at 4.3° and is 25 dB down from the main lobe; and the first null is at 3.7°. Cross polarization is more than 31 dB down from the main lobe.

CIRCLE 80 ON FREE INFORMATION CARD



Add Storage Capability To Any Oscilloscope

Scope Memory is a new add-on device from Sibex, Inc. that converts any oscilloscope into a digital storage instrument. Easily attached to any oscilloscope, the Scope Memory is an economical alternative to scope users who can not justify the expense of buying a storage scope. It stores analog and digital waveforms for display at leisure. It handles low-frequency signals, transients and one-shot pulses in a single sweep. Featuring 18 selectable sampling times, it has a 1.4-MHz maximum rate. Also included is an eight-range input selector, an overrange indicator, and a variety of triggering modes. Pre- and post-trigger modes permit viewing the waveform that occurs both before and after an event, a feature that is very useful for troubleshooting.

Input to the accessory is through BNC connectors. Input impedance is 1 megohm, shunted by 10 pF, while sensitivity (in eight ranges) is ±50 mV/division to ±10 V/division. The timebase offers a 1.4-MHz maximum sample rate using an external clock, plus seven crystal-controlled rates ranging from 100 kHz to 1 MHz. Built-in memory consists of a 2K × 8 static RAM, and a LED indicator lights up when memory is full. The output from the instrument, via a BNC connector, can be adjusted over a ±8-volt range, with 8-bit ±1 LSB resolution. $515.

CIRCLE 75 ON FREE INFORMATION CARD

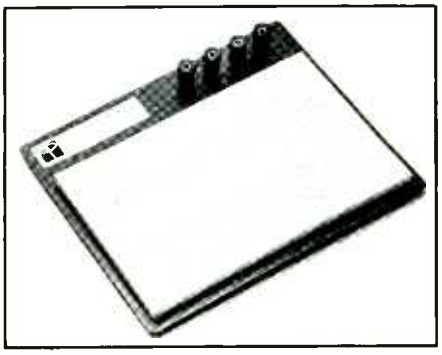
Three-Head Stereo Cassette Deck

Kenwood has brought to market a new three-head stereo cassette deck with lots of features at only moderate cost. The Model KX-780 deck offers Dolby B and C noise reduction, specially designed record and playback heads, and continuous bias adjustment. A built-in microprocessor monitors the sound right off the record head so that recorded material can be compared for accuracy with the original source. The deck offers a full range of conveniences, including normal, CrO_2 and metal tape compatibility; feather-touch electronic transport controls; LED bargraph peak level meters; a fluorescent electronic tape counter; headphone jack with its own output level control; and timer control. The playback head utilizes a new Hot Isostatic Pressed Ferrite (HIP) material designed for near-perfect reproduction, low noise and high temperature stability. The recording head is a six-laminate Sendust structure that is treated with Kenwood's Super Surface Treatment (SST) to increase head life.

A program search system allows selections to be repeated up to eight times, as well as easy locating of recordings.

Technical specifications are: 0.05% wrms wow and flutter; 74-dB signal-to-noise ratio with metal tape and Dolby C on; and 22-Hz to 20-kHz ±3 dB frequency response with metal tape.

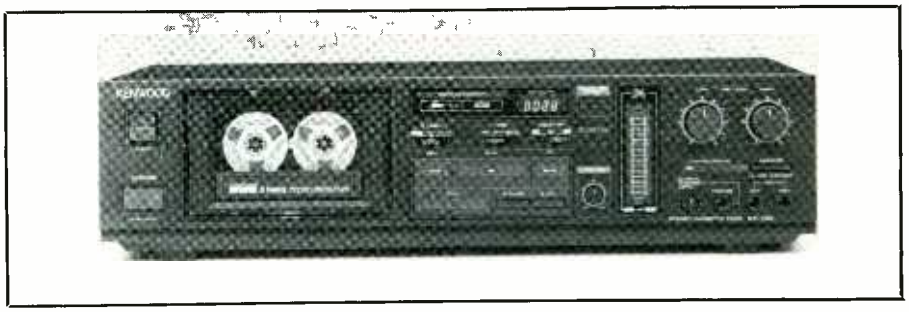
CIRCLE 78 ON FREE INFORMATION CARD



Solderless Breadboard

A new solderless breadboard, the ACE 118, has been added to AP Products Incorporated's 100 series of All Circuit Evaluators. It features four binding posts, usually found only on much larger boards, for convenient hookup of power supplies, signal generators, and other equipment.

An 1824-point solderless plug-in matrix accommodates circuit designs consisting of up to 18 14-pin or 16 16-pin DIP devices. Buses can be linked to offer such functions as voltage and ground distribution, reset



line, clock line and shift command. A picture-frame and center-line design of 544 distribution tie points complements the main plug-in matrix. IC pins plug directly into the matrix, while leads of transistors, diodes, resistors and capacitors can be left full length or trimmed to desired length before plugging into the matrix. Interconnections between circuit elements are made with lengths of ordinary 22-gauge solid hookup wire from both ends of which has been removed ¼" of insulation. All tie points are made from rugged copper alloy, and the tie-point blocks are mounted on a sturdy steel plate.

CIRCLE 77 ON FREE INFORMATION CARD

Microprocessor-Controlled PLL Communications Receiver

A microprocessor-controlled tuner that lets you preset up to nine different stations highlights Panasonic's Model RF-B600 PLL synthesized portable communications receiver. Ten-key direct-access tuning allows the user to key in the numbered buttons corresponding to the desired frequency's number. A nine-memory scan/seek function stops at every station in either frequency direction for about five seconds before continuing. The seek function automatically searches for strong signal stations and locks onto any located until the function's button is pressed.

Shortwave band Zone Auto Tuning serves as a reception clarifier. After using the manual and direct-access tuning key to set in a desired frequency range, this feature helps to ensure clear reception of stations within the limits of ±150 kHz around the selected frequency. Other features include: a five-digit fluorescent frequency display; r-f gain control; FM/LW/MW/SW band selectors; AM anl switch; wide/narrow bandwidth selector; up/down scan tuning at two speeds; CW/LSB/USB/AM mode selector; bass and treble controls; 3½" speaker; telescoping whip antenna; universal voltage adapter; and carrying handle. The receiver is powered by eight "D" cells, with memory backup provided by three "AA" cells (batteries not included). $549.95.

CIRCLE 79 ON FREE INFORMATION CARD

Surge/Noise Protector

The Philips ECG Model EMF-315 PowrPure™ is designed to protect

expensive electronic equipment against both transient voltage surges and r-f noise interference. It clamps voltages to a safe level below 500 volts, without interfering with normal current flow, and attenuates r-f noise by up to 40 dB from 200 kHz to 30 MHz. The device plugs directly into any three-wire grounded ac outlet and provides three three-wire outlets into which equipment to be protected can be plugged. There are four pins on the PowrPure; three to make contact with the ac line and ground and the fourth to provide mechanical stability. A built-in LED lights when the device is activated, indicating that both surge protection and noise suppression circuits are operating. An internal 15-ampere fuse provides overload protection. If an overload occurs and blows the fuse, the LED extinguishes and the PowrPure removes ac line power from the equipment being protected. Once the fuse blows, it is not replaceable. After the overload condition is corrected, a new PowrPure must be used to assure continued protection.

CIRCLE 74 ON FREE INFORMATION CARD

(Continued on page 86)

Video

Loaded with features for viewers and computerists alike

Sony's Model KV-20XBR Color TV Receiver/Monitor

Sony has had to share the spotlight with a few leading TV-receiver makers in viewer preference polls. The company has now geared up to make a direct thrust at these leaders with a new color TV receiver/monitor offering that's bound to make viewers take notice. It's the new Model KV-20XBR, a 19″ diagonal receiver/monitor built around a Microblack™ Trinitron tube and features cable-ready tuning, built-in BTSC/dbx multichannel sound decoder, full wireless remote control, and direct RGB (red/green/blue) video inputs (the last sure to please personal computer users who require high-resolution color displays).

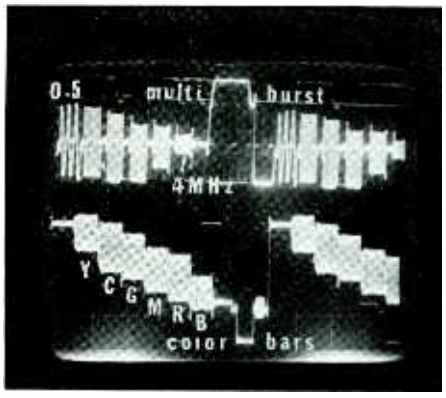
A receiver/monitor for our times, the KV-20XBR offers full vhf/uhf/CATV frequency synthesized tuning, two sets of video-stereo inputs on the rear, and the usual monitor video-stereo ouputs. All outputs are usable even though input signals are at r-f on channel 3 or 4 or baseband video or sound. There are also three r-f inputs—for uhf/vhf/CATV, auxiliary, and converter for a cable-scrambled decoder. No speakers are built into the receiver/monitor's main cabinet. Instead, Sony provides a pair of external speakers with color-coded cables that are tinned for simple insertion into the receiver's outputs.

Cabinet colors are tan and dark grey. The cabinet measures a compact 19⅞″W × 18⅜″D × 17⅞″H. Weight is 55 lbs., sans speakers. Inside the main cabinet, you'll find two clearly labeled (and removable) circuit boards on either side of the CRT. The remarkable thing about this new SCC-595C-A chassis is that all plug-in cables extend sufficiently to permit the boards to swing out or lie flat on a service bench for easy troubleshooting! Price for all this is $899.95.

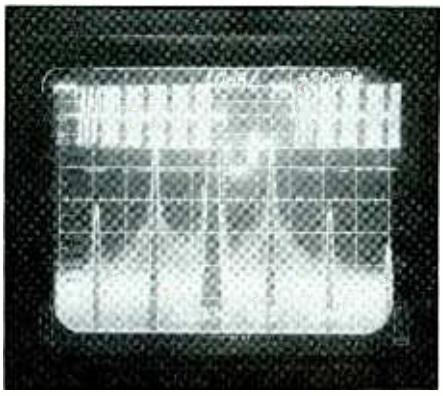
Loaded With Features

The foregoing is only a sample of what you'll find in this new Sony receiver/monitor. To make this set as compact as possible, and to offer better-than-average sound quality, Sony has located the speakers outboard of the main cabinet. These speakers can be arranged to either side of or right on the set itself, via kurled knobs supplied with the package.

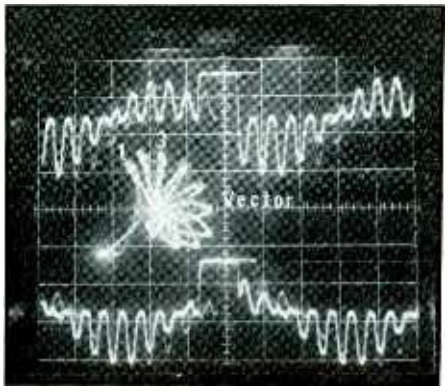
The BTSC/dbx multichannel sound system accommodates both TV stereo and SAP (second audio program), each of which can be received individually or both of which can be received simultaneously (if you can stand the mix). If for some reason someone tunes in regular FM band stereo, the receiver will decode this also and produce good-quality audio, depending on source and speakers. The L + R stereo program, however, will still be monophonic, and the 31.5-kHz AM double-sideband L – R stereo subcarrier won't trigger without the prescribed 15,734-Hz pilot carrier. If radio and TV stations feature a simulcast program, you simply connect an FM tuner to special left and right jacks on the rear of the set, tune in the appropriate station, and enjoy.



Clean multiburst and color-bar responses at CRT and video detector.



Excellent baseband multiburst oscilloscope, spectrum analyzer readings.



Chroma vector pushes reds and oranges slightly together but is satisfactory.

For those people who fall asleep while the TV set is running, the KV-20XBR's "sleep" circuit (and an indicator lamp) will turn off the receiver 60 minutes after it is activated.

Setting of user controls (BASS, TREBLE, BALANCE, COLOR, TINT, BRIGHTNESS, SHARPNESS, etc.) is aided by on-screen status displays in the form of "picket-fence" bargraphs. Each bargraph is summoned simply by pressing the appropriate button, either on the receiver/monitor's control panel or on the remote controller. The displays appear in the lower portion of the CRT screen and show the control trend in both + and − directions.

Except for programmable channel selection, all user controls can be adjusted remotely, using a compact (6⅞" × 2⅛") wireless controller. It's no longer necessary to enter single-digit channel selections (channels 2 through 9) by preceding them with leading 0s, as heretofore has been the case. If you want to watch, say, channel 4, you simply key in the numeral 4, followed by a tap on the ENTER key to make your selection. Of course, the system will accommodate all numeral selections from 1 through 125, any one of which can be selected either directly by entering its number address or by operating the usual up/down scan keys.

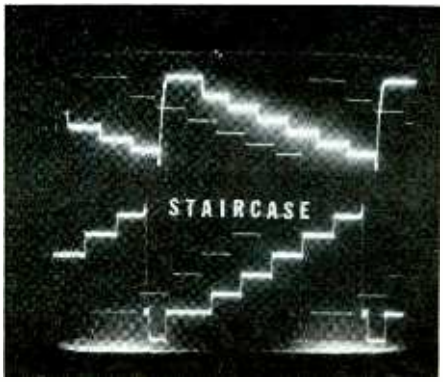
If you don't like the color temperature (tint) of the picture tube Sony has selected, simply press the TINITONE key on the controller and add red or blue to the white areas as desired until what you see on-screen pleases you.

There's still more you can do with the wireless remote-control transmitter that comes with the KV-20XBR receiver/monitor. Add to the list of controls a key that lets you select antenna or auxiliary inputs, TV/video, RGB or MTS (multichannel sound). Then throw in a key for muting the sound, a DISPLAY key to remind you of the video/TV mode and channel selected, and separate up/down picture control keys. The last lets you adjust sharpness of the picture.

From the foregoing, it's obvious that the KV-20XBR contains some sophisticated circuitry. To achieve all it does, this receiver/monitor's circuitry contains 147 transistors and 18 integrated circuits, not to mention the hundreds of diodes, resistors, capacitors and other components. For superior picture quality, the KV-20XBR uses a glass delay line and a comb filter to provide clean luminance/chroma separation. The power supply has been designed to provide superior voltage regulation of both low and high voltages. Finally, the 100° Microblack Trinitron CRT offers a fine-pitch grille aperture for excellent display resolution.

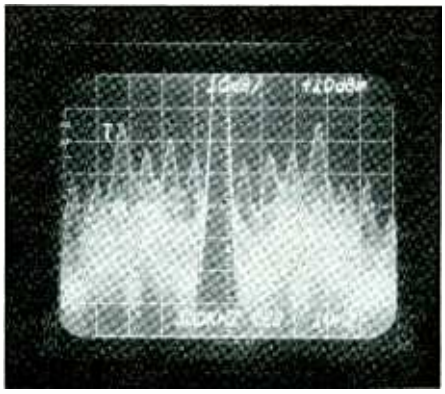
Laboratory Results

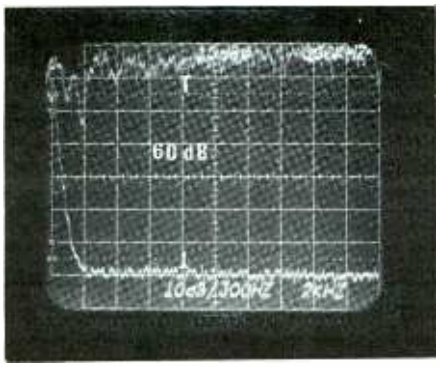
If we don't take notice of price, perfor-



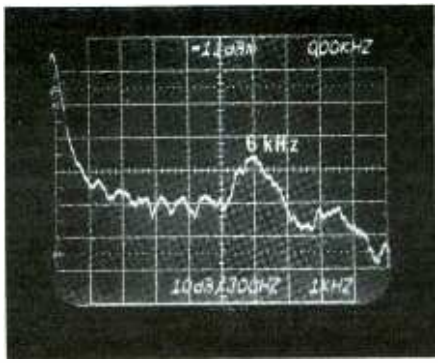
Staircase pattern at CRT (upper) and video detector reveal good grey scale.

Excellent 44-dB S/N figure at 3 MHz.

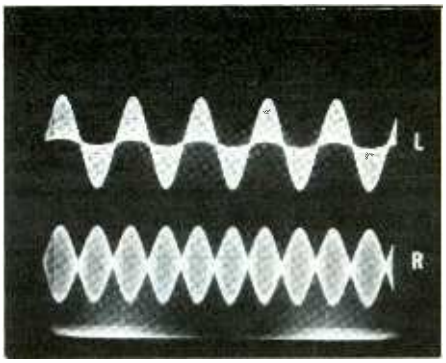




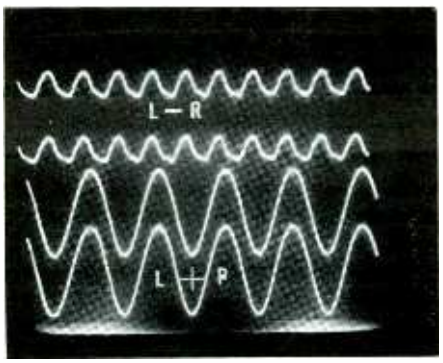
Baseband response for left (upper) and right (lower) audio channels.



Waveform shows that speaker response is fair, except for the peak at 6 kHz.

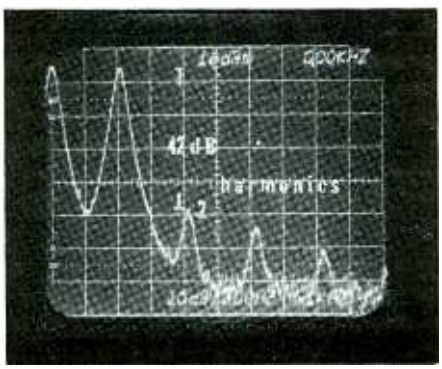


Baseband response confirms 59.1-dB stereo channel separation at r-f.



R-f response to L − R (upper) and L + R show clean detection but no stereo.

This spectrum analysis of THD and apparent power was obtained using second harmonic and fundamental at 1 kHz.



mance is the yardstick that will determine the success (or failure) of any product. Sony's new KV-20XBR color receiver/monitor is no exception. It appears that Sony has learned its lessons well. The KV-20XBR proved to be an exceptional performer in almost every important operating area, both video and audio, in our laboratory.

Video bandwidth, through the r-f antenna input on channel 3 exhibited some fall-off at 4 MHz, though color and luminance response were very good. At baseband, however, multiburst response was phenomenal. It looked even better at high frequencies than it did at low frequencies. Further measurements indicated that baseband video was usable, with only slight left-side raster compression, out to 6 MHz or better.

Tuner response was okay on the vhf channels and was passable on uhf. Tuning control was fast and positive, and the multiplicity of remote controls was remarkable. With a set as sophisticated as the KV-20XBR, you'll find that you must memorize a few of the remote controls, almost certainly an enjoyable experience in itself.

Chroma processing appeared exceptional on both gated-rainbow and NTSC color-bar signals, although oranges and reds (petals 1 and 3) in the vector display were less than 30° apart and could have been more symmetrical. Of couse, to conduct this test, we made no compensating chroma or picture adjustments to improve response; we just recorded the results as they were delivered by the receiver/monitor.

Results of voltage regulation tests were surprising, considering what we've come to expect from previous experiences in testing Sony receivers. For both low- and high-voltage supplies in the KV-20XBR, voltage regulation was superb.

Audio response in all multichannel TV receivers has always been good to approximately 100 kHz through baseband, since the SAP (second audio program) requires a carrier at 78.6 kHz. The Sony KV-20XBR is no exception here. However, audio response through the supplied speakers wasn't the greatest, especially at 6 kHz and with rapid rolloff beyond 8.6 kHz, even though both music and voice reproduction sounded quite good. Stereo L + R and L − R and mono L and R showed good responses on the test bench; so there's no electronic problem. THD (total harmonic distortion) measured a mere 0.79%. If you wish maximum possible audio performance from this receiver/monitor's audio section, you might want to connect a pair of good floor-model 8-ohm three-way speaker systems to the audio outputs on the rear of the set.

Though "serviceability" isn't exactly a laboratory bench test, we mention it here because our observations on this score were made during our performance tests. With the introduction of the KV-20XBR,

Sony has dramatically improved serviceability over its prior models. We would have liked to have seen more ac test points and an accurate chassis location diagram of all points, however. Also swapping boards could cost a bundle, unless Sony institutes an exchange program, which is rather unlikely.

User Comment

The KV-20XBR is certainly Sony's best color TV receiver/monitor. It's also more than competitive in today's marketplace. While its $900 price tag might appear to be steep for a "mere" 20-incher, one must keep in mind that sophisticated and complex electronics doesn't come in economy-priced packages. From our point of view, the price is justified, considering the performance this set delivers and the fact that it is suitable as a high-resolution computer graphics color display.

Our one negative comment has to do with an item over which Sony has no control. This is the RGB input connector, a 34-pin device that may require some tricky wiring on the user's part to get the monitor working with his computer. The problem lies in the fact that there's no industry-adopted standard regarding computer RGB outputs and, thus, no way for a monitor manufacturer to make a "universal" RGB monitor. Sony can't by itself force a standard in this area, but the company can and does supply all necessary pinout information for the connector it uses to help the user mate his monitor to his computer.

Our hat is off the Sony for a job well done. In the ratings game, we give the KV-20XBR an AAA for effort and a 9+ for execution.—*Stan Prentiss*

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Sony Model KV-20XBR Laboratory Analysis

Power drain at 117 V ac (varies with input signal)	62.3 to 80.4 W rms
Voltage regulation (100 to 130 V ac)	
low voltage	12.3 V (100%)
	134.4 to 134.5 V (99.2%)
high voltage	26.5 kV (100%)
Tuner/system sensitivity	
vhf channels 3 and 10	−3/−5 dBmV
uhf channels 15 and 40	0/+1 dBmV
Agc swing (−3 to +55 dB)	58 dB
Luminance/chroma S/N (at CRT)	44/43 dB
CRT pitch (shadow mask slot separation)	0.55 mm
CRT temperature	9000 °K
Dc restoration	91.2%
Convergence (excellent raster)	99.5%
Maximum center CRT vertical resolution	432 lines
R-f/baseband horizontal resolution	4.2/6 MHz
RGB frequency response	>8 MHz
Staircase (luminance) i-f linearity	excellent
Horizontal overscan	10%
Baseband audio response	>>20 kHz
Audio response through speakers	9 kHz (approximate)
L and R separation with/without stereo	60/59.1 dB
THD at 1 kHz	0.79%
Apparent power into speakers	31 dBm (1 W) at 50 ohms

Test Equipment: Tektronix Models 7L5 and 7L12 spectrum analyzers; Telequipment Model D66 (modified) and Hameg Model 605 oscilliscopes; B&K-Precision Models 1250 and NTSC color-bar and 3020 function generators, 2007 FM-stereo generator, and 1653 variable power supply; Sencore Models CG169 color-bar and VA48 (modified) video generators; Data Precision Models 245, 1350 and 1750 multimeters and 585 frequency counter; Sadelco Model FS-3D VU field-strength meter.

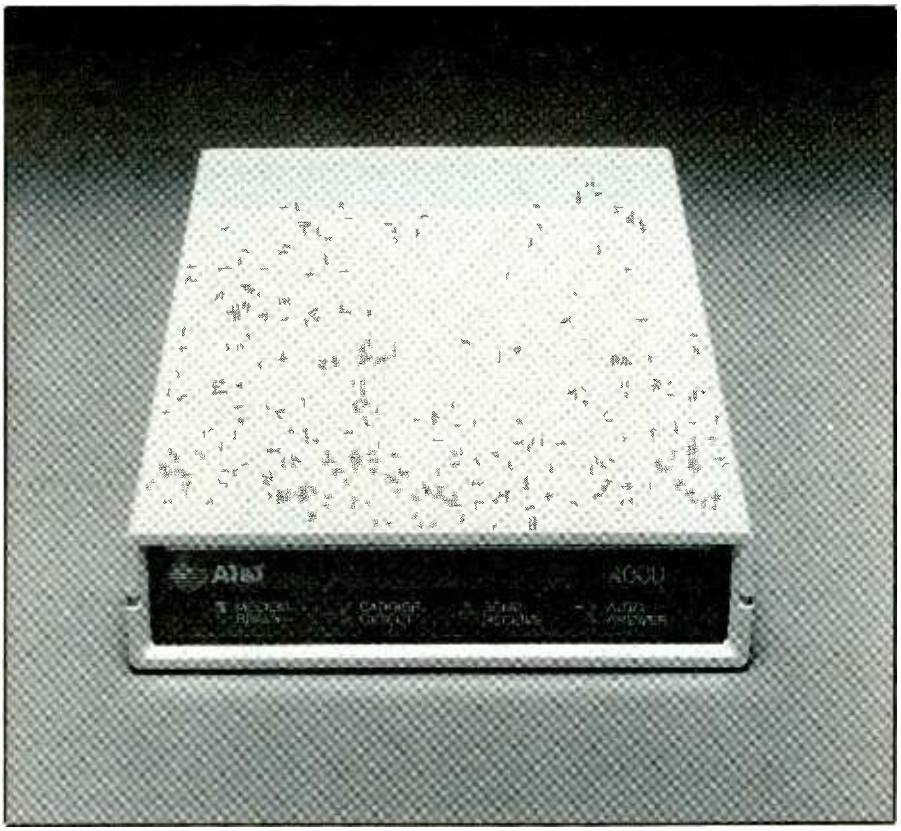
Computers

A Unique, Intelligent Data Communications Device

AT&T's Model 4000 External 300/1200-Baud Modem

Modems, which enable computer users to transmit and receive data over ordinary telephone lines, are among the most popular devices added to basic computer systems. Now AT&T, which started it all by renting modems to businesses, joins scores of other makers by offering a modem of its own for *sale*, the Model 4000. Priced at $499.95, the external modem is complemented by an AT&T communications software package, SoftCall, which carries a $79.95 price tag.

As its price implies, the modem is an intelligent, programmable 300/



1200-baud device. It has some very appealing features, which befits the wizardry that Western Electric's engineers so often display. There were some questionable design decisions made, too, that we'll examine in due course.

The Hardware

AT&T's modem is quite compact at 9"L × 5½"W × 1½"H. It's housed in a beige-color plastic enclosure and comes with a matching external plug-in-wall-socket power supply cube, whose power consumption is a scant 7 watts. Front-panel indicator LEDs are for "Modem Ready," "Carrier Detect," "Send-Receive" and "Auto Answer." At the rear are two modular phone sockets, one for connecting to the telephone line via an RJ11C plug and the other for connecting the power supply to the modem. The latter is slimmer than the RJ11C and colored red.

Inside the case is a full-size circuit board on which are mounted about a dozen integrated circuits. Ten of these are commercially available TTL logic devices, voltage regulators, and line transceivers. These feed into a customized Texas Instruments 8-bit microprocessor, which has a 4K-byte ROM operating system for the modem. Only one Western Electric IC is contained in the modem; a proprietary 40-pin WE882A Switched Capacitor circuit which is often used for analog network switching purposes. The modem also has a built-in 50-mm piezoelectronic speaker.

In typical fashion, it's compatible with the Bell System 103 and 212A standards for asynchronous communication. The 4000's data format follows the choice of 7 data bits with odd, even or fixed parity or 8 data bits with no parity, and 1 or 2 stop bits, with full-duplex operation.

There are no switches to set or pushbuttons to press since all commands are handled internally by entering single-key commands. For example, striking the command code key, "S," will display a menu for changing internal settings, such as DTR Signal on or off, Dialing Delay (from 1 to 99 seconds), Transparent Mode on or off, etc. With appropriate communications software, a variety of intelligent-modem operations are brought into play.

The modem's built-in ROM is preprogrammed to handle all normally switched functions such as baud rate, data formats, full/half-duplex operation, dialing method (tone or pulse, originate/answer mode, automatic dialing and answering, and so on). It even allows a "dumb" terminal to activate the modem's built-in menu of options.

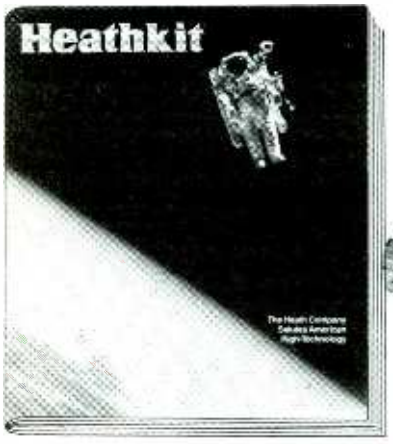
Communications Software

AT&T's SoftCall communications software is designed to take full advantage of the company's modem, though a few other packages can be used with some success. SoftCall, contained on a single-side, double-density disk, eliminates a user's need to remember any codes. Everything is menu-chosen. Moreover, a Help function can be brought up on screen at any time with a single keystroke.

SoftCall, which is specifically designed for the Model 4000, can be

(Continued on page 82)

FREE high tech catalog



Metal Detector

Triple-Trace Oscilloscope/Time-Voltage Display

Ham Radio Transceiver

Computerized Weather Station

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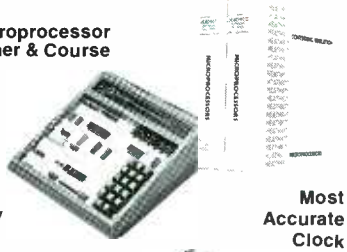
Real Time Spectrum Analyzer

Microprocessor Trainer & Course



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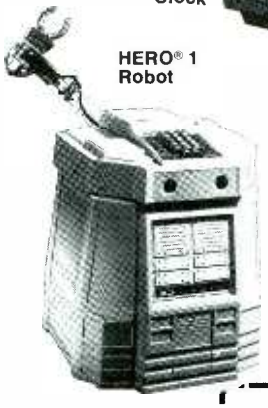

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The Booming World of Consumer Electronics

Part II (Conclusion)

A special report on the latest consumer electronic products recently introduced

Modern Electronics Editorial Staff

Last month, we covered new video, audio, and autosound products introduced to dealers at a major industry showing. This article concludes coverage of the exciting models that retailers will soon be stocking.

Computers

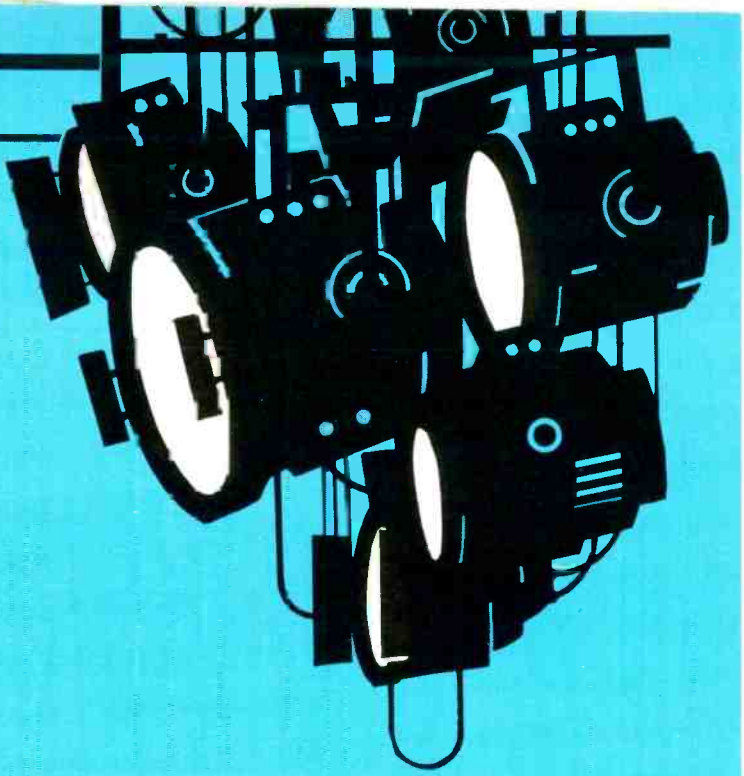
The Consumer Electronics Show is not a "computer" show by any means, though products in this area were certainly represented here. This isn't surprising since there are really few personal computers directed straight to the masses, as compared to machines for business and educational institutions. Among the handful of computer makers who exhibited were Atari, Commodore, Epson, Hewlett-Packard, NEC, and Sinclair. The computer printer field, software producers, and accessory makers were fairly well represented.

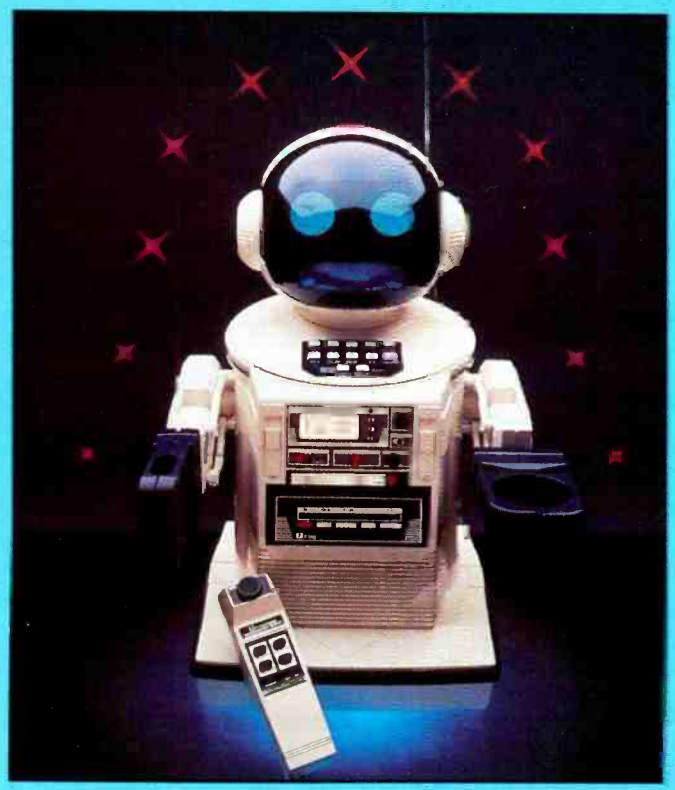
Everyone looked to what Commodore and Atari, the two major players in the mass-market computer field, would debut. After all, the top-selling Commodore 64 was getting a bit long in the tooth and hard rumors indicated that the company's 32-bit graphics wonder, the Amiga, would be unveiled . . . it wasn't! But Commodore did come through with two very exciting personal computers: the Commodore 128 and an LCD portable. The Model 128 does what the Commodore Plus/4 computer (see March 1985 review) did not—it has a C64 mode (64K RAM) that is said to make it compatible with all the older model's software and hardware! It also has a built-in CP/M mode (128K RAM) that uses Digital Research's CP/M 3.0 operating system.

The C128 mode features 128K RAM that's expandable to 512K with an external RAM disk option. It has a 48K ROM and a powerful version of BASIC. Video output includes RGB, as well as composite video and standard NTSC used for conventional TV sets. This mode as well as the CP/M mode gives the user a choice of 40 columns or 80 columns. All modes offer 16 colors.

This is a three-microprocessor machine, using the 6510A CPU for the C64 mode, a compatible 8502 CPU for the 128 mode, and, naturally, a Z80A CPU for CP/M mode. An attractive-looking computer, the 128 has a nice full-travel keyboard with function keys, cursor keys, and control keys lined atop the conventional keys in four sets of four keys. A numeric pad is located at the right. Return, Shift, and Control keys are nice and big. Retail price has not been pinned down, but the triple 8-bitter is expected to be in the $250 to $300 range. Without additional software for the 128 mode, this is just an expanded and refined C-64 computer. At its price mark, though, it's all that many home computerists may want or need, especially with about 6,000 software packages said to be already on the market.

The LCD portable from Commodore is a neat package with 96K ROM and 32K RAM, all CMOS to be gentle on battery drain. It comes with a bevy of built-in programs: word processor, spreadsheet, file manager, 300-baud modem, calculator, notepad, and BASIC. The CPU is a 65C102. Inputs/outputs are an RS232 serial port, Centronics parallel port, modem, barcode, memory



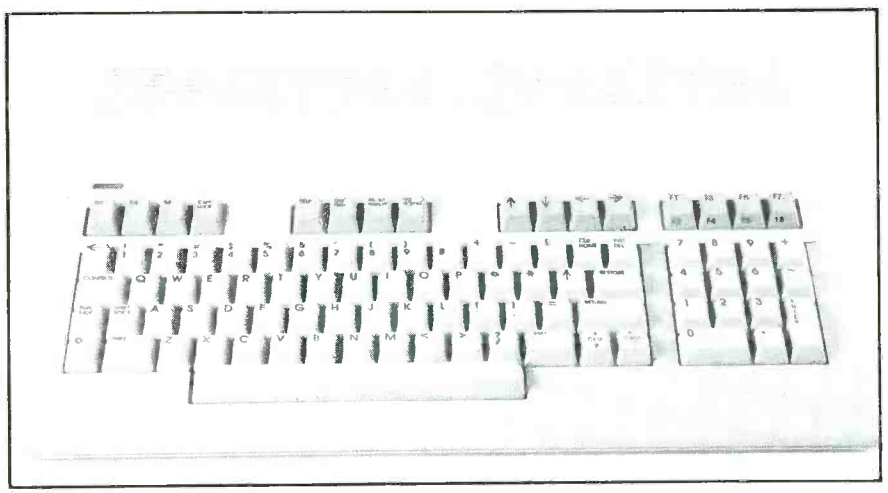


TTC's "Hearoid" personal robot, operated by voice-recognition technology, recognizes 12 different commands.

Seiko's PC Datagraph wristwatch can store up to 12 files, loaded from a computer, in its 2K of RAM memory.

Okidata's Okimate 10 thermal-transfer color printer can use plain and thermal paper or transparent acetate.

Computer Glimpses



A few personal computer companies wre on hand with new offerings. Among them was the Commodore Model 124 (upper left), with 128K of RAM, and features a C64 mode. Atari's Model 512ST (left) is a 16/32-bit machine that offers 512K of RAM, 192K of ROM and a classy GEM operating environment. Heath/Zenith was also on hand with its IBM PC-compatible Model Z-150 PC (above) desktop system.

expansion, and CBM serial port that's compatible with all Commodore 64 peripherals. The LCD folding screen features 80 columns and 16 lines, with 480 × 128 pixels in its graphics mode.

Atari didn't unveil a 32-bit computer either. But it came closer with a pair of 16/32-bit CPU machines, using Motorola's 68000 chip. These are the Atari 130ST and 520ST models, with 128K and 512K of user memory, respectively, and 192K in read-only-memory. Its outstanding claim to fame is its Digital Research-developed operating system, a GEM operating environment that produces icons, drop-down menus, windows, and two-button "mouse" control for visually oriented use. There are outputs for standard TV, low-resolution composite video, medium-resolution RGB, and high-resolution monochrome. Interfaces are RS232C serial, Centronics parallel, hard-disk, diskette, and dual joystick. Buyers will be given a choice of BASIC or Logo languages. The operating system also provides a memory management system and a real-time clock. In addition to their sophisticated sound generator, the computers have a MIDI (Musical Instrument Digital Interface) for controlling electronic musical instruments, and a ROM cartridge slot. Suggested retail prices are reportedly $599 for the 512K-RAM model and $399 for the 128K-RAM unit.

Atari also revealed four new 8-bit computers, all said to be compatible with older Atari models such as the Model 800XL. They're part of the "XE" family. Model 65 XE, with 64K of RAM, is, essentially, an 800XL with new wrappings. Suggested retail is $120. Other machines in the family include the 65XEM, which has a more advanced sound synthesis system, the 65XEP, which is portable with a built-in 5″ monochrome monitor and a floppy disk

drive, and the 130XE, which boosts user memory to 128K. BASIC is built into all of the computers.

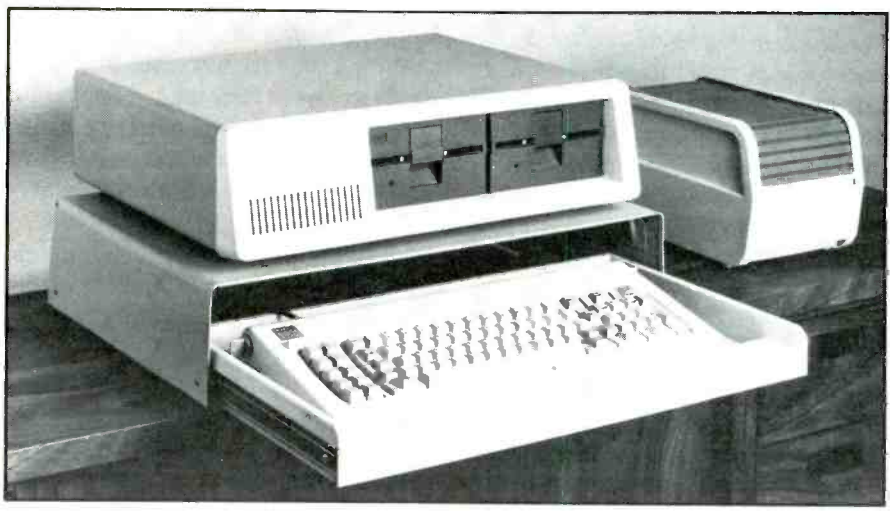
The computer maker of that little low-cost marvel of old, the ZX81, is back in the U.S. from the United Kingdom—Sinclair. The company unveiled its new Sinclair QL computer, a 32-bit Motorola 68008 CPU-based machine with 128K of RAM that's expandable to 640K. It incorporates twin high-speed tape Microdrives and four applications programs, all for under $500.

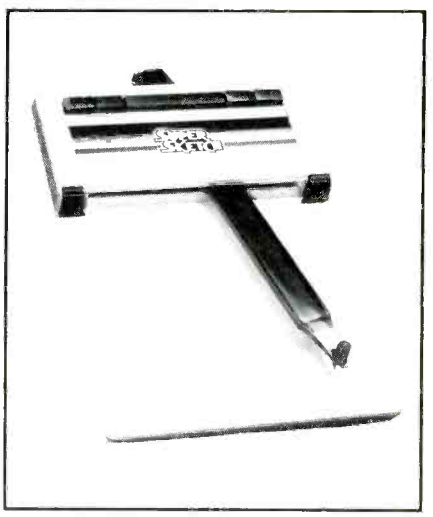
Heath/Zenith was there, too, showing off its desktop and portable IBM-compatible computers and video monitors. Epson and NEC featured their lap computers.

MSX computers and software made their debut at CES. These are low-cost computers that use the same Microsoft-developed BASIC and the same hardware/software specifications. Thus, they are entirely compatible. A slew of manufacturers from Japan are producing the computers, hoping to crack the low end of the computer market in the U.S., where American computers now reign. Twelve hardware manufacturers and 14 software makers represent MSX 8-bit (Z80 CPU) lines. These included Sony, Sanyo, JVC, Hitachi, Yamaha, and Toshiba among hardware manufacturers.

Computer Peripheral Glimpses

Among the computer accessories that caught our eye were: MicroComputer Associates' keyboard storage drawer (below); Wico's SmartBoard programmable keyboard/trackball for IBM PCs and Apple IIs (below bottom); Personal Peripherals' low-cost Super Sketch graphics tablet (right); and Telemet America's "Pocket Quote PRO" FM business information pocket receiver.





Seiko attracted considerable attention with a working demonstration of its PC datagraph quartz wristwatch that can be loaded from a computer for everyday use. The "watch" incorporates 2K of RAM and can store up to 12 files. Its LCD panel can display appointment information, reminder notes, or whatever. Naturally, it has full watch functions, including a buzzer alarm that can call up information stored in memory.

Complementing the "watch," which is priced at $150, is a 5"×7" controller, which has tiny keys on a keyboard for inputting data and a mini dot-matrix printer. It transfers data from a standard computer (Apple, IBM, Commodore, Radio Shack) to the wristwatch device through inductive coupling. The controller uses an 8-bit low-power CMOS microprocessor, has 4K of RAM, and a ROM application pack that includes BASIC. The entire Seiko Datagraph System is priced at $340.

Coleco had a giant exhibit for its ADAM computer system. The decision to get out of this end of the business evidently came too late to cancel. Coleco says it will continue to supply new software for their machine, by the way, as well as maintaining service for them.

Epson America, Inc., which gained fame with its bidirectional printer that was then adopted for use by IBM as its dot-matrix mainstay, also produces personal computers. Its Geneva portable, a lap-size computer, was prominently featured. The CP/M machine has a flip-up LCD display with 80 columns × 8 lines. A bevy of software packages come with it, including WordStar, BASIC, a spreadsheet and scheduler. It incorporates a microcassette drive and 64K of RAM. In the printer area, the company introduced its HomeWriter machine for nonbusiness users. The dot-matrix printer has a draft speed of 100 cps and a near-letter-quality mode at 16 cps. Plug-in printer interfaces are available for Apple IIc, Atari 800XL, Commodore 64, and IBM PC*jr*. Epson also showed its new JX-80 printer, a seven-color device that uses a four-color ribbon. The dot-matrix printer speeds along at a brisk 160 cps. Also delivering 160 cps, is the company's new FX-80+ dot-matrix printer. It boasts six button-selectable typestyles and six character pitches.

Okidata, too, entered a new computer printer directed for use with mass-market computers. It's the Okimate 10, a $239 thermal-transfer color printer. It prints on plain paper as well as on thermal paper and acetate, the latter for overhead-projector transparencies. Speed is 60 cps, and you take your choice of a plug-in Commodore or Atari computer interface. The dot-matrix printer measures a compact 13"L× 7½"D × 2¼"H.

Star Micronics, another major producer of computer printers, introduced its new line of dot matrix printers. The printers combine the "Star" standard and PC lines into one group that are switch selectable for popular personal computers such as the IBM PC, Apple II series and Commodore. Its top-line SR-10 and SR-15 models provide fast print speed of 200 cps in draft mode and 50 cps in near-letter-quality mode. The 10" version has a suggested retail price of $649, while the 15"-carriage model, which ups a 2K buffer to 16K, if priced at $799. Friction and tractor paper feed are standard.

Juki, which has been a leader in low-cost printers, breaks the price barrier with a new daisy wheel-like letter-quality printer that's priced at only $299. Print speed is only 10 characters per second and it takes only single-sheet 8½" × 11" manually fed paper, but, oh that price!

Smith-Corona, which started the whole low-cost letter-quality printer area, unveiled a $259 dot-matrix impact printer that runs at 80 cps. It features true lower-case descenders and bit-image graphics, too, with a Centronics parallel interface and a drop-in ribbon cassette.

But if the foregoing prices appear to be low, take a look at Ergo Systems' Hush 80 printer. It's priced at $139.99! The 80 cps machine is a dot-matrix thermal type (you expected standard paper at this price?), and includes dot-addressable graphics. Buyers can choose models with either a Commodore or Centronics-type parallel interface. An RS-232 serial version will soon be available.

Not yet priced, but you can assume it'll be high, is Mitsubishi's new full-color printer that prints pictures off a TV screen. The TV or VCR's NTSC composite video signals are converted into RGB color signals, with digital color signals for one frame stored in the printer's field memory (about ¾ of a megabyte RAM). Prints are made in about a minute.

Computer accessories were almost omnipresent at the giant show. Among the very interesting ones displayed was Personal Peripherals' "Super Sketch" model for creating color graphics on a Commodore 64 or Atari computer. It's a freehand or tracing tablet that retails for a remarkably low $29.95, including appropriate software! A more "costly" model for IBM and Apple computers is priced at under $70.

Koala Technologies showed a number of graphics products, including its IBM-PC "Speed Key" device that replaces many key strokes with one key touch and its "MacVision" desk accessory for Apple Macintosh computers that works with "MacPaint." It's a digitizer unit that takes advantage of the visuals provided by a VCR or video camera to instantly capture pictures on a Mac.

Wico premiered its "Smartboard," a programmable keyboard/trackball peripheral for the IBM PC and Apple II series computers. The keyboard uses the familiar standard Selectric layout and comes programmed with both QWERTY and Dvorak layouts. Up to eight characters can be pro-

grammed for the trackball, with two banks of memory reserved. $399.

Space organizers were displayed by Microcomputer Accessories, including a CRT Valet that is clamped to the back of a desk and supports a video monitor that can be swiveled, raised and lowered. Another space-saving product from the company is a keyboard storage drawer that enables a keyboard to roll out on ball-bearing slides for desks that have limited depth.

In the modem field, AT&T showed off its new Model 4000, an intelligent, programmable modem that's priced at $499.95. It handles both 300- and 1200-baud communications and features a unique call logging system. No, it's not Hayes compatible. Yes, an optional $79.95 communications software package that's real neat bolsters it.

In a turn away from telephone dial-up, a nationwide digital *broadcasting* system was introduced by Telemet America, Inc. Using FM sub-channel transmissions in combination with a small (6″ × 3¼″ × 1¼″) handheld receiver called, "Pocket Quote PRO," a business information system has been established that picks data out of the air. The 24-hour 7-day service provides quotes from a variety of exchanges, such as the New York Stock Exchange, major Commodity Exchanges, etc. . . . as well as UPI Business News and Sport's Scores, and Accu-Weather Forecasts. The receiver, which weighs 14 oz., incorporates an LCD one-line display and software is available for interfacing to an IBM PC or compatible computer. It's priced at $199, with a $25/month subscription charge; software is $89.

Electronic Typewriters

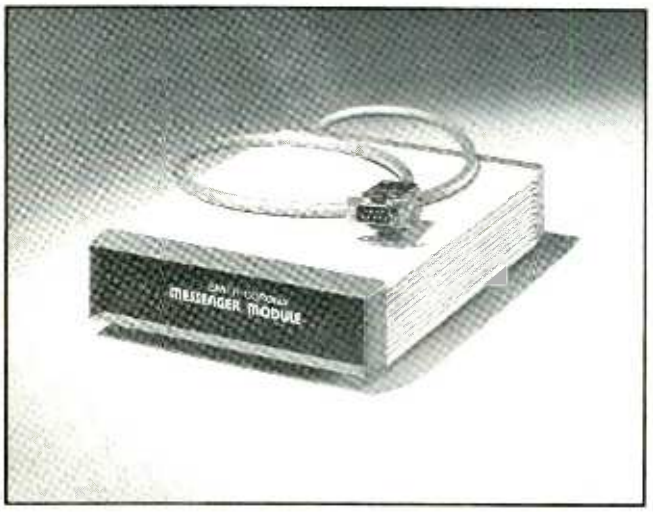
Beyond computer printers is an outgrowth of computer technology—electronic typewriters. A leader in this area, Smith-Corona, introduced three new computer-compatible models, replacing last year's Memory Correct II and III Messenger models with Models 200, 300, and 400, priced, respectively, at $459, $549, and $599. Like the earlier models, adding an optional module converts the typewriter to a letter-quality computer printer. The outstanding new feature of the machines is a word-erasing function that lifts an entire word off the page by moving the carrier to any letter within the word and tapping a single key.

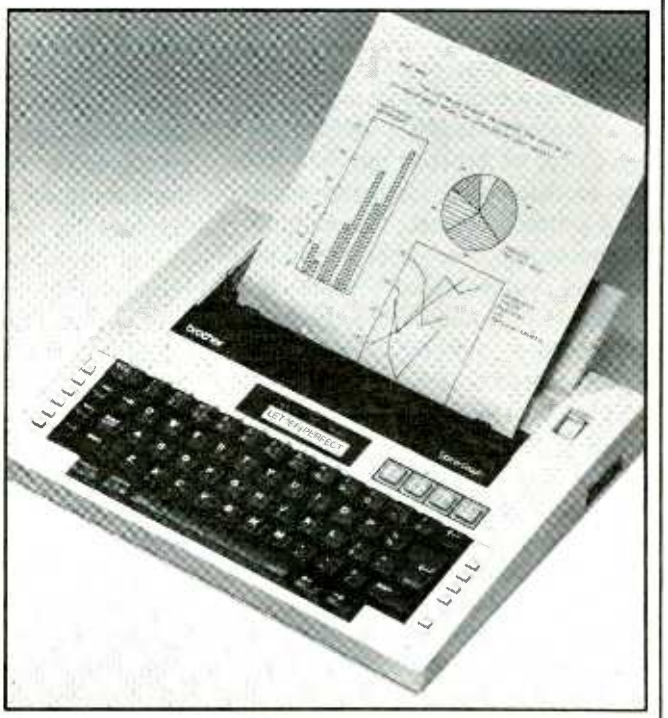
More than a typewriter, which it also is, is Smith-Corona's new portable pen plotter/typewriter. the five-pound machine creates pie charts, linear graphs, bar and grid charts when appropriate data is entered. Moreover, there's a choice of four ink colors. It runs on four D-size batteries or an optional ac adapter. Price is only $299.

Another major player in the electronic typewriter business is big Brother. Brother International introduced four new models at the show,

Electronic Typewriter Glimpses

The electronic typewriter market appears to be booming. In this arena, we found Smith-Corona's "Messenger Module" (below) to be particularly appealing for people who want to have their electronic typewriters do double duty as computer printers. Brother's Type-a-Graph typewriter (right) produces four-color copy of characters and graphics, typing up, down and across.





ranging from $300 to $599.95 for electronic typewriters, and under $300 for a typewriter with graphics capabilities. The costliest model has a 3K memory for storing phrases and text. Its "Type-A-Graph" model can draw four-color pie graphs, line graphs and two-color bar graphs, all in a choice of three different sizes.

Among other companies unveiling electronic typewriters were Juki, Canon, Panasonic, Casio, Ericsson, and Sharp. Decidedly, this area is expected to attract the attention of a lot of consumers, luring them away from just plain old "Electrics." Some can double as computer printers by adding a serial interface. Others have built-in interfaces, such as Canon's $279.95 Typestar 5R™, which has an RS-232C serial port.

Telephone Electronics

The world of telephone electronics continues to grow rapidly since the "phone" company was broken up into smaller pieces to open up competitive gates. Companies really charged into this field, with a countless number of phone instruments being peddled.

Cordless telephones are still around, now sporting new communication frequencies (46/49 MHz). Uniden Corp. of America unveiled five new models, each featuring something a little different. This includes disconnecting the base's receive function automatically when the handset is returned to its base, multiple-channel selection, selectable digital security codes, etc.

Cobra of Dyanscan Corp. introduced it Model CP-447S new-frequency model, featuring digital security coding, call-waiting capability, and speakerphone for hands-off communications. Mura, too, showed new cordless phones with the new frequencies. Adding two to its line brings the company's line up to five models now. Looks like good riddance to the old 1.7-MHz frequency, which contributed to crosstalk, false ringing, and other ills.

A host of manufacturers displayed telephone answering machines, which are growing in popularity for homes as well as very-small businesses. Beeperless remote types are "in". Record-a-Call showed its new "beeperless" Model VOX 690/2, which enables owners to call in for their messages and features two lines. Cobra/Dyanscan displayed its new 8000 series line of three machines, all of them being microprocessor-controlled. Its top-of-the-line Model AN-8500 has a beeperless-type remote at $139.95. Phone-mate revealed a compact machine measuring 6″ × 4½″ with beeperless remote and a "memo" recording function that operates at the touch of a button for $119.95 suggested retail price. Code-A-Phone, too, had new beeperless answering machines, showing its Models 2100 and 2150, both of which featured a new "stacked" cassette technology that makes possible more compact design.

There's no doubt that beeperless remotes are appealing since you can get your messages by calling your number with any Touchtone phone. Previously, you had to carry around a small beeper to control your home answering machine. Most beeperless machines also feature toll-saver calling if there are no messages on your machine for you to retrieve.

Among the plethora of telephone instruments were some slightly offbeat devices. For example, Carson, California-based TTC introduced voice-recognition telephones. The dial-less phones make a voice-print of the user's voice's (up to four preprogrammed voices) that handles a vocabulary of 100 words. The phones are priced at $380 for an 80-memory model and $200 for a 40-memory model. Another interesting phone product from TTC is its "Secret Alert" machine that's similar to a bank alarm button. Plugged into any phone jack, a press of a button silently calls up to three numbers (the police, doctor, friend) to alert them with your pre-programmed message to an emergency.

Among the many AT&T Do-It-Yourself products was a weathertight outdoor phone jack for plugging in a telephone extension on a patio or deck. From Wheelock, Inc. (Long Branch, NJ) was a modular telephone relay that turns on ac devices when your telephone rings. It plugs into an ac outlet and has provisions for an appliance (up to 5 amps) and a phone's modular line-cord plug. Aside from activating appliances and lights by phone, it's a very useful device for the hearing impaired.

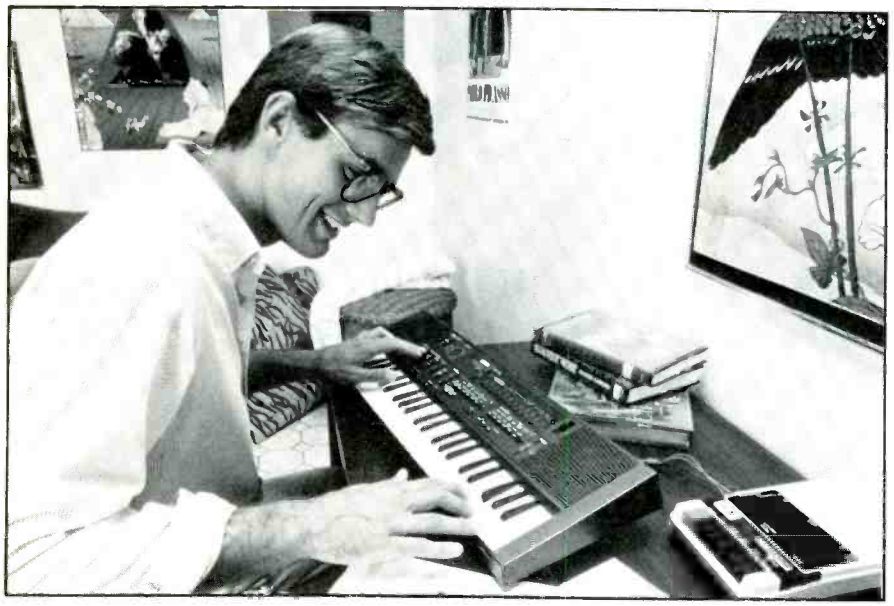
Other New Developments

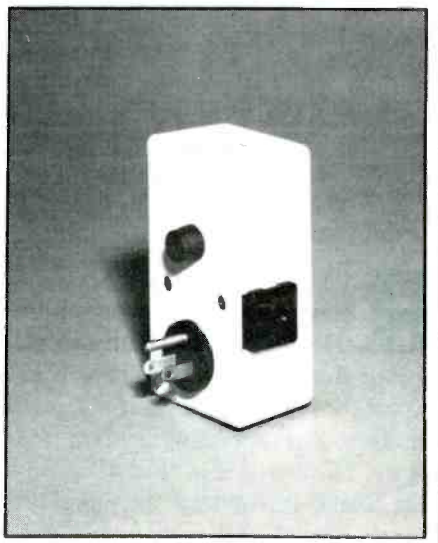
A bevy of credit-card-size calculators were shown off at the show. The most interesting one we thought was Canon's new TP-6, a printing-display calculator that can fit inside a wallet or jacket pocket with ease. Using a thermal printing system, its suggested retail price is $49.95.

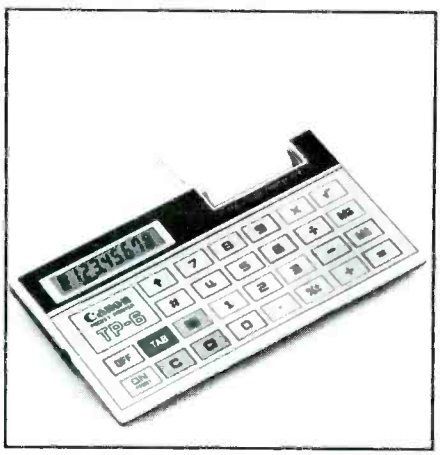
Casio, which also had an array of new calculators, showed its FM-radio card, model RD-10, which is only 1.9 mm thin and weight 7/16 ounce. The company also featured its Casio TV-21 black-and-white 2″ LCD-screen TV set that weighs in at only 7 oz. More interesting was Casio's 6″ LCD *flat*-screen color TV, a prototype of a 12″ wall-hanging version that's promised to be on the market by the end of 1985. In the wristwatch department, there were water-resistant watches, one with a built-in compass, another with a graphic countdown alarm with yacht timer functions. They're priced at $24.95 and $34.95, respectively.

In the music department, Yamaha displayed two new keyboards, the 49-key stereo PCS-500 and the 32-key PCS-30. Both use the company's PlayCard System, enabling beginners to gradually improve playing skill. There are nearly 300 Play-

Home Electronics Glimpses







Clockwise from top-left: Yamaha's PortaSound MK-100 portable keyboard has 3.2K of RAM and uses a Multi-Menu system. Sharp's MB-371H monitors and prints out systolic and diastolic blood pressure and pulse rate. Wheelock's TelRelay solid-state modular telephone relay controls power to electrical appliances. Canon's TP-6 thermal printing calculator is small enough to fit into a wallet. Casio's RD-10 FM Card radio is only 1.9 mm thin.

Cards that can be slid into the instrument to program music, with a red light lighting up above each key activated. Among the other keyboards shown was Yamaha's PortaSound MK-100, a portable keyboard that uses a Multi-Menu system based on 3.2 kilobytes of random access memory. With it, each tone selection can be customized, from orchestral voices to automatic drummer.

Another keyboard offerring, this one to mate with a Commodore-64 computer, was the Melodian. It generates a menu-driven screen display that allows a user of its 40-key, 3½-octave keyboard to experiment with music, adding different instruments one at a time. The $200 system displays musical notes right on the video screen.

Sharp Electronics' Industrial Equipment Division entered some health-oriented electronic devices. For example, its new MC-700 "Stay-Fit" calculator stores 153 foods alphabetically in memory to give instant calorie content and portion size of each for people who wish to keep tabs on their calorie intake. The 2.2-oz. pocketable calculator retails

(Continued on page 85)

Tandy's New Model-1000 Computer: The King of IBM Clones???

Radio Shack's latest desktop computer starts life with loads of available software, modest price and wide distribution, as it challenges the IBM PC windmill

By Eric Grevstad

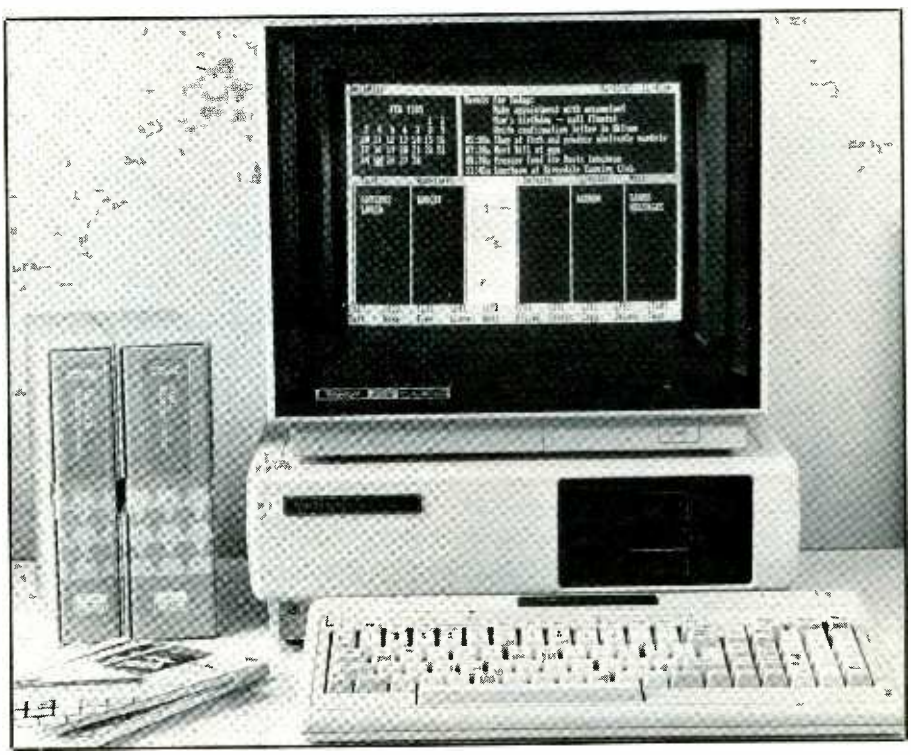
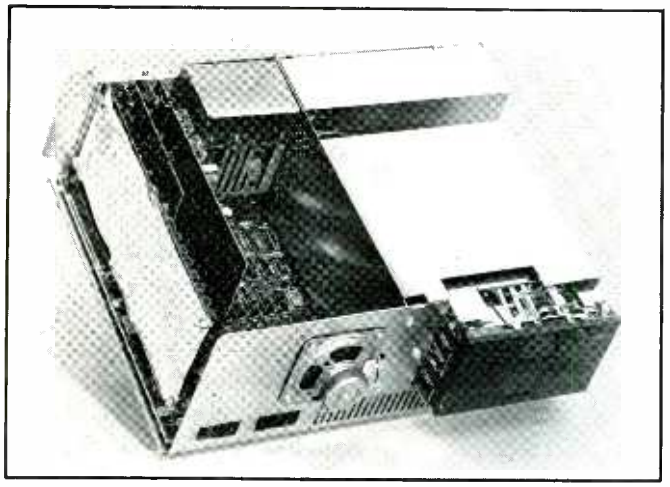


PHOTO CREDIT: JIM HEID

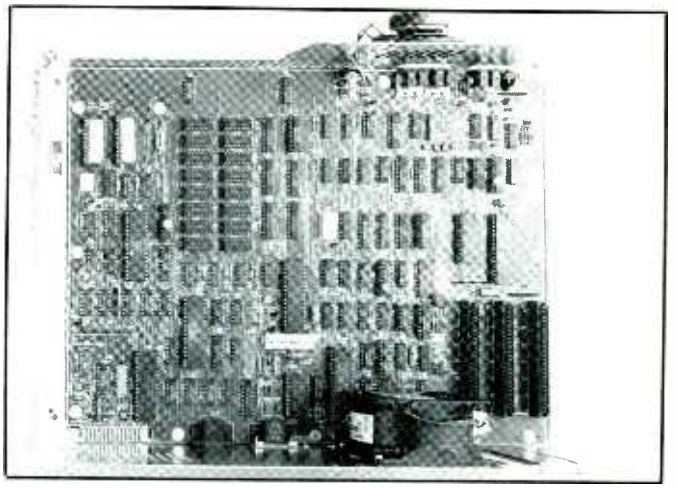
Radio Shack has been a major player in microcomputers since 1977, along with its arch competitor, Apple Computer. Like Apple, it maintained its own proprietary disk-operating system for years. This changed in 1983 when Radio Shack introduced its powerful Tandy Model 2000, which uses MS-DOS (Microsoft Disk Operating System), upon which IBM's PC-DOS is based. As a super high-performance machine, it runs programs written for the IBM PC, though it does not provide data compatibility that allows information transfer of files.

Late last year, however, Radio Shack dropped the other shoe with the unveiling of its Tandy 1000 machine, an MS-DOS computer that does indeed run many of the popular IBM-PC programs. Thus, it starts off with a big software base. Moreover, at the time of its introduction the 1000's price was substantially lower than an IBM PC's, though it offered more features. In fact, it was jostling the PC*jr*'s price, the computer that its hardware configuration most resembles. Equally important, the Tandy 1000 cannot be viewed as just another nice, lower-priced IBM-PC clone since Radio Shack is not

Tandy 1000 and Tandy 2000 are trademarks of the Radio Shack Division of Tandy Corp.



With cover removed, the Tandy 1000 presents a neat, airy layout. The disk drive(s) and power supply occupy the right half of the chassis, while the left half contains room for expansion cards and the cooling fan.



With disk drive(s), power supply, and expansion cards removed, unobstructed access is provided to most parts on the mother board. Except for CPU, ROMs and RAMs, all ICs are soldered to the board.

just another little company trying to make it in the marketplace. It is one of the few giants in the industry, with the finances and national distribution to make it a formidable force in personal computers. So let's look at this important computer more closely, which is priced at this writing at $1,199 with 128K RAM and one disk drive, with the rumor that this will soon drop to $999.

A Junior 2000?

With its white plastic case and identical keyboard, the Tandy 1000 looks like a smaller brother of the company's first MS-DOS micro, the high-performance Model 2000. (The latter is still the Tandy flagship: a much more costly one offering twice the PC's speed, graphics resolution, and disk storage.)

The 1000's front panel holds one half-height floppy drive, with a plastic panel above it covering the space for a second optional drive. Next to the keyboard socket are two joystick ports, compatible with Tandy's Color Computer joysticks ($39.95 each) or Koala Technologies' touch pad ($59.95), and a RESET button. There's little chance you'll hit the button accidentally—in fact, the keyboard blocks it when placed in line with the computer. But it's a handy alternative to the Ctrl-Alt-Del reboot sequence of an IBM PC.

Moving to the rear of the 1000, past the lighted on-off switch on the right side, you find more interfaces. This includes, praise be, a parallel port. The port has the TRS-80 Model I/III/4's male edge connector rather than most MS-DOS systems' female pin unit, so you'll have to buy your printer cable from Radio Shack. Still, that beats paying $75 for a PC's or $99 for a PC*jr*'s parallel adapter. (Apple IIc and Macintosh, of course, snub the parallel standard altogether.)

Like Junior, the Tandy comes with a light pen interface, both RGB color and monochrome monitor adapters, and an adapter for 40-column video on a color TV (with an optional r-f modulator at $24.95 plus cable). There's an audio output jack for an external speaker and a socket for the ac power cord. Though the PC has an outlet to power its monitor, the Tandy will need a second wall socket—but not, unlike a PC*jr* with expansion options, a third.

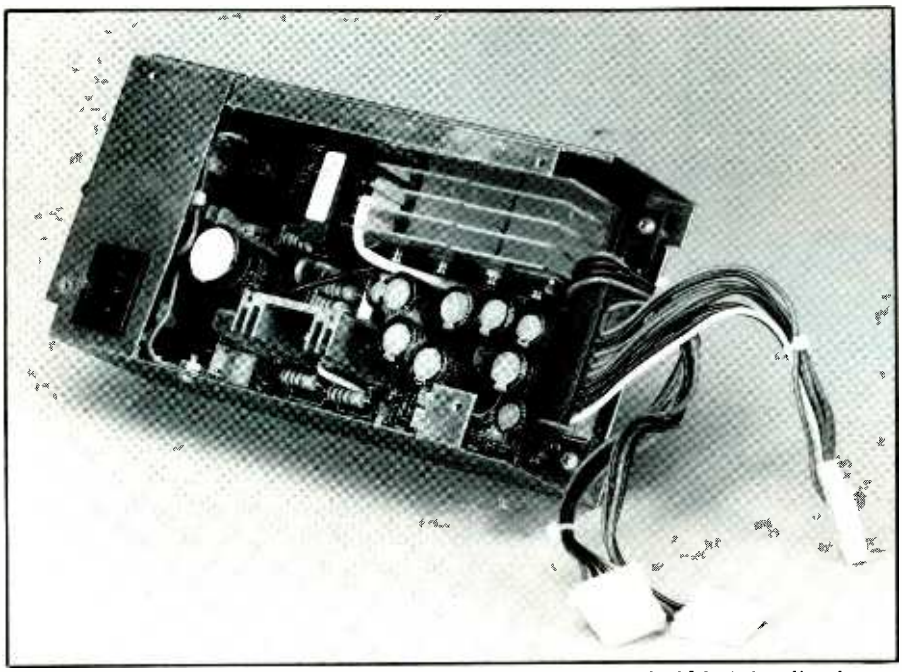
Something Old, Something New

Looking inside (an easy matter of removing two screws and the plastic case, though the floppy drive covers half the motherboard), the 1000 resembles a PC*jr* with no ROM-cartridge slots. There's the same Intel 8088 CPU, and the same Intel support chips (the 8295A interrupt controller, 8253-5 timer, and 8255A-4 peripheral interface adapter).

The motherboard carries 128K of RAM in two 64K banks, each with eight 8K-bit chips instead of IBM's usual nine, with no party checking and no error detection capability. The eight-chip arrangement is used in the 1000's memory upgrades, too.

The 1000's audio sound follows the PC*jr* recipe: a built-in speaker and Texas Instruments' SN76489A chip, a micro-orchestra with three programmable tone generators plus a white-noise generator. Tandy's GW-BASIC, with its PLAY and SOUND commands, supports everything

"The memory upgrade board is the first option a 1000 owner should buy."



The 360K floppy-disk drives used in the computer are half-height slim-line, double-sided, double-density models made by Teac. Installation is easy, requiring connection of three cables and anchoring with three screws.

from simple tone and duration choices to strings of notes for three voices in seven octaves at normal, legato, or staccato length.

Both the 1000 and PC*jr* use system RAM for video memory, rather than the dedicated RAM found on PC monitor adapters. The bad news is that this reduces your 128K system to 112K, or even to 96K if you want the best multicolor resolution available. The good news is that the 1000's color graphics match PC*jr*'s—first-rate. So we've got another small-business computer that can play Sierra On-Line's animated "King's Quest."

In regular (16K) modes, the Tandy displays 25 lines of 40 or 60 text characters, with 16 foreground and background colors (eight background colors with character blinking). Graphics with all 16 colors appear in 160 × 1200-pixel resolution; with four colors, 320 × 200; with two colors, 640 × 200. Two additional screen modes, requiring a high-resolution monitor and 32K of video memory, allow 16 colors with 320 × 200 resolution and four with 640 × 200.

One small way that Tandy tops Junior for business use is by booting up in 80-column mode (pressing the F12 key during startup gives 40 columns). IBM's micro starts with a 40-column default and requires you to type MODE 80.

Faster Access

The 1000 has an even bigger advantage over PC*jr*: it's twice as fast! Neither PC*jr* nor the standard 1000 has a DMA (direct memory access) controller to move data within RAM or between peripherals without going through the CPU, and both must share RAM between data and video information. But the Tandy does most jobs almost as quickly as the IBM PC, while PC*jr* plods through programs at half speed.

The secret is a custom-designed video gate array circuit, which works with Tandy's Motorola 6845 CRT controller. While both micros constantly check back and forth between the video and CPU memory, the 1000 checks *twice* as frequently as PC*jr*. Running at the 8088's 4.77-MHz clock rate, the IBM PC goes through one wait state to access CPU memory; the Tandy goes through two wait states, and PC*jr* four to six.

Tandy claims its GW-BASIC, running entirely in RAM, beats PC*jr*'s ROM-cartridge BASIC in benchmark tests. I staged a search-and-replace race with my word processor, changing every "e" in a 14-page article to a "#" sign; a DMA-equipped PC XT took 38.1 seconds, the 128K Tandy needed 46.2, and PC*jr* trailed at 1 minute 23.2 seconds.

Leaving a DMA controller off the motherboard was a cost-cutting measure on Tandy's part, but also reflected a consensus that most 128K software doesn't need DMA. The extra speed becomes important with larger, more complex programs; so Tandy put a controller—the same Intel 8237A-5 the PC has—on its memory upgrade board, which boosts the 1000's memory from 128K to 256K for $299.95.

The board fits in any of the 1000's three expansion slots, and requires no DIP-switch setting to install. [The Tandy has no DIP switches; ROM routines read the system configuration and inform the BIOS (basic input-output system) at startup.]

The upgrade is probably the first option a 1000 owner should buy. Not only does DMA make the 1000 fully as quick as the PC, but many 128K IBM programs, and most BASIC applications, need 256K to run a 1000. Furthermore Tandy's video steals 16K or more RAM, and its GW-BASIC loads entirely from disk. This is a 70,000-byte program compared

to 26,112 bytes for IBM's partly ROM-based BASICA.

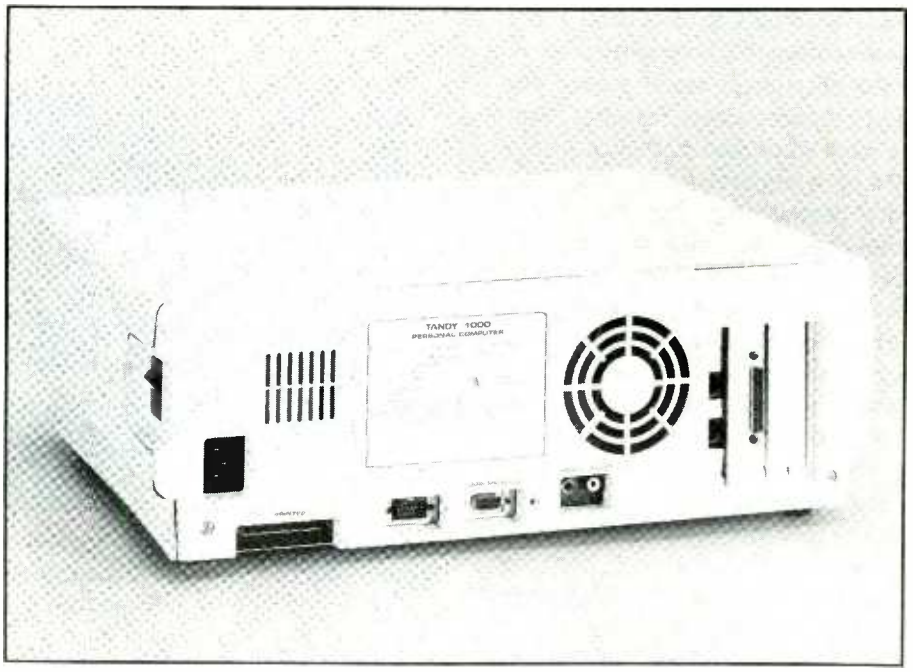
More Expansion

Discussing DMA and the upgrade board is a suitable way to introduce the 1000's greatest edge over PC*jr*: three hardware expansion slots, and room for a second floppy drive *inside* the computer. Whereas expanding a Junior is like adding a wing to your house, tacking memory and power options and a non-IBM drive onto the side of the machine, expanding a 1000 is as easy as opening the case and inserting a card.

The Tandy's not as expandable as the senior PC, which has five slots, and its slots are a bit shorter (10 inches). On the other hand, monochrome and color monitor adapters, a graphics adapter, and a parallel port are already in place; Tandy obviously feels there's no need for the long multifunction boards popular with PC owners. If you have an IBM-compatible board that doesn't exceed 10″, you're invited to plug it in—the system's advertised as both hardware- and software-compatible, accepting things like IBM serial cards as well as Tandy's own.

Even so, the options in Tandy's catalog should satisfy most users. The 1000's RAM can equal any PC's if you're willing to fill two slots. A 128K chip kit ($149.95) fills sockets on the DMA board for a total of 348K, a second board ($249.95) brings memory to 512K, and a second chip kit for that board allows a total of 640K of RAM memory.

If you want to communicate with the outside word, there's a 300-baud internal modem ($179.95). For external modems or serial printers, an RS-232C interface sells for $99.95. A clock/calendar board that saves you from having to type MS-DOS's date and time every morning, and that controls Tandy's two-button Digi-Mouse, is also $99.95. So is the mouse itself.



On the rear panel are all input and output connectors—card-edge printer port connector, DB-9 (nine-pin) RGB output, separate monochrome video and audio outputs, and those on any expansion cards that might be installed.

The second floppy drive, a slimline, double-sided, double-density (360K) Teac to match the first, costs $299.95; Tandy recommends you have the dealer install it, but it's an extremely simple job. (Extra power and disk controller cables are already attached to the first drive; you connect them and mount the new drive with three screws.)

The Tandy's 54-watt power supply isn't especially a healthy one, but it should keep an expanded machine running smoothly. The on-board cooling fan, always audible but not as noisy as many clones', helps too.

There are only two PC options the 1000 lacks: an 8087 math corprocessor for number crunching and an internal Winchester disk to match the PC XT's. Tandy does sell a hard-disk controller board and software ($349.90) that lets you use one or two external drives, such as the firm's 15-megabyte model ($1,995), but I suspect a third party will slip a half-height Winchester into the 1000's second drive space before long.

Coming up soon, we've been told by Radio Shack's market-planning director, Ed Juge, are a hard-disk controller board, a mouse/clock board, and a VIANET board.

A Keen Keyboard

The IBM PC keyboard has 83 keys; the PC*jr* gets by with 62 and a lot of multiple functions. The Tandy 1000 has 90 keys, in the same layout (in fact, the same keyboard) as its Model 2000. The 1000's is faster, quieter, and more convenient to use than IBM's . . . once you learn its slightly different arrangement.

To mention the largest differences, there are 12 horizontally arranged function keys instead of the IBM's 10 vertical ones. (The Tandy arrange-

ment, which PC*jr* also has, is the most common arrangement.) A HOLD key (much easier than Control-S) freezes screen scrolling, and the NUM LOCK and CAPS LOCK keys light up when pressed. To allow for better-placed SHIFT and ENTER keys, some obscurities such as the backslash and tilde have been moved to the numeric keypad, bumping the cursor movement keys from there to their own inverted-T pattern. So Tandy has the edge by far here.

Some people might find the layout a little crowded, but the 1000's keyboard is superbly fast and responsive. With its plastic feet propped up, it's at an ideal angle for typing; with its coiled cord, it lets lap typists lounge perhaps two feet from the desk.

It's also one of the 1000's few sources of possible IBM incompatibility. At the BIOS level, where most programs read input, its ASCII and extended ASCII codes are almost identical to Big Blue's, but it generates different codes at the hardware interrupt level.

Tandy's MS-DOS 2.11 disk contains a patch to fix some keyboard and software mismatches; a friend found that Living Videotext's "ThinkTank" didn't respond to the 1000's keypad plus and minus keys, but installing a CONFIG.SYS file with a 200-byte driver called KEYCNVRT.SYS fixed the problem. My own keyboard snafu was more obvious: Ashton-Tate's "Framework" loaded and ran successfully on a 256K Tandy,but one of its functions uses the PC's SCROLL LOCK key, not found on the 1000 board.

Displays and Compatibility

Graphics- and game-oriented buyers will want an RGB color monitor. The one Tandy offers, the CM-2 ($549.95), is comparable to IBM's, offering bright graphics with mediocre text clarity. I'm happier with the VM-2 monochrome monitor ($159.95), which can, Compaq-style, present graphics in 16 shades of green.

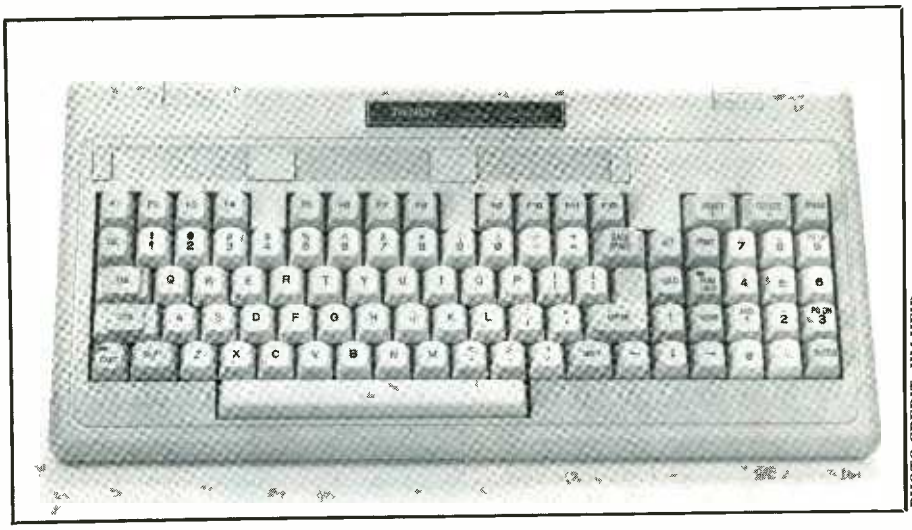


PHOTO CREDIT: JIM HEID

The Model 1000's keyboard is the same as that supplied with Tandy's flagship Model 2000 computer. It is faster, quieter and easier to use than the IBM PC's. Though its arrangement is slightly different, it is better, too.

The VM-2 is quite readable, though, like PC*jr*'s, its text doesn't match the sharpness of the PC's fine monochrome display (it's more like Apple's Monitor II). Worse, it shows another flaw in the 1000's compatibility: software written for the PC's monochrome adapter, with its onboard RAM, won't work properly on monochrome 1000s.

This does not mean that programs won't run, but that they won't be at their best. For example, the underline attribute isn't supported. For example, my word processor boasts onscreen underlining, but shows just plain text on the VM-2. In fact, on color monitors the program shows underlined text as blue, which the VM-2 thinks is virtually invisible low-intensity white.

Fortunately, my word processor comes with a customization or installation program, so I changed the missing text from underlined blue to boldface white (the VM-2 shows boldface with no problem). Since then, everything's worked perfectly.

DOS and Compatibility

I've mentioned the 1000's obstacles to perfect PC compatibility: the memory-hogging GW-BASIC and 16K stolen for video RAM, a few different keyboard codes, its non-IBM monochrome adapter, no DIP switches for programs that consult them instead of the BIOS, and its timing and wait states. Programs that depend on shortwave timing or delay loops, such as some communications packages and joystick games, won't run as they do on the PC. In fact, vendors will have to configure them for the different speeds of 128K and 256K (DMA-equipped) 1000s.

That sounds like a long list, but in day-to-day use the problems are trivial. The 1000 is highly compatible with the PC, as much so as the PC*jr* or most of the IBM clones. Lotus 1-2-3, dBase II, and the pfs series pose no problems. Programs written for IBM's graphics adapter, like Microsoft's Word or Flight Simulator,

are a piece of cake. But it is not 100% software compatible, so bear this in mind when buying software.

The 1000 comes with two Microsoft products: GW-BASIC and MS-DOS 2.11. The former needs to be updated from the first version (a half-dozen features, such as external speaker sound and multiple video pages for graphic modes, aren't implemented yet), but the DOS is a fair edition of the software standard. Some of the new Tandy-specific utilities lack documentation, but others—the KEYCNVRT driver, a MODE command that lets you set various monitor and printer configurations—are nice touches.

Besides its own operating system, my 1000 successfully booted and ran under PC-DOS 2.00 and 2.10 and the MS-DOS 2.11 from NCR's PC4. The PC, by contrast, though it reads data and runs programs from Tandy MS-DOS disks, can't boot them ("Diskette is bootable only on the Tandy Model 1000").

If you anticipate disk-swapping, you can format and create PC-DOS disks in a 1000. The Tandy, like other compatibles, can't run IBM BASIC (which looks for much of its code in ROM), but I put Tandy's GW-BASIC on a PC-DOS disk; it seemed to work in a borrowed PC, though with no visible cursor.

The ROM BIOS is the heart of any would-be compatible, and (as Eagle and Corona found in 1984) the secret most jealously guarded by IBM's copyright lawyers. Tandy is the first major company to license the built-from-scratch BIOS of Phoenix Compatibility Corp. (Norwood, MA), which locked a TI 9900 programmer in a closet with a list of interrupts and entry points to create a reverse-engineered, lawsuit-proof equivalent of IBM's code.

The result, at least as revised and implemented by Tandy, must be judged a success. If you have some PC software, odds are good that it'll run on the 1000. If you have some PC*jr* software, it's more likely to run on the 1000 than on the PC.

Free Bonus: Deskmate

While the 1000's hardware isn't innovative, the computer breaks new ground in bundled software. Rather than supplying a "Meet Your Keyboard" tutorial like Apple's or a dozen assorted-quality programs like Kaypro's, the 1000 comes with a brand-new package called "DeskMate," which is an easy-to-use sampler that provides six limited, but creditable applications.

To use the current jargon, DeskMate has a consistent user interface. Each of its functions works the same way, with similar commands given via the function keys. The functions (text editor, spreadsheet, filer, telecommunications, calendar, and interoffice mail) are reached from the main menu, which shows the current month's calendar and the day's schedule. An alarm reminds you of appointments.

As in Tandy's Model 100 portable, applications (such as the editor) or individual files (such as a letter) are opened by moving a cursor and pressing ENTER, selecting them from the main menu. From the menu or anywhere in DeskMate, pressing ALT and a function key calls a subfunction: help screens, a four-function calculator, an auto-dialing phone directory, a menu of printout options (which include margins, spacing, and pause between pages).

Most of the six programs use Model 100-style cut-and-paste editing. The F7 key always selects a block of text or spreadsheet cells, F8 copies it, and F9 deletes it. While Tandy promotes DeskMate as a first step, something that lets owners start work right away and teaches novices the bare bones of word processing or database work, it's as integrated as a mini (well, micro-) "Framework" or "Symphony." Spreadsheet rows can be merged with a text file, and a block of spreadsheet cells can be reserved for text, with all word-processor functions available.

The functions are no match for dedicated programs, though. The word processor has merge and search and replace features, but no justification or underlining. The maximum spreadsheet size is 99 rows by 99 columns, and changes are recalculated by the F2 key instead of automatically. The number of database records is limited only by disk space, but each record is restricted to one screen (up to 21 fields of 255 characters).

Even so, DeskMate is impressive—the biggest 128K program yet. And once it's taught you the balance, Tandy is ready to sell you a roomful of MS-DOS software: 38 programs in the current catalog, ranging from "Fraction Fever" and "Touchdown Football" to "Lotus 1-2-3" and Microsoft "Word." In the TRS-80™ days, you could only buy one word processor (Scripsit) and one database manager (Profile). Today, even sticking to Radio Shack stores instead of PC software shops, Tandy 1000 owners can choose among four of each.

Radio Shack has also announced an integrated accounting system, "Quartet," for the 1000 model (as well as its 1200 HD and 2000 computers). The $399.95 package has four major functions: Payables, Receivables, Payroll, and General Ledger. A special user interface is said to exhance its utility, such as filling out checks while paying bills.

Documentation

Except for DeskMate, Tandy 1000

(Continued on page 87)

Using Voltage Comparators

A hands-on look at the popular and readily available LM339

By Robert Witte

First cousin to the ubiquitous op amp, the versatile voltage comparator offers circuit designers and experimenters a convenient means for bridging the worlds of analog and digital circuits. The need for such a bridge grows as more and more digital circuits have built into them or must communicate with external analog elements.

A typical case is the personal computer, which often requires some sort of interface circuit to translate the real world's analog informaton into the digital format it needs. Here, the voltage comparator provides a TTL logic signal that is high when a sensor reaches a particular temperature, pressure, light level, or any other condition that can be monitored electronically. Comparators can be used in a variety of other applications, too, such as monitoring the voltage on a battery and converting from one logic family to another. As you follow the examination of this device, other uses will suggest themselves. Our discussion focuses on the popular LM339 voltage comparator, which is readily available from mail-order houses such as Digi-key for only 88¢, as well as from many local electronics parts stores.

The LM339 offers four separate comparators in a single 14-pin DIP. It can be powered from any +2- to +36-volt dc supply, including batteries, making it suitable for 5-volt logic circuits and portable applications. It is easy to incorporate into circuit designs and is ideal for electronics experimenting.

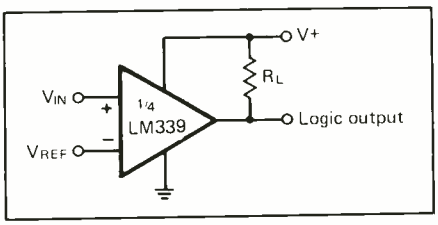


Fig. 1. The basic comparator circuit.

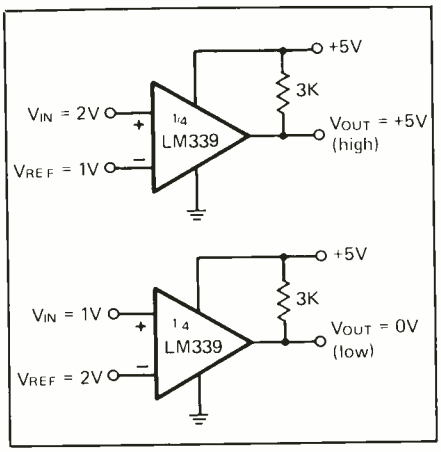
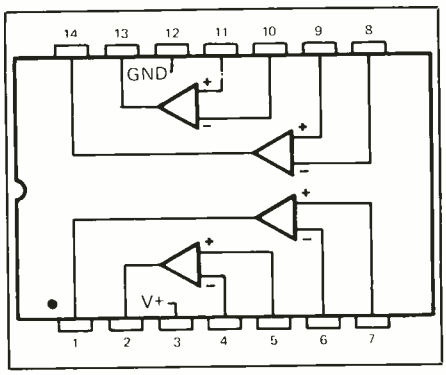


Fig. 2. Depending on input voltage.

Fig. 3. Contained inside a single LM-339 are four comparators.



How It Works

Operation of a compatator is really quite simple. Referring to Fig. 1, if the voltage at the noninverting (+) input, referred to as V_{in}, is greater than the voltage at the inverting (−) input, referred to as V_{ref}, the output is a logic high. However, if V_{ref} is greater than V_{in}, the output is a logic low. Hence, with a 2-volt V_{in} and a 1-volt V_{ref}, output voltage V_{out} will be high (approximately the same as supply voltage V+). On the other hand, if V_{in} is 1 volt and V_{ref} is 2 volts, V_{out} will be low (approximately 0 volt). Both of these conditions are illustrated in Fig. 2.

The LM339 voltage comparator (see pinout diagram in Fig. 3) has an open-collector output, which means that no pull-up resistor is required to make it TTL and CMOS compatible. Since the LM339 is the subject of this article, it is important that you know something about its operating parameters. Its major specifications are as follows:

Supply voltage	2 to 36 volts dc
Supply current	2 mA maximum, 0.8 mA typical
Response time	1.3 μs typical
Output sink current	6 mA minimum, 16 mA typical
Saturation voltage	400 mV maximum, 250 mV typical
Input bias current	100 nA maximum

With a maximum supply current of 2

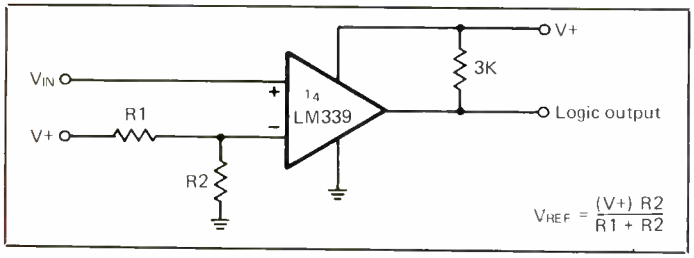


Fig. 4. Shown here is the basic comparator circuit that compares an input voltage (V_{in}) with a reference voltage (V_{ref}), the latter supplied by the voltage-divider R1/R2.

mA, this chip is suitable for low-power applications. Though response time is not as fast as a TTL gate's response time, 1.3 μs is good enough for many circuits.

The output of each comparator in the LM339 can sink 6 mA or more current, which will handle at least one TTL and several CMOS loads. Output saturation voltage is the point at which the output is at logic low. Input impedance is very high, allowing the comparator to draw a mere 250 nanoamperes of current.

Circuit Applications

Basic Comparator Circuit. Shown in Fig. 4 is the basic comparator circuit that compares a V_{in} to a V_{ref}, the latter supplied by bias resistors *R1* and *R2*. This circuit can be used to monitor the voltage from a solar cell to produce a high whenever the voltage exceeds a given value of V_{ref} to indicate the presence of light. This TTL-compatible logic signal can be used to drive an I/O (input/ output) line in a computer. V_{ref} is calculated using the formula $V_{ref} = [(V+)R2]/(R1 + R2)$.

Time-Delay Circuit. A time-delay circuit can be built by preceding the comparator with an RC network, as shown in Fig. 5. When the comparator's output goes from 0 volt to V+, the potential on *C* rises exponentially. When the voltage on *C* reaches 70% of V+, the comparator's output switches from low to high. The time it takes for the charge on *C* to reach 70% of V+ delays the change of state in output voltage relative to the input voltage by the time constant of the RC network. For example, if *R* is 100,000 ohms and *C* is 10 microfarads, the time constant (T = RC) and, therefore, time delay is 100,000 ohms × 0.00001 farad = 1 second. The low input current of the comparator permits a wide range of *R* and *C* values to be used.

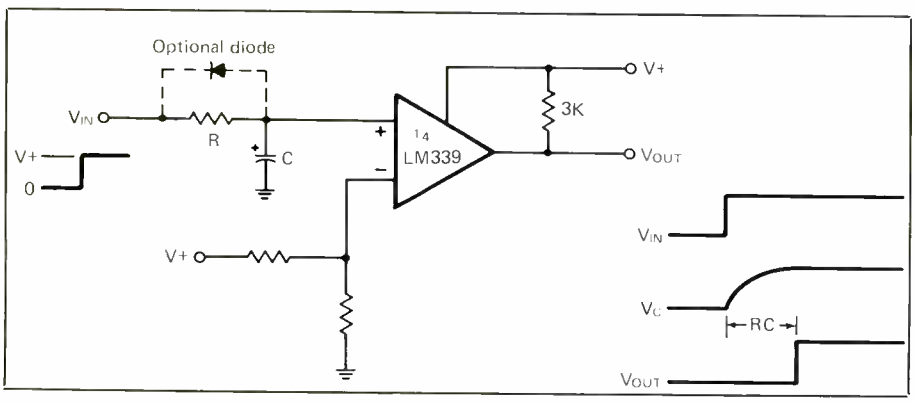


Fig. 5. R and C in this circuit provide a delay in output, as shown in the lower-right. Diode D1 provides an immediate reset when the output goes low.

An optional diode can be added to make the circuit reset as soon as the input voltage goes low. Without this diode, some time will be required for the voltage on *C* to discharge back to zero before the circuit resets.

Window Comparator. By using two comparators, as shown in Fig. 6, you can build a "window" comparator. The object of this arrangement is to have the comparator's output go high if the input is between two predetermined voltages, which we will call V_{hi} and V_{lo}, produced by their respective resistor bias circuits.

In Fig. 6, the upper comparator's output goes high when the input voltage is less than V_{hi}. The lower comparator's output goes high when the input voltage is greater than V_{lo}. The comparators operate independently of each other, though their outputs are tied together to provide a single output condition.

Since the output of the comparator is an open collector of an npn transistor, either comparator can pull the output low. However, both comparators in Fig. 6 must be high for the output to be high. This is sometimes referred to a "wired-AND" configuration, because the output goes high when the outputs of the upper *and* lower comparators are both high. Notice that V_{in} is connected to the inverting (reference) input of the upper comparator and the bias voltage from the resistor network goes to the noninverting (V_{in}) input. This arrangement causes the logic output of the upper comparator to be inverted with respect to the input.

Zero-Crossing Detector. A sine wave, such as a low-voltage version of the 60-Hz power-line signal, can be converted to a square wave simply by using a zero-crossing detector. This type of circuit, shown in Fig. 7, simply compares the input voltage against ground (0 volt) and outputs a high whenever the input is greater than 0 volt. The circuit is slightly more complicated than this, since the LM339 cannot handle voltages more negative than −0.3 volt.

To keep the voltage from going very negative, a diode is added to the circuit to limit the voltage to some small negative value, typically 0.7 volt for a silicon diode. The 10k and 1k resistors in the Fig. 7 circuit provide additional voltage attenuation.

A good application for the Fig. 7 circuit would be to supply a computer or other digital system with a known signal frequency to be used as the reference for a software-based real-time clock.

Hysteresis

Since the comparator is a very-high gain device, if no special steps are taken, a slowly varying input can cause an erratic output to be generated when V_{in} is close to V_{ref}. Consider a slowly rising V_{in} that typically includes some small amount of noise (Fig. 8). As V_{in} increases, it will pass through the $V_{in} = V_{ref}$ point, causing the output to swing high. As it passes through the $V_{in} = V_{ref}$ point, any noise (or feedback caused by stray capacitance) can momentarily cause the output to rapidly switch between the high and low states. In many circuits, this toggling of the output may be of no concern. However, if the comparator's output drives an edge-sensitive circuit, such as the clock input to a digital counter or flip-flop, erratic operation will result. Consequently, the edge of the signal must be cleaned up to assure stable operation of the circuit.

A small amount of positive feedback—commonly called "hysteresis"—from the output back to the input of the comparator solves this "glitching" problem. This feedback arrangement is illustrated in Fig. 9, where the 1-megohm resistor feeds a small amount of the comparator's output voltage back to its noninverting input. When the output first swings high, the feedback causes the voltage at the noninverting input to increase slightly. This increase is

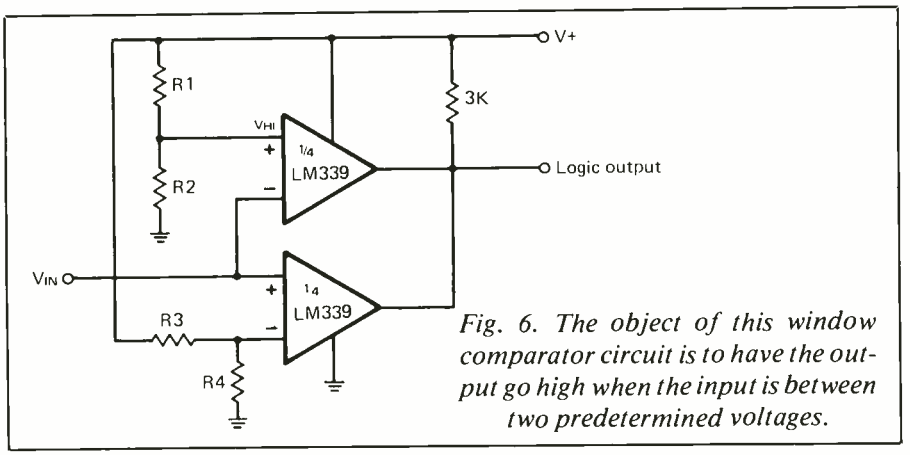


Fig. 6. The object of this window comparator circuit is to have the output go high when the input is between two predetermined voltages.

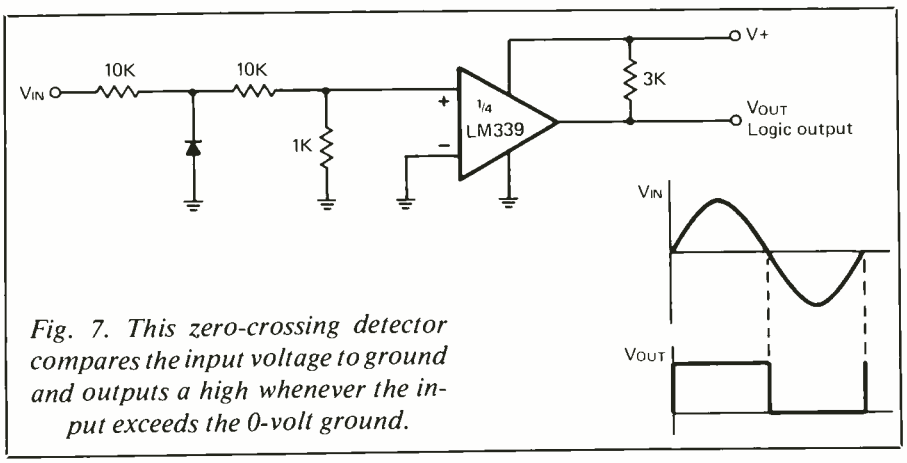


Fig. 7. This zero-crossing detector compares the input voltage to ground and outputs a high whenever the input exceeds the 0-volt ground.

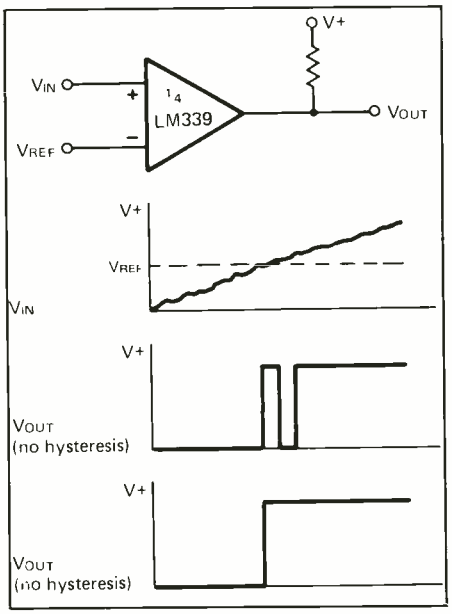


Fig. 8. If no special steps are taken with the very-high-gain comparator, noise can cause the output to be erratic (V_{in}). Adding a small amount of feedback, called "hysteresis," assures stable operation.

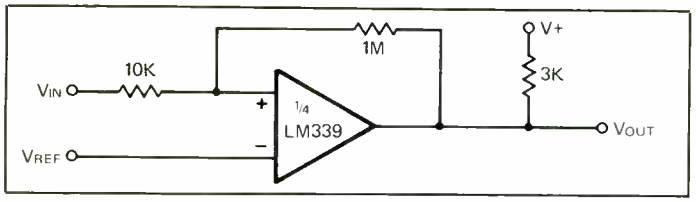


Fig. 9. Hysteresis is obtained simply by installing a resistor between the output and the noninverting input.

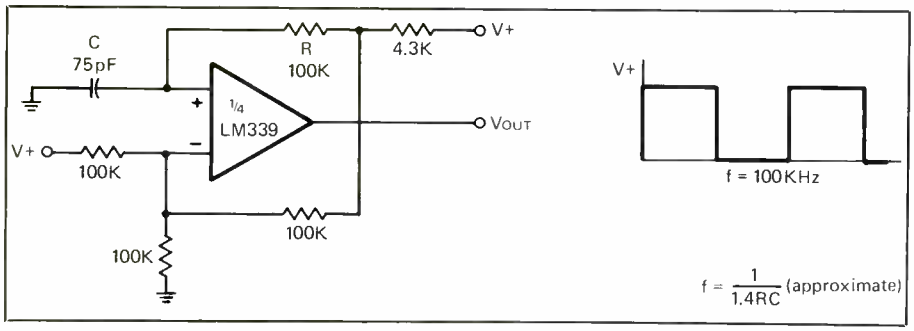


Fig. 10. In this circuit, the comparator operates as a 100-kHz square-wave oscillator. Change R and C values to obtain other frequencies.

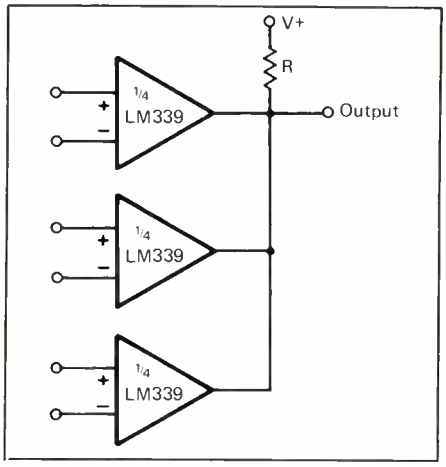


Fig. 11. A wired-AND arrangement.

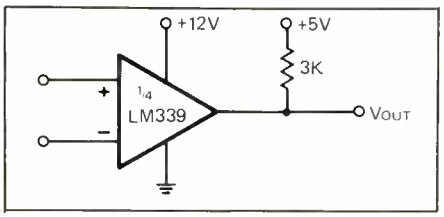


Fig. 12. How to make a comparator powered from +12 volts compatible with the requirements of TTL logic.

greater than the noise present and keeps the comparator's output from switching back to low. Thus, the output switches low to high with a good clean edge. Similarly, the high-to-low transition is also kept glitch-free.

Oscillator Circuit. A comparator can also be configured as a square-wave oscillator, as shown in Fig. 10. This is really a simple time-delay circuit whose output is fed back to its input. Assuming the output is initially high, the capacitor at the inverting input charges up until the voltage exceeds the potential applied to the noninverting input (67% of V+). At this point, the output swings low and the capacitor starts discharging. The comparator would instantly switch back to low but for the fact that the voltage at the noninverting input is simultaneously changed to 33% of V+, due to the 100k feedback resistor. As the voltage on the capacitor decreases, it will become less than the voltage at the noninverting input, causing the comparator's output to swing to high and repeat the process.

The Fig. 10 circuit, taken directly from the manufacturer's data sheet, produces a 100-kHz square-wave output. It can be modified to oscillate at other frequencies by changing the value of *R* and *C*, using the formular $F_{o(approx.)} = 1/1.4RC$.

Open-Collector Output. By not committing the collector of the output npn transistor in each comparator in the LM339, the manufacturer has made it possible to provide the user with several design advantages. The major advantage is that the open-collector output can be adapted to diverse applications. For example, when the comparator is powered by a 5-volt source, a single pull-up resistor with a value of about 3000 ohms can produce a TTL- and CMOS-compatible logic signal. Multiple open-collector outputs can be connected together in a wired-AND configuration (Fig. 11), but keep in mind that all comparator ouputs must be high before the wired-AND signal actually goes high. Note in the wired-AND circuit that only one pull-up resistor is required.

A major advantage of the open-collector is its ability to handle different supply voltages in different parts of a circuit. Typically, +12 volts might be required in the analog and +5 volts in the digital portions of a project. Using an open-collector solves the match. Figure 12 shows that a comparator used to sense some analog signal can be powered from a +12-volt supply but deliver a 5-volt logic signal simply by connecting the pull-up resistor to the +5-volt supply. The reverse situation is illustrated in Fig. 13, which shows how the comparator's output signal can be greater than the voltage powering the comparator. Here the comparator translates a 5-volt logic signal to a 12-volt signal. The comparator's output can exceed the power supply

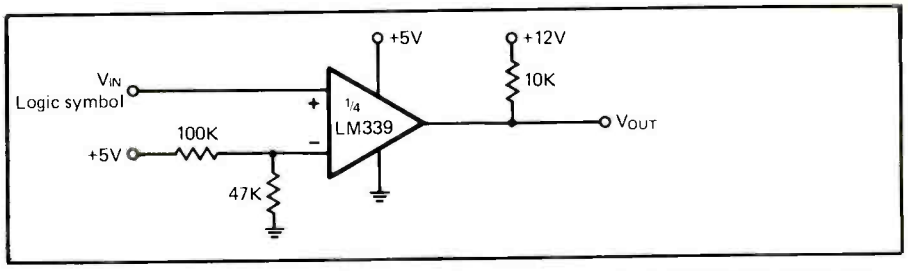


Fig. 13. A comparator's output can also be greater than its supply voltage.

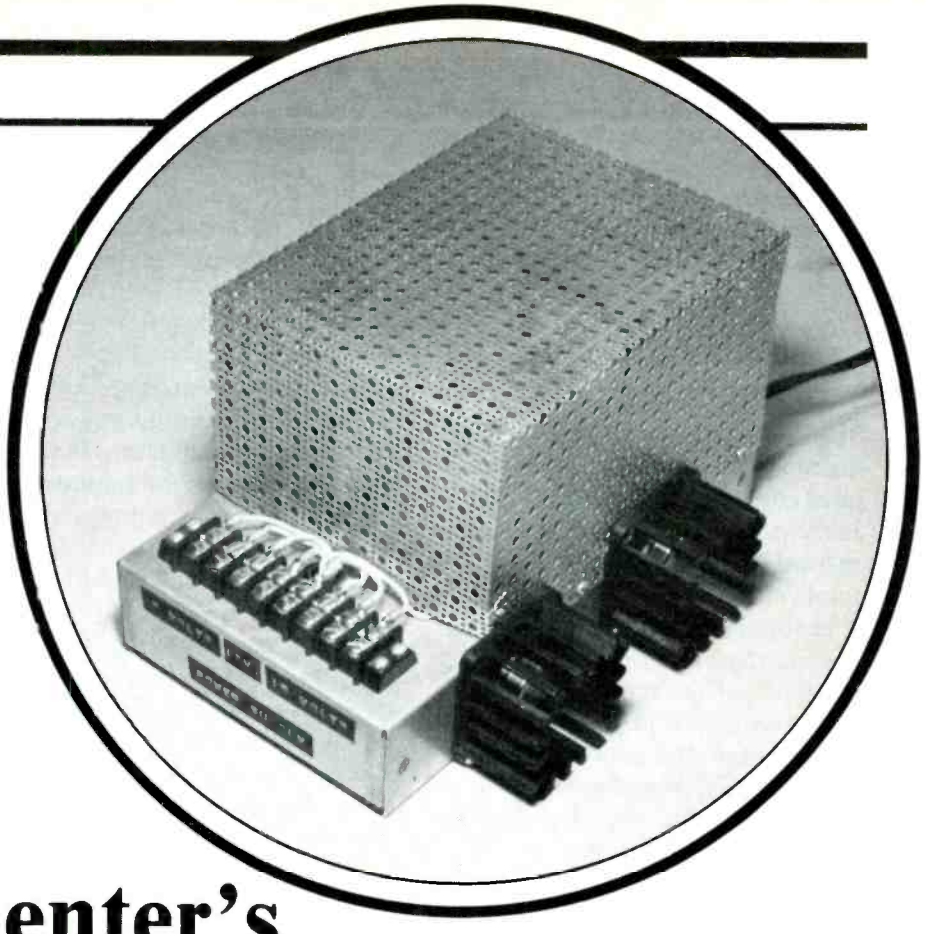
voltage, but only up to the maximum specified supply voltage (+36 volts for the LM339).

Summing Up

Since the LM339 contains four separate comparators, it is ideal for digital applications. Conveniently, two LM339s can supply a full byte-wide (8-bit) bus with appropriate signals in a computer.

Although the LM339 does not usually require careful power supply bypassing, it is still a good idea to practice good circuit layout techniques. That is, keep component leads and circuit board traces (or wires) short to minimize stray capacitance and other forms of coupling, and be sure to ground all unused pins of the comparators.

In this article, we have merely laid the groundwork for using voltage comparators. If you want more information on the LM339, consult the *Linear Databook* published by National Semiconductor Corp. **ME**



An Experimenter's Multi-Voltage Power Supply

Designed to provide all the voltages required by modern IC circuits, it may be all the power supply you ever need on your workbench

By William R. Hoffman

Most power supplies for the experimenter's workbench are inadequate for modern circuit designs. The problem is not that they do not provide sufficient current for complex circuits or that voltage regulation is not up to snuff. Rather, it is that even relatively simple circuits nowadays are likely to contain a mix of analog and digital IC devices that can require up to four different voltages and polarities. Few low-cost power supplies are capable of delivering what these circuits need. The solution to the dilemma is to build a power supply that can, such as the multi-voltage supply described here.

The Experimenter's Multi-Voltage Power Supply may be the ultimate low-cost solution to your breadboarding powering problem. It offers simultaneous outputs at +15, −15, +12 (or −12), +5 and −5 volts. Full regulation is supplied on all output lines, and current delivery is sufficient for the great majority of experimenter projects. This article discusses the design concept, provides the formulas and procedures to design and build your own supply designs, and lists and assortment of popular three-terminal voltage regulators along with their important specifications.

Designing The Supply

Designing a power supply for a particular set of needs requires that you give careful consideration to the transformer/rectifier and regulator circuits. Figure 1 illustrates four common transformer/rectifier circuits. Keeping in mind that the regulator requires an input that is 2 to 10 volts greater than its output voltage, select the circuit that most nearly supplies the correct voltage with the transformer you plan to use.

You can determine rectifier output

voltage relative to transformer output voltage using the appropriate formulas as follows:

(A) $V_o = T_o \times 0.7$
(B) $V_o = (T_o/2) \times 1.4$
(C) $V_o = T_o \times 1.4$
(D) $V_o = (T_o/2) \times 1.4$

The letters in the parentheses preceding each formula are keyed to the lettered configurations shown in Fig. 1. In these equations, V_o is a transformer/rectifier output voltage and T_o is total voltage at the secondary of the transformer. These are the approximate voltages that will be delivered to the input of the regulator. Keep in mind, too, that the result obtained with equation (D) is for *total* voltage from + to −; the voltage from + to ground and from − to ground will be half the calculated value.

The best way to undertand how to design a power supply (or any circuit, for that matter) is to run through an illustrative example. Let us assume for the moment that you want to build a 12-volt dc supply using a 24-volt center-tapped transformer. Using the formula for this particular circuit, you obtain $(24/2) \times 1.4 = 16.9$ volts output from the circuit, which is about the minimum voltage required by the regulator for this circuit.

The next step is to select the filter capacitor. This is a fairly simple task. Just keep in mind that the voltage rating of the capacitor should always be at least 50% greater than the calculated rectifier output voltage and that you should figure about 1000 to 2000 μF of capacitance for each ampere the supply is to deliver.

Selecting the appropriate regulator is your final task. Shown in Fig. 2A is a typical regulator circuit, which consists simply of the regulator IC itself and a 0.1-μF bypass capacitor. Choose you regulator according to the desired output voltage and current levels and polarity of output voltage. The IC Voltage Regulator specifications table shown elsewhere in this article will be a good reference for this step. The table lists most popular types of three-terminal regulators in IC packages.

Choose a positive supply regulator for a positive regulated output voltage or a negative supply regulator for a negative output voltage. Should your application require both positive and negative output voltages, use both types of regulators. If you already have a pair of same-polarity regulators (or cannot obtain both polarity devices), you can use these to fill your needs, as shown in Fig. 2B. It is extremely important that both transistor/rectifier circuits be *completely* isolated from each other when using same-polarity regulators. A center-tapped transformer will not do. You *must* use either a transformer with two separate and isolated secondaries or two separate transformers.

About The Circuit

Now that you know how to design a power supply, let us take a quick look at the Multiple-Voltage Power Supply that is the subject of this article. It is shown schematically in Fig. 3. Note that this supply actually consists of four different power supplies on the same chassis, each with its own transformer, rectifier, filter capacitor and

Designing Your Own Supply

Designing a power supply is a relatively easy task. Here are the steps to follow:

1) Determine what voltage(s) and maximum current your supply will have to deliver for your breadboarded projects.

2) Next, using Fig. 1 and the equations presented in the main article, determine what transformer/rectifier configuration will suit the parts you have on hand or can obtain.

3) Choose rectifiers that have an equal or greater current rating than your circuits will require, preferably the latter, and with a voltage rating at least twice that of the transformer's output voltage.

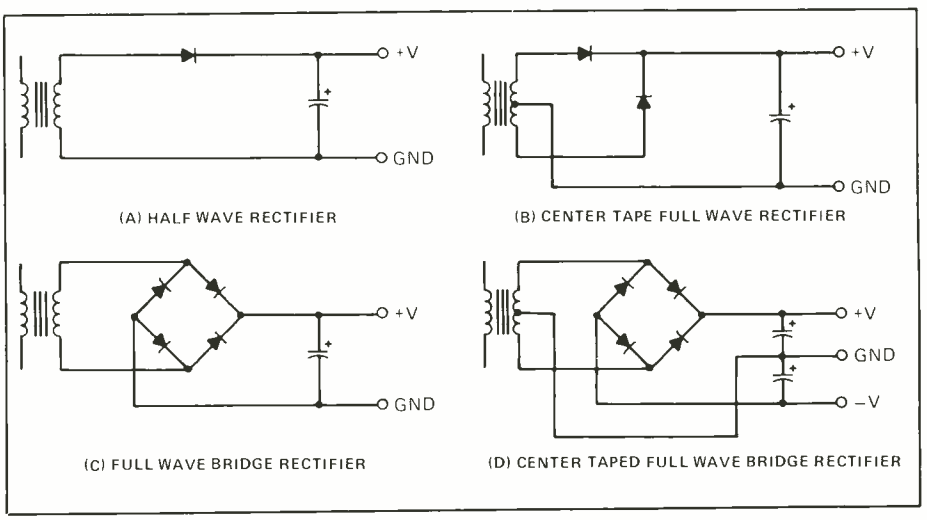
4) Determine the value of the filter capacitor, figuring 1000 to 2000 μF for each ampere the supply is to deliver.

5) Select the appropriate regulator(s) from the table.

6) Make sure to adequately heat sink all regulators; no regulator should ever become so hot that it is uncomfortable to the touch.

7) Select a fuse for the incoming ac line, figuring about ½ ampere for each ampere of current drawn by 5-to-6-volt sections and ⅜ ampere for each ampere drawn by 10-to-15-volt sections. A fast-blow fuse is best here.

Fig. 1. In these drawings are illustrated the four basic transformer/rectifier configurations commonly used in electronic circuit designs.



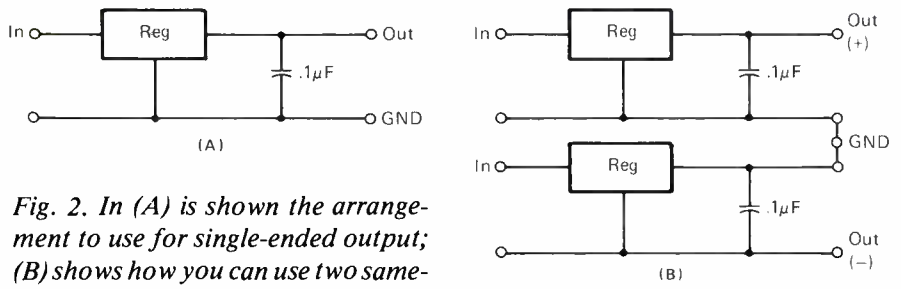


Fig. 2. In (A) is shown the arrangement to use for single-ended output; (B) shows how you can use two same-polarity regulators to obtain both positive and negative output voltages.

voltage regulator. Each of these supplies can be individually turned on and off, if desired, simply by putting an spst switch and appropriate size fuse in one transformer primary line and then wiring all to the main ac line cord. However, it is more convenient to use just one switch and fuse, as shown, to control power to all supply sections simultaneously.

In this power supply, the topmost section delivers +15 and −15 volts, the second +12 (or −12) volts, and the third and fourth sections +5 and −5 volts, respectively. Note in the last two sections that same-polarity (+5-volt) voltage regulators are used to provide the positive and negative outputs. Consequently, these sections each have their own separate transformer/rectifier and regulator circuits, as described above and that each polarity of the 5-volt output is referenced to the terminal between the +5- and −5-volt outputs.

Within the supply itself, no portion is referenced to chassis ground. This being the case, you can select the grounding desired in the circuit to which the supply is connected and thereafter use the 12-volt supply as either a positive or a negative source, depending on your circuit's needs.

Though the schematic in Fig. 3 does not show one, you can have a power-on indicator, too. Simply connect a panel-type neon lamp across the primary circuits of the transformer, after fuse *F1*. Before installing this pilot lamp, check to see if it has a current limiting resistor built in. If it does not, install a 100,000-ohm (100k) resistor in series with the lamp.

Construction

With the components specified in the Parts List, the power supply can be built on a standard 8″×4½″×1½″ aluminum chassis. The transformers and the 8-contact screw-type terminal block that serves as the supply's output connector mount on top of the chassis. The power switch (and power-on indicator and fuse holder, if you use these items) mount on one short wall, which should also be drilled to provide access for the ac line cord. On one of the two long walls you should mount the 5-volt and 12-volt regulators, using standard insulators and silicone or other thermal paste and appropriate hardware. The other long wall accommodates the 15-volt regulators, each mounted on pc-board type heat sinks with insulators, thermal paste and appropriate hardware.

Because of the simplicity of the power supply's circuit, no printed-circuit board construction is required. The entire circuit can be wired using standard solder-lug terminal strips mounted on the under side of the chassis and held in place with the same hardware that secures the transformers in place. The photo shows a pig-tail fuse soldered into the circuit, but you can use a bayonet-type fuse and holder. Chances of the fuse blowing are small; so a soldered-in fuse is fully practical. The regulators are all internally current limited so that a shorted load on any of the supplies will not be reflected back as an overload. The only time the fuse would blow is if one of the diodes or a filter capacitor shorted.

With regard to heat sinking the regulators, the heat sinks shown in the photo for the +15- and −15-volt supplies were chosen for compactness and radiating ability. Other

IC Voltage Regulator Specifications

IC type	Case	Current	Output Voltages
LM-309	TO-5 TO-3	200 mA 1 A	+5 volts only (negative regulator)
LM-320	TO-3 TO-5 TO-220	1.5 A 0.5 A 1.5 A	−5, −6, −8, −9, −12, −15, −18, −14 volts (negative regulators)
LM-340	TO-3 TO-220	1.5 A 1.5 A	6, 6, 8, 10, 12, 15, 18, 24 volts (positive regulators)
MC-7800	TO-3 TO-39 TO-92 TO-220	1.5 A 100 mA 100 mA	5, 6, 8, 10, 12, 15, 18, 24 volts (positive regulators)
MC-7900	TO-3 TO-39 TO-92 TO-220	1.5 A 100 mA 100 mA 0.5 A	−5, −6, −9, −9, −12, −15, −18, −24 (negative regulators)

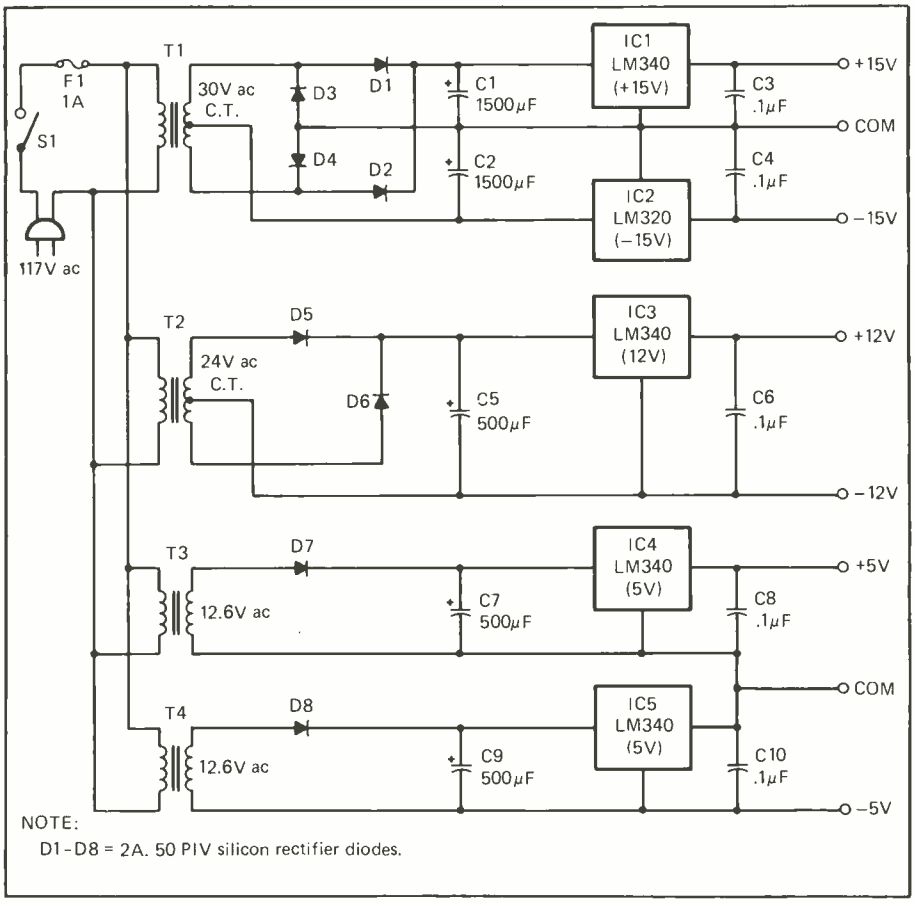


Fig. 3. Overall schematic of the multi-voltage power supply. Note use of separate transformer/rectifier/regulator arrangements for each output.

PARTS LIST

Semiconductors

D1 thru D8—2-ampere, 50 PIV rectifier diodes

IC1—LM340 (+15-volt) regulator in TO-3 case

IC2—LM320 (−15-volt) regulator in TO-3 case

IC3—LM340 (+12-volt) regulator in TO-220 case

IC4,IC5—LM340 (+5-volt) regulator in TO-220 case

Capacitors

C1,C2—1500-μF, 25-volt electrolytic

C3,C4,C6,C8,C10—0.1-μF, 100-volt plastic

C5,C7,C9—500-μF, 25-volt electrolytic

Miscellaneous

F1—1-ampere fast-blow fuse (see text)

S1—1-ampere, 125-volt spst toggle switch

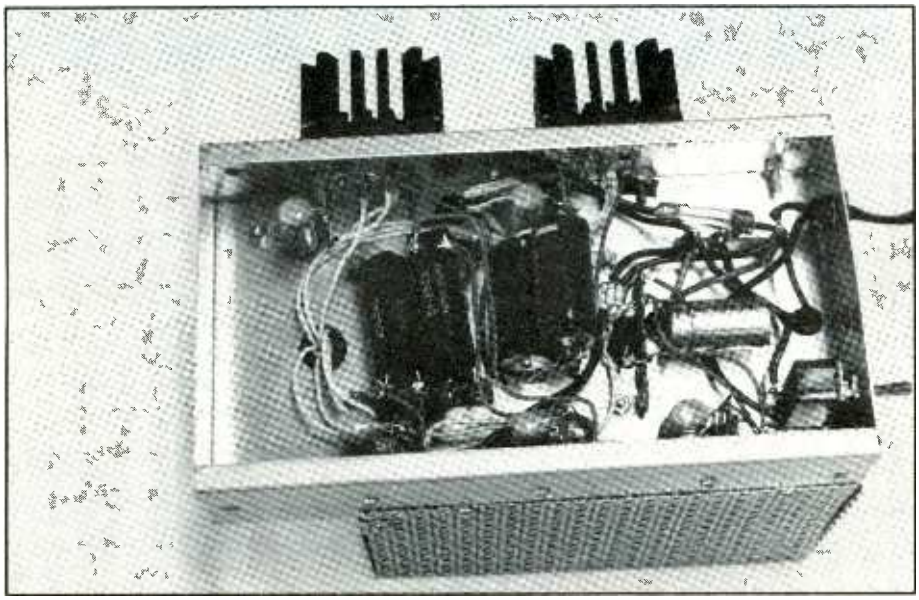
T1—30-volt, 1-ampere center-tapped transformer

T2—24-volt, 0.5-ampere center-tapped transformer

T3,T4—6.3-volt, 0.5-ampere transformer

Metal chassis (8"×4½"×1½"); eight-lug screw-type terminal block; assorted standard solder-lug terminal strips; holder for F1 (optional); heat sinks; transistor sockets; panel-type neon lamp and 100,000-ohm limiting resistor (optional); semiconductor insulators; perforated metal for transformer cover; line cord with plug; plastic line cord strain relief; rubber grommets; labeling kit; heavy-duty stranded hookup wire; machine hardware; solder; etc.

All components mount on terminal strips; incoming/outgoing wires pass through rubber-grommet-lined holes to guard against short circuits.



types can be used, including many of those available from surplus parts dealers. The actual need for a heat sink is determined by the load the regulators are to feed. Keep in mind that the greater the input voltage to the regulators from the transformer/rectifier circuits, the more power will have to be dissipated as heat. Because of this, the input voltages should be as close as possible to the regulators' minimum input voltage (see table).

As you build the multiple-voltage power supply, keep in mind that all conductors going to the terminal block and all leads from the trans-

formers must go through rubber-grommet-lined holes for connection to the terminal strips on the underside of the chassis. Failure to do this might result in insulation wearing away and causing a short circuit to the chassis.

Checkout

There is only one check to be made once the circuit is fully assembled. That is to measure the voltages available at each of the supply's outputs. Just plug in the line cord, flip *S1* to on, and measure away with a voltmeter, noting polarities as you go. If you have installed a power-on indictor, the lamp should light when the power switch is flipped to on.

If everything checks out okay, turn off the power and disconnect the line cord from the ac line. Install the bottom plate on the chassis, checking to make sure that all electrically "live" points of the circuit do not come into contact with either the chassis or the plate. Then fabricate a "cage" out of perforated metal to fit over all transformers and bolt this into place. Finally, label each of the supply's terminal block positions with the appropriate output voltage and polarity **ME**

A Pilot-Lamp Beeper

Audibly alerts you when an electrical appliance with a pilot lamp is left on

By Dan Becker

Many electrically powered appliances for the home use a pilot lamp to indicate when certain functions, among them power-on, have been activated. Visual indicators, however, frequently go unnoticed, especially if they're small lamps. Forgetting to turn off some types of appliances may simply cost you some extra money on your monthly electric bill. Others can pose serious hazards to you and your family, such as the potential fire hazard of a left-on electric stove. In a case like this, an *audible* indicator, which isn't so easy to ignore, is much the better choice. You can equip your electrically powered appliances with an audible alarm, using the Pilot Lamp Beeper described here.

The Pilot Lamp Beeper sounds a series of "beeps" whenever it detects light from the pilot lamp of an electrical appliance. A simple light coupling arrangement from the appliance's pilot lamp to a phototransistor triggers a solid-state beeper in the project. The phototransistor/beeper circuit can be set to monitor any incandescent or neon lamp or light-emitting diode used as a pilot lamp. It requires no electrical connection to the lamp circuit. It is always powered; so you don't have to remember to turn it on. A low-power circuit design allows the Pilot Lamp Beeper to operate many months from a single 9-volt battery. Finally, there are only two set-and-forget controls, one to adjust pickup sensitivity to deal with various ambient lighting conditions and the other to set the beep repetition rate as desired.

About The Circuit

The Pilot Lamp Beeper, shown schematically in Fig. 1, is designed around two key elements. One of these is phototransistor *Q1*, which serves as a variable-resistance light sensor and is part of a voltage divider (*R3* and *R4* are the other two elements that make up the divider network). The other key element is piezoelectric buzzer *X1*, which is an integrated device that sounds a "beep" whenever a dc voltage is applied across it. The circuit is designed to periodically sound a beep whenever *Q1* detects a light-on condition, even in the presence of some ambient light.

This circuit is powered by 9-volt battery *B1*. Battery powering is practical in this application because the components, including the CMOS version of the 555 timer used for *IC1*, draw very little current in the standby mode. Additionally, the circuit will normally be triggered for only a small fraction of the time, when compared with its standby mode condition. Consequently, you can expect a very long life from the 9-volt battery.

With light falling on the photosensitive surface of *Q1*, pin 4 of *IC1* is effectively at V+ (about +9 volts). This puts *IC1* in its astable timing mode. Thereafter, once during each timing cycle, pin 3 momentarily goes low (to ground) and provides a current path through field-effect transistor *Q2* to briefly sound *X1*.

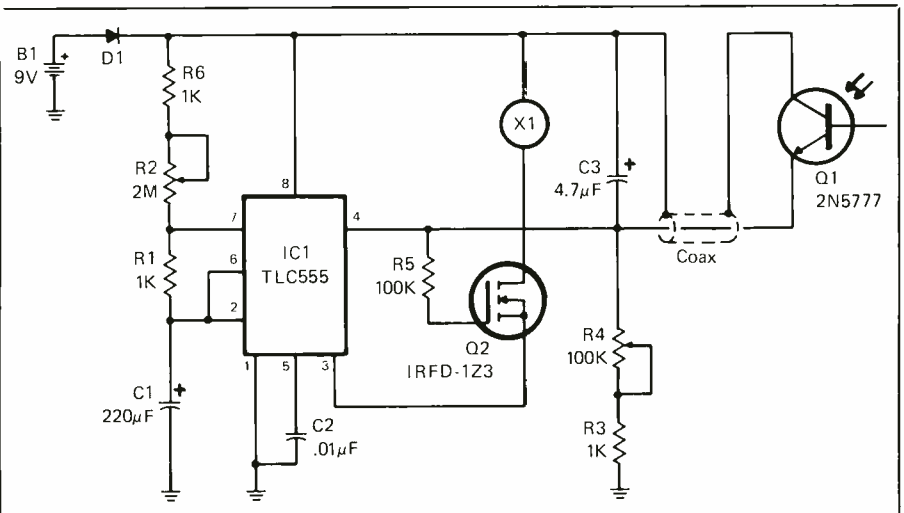
In this circuit, potentiometer *R4* serves as a sensitivity control. It can be set so that the circuit will reliably trigger under various ambient lighting conditions. The values of *R1*, *R2* and *R6* determine the length of silent time between beeps. By adjusting potentiometer *R2*, this period can be set from zero (continuous beeping) to one beep about every seven minutes.

With no light falling on *Q1*, the phototransistor's resistance is very high. This forces *IC1* into the reset mode, which interrupts the astable timing mode and causes pin 3 to go low. To prevent *X1* from sounding again when this occurs, *Q2* is biased by *Q1* to turn off the IC when no light is detected.

Capacitor *C3* smooths out any rapid variations in voltage that would be passed from *Q1* to *Q2* when the circuit is used to monitor the status of neon lamps. (Neon lamps operated from the ac power line almost always flicker at the 60-Hz rate.) Without this capacitor in the circuit as shown, *Q2* would rapidly turn on and off at the 60-Hz rate and cause the beeper to emit more of a "chirp" than a beep.

Construction

This very simple circuit is quite easy to build. It can be assembled on a home-made printed circuit board (see Fig. 2 for actual-size etching-



PARTS LIST

Semiconductors
D1—1N4001 or 1N914 diode
IC1—TLC555 CMOS timer
Q1—2N5777 or similar phototransistor (Circuit Specialists, P.O. Box 3047, Scottsdale, AZ 85257)
Q2—IRFD-173 MOSFET (Radio Shack No. 276-2073)

Capacitors
C1—220-μF, 16-volt electrolytic
C2—0.01-μF ceramic disk
C3—4.7-μF tantalum

Resistors (all ¼-watt, 10%)
R1,R3,R6—1000 ohms
R5—100,000 ohms
R2—2-megohm pc-type trimmer potentiometer
R4—100,000-ohm pc-type trimmer potentiometer

Miscellaneous
B1—9-volt battery
X1—Piezoelectric buzzer (Radio Shack No. 272-131)
Printed-circuit board or perforated board and solder posts; suitable plastic enclosure; socket for IC1; battery holder; connector for B1; coaxial audio cable; heat-shrinkable tubing; machine hardware; hookup wire; solder; etc.

Fig. 1. Operation from a battery is practical because of the use of low-power devices. Significant power is drawn from B1 only when X1 sounds.

and-drilling guide and components-placement diagram), or perforated board with solder posts. Whichever you choose, use a socket for *IC1*.

All components, except *Q1*, mount directly on the circuit board. When installing components on the board, be sure to observe proper orientations, and use safe handling procedures for the MOS devices (*IC1* and *Q2*). Also, if you're using a pc board, make sure you install the wire jumper on it as shown in Fig. 2, and use heat and solder sparingly.

Phototransistor *Q1* connects to one end of a coaxial audio cable. The length of the cable will be determined by the particular application(s) for which the project is to be used. In any event, keep this cable to 6 feet or less in length.

Prepare both ends of the cable by removing 1" of outer insulation and separating the wire braid from the inner conductor. Tightly twist together the fine braid wires at each end of the cable and lightly tin with solder. Then strip away ¼" of insulation from the inner conductor at both ends of the cable.

Slip a ½" length of small-diameter heat-shrinkable tubing over the shield and the inner conductor at one end of the cable. After trimming the leads of the phototransistor to about ½", form a small hook in each lead stub and crimp around the cable's conductor's (emitter to inner conductor, collector to shield). Solder the connections. Slide the tubing over the connections and butt it against the bottom of the transistor's case and carefully shrink it. Slip a 1½" length of larger-diameter heat-shrinkable tuning over *Q1*. Position it so that is does not overhang the sensitive (lensed) end of the transistor and heat to tightly shrink it.

Place the circuit board assembly inside the plastic box that is to house it, in the exact location where it's to be mounted. Mark the locations on the box where the holes for cable exit, access to the adjust slots of the pots, and mounting of the board are to be drilled. Remove the circuit board and drill the appropriate-size holes at the marked locations.

Pass the free end of the cable through its hole, route the conductors to the proper points on the board and solder. Mount the battery holder on the board with machine hardware. Connect and solder the battery connector's leads into the circuit. Then mount the circuit board assembly in the box, using spacers and machine hardware.

Determine where under the top of the box *X1* will be when the project is fully assembled. Drill a dozen or more ⅛" holes in a circular area around this location to allow sound from the buzzer to escape.

Checkout And Adjustment

Set both trimmer pots to their fully counterclockwise positions and plug the battery into its connector. Cover the phototransistor so that no light can fall on it. No beeping should be heard. Now allow light to fall on *Q1*; this time, if all is well, the beeper should sound with a repetition rate of

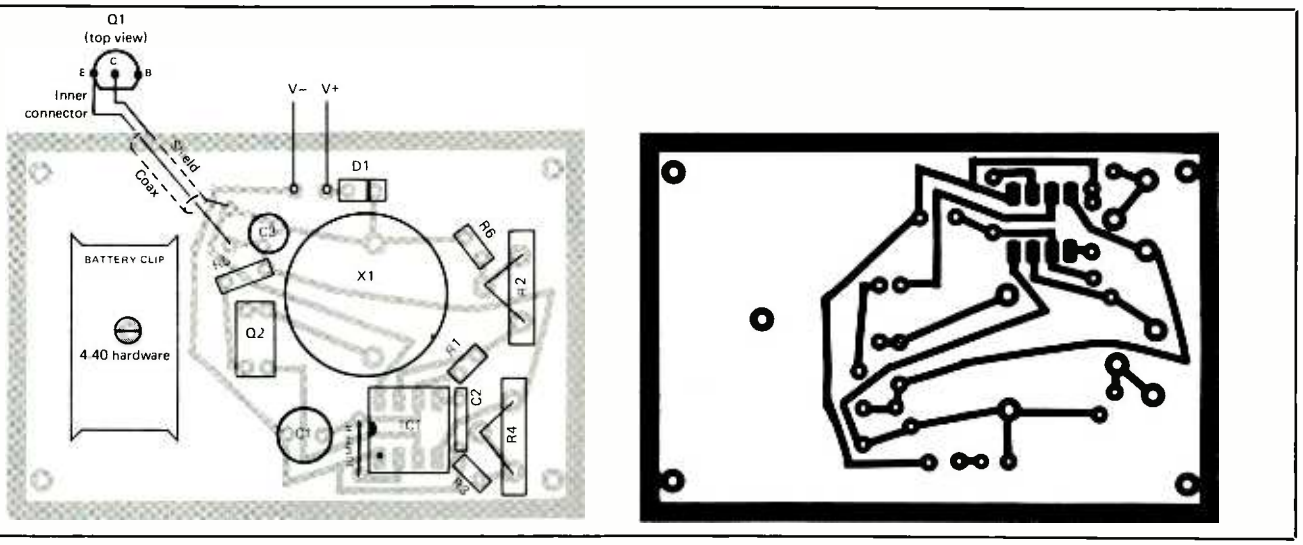


Fig. 2. An actual-size etching-and-drilling guide for home fabrication of a printed-circuit board is shown at right. Wire the components to the board as shown in the placement diagram at the left; observe polarity!

about two beeps per second. Adjusting *R4* fully clockwise should cause the beeping to cease.

Slowly rotate *R4* counterclockwise just enough to reestablish strong, clear beeping. This is the correct setting for this control under *existing* lighting conditions. You'll have to readjust the trimmer pot to suit the conditions of the actual application(s) to which the project is put.

The intervals of silence between beeps can also be adjusted. The interval range, with the value for trimmer control *R2* specified in the Parts List yields up to one beep about every seven minutes with the pot set fully clockwise.

When you've completed testing and adjusting the Pilot Lamp Beeper, fasten the lid of the box in place. This done, you can install the project anywhere convenient to the pilot lamp it is to monitor.

Installation of the project is really very simple. You must first determine if the project is to be used exclusively with one specific appliance only. If so, find an out-of-the-way location into which you can tuck the box that houses the electronics and route the pickup cable to the pilot lamp the project is to monitor. If there's a way to couple the phototransistor to the pilot lamp from inside the appliance, so much the better. If not, make the coupling to the front of the lamp assembly. Remember, the tighter the coupling, the more reliable the operation of the project. With permanent installations, such as in an electric stove, you can complete mechanical coupling by cementing the lensed end of the phototransistor to the pilot lamp with *clear* fast-set epoxy.

If you plan to use your Pilot Lamp Beeper to monitor more than one appliance, you'll have to determine how to fabricate a coupling arrangement that will suit whatever different pilot lamp arrangements are involved. This might be something as simple as a plastic tube that fits snug over the phototransistor and lenses of the pilot lamps. **ME**

"I've finished my homework for the next seven years."

Microwave Leak Detector

By Ralph Neal

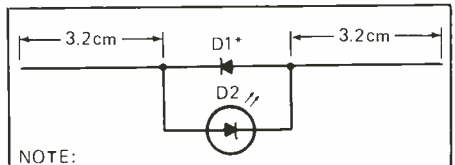
Microwave ovens have been around now for some years. There's always been some lingering concern about leakage due to seals on oven doors losing their effectiveness for one reason or another.

Simple detectors are available to check for possible leaks. They're usually in the form of a plastic wand with a go-no go LED that lights when near a dangerously high level of microwave leakage. One can be made in only a few minutes time at a cost of less than one-fifth that of a commercial unit. The circuit uses only a microwave diode and an LED.

This circuit is basically a microwave receiver tuned to the microwave oven's operating frequency. Tuning is accomplished by taking advantage of the natural resonance of the dipole antenna, in this case the very leads of the microwave diode itself. In the presence of microwave leakage, a voltage is generated across the diode, which acts as a detector. If this voltage is significant, it lights the LED.

The leak detector can be built on a small piece of perforated board or even a small piece of card board in only a few minutes time. As you can see from the diagram, each leg of the dipole must be close to 3.2 cm. in length for it to be tuned to the operating frequency of the oven (2400 MHz). To my surprise the lead lengths of the microwave diode were almost exactly that. Thus, all I needed to have a working leak detector was simply to solder the LED across the microwave diode.

When making this connection be careful to observe the polarity of both diodes. Be sure that they are connected anode to cathode or the circuit will not function! When making the solder connection be sure to solder the LED leads as close to the body of the microwave diode as possible. Place a strip of tape over the legs that form the dipole antenna to protect it from possible damage.



The circuit is very simple, consisting of a microwave diode and a LED.

Once the detector is built you will, of course, want to check your own microwave oven for possible leaks. To perform this check, first place a small cup of water in the microwave oven. Then hold the detector in such a way that the dipole antenna is horizontal to the microwave oven. Turning on the microwave oven and taking care not to tilt the detector out of the horizontal plane, move the leak detector up and down in front of the oven door, keeping a close eye on the LED. If the LED lights up you have found an area where the oven is leaking excessive microwaves. From the few ovens I have tested, most seem to leak at the door handle, with enough microwave radiation to set off the detector. Note that this leak detector does not measure the *amount* of microwave leakage, but only that significant leakage exists. When tested side by side with a commercial detector, the LED of the detector would light only when dangerous levels of leakage were indicated on the commercial detector. **ME**

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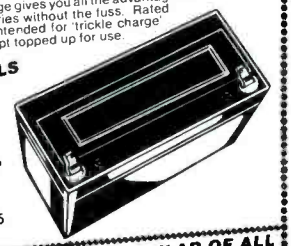

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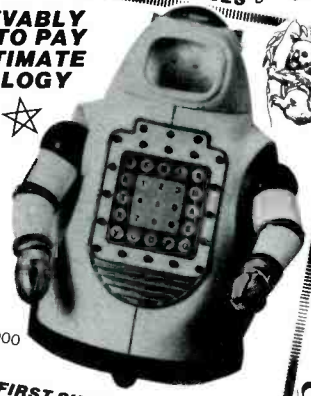

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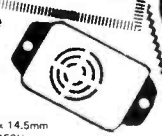

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Experimenter's Interface Device

Part II (Conclusion)

Simple add-on device lets you explore electronic control with your home computer

By Kendra R. Bonnett & Dovell M. Bonnett

Last month, we described what the Experimenter's Interface Device is, its design concepts, and some of the construction details. In this concluding part, we continue with assembly instructions, tell you how to fabricate the EID-to-computer cable, and detail how to test the project.

(7) Preparing The Top Assembly

Referring to Fig. 6, trim the smaller blank perforated board to about 5½" × 1$^{7}/_{16}$". Insert 13 solderless terminal blocks on this board, locating the first ⅜" from the sides and one end of the board. Leave a space between each block. (As you install each block, push it firmly into place so that its body touches the surface of the board.) Skip three spaces and install eight more blocks, with a space between each. Finally, skip three spaces and install the last block.

Measure the distance between the first and last solderless terminal blocks to determine how long a slot you must cut in the lid of the plastic box (it will be about 4$^{1}/_{16}$" as shown in Fig. 6). Draw the slot outline on the box lid as shown. Drill a ¼" hole in the center of the slot area and use a coping saw to remove unwanted plastic and a file to smooth the cut edges. Make a slot just wide enough for the terminal blocks to fit through.

Orient the lid so that the slot is away from you. Insert the block assembly from beneath, with the set of 13 blocks to the left and the single block to the right. Then drill the $^{7}/_{64}$" holes in the indicated locations and mount the terminal block assembly to the lid with 6-32 × ¼" machine screws, nuts and lockwashers.

Enlarge the holes in the corners of the large solderless breadboarding socket to about $^{7}/_{64}$". Position the socket on the box lid as shown in Fig. 6. Drill one corner hole in the lid and secure the socket with a 6-32 × ½" machine screw and nut. Reposition the socket and drill the hole diagonally opposite the first and secure with another 6-32 × ½" screw and nut. Repeat for the other two holes.

Locate and drill the two ¼" holes. Install DIRECTION switch *S1* in the upper hole and ENABLE/DISABLE switch *S2* in the upper and lower holes, respectively. Before tightening the mounting nuts on these switches, make sure that both toggle up and down and that the red wire on *S1* is toward the top of the box lid and the black wire on *S2* is toward the bottom of the box.

Orient the box lid with the solderless terminal blocks toward the top (block 1 to the far left). Wire Wrap the red Kynar wires to the posts of the appropriate terminal blocks, as shown in Fig. 4 and Table II. However, *before* you do this, make the following changes in Table II and wire accordingly: 1) reverse the order of the entries in the "Connect To" column to read backward from SB22 to SB14 for pins 11 through 18 of IC4; 2) reverse the entries in the "Function" column to read backward from PB7 to PB0 for pins 2 through 9 and forward from PB0 to PB7 for pins 11 through 18 of IC4.

While you're at it, go back to Table I and make the following changes: 1) in the "Function" column change the +9 V and −9 V entries for pins 10 and 11 to read 9 V ac + phase and 9 V ac − phase; 2) in the "Direction" column, change the entries for pins 11, A and B to read uni (out), uni (in) and uni (in), respectively.

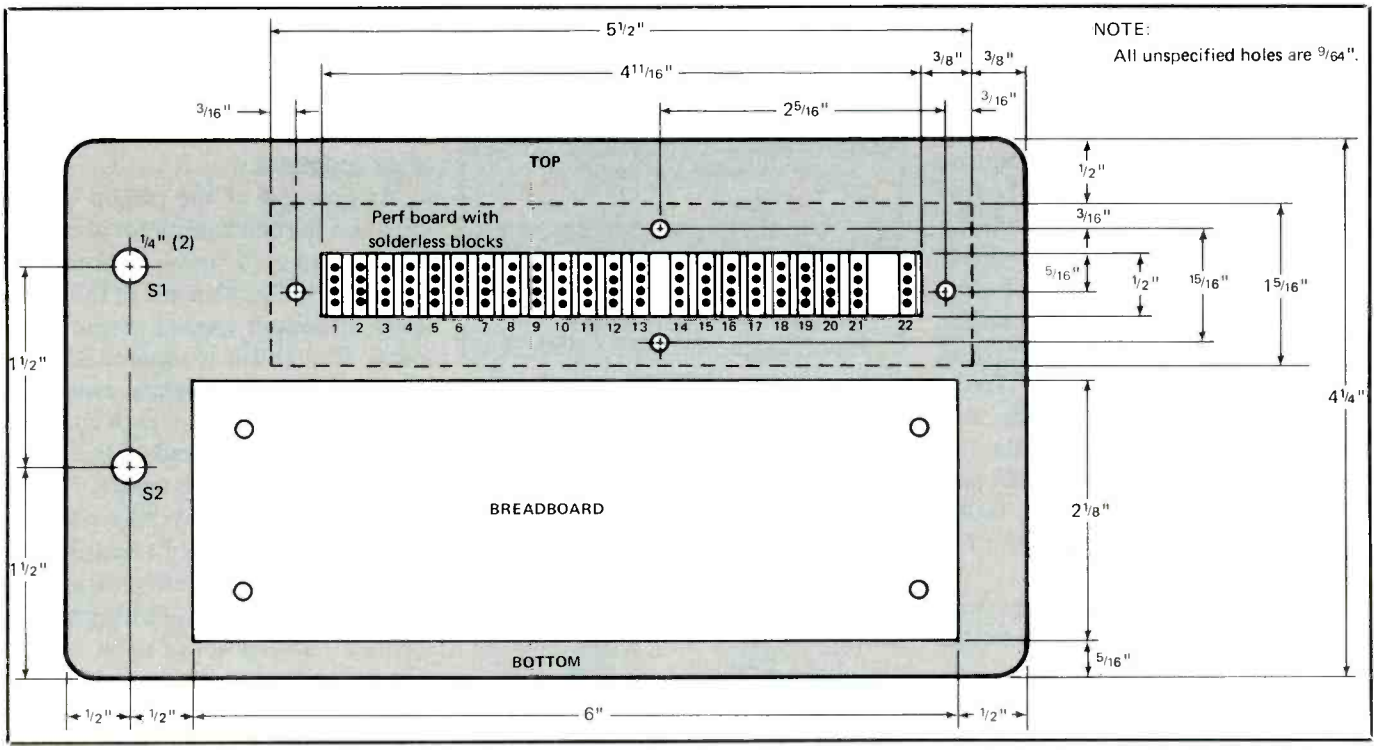


Fig. 6. Top of box must be machined to accommodate breadboard, switches and distribution block assembly.

Connect and solder the free end of the red stranded wire coming from the power supply module to solderless terminal block 2. Similarly, solder the black stranded wire from the power supply's ground bus to block 22. These wires provide the 5 volts dc for any circuits you assemble on the breadboarding socket.

Solder one end of a 9″ red Kynar wire to pin 3 of the male DB-25 connector and Wire Wrap the other end to solderless terminal block 3. Solder one end of a second 9″ red Kynar wire to pin 10 of the DB-25 connector and wrap the other end around the block 12 post and a third such wire to pin 11 of the DB-25 connector and terminal block 13. Finally, connect and solder a red stranded wire from the center lug of *S1* to terminal block 1. Trim the excess wire above the wrapping on all Wire Wrap posts.

Carefully insert the ICs into their respective sockets. With the project

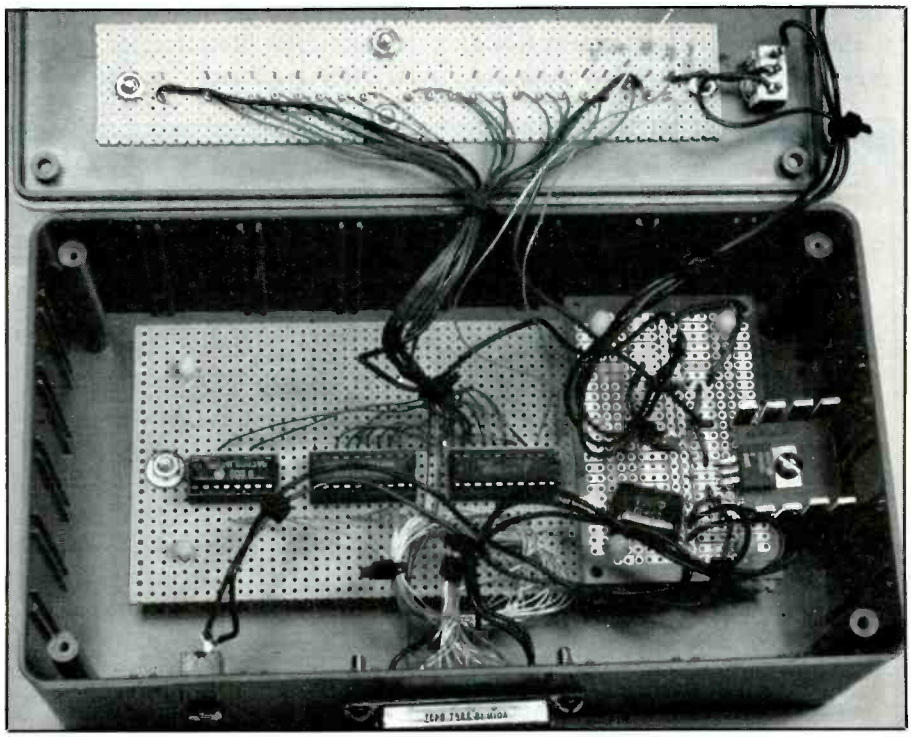


Fig. 7. Shown here are the details for mounting the parts that make up the project. Note the use of cable ties to neatly bundle the wires.

oriented as shown in Fig. 4, note that the notches of *IC3* and *IC4* point toward the left, while the notch of *IC2* points toward the right.

Insert the short plastic separators into the holes in the buffer board. Plug in and push home the plastic separators on the power supply module into the holes in the buffer board. Align the holes in the buffer board with the holes in the bottom of the box. Insert a 6-32 × ¾" screw from the outside of the box and through the appropriate hole the board. Drop on a lockwasher and follow up with a machine nut. Tighten gently. Repeat the procedure for the other hole location.

Install the adapter jack in its hole in the side of the box. Push the male DB-25 connector into its slot so that pins 1 through 13 are on the top. Secure with 6-32 × ½" machine screws, inserted from outside the box, and machine nuts. If you wish, you can use plastic cable ties to neatly bundle the wires, as shown in Fig. 7.

Place the lid on the box and use the previously removed screws to secure it in place. Turn over the box and place a self-stick rubber foot in each corner. Finally, you might want to label the solderless terminal blocks with the function each performs and the switches according to identification and position function.

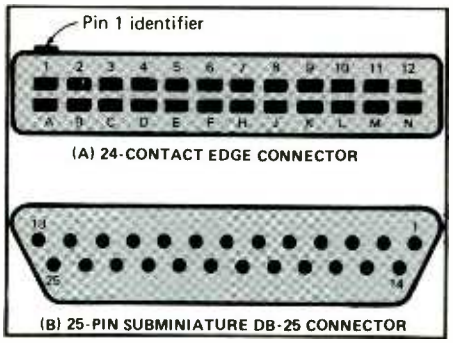


Fig. 8. Edge connector (upper) that plugs into computer has numbered and lettered contacts; only numbers are used for DB-25 pins (lower).

(9) Making The Interface Cable

You need a 36" or so length of 24-conductor ribbon cable (preferably color-coded), 24-contact pc board edge connector, and solderless 25-pin female DB-25 connector for the cable that interconnects the Experimenter's Interface Device with your computer.

At one end of the ribbon cable, separate the conductors for about 1" and trim away ¼" of insulation from each. Leave the other end of the cable as-is; it doesn't require preparation other than to cut it square. It's important that you tightly twist together the fine wires in each conductor at the prepared end of the cable and sparingly tin with solder.

Mark one side of the edge connector with some kind of identifier. It helps if you can identify each contact, but if you can't, at least identify contact 1 with a dot of paint or nail enamel on the housing near that contact's lug. With the connector lugs facing you and the identifier on the top, the lug at the top-left is contact 1. The two rows of lugs are identified with numbers (upper) and letters (lower), as shown in Fig. 8A.

Consecutive conductors from the prepared end of the ribbon cable alternate between the upper and lower rows of lugs on the edge connector. That is, the first conductor goes to lug 1, the second to lug A, the third to lug 2, and so on. Make sure each conductor is mechanically secure to its respective lug before soldering the connection, and use solder sparingly. Keep the insulation as close to the solder lugs as possible to reduce the possibility of short circuits, and carefully inspect all connections immediately as each is made.

A *solderless* connector is the only type of female DB-25 connector to use at the other end of the cable. With this type of connector, all you have to do is line up the first conductor in the ribbon cable (the one connected to pin 1 of the edge connector) with the pin 1 contact of the DB-25 connector and firmly press home the connec

Table III. Solderless Terminal Block Designations

Block No.	Function
1	Direction
2	5-volt dc power supply
3	RESET
4	CNT1 (serial port counter from CIA No. 1)
5	SP1 (serial port from CIA No. 1)
6	CNT2 (serial port counter from CIA No. 2)
7	SP2 (serial port from CIA No. 2)
8	PC2 (handshaking line; unidirectional output)
9	FLAG2 (handshaking line; unidirectional input)
10	PA2 (handshaking line; bidirectional)
11	SERIAL ATN (connects to ATN on serial bus)
12	+9V (connects to ac adapter positive)
13	−9V (connects to ac adapter negative)
14	PB7 (data line)
15	PB6 (data line)
16	PB5 (data line)
17	PB4 (data line)
18	PB3 (data line)
19	PB2 (data line)
20	PB1 (data line)
21	PB0 (data line)
22	GND (ground)

tor's hood. Tiny metal contacts in the DB-25 connector penetrate the insulation on the cable and automatically align all conductors with their respective pins.

Pin identifications are usually molded right onto the plastic that separates the pins of the DB-25 connector. Just in case they aren't with the connector you buy, Fig. 8B shows you which is which. This view of the connector looks into the holes in the receptacle end. Note that the pins are numbered from 1 to 13 in the top row and 14 to 25 in the bottom row, reading from right to left.

Make sure when you assemble this end of the cable that you *tightly* clamp the connector hood into place. If you don't the insulation-penetrating contacts may not make good contact with the conductors.

It's best to check connector-to-connector continuity with an ohmmeter when you're finished assembling your cable. You should obtain a 0-ohm reading when the ohmmeter's probes are touched to the contact pairs as follows:

1/1	7/7	A/14	H/20
2/2	8/8	B/15	J/21
3/3	9/9	C/16	K/22
4/4	10/10	D/17	L/23
5/5	11/11	E/18	M/24
6/6	12/12	F/19	N/25

The numerals and letters to the left of the slashes represent the contacts on the edge connector to which one probe of the ohmmeter goes. The numerals to the right of the slashes represent the pins of the DB-25 connector to which the other probe goes.

(10) Testing The Interface

Using the cable you just prepared, connect the Experimenter's Interface Device to your computer. Plug the ac adapter into the jack on the project and into an ac outlet. Then set *S1* to DISABLE (toggle pulled toward you with the project oriented as in Fig. 6).

Insert a jumper wire from GND at solderless terminal 22 to the bottom horizontal bus of the large solderless breadboarding socket. (Note: All jumpers used in building circuits on the breadboarding socket must be insulated solid 22-gauge hookup wire with ¼" of insulation removed from each end.) The horizontal bus on the socket now becomes the GND BUS for circuits being breadboarded. Connect a short jumper from GND BUS to any of the vertical buses below the horizontal groove in the center of the breadboarding socket.

Insert a light-emiting diode (any color) so that its leads span the horizontal groove and the short cathode lead plugs into the vertical bus connected to GND BUS and the long anode lead plugs into any vertical bus above the groove. Plug one lead of a 100-ohm resistor into the same vertical bus into which the LED's anode lead is plugged and the other lead to the top horizontal bus of the breadboarding socket. Insert one end of a long jumper wire into the top horizontal bus. The other end of this wire will be used to test the solderless terminal blocks.

Set *S2* to ENABLE by flipping its toggle away from you. Set *S1* for the computer-to-breadboard direction by flipping its toggle toward you. (If you wanted a breadboard-to-computer direction, *S1*'s toggle would have been flipped away from your.) As you touch a connection at each of the terminal blocks with the long jumper wire, the LED should light. The only exceptions are at block 9 (FLAG2 is a unidirectional input control line) and at block 22 (GND).

Test the eight data lines by typing into your computer POKE 56579,0 and a carriage return. The LED should light as you touch the connections of the data terminal blocks. If you obtain these results, type POKE 56579,255 and a carriage return. Now the LED should remain off when you touch the jumper wire to the contacts on the data blocks.

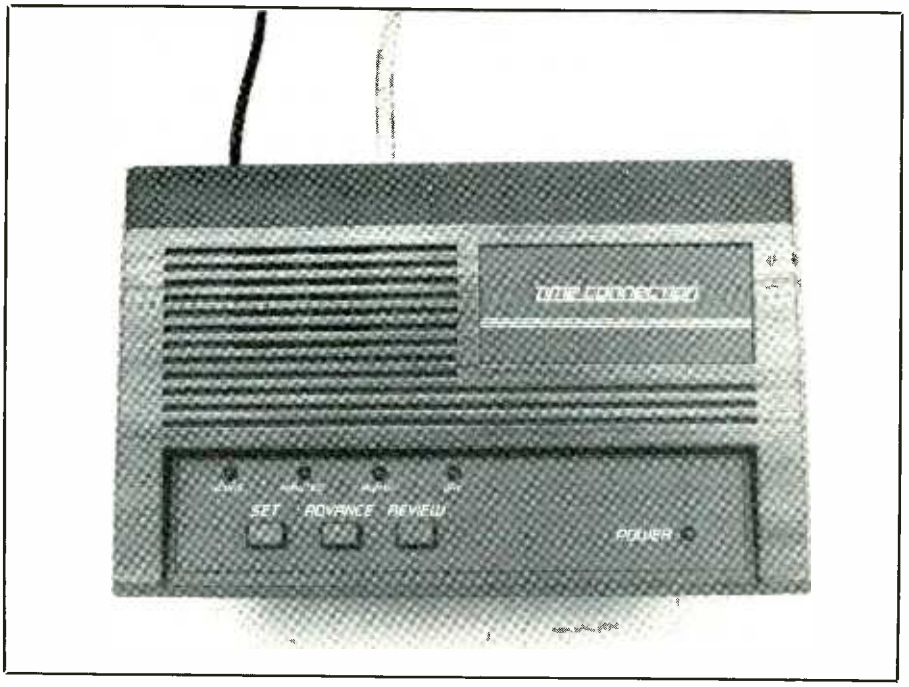
In Closing

The Experimenter's Interface Described here can open up a whole new world of experimenting with your home computer. In the future, we'll explore some circuits you can assemble on the EID's breadboarding socket that will let your computer do some things that it can't currently do with existing hardware and software —like handling home security, keeping tabs on temperature, and much more. Perhaps as we go along, your own creativity will be triggered. **ME**

"The Time Connection"

An Intelligent Telephone Answering Set Accessory That "Talks" To You.

By Fred Blechman



If you own a telephone answering machine, as so many people do, you probably don't have a call-counter or time-received function. These features are usually reserved for the more costly machines that most people don't buy, though some late models do have a blinking LED that indicates how many calls were received according to the number of blinks, but no automatic receiving time indicator.

As the owner of an ordinary basic-model phone-answering machine, I was therefore attracted by a mail-order catalog's accessory product that would add the cited feature to my more limited machine. An additional lure was the new device's voice synthesis capability that *told* me how many calls were made and their dates and times. Neat, I thought. And at $59.95 retail, I succumbed and ordered one.

The device, which was promptly delivered, comes in a 6″×4″×1½″ plastic enclosure with simulated-walnut trim to match the color scheme of many telephone answering devices (TAD). Here are my experiences with the accessory.

Talking Accessory

When a call comes in and is answered by the TAD, The Time Connection™ automatically "announces" the time and date on the playback message tape for playback with the incoming message. At any time, the user can press a button on The Time Connection to hear the time, date and number of calls received.

The device uses a special microprocessor to keep track of the date and time-of-day within a one-year calendar, with accurate timing supplied by the ac line. A speech-generator chip "speaks" using a synthesized man's voice. When triggered, the speech is fed into the phone line (or through a self-contained speaker), announcing the time (hours and minutes, AM or PM), and the day and month. When requested, the number of calls since the last "clear" is also announced.

The Time Connection installation takes only seconds. It plugs in between the modular telephone jack supplied by the local telephone company and the user's TAD, and is externally powered by the wall-plug ac adapter. No modification whatever is required to your TAD.

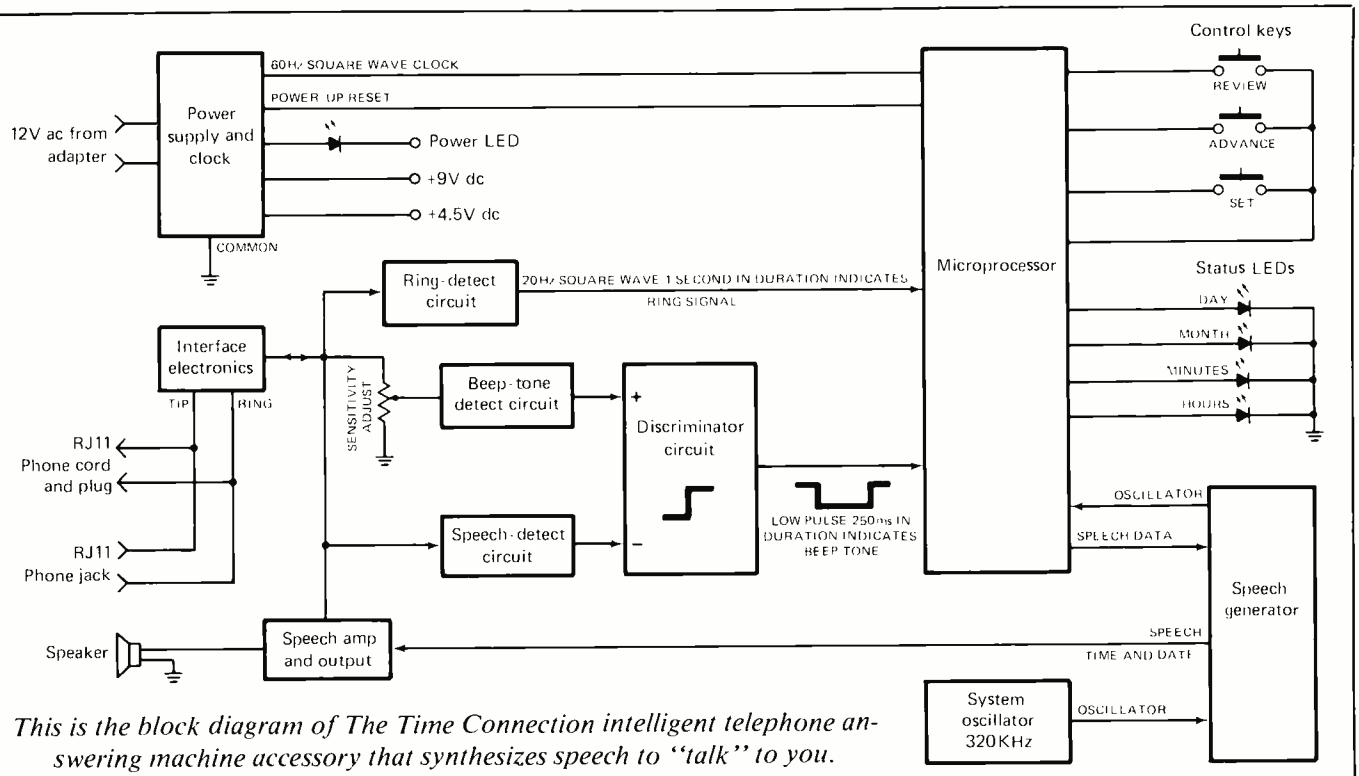
Operation

When powered and set, The Time Connection operates as follows:

(1) When the user's phone rings, the Time Connection senses this and immediately goes on standby.

(2) The TAD picks up the line, delivers the outgoing announcements, then generates a beep-tone as a signal for the caller to start speaking.

(3) The Time Connection senses the beep-tone and announces the time and date into the telephone line,



This is the block diagram of The Time Connection intelligent telephone answering machine accessory that synthesizes speech to "talk" to you.

so it is recorded at the very beginning of the incoming message. The caller now leaves his message.

(4) The Time Connection also increments an internal electronic call counter, to keep an accurate count of the number of messages received.

When the user returns, he presses a REVIEW button on The Time Connection, which then announces the time and date. A second press of the button announces the number of calls received. A third press of this button clears the call counter, and the word "Clear" is announced.

The Time Connection block diagram in Fig. 1 illustrates its 4-bit microprocessor chip, a speech generator, a system oscillator, various detector circuits, and a speech amplifier. There are four ICs, three switches, five LEDs and numerous other discrete components used in this high-tech device.

The UL-approved ac adapter supplies 12 volts ac to the power supply and clock circuitry. This circuitry generates 9 volts dc and 4.5 volts dc for the digital and analog circuits, as well as power-up reset and clock pulses for the microprocessor, and an LED to indicate power in ON. Since the clock pulses are derived directly from the closely-held average 60 Hz generated by the local electrical power company, time is kept accurately.

When The Time Connection is initially plugged into wall power, the POWER LED comes on, the speaker says "Clear," and four status LEDs blink on and off to indicate that the system's time and date must be set to the current time.

This is done very easily with the SET switch (which selects hours, minutes, month or day, in sequence, lighting the appropriate LED) and the ADVANCE switch. When you press the ADVANCE switch, the synthesized voice announces the current setting for that function. Just hold down the ADVANCE switch until the desired time, day or month is announced. Simple—and fascinating to listen to.

When The Time Connection is set, the hours LED blinks on and off. To check you settings, press the REVIEW switch. The first press turns off the hours LED, turns on the days LED, and announces the time and date. The second press announces the number of calls received since last "cleared." The third press clears the call counter.

If no key is pressed for 10 seconds, The Time Connection automatically returns to the standby mode (hours LED blinking.) It is not necessary to clear the call counter if you wish to keep track of accumulated calls over several answering periods.

The modular RJ11 female phone jack and male cord plug are connected together in parallel. The plug from The Time Connection mates with the telephone line socket, while the plug from your TAD mates with The Time Connection socket. It is

not necessary for a telephone to be connected at the same location. If a phone is used, you'll need a simple duplex jack.

The phone line (TIP and RING) connects to the FCC-approved interface electronics in The Phone Connection. This circuitry provides a voltage clamp between common and 9 volts dc, so the rest of the unit circuitry is protected from large ring signals, line surges, and lightning strikes.

How It Works

The interface circuitry splits off into three analog processing circuits: the ring-detect, the beep-tone-detect, and the speech-detect circuits.

The ring-detect circuit simply converts the ring signal into a 9-volt square wave and feeds this signal to the microprocessor.

The beep-tone-detect circuit is a filter with a passband of 800 to 2000 Hz. This is the frequency range of all of the standard telephone answering device beep tones currently on the market. After passing through the filter, the signal is half-wave rectified and low-pass filtered, then sent to the discriminator circuit.

A potentiometer, accessible with a small screwdriver from the back of The Time Connection, provides sensitivity adjustment of the beep-tone-detect circuit. This allows for the wide variation of beep-tone amplitudes and frequencies in different TAD's, although adjustment is not necessary for most of the popular answering devices.

The speech-detect circuit is a filter with a passband of 300 to 600 Hz. Most human speech energy is contained in this frequency band. After passing through the filter, the signal is half-wave rectified and low-pass filtered, then sent to the discriminator circuit.

The discriminator compares the beep-tone and speech detect circuit outputs, and, if the beep-tone output is larger, the discriminator output goes low. This indicates to the microprocessor that a beep-tone is present.

During on-line operation the microprocessor waits for a ring signal, which it detects by looking for a square wave of approximately 20 Hz out of the ring-detect circuit for at least one-second continuous (so pulse-dialing is ignored). The Time Connection then goes into a wait mode, ignoring any additional rings and the TAD outgoing message, looking for a beep-tone from the TAD. This is signified by a low signal from the discriminator for a minimum period of 250 milliseconds.

The microprocessor then waits another 250 ms before directing the speech generator to announce the time and date stored in the microprocessor's memory. The speech amplifier delivers this signal to the speaker and to the phone line through the interface circuitry. The caller can hear the synthesized spoken time and date while the answering device is simultaneously recording the announcement of its incoming message tape.

After the announcement is delivered, the microcomputer updates the call-counter and returns The Time Connection to on-line mode, ready to receive another phone call.

The microcomputer will only wait for a beep-tone for 60 seconds after it detects a ring signal. Therefore, if a caller hangs up before the end of the outgoing announcement and the TAD does not deliver the beep-tone, the Time Connection will return to on-line mode after 60 seconds.

User Comments

The instructions are simple, the installation is simple, the operation is simple, and the unit works beautifully! The time/date setting procedure is straightforward. It's so easy to use I find myself using The Time Connection as a "talking clock." Everytime I pass by, I can't resist pressing the REVIEW button to hear the time and date.

About the only suggestion I would make to the manufacturer is to include a volume control, since I found my unit somewhat louder-sounding than I'd like. I did not find it necessary to adjust the beep-tone sensitivity with my telephone answering device, however, which I appreciated.

The Time Connection appears to be universally adaptable to any answering device by just plugging it in. Finally, if you have any need to know the number of calls received on your TAD, and the time received, The Time Connection can be a lot less expensive than buying a TAD with those special features. It's a welcome development. **ME**

This new product may not yet be available in retail stores. It is available from Heart Marketing, 314 S. Main St., Dayton, OH 45322 Phone: (513) 832-0188 or Fordham Radio, 260 Motor Parkway, Hauppauge, NY 11788 Phone: (800) 645-9518 or (516) 435-8080 in NY, or from the manufacturer, Rocky Mountain Products, Inc., 23132 La Cadena, Unit H, Laguna Hills, CA 92653.

An Experimental Security Alarm

By Forrest M. Mims III

A high crime rate is an unfortunate byproduct of our "modern" civilization. Illegal entry of homes, offices and businesses are particularly common. The burglary epidemic isn't limited to the cities. Even in the rural area where I reside, several neighbors have been victimized by burglars.

With these unpleasant thoughts in mind, let's look at an experimental do-it-yourself security alarm system you can assemble. The system is battery-powered and can identify which of up to eight sensor switches has been triggered. You can use the system with an existing network of normally-closed sensor switches; or you can start from scratch and install your own sensor switch network.

Even if you don't need a security alarm system, you might find the circuit described below of some interest, because it uses an LM3914 dot/bargraph display driver. This chip has many important applications, and the circuit given here might give you some good ideas.

Alarm Sensor Switches

Over the past decade, many kinds of sophisticated sensors for detecting intruders have been developed. Though some pretty sophisticated sensors have been developed, various kinds of mechanical switches are still the most common sensor devices used for intrusion alarm systems. Generally, these are normally-closed switches that can be used in a closed-circuit alarm configuration.

There are many kinds of mechanical sensor switches for intrusion alarms. The simplest is a strip of self-adhesive aluminum foil installed around the perimeter of a glass window. If the window is broken, the foil breaks and triggers an alarm. Another simple sensor is a pressure-activated floor switch placed at a doorway or other entry point.

One of the most common mechanical sensor switches is the magnetic reed switch. This device consists of two cantilevered metal strips sealed inside a glass tube. In the normally-closed version, the two strips remain in electrical contact as long as a magnet is placed nearby. If the magnet is moved more than an inch or so away from the switch, one strip pulls away from the other and opens the circuit. Normally-open magnetic reed switches are also available.

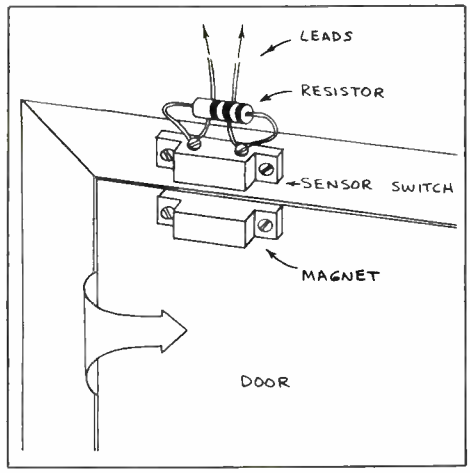


Fig. 1. Magnet sensor installation.

Magnet sensor switches are usually installed at entry points like doors and windows. If the door or window is partially opened, the switch opens (or closes) and triggers an alarm. Figure 1 shows a typical installation on a door. The magnet is installed on the door itself, the sensor switch at a nearby fixed location on the door frame.

Some sensor switches are vibration sensitive and will trigger an alarm before actual intrusion into a protected structure has occurred. Vibration sensors are often used to protect cars and windows. Others use a simple plunger to detect the movement of a door or window.

A Resistor/Switch Sensor Network

A security alarm system generally incorporates a network of several sensor switches, each of which can trigger a central alarm. This poses the problem of determining which sensor has been activated. One way to solve this problem is to run separate wires from each sensor to the alarm console. A panel of lamps or LEDs can then be used to indicate which sensor has been tripped. This method, however, may require considerable wiring and may be difficult to implement in a home or business.

An alternative method with which I've recently experimented is illustrated in Fig. 2. Here, a series network of standard normally-closed sensor switches is connected to a multimeter. Each switch is bypassed by a different-value resistor. Normally, all switches are closed and network resistance is only that of the wiring, perhaps a few ohms at most. However, if any one switch is opened, its resistor becomes part of the circuit and its value is indicated on the multimeter. If the resistors have values of 100, 300 and 500 ohms, then the meter can indicate any combination of switches that have been opened:

100	1
300	2
500	3
400	1&2
600	1&3
800	2&3
900	all

I don't know if this method is an original idea, but it works quite well. Indeed, I've used it to design a sophisticated intru-

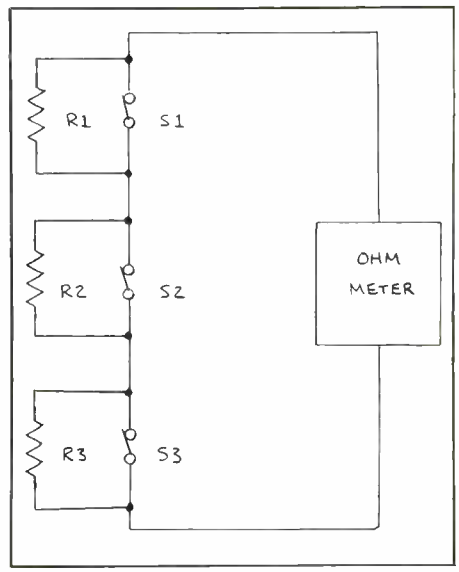


Fig. 2. A resistor/switch network.

sion alarm system that uses a personal computer as a programmable controller. The computer permits the system to be switched on at any desired time and prints on its screen information about which sensor has been triggered.

Security Alarm With Resistor/Switch Sensors

Though a computerized instrusion alarm system has important advantages, most home and personal computers require household current; therefore, such a alarm will only function when power is available. For this reason, I've designed an experimental battery-powered circuit that can be used with resistor-bypassed sensor switches. Figure 3 shows the circuit diagram. Figure 4 shows how the system is connected to a network of up to eight resistor-bypassed sensor switches.

The circuit is powered by a pair of 6-volt lantern batteries connected in series. An LM317T voltage regulator provides a steady output of about 8.5 volts. This guarantees that the circuit will function properly until the battery voltage falls to about 10 volts or so. The output voltage of the LM317T is determined by *R13*. Capacitor *C1* is included in the event the supply leads from the lantern batteries exceed a length of about 6 inches.

The electronic nerve center of the circuit is an LM3914 dot/bargraph display driver chip. This unique chip can be considered an analog-to-digital converter that indicates the magnitude of an input voltage by means of a row of 10 LEDs. The LEDs can function in a bargraph or moving-dot mode. The LM3914 is very easy to use and requires a minimum number of external components. Moreover, the current delivered to the LEDs is controlled by means of a single resistor, *R11*.

Referring to Fig. 3, the LM3914 is operated in a moving-dot mode by connecting pin 9 to pin 11. As the voltage at pin 5 on the LM3914 increases, the LEDs connected to the chip's 10 output pins switch on and off until the highest-order LED (*LED10*) is illuminated. A very small amount of overlap between outputs, about a millivolt or so, is designed into

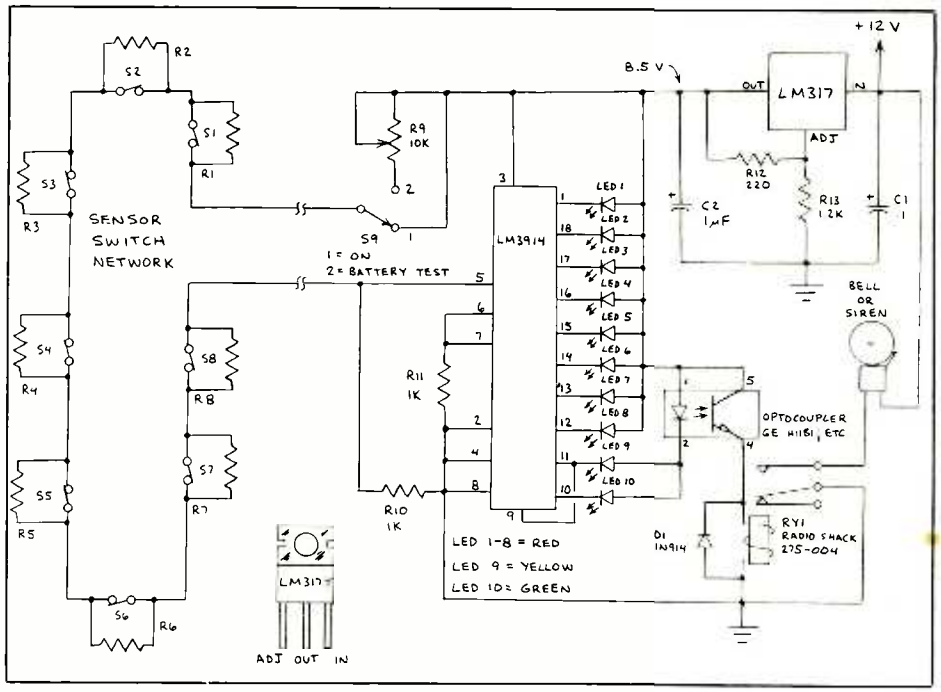


Fig. 3. An intrusion alarm with individual sensor-switch LEDs.

the LM3914 so that at no time are all the LEDs off. This prevents any annoying flicker that occurs when the LEDs switch rapidly on and off without overlap.

Resistor *R11* controls the brightness of the LEDs. The current through *R11* is approximately a tenth of that through the LEDs. When *R11* is 1000 ohms and the supply voltage at pin 3 of the LM3914 is 8.5 volts, LED current is about 11 mA.

A network of resistor-bypassed sensor switches is connected in series with *R10* to form a voltage divider. The top half of the divider (*R1/S1*) is connected to +8.5 volts. The bottom of the divider (*R11*) is connected to ground. When all sensor switches are closed and *S9* is at position 1, the positive supply voltage from the LM317T is applied directly to the input of the LM3914 and highest-order *LED10* is illuminated.

Note that the anodes of *LED9* and *LED10* are connected to the positive supply voltage through the internal LED in the optocoupler. Therefore, when either of these LEDs is on, the optocoupler LED also receives forward current. This switches on the photodarlington transistor in the optocoupler. In turn, this applies current to the coil of relay *RY1*. When *RY1*'s armature is pulled down, the external alarm bell (siren or other signaling device) is switched off. Diode *D1* across the relay's coil absorbs the high-voltage surge generated when current through the coil is switched off.

Though I used a General Electric H11B1 photodarlington optocoupler, any similar device should work. Devices with an ordinary phototransistor might also work, but the photodarlington will provide better sensitivity and more reliable triggering.

When any sensor switch is opened, presumably by an intruder, the resistance of its bypass resistor is placed between *R10* and the positive supply from the LM213T. The voltage at the junction of this resistor and *R10* then appears at pin 5 of the LM3914. If the values of resistors *R1* through *R8* are properly selected, the LED with the same number designation

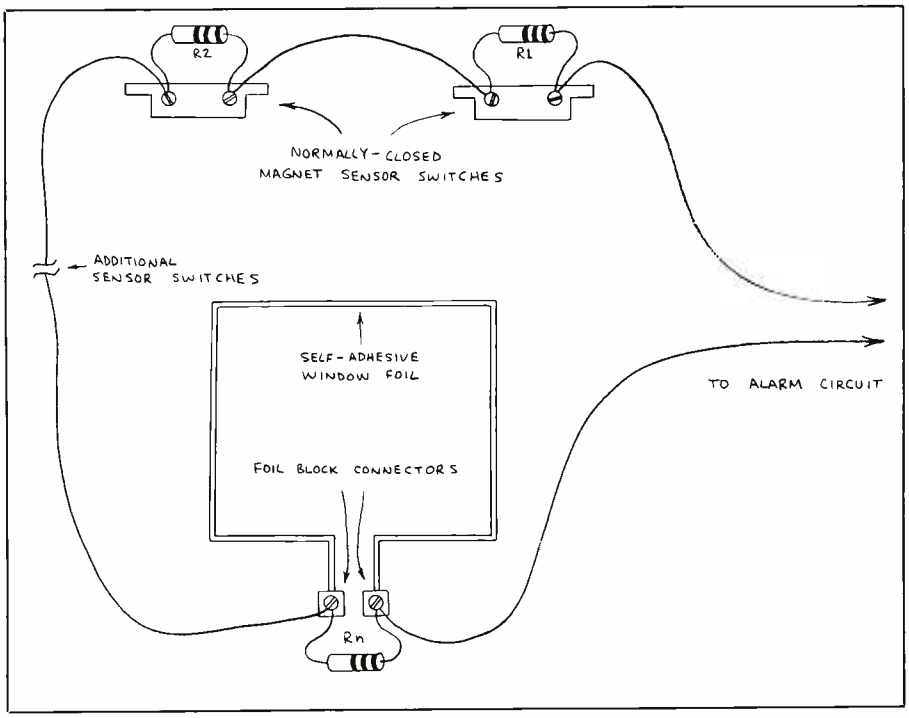


Fig. 4. Illustrated here is a practical resistor/switch sensor network.

as the resistor will glow when its respective sensor switch is opened.

I measured the resistance range over which each LED switched on in a test version of the Fig. 3 circuit. First, I connected a resistance substitution box between pin 5 of the LM3914 and the positive supply. Then I found the maximum and minimum resistance values over which each respective LED remained illuminated (*R1 = LED1, R2 = LED2 . . . R8 = LED8*). Here are the results of those measurements:

Resistor	**Range** (Typical Value)
R1	36.2k—73.0k (47k)
R2	23.9k—36.0k (33k)
R3	17.6k—23.7k (22k)
R4	13.9k—17.4k (15k)
R5	11.5k—13.8k (12k)
R6	9.7k—11.4k (10k)
R7	8.4k—9.5k (6.8 + 2.2k)
R8	7.3—8.2k (6.8 + 1k)
R9	6.5k—7.2k (10k Pot)
R10	0k—6.4k (switches)

The numbers shown in parentheses are suggested standard resistance values that fall within the range of each measurement result. To test the circuit with these values, I installed on a plastic breadboard resistors with the values given above and then shorted each resistor with a wire to simulate a normally-closed switch. When shorting wire across *R1* was opened, simulating the opening of *S1* in Fig. 3, *LED1* glowed. Likewise, when the wire across *R2* was opened, *LED2* glowed. All LEDs glowed in turn as the shorting wires across their respective sensor switch resistors were opened.

By now you may be wondering about the function of *LED9*. In Fig. 3, you'll note that position 2 of *S9* is designated BATTERY TEST. When *S9* is at position 2, *R9* is connected between pin 5 of the LM3914 (through the sensor switch network) and the positive supply voltage. When *R9* is adjusted to a resistance between 6.5k and 7.2k, *LED9* will glow when *S9* is at position 2.

To use *LED9* as a battery-test indicator, place switch *S9* in position 2 and adjust *R9* until both *LED9* and *LED10* are on. Then slightly back off on *R9* until only *LED10* is on. Now, when the total voltage from the two 6-volt lantern batteries falls below about 10 volts, *LED9* will glow when *S9* is switched to position 2. Otherwise, *LED10* will glow. It may be necessary to experiment with *R9*'s setting for reliable results.

Why a battery test mode? Remember that the LM3914 input is voltage sensitive. If battery output falls below about 10 volts, the output from the LM317T regulator will also fall. This means the voltage from the divider formed by the sensor resistors and *R10* will be altered. Consequently, the relationship between the sensor resistors and indicator LEDs will change so that a different combination of LEDs will glow when the various sensor switches are opened.

Incidentally, when a battery test is made by switching *S9* to position 2, the relay will automatically drop out for an instant or so. This will cause a brief burst from the alarm bell or siren, thereby testing it as well as battery status.

Be sure to take advantage of multicolored LEDs when assembling the circuit in Fig. 3. For the prototype version of the circuit, I used red LEDs for *LED1* through *LED8*. I used a green LED for *LED10* to indicate proper circuit operation and a yellow LED for *LED9* for low-battery indication.

What Can Go Wrong?

I'm unaware of a foolproof security alarm system. Though the experimental circuit described here has several built-in safeguards, it isn't perfect. Let's look at some of its vulnerabilities from a burglar's perspective.

First, the system will work properly only when one sensor switch has been opened. If two switches are opened, the alarm will sound, but only one LED will glow, and it might not indicate which sensor has been triggered. If enough switches are opened, all the LEDs will be extinguished, but the alarm will sound.

The system doesn't include a lock-in provision. In other words, the alarm will stop sounding as soon as an opened sen-

sor switch has been closed or jumpered by a clip lead.

If any of the sensor network's wiring is installed outside the protective area, an unwise procedure, a naive burglar might be tempted to clip the wire. Should that occur, all the LEDs will be extinguished and the alarm will sound.

A smart burglar will realize that most alarm systems use normally-closed sensor switches and that cutting a sensor wire will trigger the alarm. Therefore, he might attempt to bypass, with a clip lead, the sensor switch at the entrance he wants to penetrate. For this reason it's absolutely essential to install the sensor switches *inside* the protected area, preferrably in an inconspicuous location.

Then there's the alarm bell or siren. If it's mounted outside so neighbors can hear it when the system has been tripped, are its connecting wires exposed? If so, all your work can be defeated in an instant by a single clip of wire cutter. Even if wiring is protected or concealed, the alarm device itself can be defeated. Some bells and sirens can be muffled or silenced by injecting plastic foam inside their housings. Keep this in mind when you select an outside location for an alarm device.

As for cutting off outside power, the system shown here is battery powered. But if the batteries haven't been checked recently, the wrong LED may light when a sensor switch is triggered. Worse, if the batteries' reserve power has dropped to a very low level, the heavy current drain of most alarm bells and sirens will quickly exhaust remaining power.

Fortunately, security alarm systems are like insurance. You may never need them but when you do they more than pay for themselves. Unlike insurance, however, security alarms can cause major problems when they malfunction. Some communities have been so deluged with false alarms from home and business security systems that they have passed ordinances that fine repeat offenders.

It's essential, therefore, that a burglar alarm system, particularly a do-it-yourself version, be carefully designed and installed to minimize the possibility of false alarms. In particular, sensor switches should be installed securely. Door and window magnet sensor switches should be mounted close to their respective magnets to avoid false triggering that might occur should the wind cause slight movement. Likewise, vibration sensors should not be adjusted to be so sensitive they respond to wind or loud sounds.

The wire connecting the network of sensor switches can also cause problems. For example, it can pick up stray electrical signals or even lightning, thereby causing an alarm malfunction.

For all these reasons, always consider the installation of a security alarm system a serious matter. All control circuitry should be built well and installed in dust-free enclosures. The batteries should be checked frequently. Each sensor switch should be periodically triggered to determine if the alarm works properly. Be sure to brush away dust and cobwebs from the switch terminals to prevent possible malfunctioning of the system.

Going Further

An obvious drawback of the alarm system shown in Fig. 3 is the lack of a timer to allow you to enter and exit a protected area without triggering the alarm. For this reason, it's necessary to activate the system with a concealed switch located outside the protected structure. The switch can short the sensor switch at the entry-exit point, or it can be placed between the batteries and the circuit.

One way to eliminate the need for an external switch is to add one or two 555 timer circuits. A timer-driven relay whose contacts are placed between the batteries and the circuit will automatically switch the circuit on after a predetermined interval. This will allow you to switch on the alarm and then leave through any exit before the system is activated.

A second timer-driven relay can be connected between the alarm bell or siren and *RY1* in Fig. 3 to give you time to enter the protected structure and switch off the system before the alarm sounds. Unfortunately, this timer may allow a fast working intruder to enter through a "protected" entrance and bypass the sensor switch with a clip lead before the alarm has had time to sound.

Still another timer can be used to keep the alarm switched on for a fixed interval even after a triggered sensor switch has been closed. Keep in mind that some communities impose fines if an alarm remains on more than 10 or 15 minutes.

As you can see, building and installing intrusion alarm systems is both serious and tricky. An excellent article on commercial burglar alarm systems was published in the October 1984 *Consumer Reports* (pp. 568-571, 606). This observes that living with a burglar alarm can be a nuisance, and that good locks and a smoke detector should have a higher priority. Many books have been written on the subjects, and you can probably find one at a good library or book store. Meanwhile, here's hoping the system you build will always work, never give a false alarm and never be needed. **ME**

A 1-Hz square-wave source, faking plated-through pc holes, low-power voltage regulators, and more

By Don Lancaster

Uh, is anyone still around after last month's April-Fool tease? Marcia is, well . . . Marcia. That aside, let's start off on this month's bunch of new goodies . . . .

I need a low power 1-Hz oscillator.

Low power is easy; its micropower that gets tricky. One obvious way to get a 1-Hz oscillator is to take a $4 stick-on LED clock and grab the colon output, stepping it up to a suitable voltage.

Chances are you need something fancier, or less klutzy, possibly with multiple outputs. Figure 1 shows the "stock" low-power way of getting one-pulse-per-second and related outputs. You start with a 16.384-kHz crystal, available from *Statek* for under $5, and use the built-in oscillator of a 74HC4060 oscillator/divider, a $1.20 part. Out comes a 1-Hz square wave, along with higher binary multiples. Not bad for five parts.

Total supply current is around 5 mA at 5 volts. Which doesn't sound like a lot, until you try to get this current out of a 9-volt battery for three months or more.

Let's see. A 9 volt battery is roughly a 0.25-ampere-hour device. So 5 mA of current drain will last around 250/5 = 50 hours, or a tad over two days, which may be okay in some applications. However, a client of mine needed a system he could literally bury for six months. Every 15 minutes, the system has to "wake up," record a single digital value, and then go back to sleep. It had to be small and powered by a single 9-volt battery. Obviously, five mils just won't hack it.

Let's review the rules for low-power operations. You should use CMOS devices, of course. Only it turns out that older 4000 series CMOS draws less dynamic current than does the newer 74HC stuff. You should run at the lowest possible supply voltage, and all unused inputs should go solidly to ground or to the supply's V+ bus. All real inputs should be fast-rise square waves. Above all, no input should ever be allowed away from either supply rail except for a very brief rail-to-rail transition.

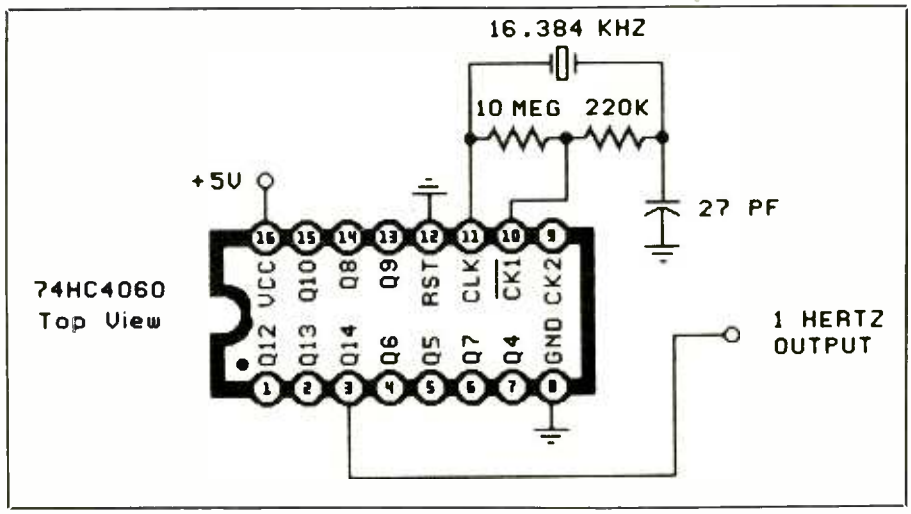


Fig. 1. Here is a "standard" way of getting a 1-Hz square wave. Current drain of 5 milliamperes however, is excessive for very-low-power, long-term use.

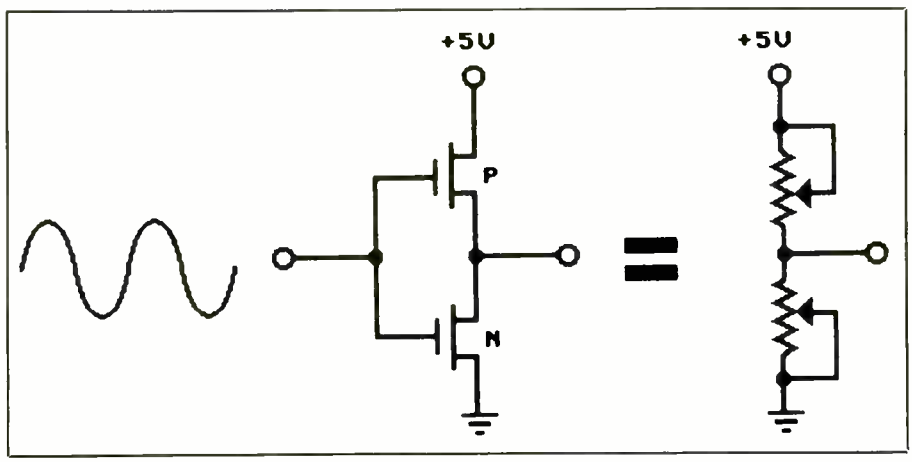
Where does the Fig. 1 circuit fall short? The oscillator uses an inverter that is purposely biased into its linear region, half of the way up to the supply voltage. As Fig. 2 shows, this is bad news.

If a CMOS inverter has its input connected to ground, the top p-channel field-effect transistor turns on, and bottom n-channel field-effect transistor turns off. The output goes positive, since there is a very small resistance to the positive supply and an essentially open circuit to ground. Most importantly, there is no conductive path from supply to ground, so the inverter draws essentially zero power when it is sitting in its low state.

Make the input high, and the opposite happens. The n-channel FET at the bottom turns on and the p-channel FET at the top turns off—a low output, with a low-impedance path to ground. Again, there is no positive-to-ground path, and essentially zero power is consumed.

This "no internal current path" is ty-

Fig. 2. When a CMOS circuit is not driven rail-to-rail, a resistive path appears from supply to ground, excessively raising the operating current.



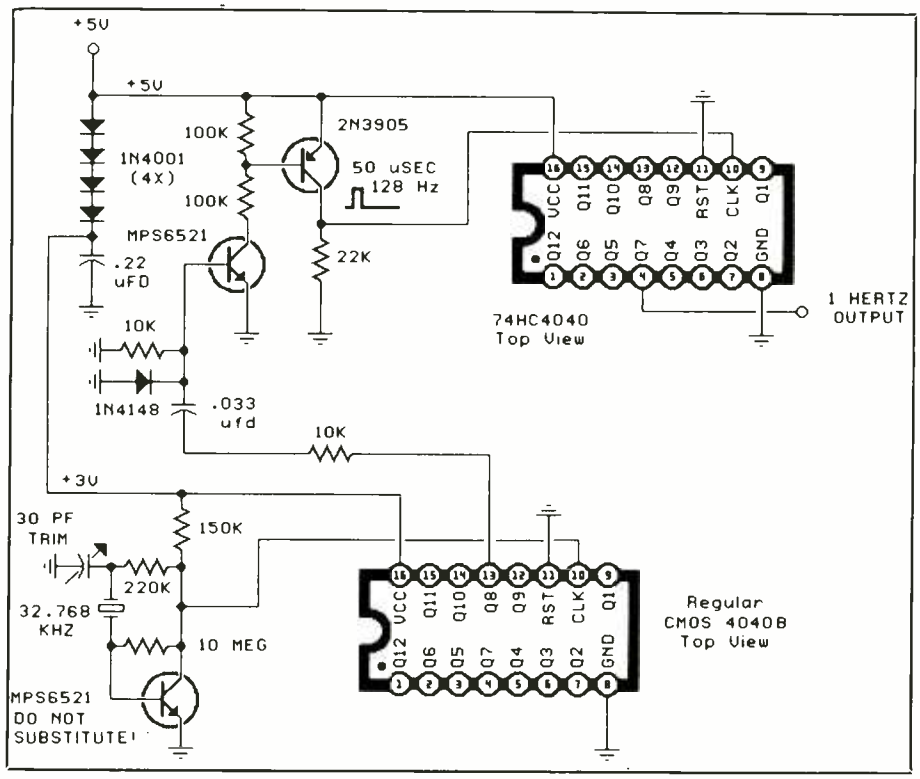


Fig. 3. Improved circuit needs only 15 microamperes of supply power. It is trimmable, offers better stability, and uses a less expensive and easy-to-obtain crystal.

pical of CMOS operation. The only time you need any supply power is when you *change* the output, charging or discharging unavoidable stray capacitance. The more often you change an output, the greater the supply current. Thus, the operating currents of most CMOS circuits are proportional to frequency.

The bad scene takes place when you bias the input halfway up. Both n- and p-channel FETs conduct, and you get a fairly heavy current path directly from the supply to ground. In the Fig. 1 circuit, the oscillator's inverter is intentionally biased this way. Virtually all of the 5 mils gets burned up in this first stage.

Even if you do not bias this stage halfway up, if you input a sine wave or even a slow-rise square wave, current conducts directly from supply to ground during the times the input is not sitting on a rail. The slower the rise time, or the smaller the signal, the worse things become.

CMOS Schmitt triggers won't help much in solving the problem. They also draw excessive supply current when their inputs are not sitting on a supply or ground rail. Schmitt triggers do convert a slowly changing input into a fast-rise square-wave output, but this route will get your currents down only into the hundreds of microamperers.

Figure 3 shows a circuit I came up with. Total supply current is under 15 microamperes, giving over a 300:1 improvement in battery life. the secret is to run the fast part of the circuit at 3 volts, the minimum supply for 4000 series CMOS. At this supply voltage, even when the n- and p-channel FET transistors are on simultaneously, they cannot draw very much current, since they are only weakly turned on.

You can get 3 volts with four series diodes as shown. Otherwise, use a low-power regulator for extra stability. Needless to say, a resistive divider is a no-no.

Action starts with a bipolar oscillator, using a special Motorola transistor that has exceptionally high gain at very low collector currents. In general, bipolar oscillators have more stability and higher gain than CMOS oscillators. Also, use a stock 32.768-kHz clock crystal. These are cheaper and easier to get, and are more robust and offering much higher output.

The oscillator directly drives a regular 4040B CMOS divider. Thanks to the low supply voltage and the large input swing, the current is very low. You can trim the oscillator's frequency for exact timing.

You divide the signal down as far as you can. Unfortunately, you cannot reach 1 Hz this way. An 8-Hz square wave is the lowest you can get with one chip.

In the intended application, I needed outputs from 128 Hz on down. I also needed operation at +5 volts. Fortunately, even 128 Hz is so slow that it really doesn't matter what you do at that rate. To prove it, I put in a bipolar pulse shaper to translate the 128 Hz up to a 5-volt pulse. The pulse is made some 50 microseconds wide, and this two-transistor translator and all its resistors draws something like 0.75 microampere. Why so low? Because the shaper is totally off during most of the time.

The translated 128-Hz signal then drives a 74HC4040 binary divider to give the needed 1-Hz output. You could use a plain old 4040 here just as well.

The result: A 5-volt oscillator/divider that runs at 15 microamperes total supply power. By hand picking parts, you can even get down under 5 microamps total.

What is wrong with it? Though still cheap enough, there are too many parts, and some slight instability is introduced by the voltage dropping diodes. You could probably eliminate the translating transistors by using the hard-to-find 74HCT4040 instead, along with a single resistor and capacitor. Note that you must keep the input to the 74HCT at ground most of the time, or it will gobble up hundreds of microamperes worth of supply current.

Show us the best improved circuit you can come up with that outputs a 128-Hz

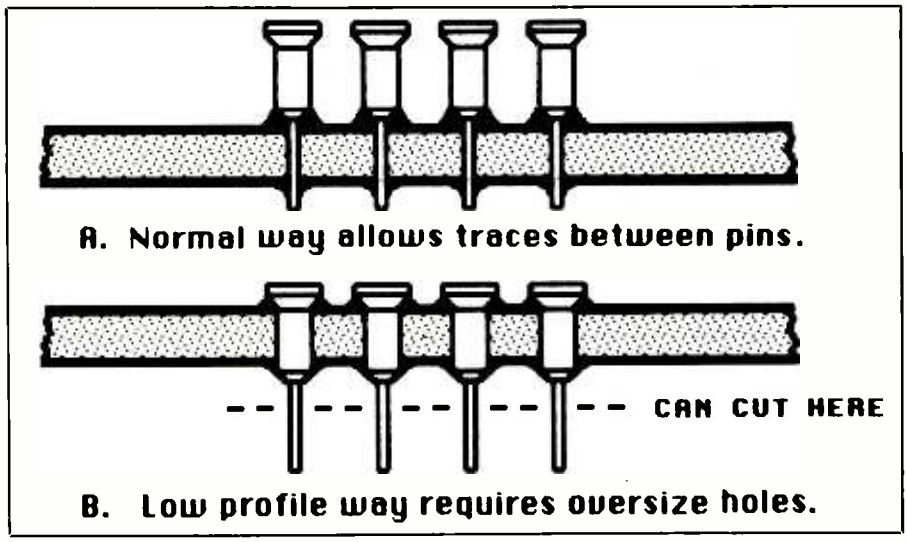


Fig. 4. Plated-through circuit boards can be faked by using pins from machined-contact DIP sockets. This approach is far simpler and cheaper for prototyping.

and lower square wave at 5 volts with 10 microamperes or less of total current.

Have fun.

How can I fake pc-board plate-through holes?

Making single-sided printed-circuit boards is no big deal. Most people can handle this one on their own or in a school or club lab lashup. Going double sided is not that much more complicated. All you have to do is repeat the single-sided process twice, being very careful to register the two sides to each other, and to protect the back side. Plated-through holes is the sticky problem.

Fortunately, prices are dropping on commercial prototype plated-through boards. But there is still the hassle of onesie-twosie orders not getting the attention they deserve.

The trick for your first prototype boards is to fake plated-through holes. Use a plain hole and put something through it that you can solder to the traces on both sides of the board. Figure 4 shows two good methods.

You can get machined-contact pins from the same sources that sell machined-contact pin sockets. Just do a double-sided board without plate-through, drill the holes, and push these pins through the board. Then solder the pins to both top and bottom traces.

In the normal way, you use small holes so that only the tail of the socket fits through. Solve the hassle of soldering under sockets simply by not using sockets. Use the pins only, and every side of every pin is then reasonably available. If you are *very* careful about your soldering, you can even have traces running between pins.

With the low-profile way, you use larger holes that hold the body of the socket. The tops of the socket pins are more nearly flush with the top of the pc board, and you end up with a lower profile and a neater appearance—except that you must be very careful about drilling and keep in mind that traces between pins are not permitted.

One source of continuous socket pins that are cheaper than most is *Mark Eyelet. OK Machine* also has solid pins that can be used to do the same thing, except they are fairly expensive and cannot be used as sockets. OK Machine also has a convient inserting tool.

What is in Enhance II?

By the time you read this, my latest book *Enhancing Your Apple II, Volume II* should finally (!) be in print. Check *B. Dalton's,* other bookstores, or your local computer dealer. Stock number is SAMS #21425. It can also be ordered directly simply by dialing the 1-(800)-428-SAMS, the Sams order hotline.

It's chock full of goodies for Apple II/II+/IIe/IIc users. There are enhancements on microjustifying and proportional spacing word processors, an absolute reset for the IIe or IIc, a *vaporlock* exact field synchronization scheme that requires no hardware mods or software royalties, more on the tearing method, and a thorough and detailed disassembly script and source code capturing procedure for *Applewriter IIe.* There are even an escape map and playing hints for *Castle Wolfenstein* and the usual response cards, reader helpline, companion diskettes and update service.

The vaporlock is particularly neat, since it lets you mix and match text, HIRES, and LORES in any combination anywhere on the screen, besides allowing for flawless, glitch-free animation. Locking time is extremely fast, compared to older versions.

Is there a micropower voltage regulator?

You bet! The *Intersil* gang has long advertised and cataloged an absolute jewel called the ICL7663. Trouble is that nobody stocks it and dealers have been less than enthuastic about custom ordering it.

A second source, *Maxim,* now is producing the part in volume. This one is readily available, at a cost of around $3.60 in onsies. *Bell* is one distributor.

Modern Electronics advertisers please note: This one is a real winner, so PLEASE offer it.

The basic circuit for using this device is shown in Fig. 5. The regulator accepts up to 16 volts in and can output almost any voltage down to 1.3 volts, set by the divider between the output and the SET pin. The resistor values shown are good for 5 volts out. Maxim's "-A" version has tighter specs, so you normally do not need to trim the exact output voltage.

Supply current is around 5 microamperes total, *including* the output divider. Yes, that's *micro*amps, not milliamps.

This device is ideal for the oscillator/divider discussed earlier. The input and

output capacitors, required for stability, should have short leads.

Figure 6 shows some added bells and whistles. There is an automatic current limiter that senses maximum load current. Maximum output current is around 25 milliamperes with the Fig. 5 circuit. Adding the pass transistor in Fig. 6 ups this to as high as 1 ampere. The part number and size of the pass transistor depends on output load current and duty cycle, but almost any old medium-power, high-gain npn transistor should hack it.

The formula for the current-limiting resistor is that 0.7 volt shuts down. Thus a 0.7-ohm resistor senses one ampere, while a 27-ohm resistor limits to 25 mils or so. Ohm's law and all that.

The formula for the divider says to attenuate the output until it is 1.3 volts and then feed it back into the regulator, where it can be compared against the internal 1.3-volt precision reference.

You can turn the output on and off with the gating pin 5. A low here turns the output on and a high turns if off. Input gating current is negligible.

For extremely long duty cycles on very small batteries, it may be better to gate the supply with a series pnp transistor or p-channel FET. This transistor is not needed if your application can get by with a continuous drain of microamps.

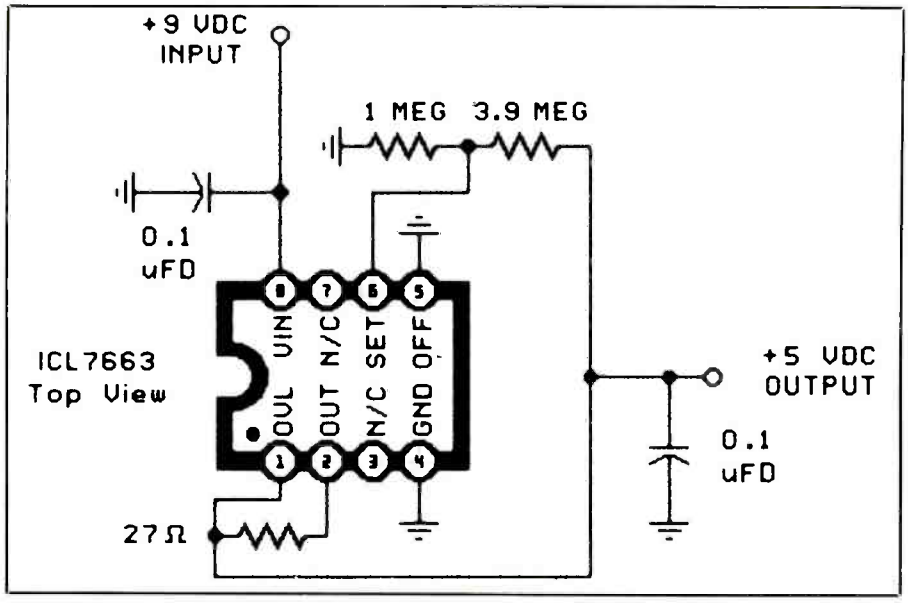


Fig. 5. This micro-power regulator circuit draws only 5 microamperes of standby power. In operation, it can deliver up to 50 milliamperes to the output load.

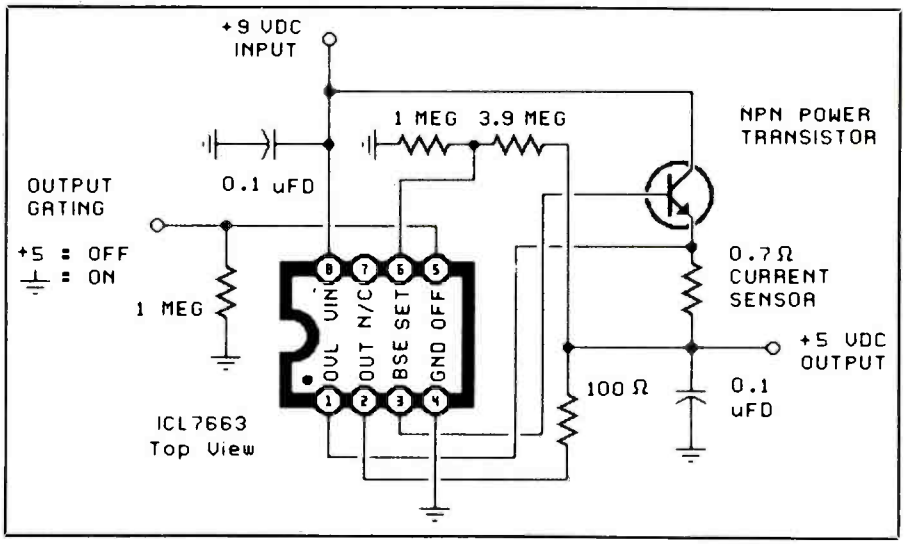
What is the word on ProDOS Applewriter?

There is a brand new version of *Applewriter* that runs under the ProDOS operating system and has bunches of new features. These include faster operation, better compatibility with other ProDos programs, easy hard-disk access, a built-in send and receive modem, settable screen margins for "what you see is what you get," spreadsheet editing to 240 columns, an optional page/position display, and many other improvements and performance upgrades. Best of all, the new version is unlocked, unprotected, and freely copyable for any number of backups. Even the source code is capturable.

What's wrong with it? Very little. A few parallel printer cards will not work properly on first try, notably the *Grappler* and the *Pkaso*. But I have a free patch that cures this. The NULL patch is no longer needed, since a [__] can be substituted. The "shortline" problem remains, but I have another free repair patch to overcome it.

Many people grossly and utterly underestimate Applewriter. Give it a chance, and once you really get into it, there is virtually nothing it cannot do in a fast and friendly manner. Its greatest abilities lie in its being totally program-

Fig. 6. You can add an external power transistor to boost output to 1 ampere.



Names and Numbers

Apple Computer
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010

Applewriter Upgrade
Box 306
Hale Moon Bay, CA 94019
(408) 996-1010

Bell Industries
1705 West 4 St.
Tempe, AZ 85281
(602) 267-7774

Intersil
10710 N. Tantau Ave.
Cupertino, CA 95014
(408) 996-5000

Mark Eyelet & Stamping
169 Wakelee Rd.
Wolcott, CT 06716
(203) 756-8847

Motorola
Box 29012
Phoenix, AZ 85018
(602) 244-6900

OK Industries
3455 Conner St.
Bronx, NY 10475
(212) 994-6600

Howard W. Sams & Co.
4300 West 62 St.
Indianapolis, IN 46206
(800) 428-SAMS

Statek
512 N. Main St.
Orange, CA 92668
(714) 639-7810

Synergetics
Box 809
Thatcher, AZ 85552
(602) 428-4073

mable through a companion programming language called WPL. Thus, word processing tasks can easily be customized or automated in any manner you like.

Cost of the latest ProDOS version is $150 from your local Apple dealer. But, there is a $50 upgrade service if you send in any older Applewriter first factory disk and a manual cover to *Applewriter Upgrade* to obtain it.

I've even been able to add full microjustifying and proportional-spacing, author's keyword indexing, multiple columns, HIRES dumps, and unique self-prompting glossaries to it, along with code extensions and many other goodies.

I have some free *Applewriter* patches available specifically for you. Just ask. I also have my own $59.50 *sixteen* diskette-side toolkit that really puts a final polish on Applewriter. You can order this directly from *Synergetics*.

Until next time, keep those cards and letters coming! **ME**

Need Help?

Phone or write your hardware hacker questions and comments directly to:

Don Lancaster
Synergetics
Box 809
Thatcher, AZ 85552
(602) 428-4073

A pair of interesting skill-learning software packages

By Art Salsberg

The advantages of using personal computers to learn new skills are exemplified by the two software programs examined here. One is a Morse-Code trainer for people who wish to develop this skill in order to get a radio amateur license, while the second is a typing development course, "Typing Tutor III."

"Morse Code Drills"/IBM Personally Developed Software/one 5¼" disk for IBM PC, PC XT, PC*jr*, and compatibles/ toll-free 1-800-IBM-PCSW, $14.95 + $2.95 p&h.

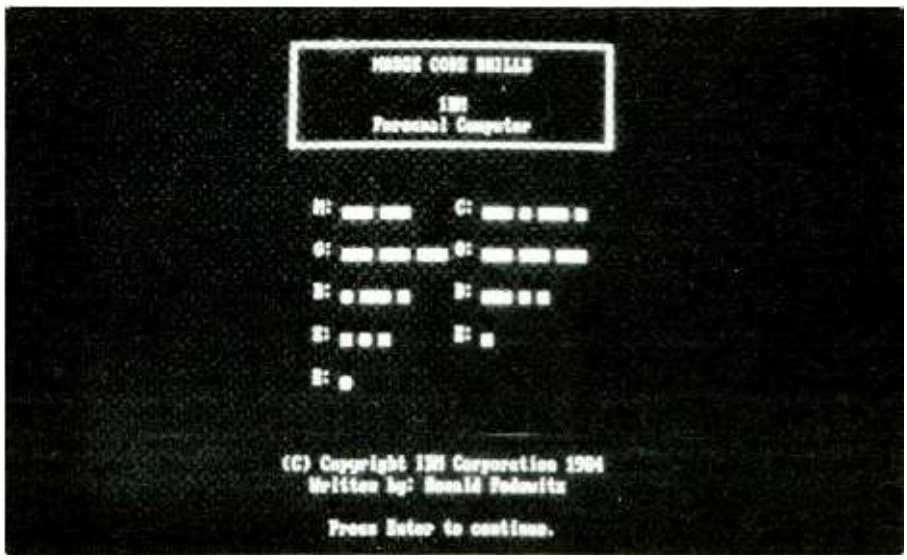
IBM has truly become "personal." First came its line of personal computers. Now the giant corporation has established "Personally Developed Software," a low-cost series of software packages developed by creative individuals who are identified by name and a headshot photograph in its first catalog, The Directory. Among its initial offerings of 36 programs is a $14.95 program that teaches a user to decode Morse Code.

To use the program you need an IBM personal computer, of course, or a compatible one. A minimum of 128KB of memory and one diskette drive are required. The program will run with all of IBM's disk operating systems, from DOS 1.10 and later. Either monochrome or color video monitors will do just fine.

The program disk is packaged in a most spartan manner. It consists of simply a colorful cardboard folder with a pocket that holds the disk. No manual accompanies the disk. It's all in the program and brought up on screen when the disk is loaded, starting with a menu that gives the user a choice of topics to select: Introduction, Modes, and The Keys You Use.

Here you will learn that the Morse-Code Drills cover practice for alphabetical letters, numbers 0 to 9, and some punctuation (question mark, comma, period, and slash mark).

The program offers five modes of instruction. Its "Instruct" mode permits you to type up to 10 different characters, each of which emits the proper code sound as the keys are struck. Pressing the Enter key, whatever is chosen will be sounded repeatedly and the user is supposed to type the characters he hears. To see how you're doing, simply press the Enter key again, which will cause the screen to display the actual characters heard. A Visual Instruct mode displays the dot-dash code as well as sounding it for every character typed.



A typical screen display generated by the Morse Code Drills program.

A Drill mode is an Instruct mode that enables you to repeat a sequence in random order, while a Test mode generates five-character code groups. Finally, a Message mode allows you to type a whole message with up to 144 characters. The Morse Code sound is then generated and you type the message along with it, later comparing what you did with the actual message on-screen.

Selected keys on the keyboard make controlling the system easier. For example, striking a left-arrow key makes the code speed slower (minimum 5 wpm), while the right-arrow makes it faster (40 wpm maximum). A down-arrow makes the tone lower, while an up-arrow makes it higher, all in steps. You don't have to leave the program to make these changes.

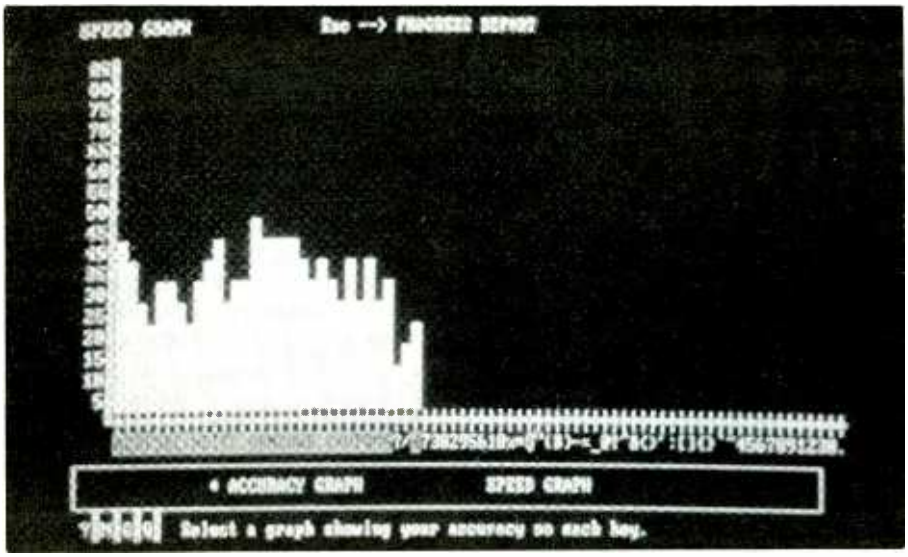
Function keys help, too. Striking F1 gives you an explanation of the modes and keys. F2 starts a code sequence again. F9 exits the program. F10 pauses the program while using the drills. Striking an Escape key, you are returned to an Option Selection Menu. Instruction labels are displayed at the bottom of the screen for quick reference.

User Comments

This is a neat program. The author, Ronald Pedowitz, did a fine job in writing a computer program that is easy to use and versatile. It has its shortcomings, though.

As an example, it does not provide guidance on some of the now-accepted ways to improve speed. A tyro, studying for his novice or tech, might approach code-learning by practicing at 5 wpm or so instead of attacking things at 10 or 13 wpm. Happily, though, code below 10 wpm is sent at 13 wpm, using additional spacing between words to get the selected speed. Fine for words, but not for character practice.

Equally important, there is no guidance provided on which letters should be



One option in Typing Tutor III gives you a graphic display of typing speed.

practiced first. Given the structure of Morse Code, it has been concluded that learning the vowels first, or practicing letters in alphabetical order, will likely impede progress. In fact, there is not even an elementary suggestion as to what the code minimum or other requirements are to get a particular license, who to contact in order to pursue this, and so on. A lot is taken for granted.

It would have been nice, too, to have included some Q signals and maybe even some code abbreviations. But this is probably asking for too much at the price, given what software generally sells for. Also, this written-in-BASIC program is the slowest-loading one I've come across in a long time (about 35 seconds).

Weighing all factors, however, it's a pleasure to see some useful software being sold at a *very* reasonable price. Better this way than paying an additional $65 for some niceties one can make do without. One backup copy can be made before copy protection takes place.

Typing Tutor III/Simon & Schuster, Inc./For IBM PC, Apple II, Commodore C-64 computers/One 5¼" disk drive and 64K RAM/$49.95.

Typing Tutor III's predecessor, Typing Tutor II, was a best-seller software program. The newest version is even better. A nice screen introductory series walks the user through the entire program, a sort of software tour. This is cursor selected when the program is loaded, giving a choice of the main menu or the intro.

Choosing the main menu, the user is prompted to type his or her name, which will build a permanent record for the typist, or leave it blank if you don't want a running record.

The main menu is a full one. You can choose practicing typing of alphabet keys, keyboard numbers, numeric pad, word test, full keyboard test, numbers test, standard speed test, a letter "invaders" test, status report, and even back to the introduction screens.

At the bottom of the screen are four symbols: ?, M, G, and Q. They stand for help, menu, graph, and quit. An information line to the right guides the user.

A representation of a keyboard is displayed when training for keyboard alphabets or numbers, with the random test alphanumerics displayed in reverse. When through with each set of letters, punctuation, and numbers used in the practice sessions, your typing speed per minute, accuracy percentage, and speed after accounting for mistakes (deducting five words per minute for each one) are shown. Each "lesson" consists of two sets of four keys in random order. You can get progress reports any time by pressing the Escape key. At the end of each lession, reversed keys on the diagram indicate that these are your "fast" keys. You can also change parameters: sound on or off, words per minute reference, number of lesson repetitions, and number of test lines used when testing yourself with words instead of letters.

Choosing the graph option, you have a choice of seeing a graphic representation of how fast you type each character or your accuracy percentage for each one. This provides the user with a marvelous opportunity to know and practice typing giving him trouble. The program itself, however, continually monitors user response speed to each key, storing this information and automatically creating lessons to strengthen typing skill for the "weak" letters.

A typing game has been added to Typing Tutor III that's based on the well-known "Space Invaders" arcade game. Here, letters appear to fall down from the screen's top. If you type the correct letter, the falling letter-bombs are destroyed; if not, the letters chip away at land at the bottom of the screen. Once in a while a series of three letters are contained in the falling missile; typing them correctly gives you bonus points. This is a good change of pace. Using a monochrome IBM video monitor, however, makes it difficult to see the three-letter bombs since the monitor's longer-persistance screen causes blurring.

The program seems to have covered all bases for helping you to increase typing skill, down to an audible beep when you make a typing mistake. Highly recommended for anyone who wishes to learn how to type or to increase typing speed. The price of the copyable program is right, too. **ME**

Warm-Weather Scanning

By Tom Kneitel, K2AES

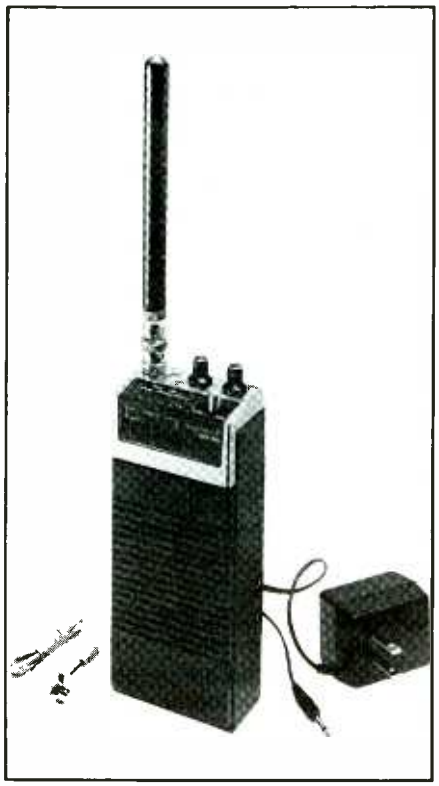
Don't forget to take that hand-held scanner along with you on your vacation or that long weekend, even on your Sunday drives to the mountains or seashore. There's lots of behind-the-scenes activity going on that you can hear to place you closer to your surroundings.

For instance, if you're heading towards any of our many National Parks, the park transportation systems (usually buses) operate on 40.07 and 40.21 MHz. Other types of operation at the various National Parks turn up on assorted frequencies that differ from facility to facility, but are usually drawn from the following frequencies: 162.615, 163.075, 163.125, 164.175, 164.20, 164.25, 164.425, 164.475, 164.55, 164.725, 164.80, 164.985, 165.315, 165.415, 165.925, 165.975, 166.30, 166.325, 166.35, and 166.375 MHz. There are other frequencies, but these seem to be in heaviest use.

Communications of the U.S. Fish and Wildlife Service always take place on 34.81 and 34.83 MHz. These are especially active in the areas surrounding National Wildlife Refuges and at National Fish Hatcheries.

Frequencies used by the nation's railways are in the band that lies between 160.215 and 161.565 MHz, but lost in the shuffle are frequencies used by long-distance buses. It's a great and inexpensive way to travel, but eventually you get a bit bored with watching the trucks passing you on the Interstates. Nobody seems to know it, but these buses have their own special frequencies set aside for their own use. They are: 43.70, 43.72, 43.74, 43.76, 43.78, 43.80, 43.82, and 43.84 MHz.

While on the subject of "getting there," let's not forget the most popular method of long-distance transportation, the airlines. Without getting into the highly complex air/ground communications systems used by the airlines, it will probably be of interest to you to know about the airport operations frequencies used by the major airlines.



Bearcat Five-Six scanner.

These frequencies are used by low-power base and mobile (including hand-held) units. By monitoring this group of stations you can get all sorts of inside information on security problems, find out the real reasons for arrival/departure delays and cancellations, baggage foul-ups, passenger complaints, and the like. Each airline has its own little communications system; some of the more popular frequencies used for this purpose include:

- Air France: 460.70, 460.775 MHz
- American Airlines: 460.675, 460.725, 460.775, 460.80, 460.875, 460.9125 MHz
- Avianca: 460.80 MHz
- Continental Airlines: 460.65, 460.70, 460.85 MHz
- Delta Airlines: 460.70, 460.80, 460.825, 460.875 MHz
- Eastern Airlines: 460.65, 460.75, 460.85 MHz
- KLM Royal Dutch Airlines: 460.65 MHz
- Lufthansa Airlines: 460.775, 460.80, 460.825 MHz
- Northwest Orient Airlines: 460.65, 460.675, 460.80, 460.85, 460.875 MHz
- Ozark Airlines: 460.675, 460.70, 460.725, 460.85, 460.9625 MHz
- Pacific South Western Airlines: 460.65, 460.80, 460.825, 460.875 MHz
- Pan American World Airways: 460.65, 460.775, 460.85, 460.9625 MHz
- People Express: 460.75, 460.85 MHz
- Piedmont Airlines: 460.65, 460.775, 460.80, 460.85, 460.875 MHz
- Republic Airlines: 460.80, 460.825, 460.875 MHz
- SAS Scandinavian: 460.80 MHz
- Seaboard World Airways: 460.85 MHz
- Southwest Airlines: 460.675, 460.80 MHz
- TWA: 460.675 MHz
- United Airlines: 460.675, 460.725, 460.825, 460.875 MHz
- USAir: 460.65, 460.70, 460.875 MHz
- Western Airlines: 460.65, 460.75, 460.85 MHz

If you like to drive into the boonies you're sure to pass one or more small airports catering to private pilots flying small aircraft. Be sure to bring along your scanner. It's great fun to sit at the end of the runway and monitor the pilot chatter. This usually takes place on 122.7, 122.8, and 122.9 MHz. Helicopter landing areas offer communications on 123.05 and 123.075 MHz.

Nice weather is the time of the year for air exhibits, shows and races. Fire up your scanner on 122.9, 123.1, 123.3 and 123.5 MHz to hear this activity. Hot-air balloons like to use 151.625 MHz. The biggest balloon of all, the Goodyear Blimp, operates on 132.0 and 161.64 MHz.

Let's also keep in mind those days at the seashore. They also offer their own listening excitement. You don't have to own a boat to get in on the action. Put your scanner on 156.80 and 157.10 MHz and you'll hear plenty of activity, including the Coast Guard working boat owners with various problems ranging from emp-

ty fuel tanks to discovering hitherto unknown sandbars.

Small boat "skippers" also have their favorite channels for chit-chat, and sometimes it's quite entertaining. Take a listen on 156.425, 156.475, 156.525, 156.575, 156.625, and 156.925 MHz for this type of activity.

Lots of folks head for America's great gambling Meccas for their vacations—Atlantic City, Las Vegas, Reno. A scanner in one of these cities of gold lets you listen on the operations of the glitter merchants. Some of the fabulous spots in these famed tourist areas are shown in Table 1. If you visit these areas and leave your hand-held scanner at home, you'll be missing *plenty!*

Professional sports teams often make use of two-way communications. While you're in the grandstands, hopefully you can manage to hold your scanner in one hand while you balance a hot dog and drink in the other. It will be well worth your while to master the technique. You can hear owners yelling at managers, managers yelling at coaches, and all sorts of other colorful happenings. Much of this communication takes place on 154.57 and 154.60 MHz, and those are good frequencies to check out in lieu of specific data on your favorite team.

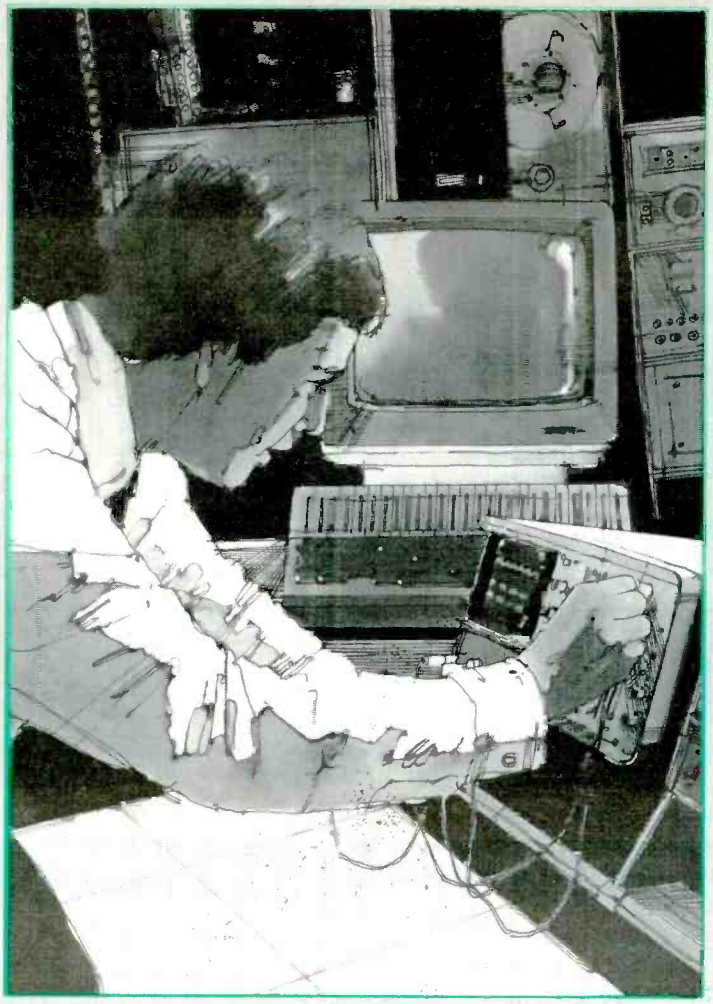
A listing of some of the more popular professional sports frequencies is given in Table 2. Have a ball!

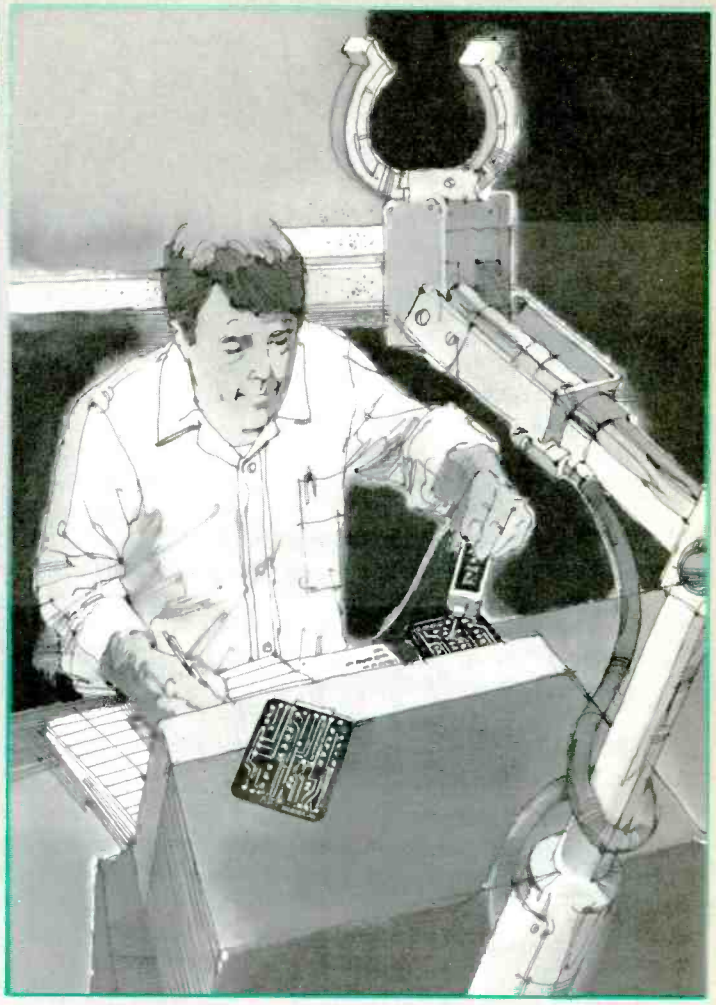
What with jogging, hiking, and backpacking so popular, you may want to do all of your exercising by opening up your hammock and resting on your, er, laurels with your scanner propped up on your chest. With this configuration you can tune in on the favorite frequencies used by the nation's health, fresh air, and granola freaks. Just listening to these people enjoying themselves is actually invigorating. Listen on 49.830, 49.845, 49.875 and 49.890 MHz.

If you've got the capability to monitor

Table I- Glitter Resort & Casino Monitoring

Atlantic City, NJ	
462.80 MHz	Bally's Park Place
462.875	Claridge Hotel
463.2125	Sands Hotel & Casino
463.60	Bally's Park Place
464.075	Resorts International
464.10	Bally's Park Place
464.125	Golden Nugget
464.275	Resorts International
464.675	Resorts International
464.725	Ramada Inn
Las Vegas, NV	
35.08 MHz	Las Vegas Hilton
151.715	Nob Hill Casino
151.745	Hotel Riviera
	El Cortez Hotel
	Circus Manor
	Lotus Inn
151.775	Horseshoe Inn
	Hotel Frontier
151.865	20th Century Hotel
	Treasury Hotel
151.895	Circus Manor
151.925	Circus Circus
151.955	Bali Hai Hotel
154.515	Aladdin Hotel
158.46	Caesars World
451.60	MGM Grand
451.70	Caesars Palace
461.05	Horseshoe Club
461.10	Silver Nugget Casino
461.20	Imperial Palace
461.275	La Concha Hotel
461.325	Flamingo Capri Hotel
461.425	California Hotel & Casino
461.675	Tropicana Club
461.75	Hotel Golden Nugget
461.775	Caesars Palace
461.925	Hotel Conquistador
461.95	Caesars World
462.00	Golden Nugget
462.15	Four Queens Hotel
462.85	Hotel Sundance
	Las Vegas Hilton
462.875	Fremont Hotel
	Riviera Hotel
	Golden Gate Casino
463.325	Las Vegas Hilton
463.375	Las Vegas Hilton
	Union Plaza Hotel
463.40	Caesars Palace
463.475	Holiday Inn
	Western Hotel & Casino
463.775	Castaways Casino
	Silver Slipper
	Hotel Castaways
463.825	MGM Grand
463.90	Showboat Hotel
464.025	Mint Hotel
	The Inn At Las Vegas
	Royal Inn
	Mint Hotel
464.25	Riverboat Casino
464.375	Holiday Inn
464.625	Dunes Hotel
464.85	Maxim Hotel
464.925	Shenandoah Hotel
464.95	Hotel Riviera
465.00	Landmark Hotel
Reno, NV	
151.775 MHz	El Dorado Hotel
151.805	Harrah's
151.955	Maples Casino
154.515	Ramada Inn & Casino
154.625	Ramada Inn & Casino
157.74	Harrah's
461.225	The Grand
461.25	Circus Circus
461.30	Plaza Hotel
461.525	Harold's Club
461.85	Reno Hilton
	Sahara Reno
462.05	Peppermill Casino
	Riverside Hotel
462.175	Comstock Hotel
462.775	Reno Hilton
462.80	Reno Hilton
462.875	Peppermill Casino
	Harold's Club
463.25	Circus Circus
464.375	Holiday Inn
464.60	Harrah's
464.925	Onslow Hotel & Casino





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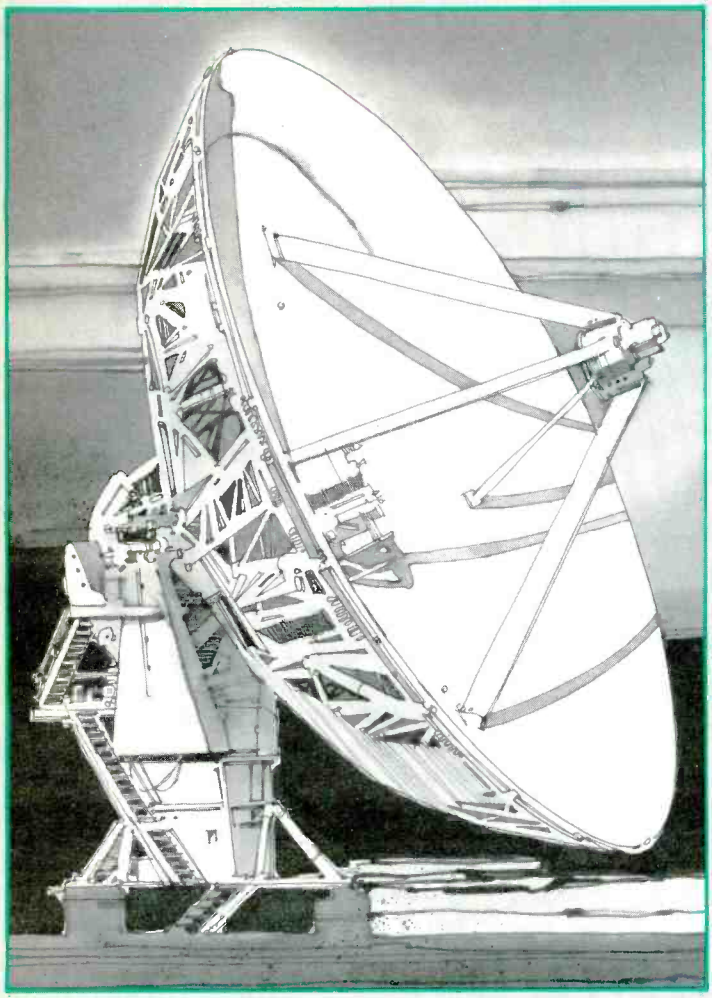

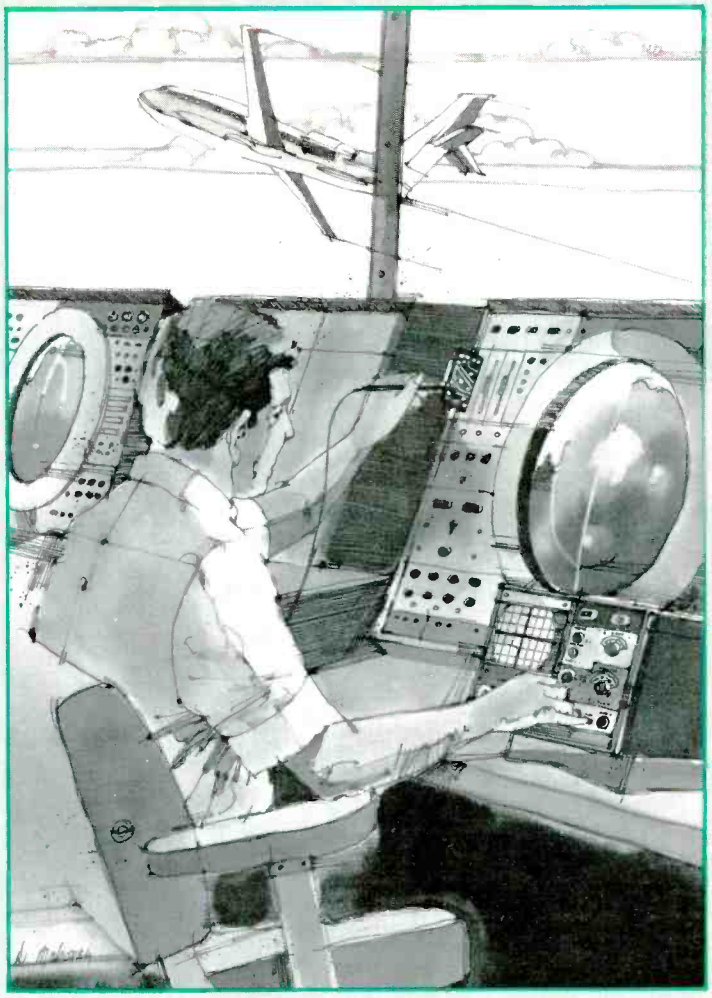

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MAIL TODAY! MO-32

Table 2– Selected Pro-Sports Frequencies

Atlanta Braves	462.575, 463.325, 467.575 MHz
Boston Red Sox	463.325, 464.075 MHz
Cincinnati Reds	462.175, 467.175 MHz
Cleveland Indians	154.515 MHz
Darlington Raceway (GA)	464.50, 469.50 MHz
Daytona Int'l. Speedway (FL)	154.515, 154.54, 464.775, 464.90, 469.775 MHz
Indianapolis Colts	151.715, 154.60 MHz
Indianapolis Speedway (IN)	154.60 MHz
Kansas City Chiefs	464.775, 469.775 MHz
Los Angeles Dodgers	154.57 MHz
Madison Square Garden (NY)	154.60 MHz
Milwaukee Brewers	151.625, 151.805 MHz
Minnesota Vikings	151.955 MHz
NASCAR races	464.50, 469.50 MHz
Professional Golf Assn.	464.55 MHz
Riverside Int'l. Speedway (CA)	154.54 MHz
Road America (WI)	464.375, 464.525, 469.525 MHz
San Francisco Giants	151.805 MHz
Spectrum Stadium (PA)	154.60 MHz
Sports Car Club of America	151.625 MHz
Texas Rangers Baseball	464.5375 MHz
The Omni (GA)	464.375 MHz
U.S. Auto Club	151.625, 151.655 MHz
Washington Capitals	467.80 MHz
Watkins Glen Raceway (NY)	155.295, 155.34 MHz

CB frequencies, Channel 19 (27.185 MHz) is where to listen for America on the roll; it's the channel used on all Interstates and major highways. Channel 13 (27.115 MHz) is in wide use by owners of recreational vehicles (also known as RV's) and all manner of off-the-road vehicles.

As you can see, there's much to monitor while taking time out for relaxation and recreation. Of course, you have to have the scanner to accomplish the feat of listening while you're taking a holiday.

Hand-held scanners come in several varieties, most notably the keyboard programmable type and the kind that requires plug-in crystals. Keyboard programmables are state-of-the-art hardware, though they are more expensive than the type that requires that you obtain plug-in crystals. On the other hand, with a programmable unit you don't have to buy any crystals, or wait for them to be custom made if they're out of stock, and you can monitor any frequency you desire on a moment's notice. Still, there's much to be said for the crystal-controlled scanner, not the least of which is the relatively inexpensive price of these units.

Let's take a quick look at some of the hand-held scanners presently available.

The *Uniden Bearcat 100* is the original keyboard programmable hand-held. It covers the low/high/uhf/uhf-T bands and can be programmed for 16 channels at a clip. Nice features include LCD frequency readout and frequency search.

The *Regency HX1000* is a new hand-held that's fully keyboard programmable and will accommodate 30 channels at one time. A nice die-cast aluminum chassis gives it a ruggedized outlook on life. A backup lithium battery saves memory for two years if you forget to recharge the nickel-cadmium cells.

The *Regency HX650* is a plug-in crystal design hand-held, which is one of the smallest units ever. New advanced circuitry using sophisticated chips really gave Regency a handle on the mini-circuitry in this receiver. Covers all public service bands between 30 and 512 MHz; operates from four AAA-size NiCd cells. Receives any 5 channels.

For those who are intrigued by the new 800- to 950-MHz band, there's also the new *Regency HX2000* hand-held, which also receives all other regular scanner frequencies (including the 118-to-136-MHz vhf aero band). This is a keyboard programmable unit which offers 20-channel operation. Operates from batteries, also from 117 volts ac (without an external power converter).

Radio Shack's *Realistic PRO-30* is a 16-channel keyboard programmable hand-held which covers the standard public safety bands plus the aircraft band and the 6-meter ham band. Operates from six size AA batteries, plus four silver-oxide cells in its memory-saver circuitry.

The *Uniden Bearcat FIVE-SIX* is a crystal controlled, hand-held that monitors any 6 channels in the standard public service bands. A really nice little unit that has LEDs to show you which channel you're receiving.

The *Fanon 6HLU* is a small six-channel crystal controlled hand-held scanner that covers the standard public safety bands. A nice little economical receiver that will fit in your jacket pocket and weighs a mere 7½ ounces.

As you can see, there's a wide selection of hand-held scanners. Depending upon what you're looking for, and how carefully you shop, you can expect to spend anywhere from about $80 to approximately $360 for a handful of scanner.

Even if you aren't especially interested in listening in on the behind-the-scenes action, surely the ability to tune in the National Weather Service forecasts (primarily on 162.40, 162.475 and 162.55 MHz around the nation) will give your outdoor activities a new, exciting dimension. **ME**

NEW LITERATURE

Computer Protection Guide/catalog. Electronic Specialists is offering a 40-page color catalog that describes such power-line problems as noise and high-voltage spikes and the damaging and disruptive effects they can have on microcomputers. Typical computing problems and suggested solutions are included. The publication then lists and describes hundreds of protective and interference-cure products. For a free copy of Catalog No. 851, write to: Electronic Specialists, Inc., 171 S. Main St., P.O. Box 389, Natick, MA 01760.

Soldering/Desoldering Catalog. A full-color short-form catalog that describes a complete line of soldering and desoldering tools and accessories for the electronics workbench is available from OK Industries. The eight-page catalog contains complete descriptions and specifications for an array of soldering and desoldering irons, guns, pumps and stations and includes descriptions of such useful accessories as a soldering aid kit, pc board holders, and a smoke absorber to help dissipate fumes. For a free copy of the "Solder/Desolder" catalog, write to: Customer Service, OK Industries, 3455 Conner St., Bronx, NY 10475.

New Heathkit Catalog. It is time once again for you to get a new edition of the Heath catalog, if you are not already on the company's mailing list. Highlighted and fully described in the latest catalog are more than 400 products ranging from hi-fi to TV/video to general electronics equipment; test equipment; communications gear; computers and software; and much more. Many of the electronic products listed and fully described are in money-saving kit form. This is a do-not-miss catalog for the electronics hobbyist. You can obtain a free copy by writing to: Heath Co., Dept. 150-465ME, Benton Harbor, MI 49022.

Get A Modem Pamphlet. Multi-Tech has a pamphlet for computer owners who do not as yet have a modem and for prospective computer buyers. It briefly explains the benefits to the computer user of owning and using a modem for communication with other computers, databases, banking and bulletin boards. For a free copy of the "Extend Your Computer . . . Get A Modem" pamphlet, write to: Multi-Tech Systems, Inc., 82 Second Ave S.E., New Brighton, MN 55112.

CMOS/NMOS Special Functions Data Manual. Motorola has just published the *CMOS/NMOS Special Functions Data Manual* that provides complete specifications and applications information for more than 60 special function VLSI integrated circuits available from the company. The Manual consists of 11 chapters, each covering a different family of devices (CMOS ADCs/DACs, CMOS decoder/display drivers, CMOS operational amplifiers/comparators, etc.). Provided is the latest technical data for the design engineer, including extensive data sheets with pinouts, block diagrams, electrical characteristics, and testing and applications information. You can obtain a copy by sending $1.60 for book No. DL130 to: Motorola Literature Distribution Center, Broadway Bldg. No. 1, 616 W. 24 St., Tempe, AZ 85282.

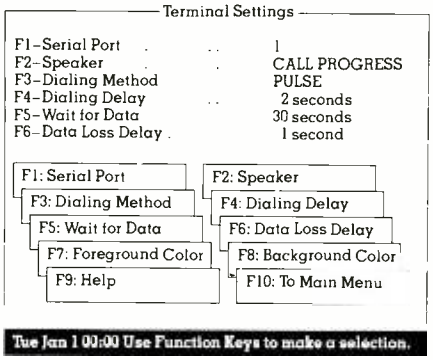
used with AT&T's 6300, IBM PC/XT/Portable, Compaq and Compaq Plus, and fully compatible computers. Thus, it requires using appropriate disk operating systems: PC-DOS or MS-DOS, versions 2.0 or later. At least 128K of RAM is needed for any of these computers, which is par for the course.

The software allows storing and automatic dialing of up to 30 telephone numbers, each one with a 32-character dialing buffer. Furthermore, communication parameters initially set for each phone number listed are automatically utilized when the number is selected from a displayed directory.

Additionally, the software generates a Call History Log with a record of date, time, call duration, telephone number and baud rate of all calls made and received. Furthermore, it automatically detects the presence of a color-graphics boards and self-tests the 4000 quickly when it's first turned on. If there is a problem with the modem, you'll be alerted to it on-screen. Testing it with a miswired RS-232 connector, the program certainly caught the problem. Correcting this, we were greeted with a user-friendly screen of parameter setting options. Then pressing function key F10 invokes the main menu.

Options are available for adjusting foreground and background color when using a color board, uploading and downloading programs, sending output to a printer, recording the communications session for later editing, and even changing modem parameters.

In the auto-answer mode, you can call another SoftCall-controlled Model 4000 and leave mail. Moreover, if you arranged to know a remote unit's password, you can manipulate files and commands from



within the SoftCall program as if you were at the console. Be sure not to write-protect the disk since the program creates directory, log-in, calling log and message files on the program disk. Protocols XON/XOFF or XMODEM can be used with a remote source.

User Comments

AT&T's Model 4000 modem, used with its SoftCall communications software, is the easiest intelligent modem we've used. Everything is software controlled, made easy as pie with clear menu choices and full use of the computer's function keys. There are a few shortcomings, though, as follows.

When in the Auto-Answer mode, it will detect data coming in at a 1200- or 75-to-300-baud rate. If your baud rate is not properly set, however, the unit will *not* automatically reset them. Instead, a screen message warns: "CONNECTED-BAUD RATE MISMATCH". You are then expected to manually reset the rate. In turn, if you are calling a 300-baud system while set at 1200 baud, you won't be able to make the connection until you reset to 1200 baud and then redial.

There is a host of built-in diagnostic tests that overjoyed us. But other than two tests, they're not really built-in ones so much as they are routines used to allow the unit to be interconnected with remote systems.

We don't like the use of the phone connector for supplying power to the modem. As shown in an accompanying illustration, the connector uses pin 22 for Ring Indication in the Auto-Answer mode, as well as the standard pins 2 through 8 and 20. Consequently, you cannot modify connections should you use some other communications software programs in this mode.

Aside from the foregoing, which most people will consider to be minor sins unless you're a heavy Auto-Answer person, it is not Hayes-compatible! Just as AT&T established a host of *de facto* phone-line data standards long ago, Hayes Microcomputer Products established a set of software commands with its Smartmodem products that most software makers follow. (Hayes software commands start with "AT," so you'll often see the phrase AT-compatible used.) Too bad. This locks one out of using a common feature of popular desk-organizer software, such as "SideKick," to automatically dial a number in the latter's telephone directory when in the middle of an applications program.

Nonetheless, the AT&T modem is enhanced beyond expectation when SoftCall is used. Essentially, though, this is the software package you'll likely to be limited to, though we used both Crosstalk and PC-Talk with some adjustment of control-code sequences. If it fits your bill, you'll get a truly great combination here that's more than a match for Hayes-compatibles. This is an important "if," however.—*Charles Rubenstein* **ME**

CIRCLE 50 ON FREE INFORMATION CARD

Booming World of Electronics *(from page 29)*

for $30. Sharp also introduced a blood-pressure monitor with printout, logging date and time. An LCD display on the MB-371H shows systolic and diastolic blood pressure.

TTC's "Hearoid" robot marks what's claimed to be the world's first robot to be operated by remote voice-recognition technology. The machine recognizes 12 different voice commands, placing voiceprints in memory. It has a trigger-activated grasping hand, serving tray, built-in battery with charger, programmable digital clock and built-in cassette-tape entertainment center. Voice command can make it move forward and backward, make right and left turns, blink headlights, control the cassette deck, and is said to be programmable for such chores as carrying objects with its hand, lighting the way at night, etc. Price is $400.

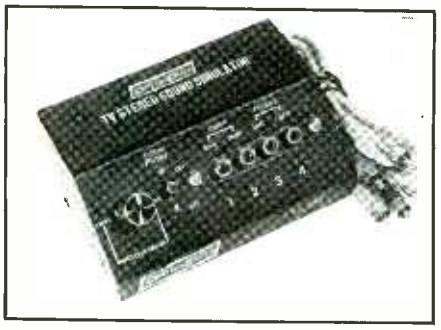
A smidgen more into the future. Sony sneak-previewed its first digital TV model. In addition to digitally handling TV video and audio signal processing, it has a host of other functions. These include using the TV set as an electronic memo pad for storing information and for programming instructions for automatic turn-on and off and channel blocking. Called the "Home Management Helper," the system uses an alphanumeric control pad that can call up a variety of programs such as appointments, birthdays, etc. The 25" system is scheduled to be sold sometime later this year.

Even farther into the electronic/computer future was Mitsubishi's House of Tomorrow. The company presented an automated house that can accept a variety of commands that it automatically performs. By entering code with any pushbutton telephone, the system is designed to automatically turn on or off lights, control air conditioning, start dinner, talk to anyone with a synthesized voice, and so on. It'll give the owner a hard-copy photograph of anyone who rang your doorbell, printed out through its video security/printer system. Moreover, a near-infrared Picture-Phone Sentry allows viewing on its video monitor even in near-total darkness. The digital TV itself can be set up with nine "windows" simultaneously on the screen. Add fire, gas, and buglar sensors, electronic shopping, electronic newspaper, etc., and you've got what Mitsubishi thinks is only a year or two down the road.

For right now and for tomorrow, this latest Consumer Electronics Show was demonstrably a big hit. **ME**

NEW PRODUCTS . . .

(from page 13)



Stereo Simulator For TV Sound

The Carter Craft Model 60-302 TV stereo sound simulator promises to add a new dimension to your viewing if all you are getting is monophonic sound. Easy-to-follow instructions show you how to attach one cable into a TV receiver's earphone jack and another cable into a stereo system. Volume, tone and balance are then set with the controls in your stereo system, while a noise filter in the simulator minimizes TV noise.

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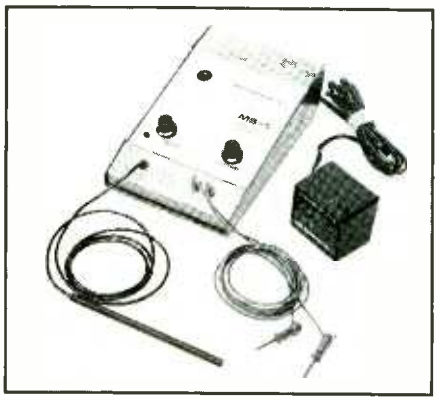

Short-Circuit Locator

A new instrument that rapidly locates the source of short-circuit faults in printed-board assemblies has been introduced by MD Systems (3178 Doolittle Dr., Northbrook, IL 60062). The company's Model MS-1 tester goes beyond previously available testers in that it is able to trace along a shorted path to locate the actual fault. The MS-1 uses a self-contained 300-kHz low-voltage signal source to create an ac magnetic field in the vicinity of the short-circuit current path. The instrument's unique Omin-Probe™ is responsive to any orientation of the resulting three-dimensional flux patterns. An audible tone is emitted whenever the probe is held near a 300-kHz current-carrying conductor. Using the Model MS-1 tester, you can locate a short-circuit fault in less than a minute. $299.

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Tandy's New Model-1000 Computer

(from page 35)

documentation is on the skimpy side. There's a spiral-bound DeskMate manual and reference guides for DeskMate and GW-BASIC, but the "Introduction to the Tandy 1000" manual is a DeskMate tutorial prefaced by a few pages of instructions for setting up the computer. You'll learn how to back up your MS-DOS and DeskMate disks, but you'll never learn MS-DOS' DIR command, much less anything about batch files or subdirectories.

Even though not everything on the 1000 disk has been mentioned, you'll probably need the MS-DOS and GW-BASIC reference manuals ($34.95 each). Serious hackers can buy programmer's ($14.95) and technical reference manuals ($29.95), and BASIC tutor David Lien's "Learning BASIC" book for the 1000 and 2000 ($19.95).

[*Author Eric Grevstad and* Macworld *consulting editor Jim Heid are writing a Tandy-1000 book for publication by Ashton-Tate, and sale in bookstores and Radio Shacks this summer. It's a beginner-to-intermediate-level text that gives an overview of the 1000's hardware, software library, and MS-DOS.—Ed.*]

Conclusions

The 1000's manuals are poor, its text display's not worldclass, and it's a tight fit for programs without a 256K upgrade. Otherwise, the Tandy 1000 knocks PC*jr* into a derby hat—more speed, a better keyboard, room for 640K of RAM and two built-in drives. And at $1,359 with 128K, one 360K drive, and a monochrome display, it's devastating competition for Apple's inexpandable IIc, with access to the *de facto* software standard today, with more compatibility than other modestly priced MS-DOS systems such as Sanyos.

The biggest factor in deciding whether or not to buy a Tandy 1000 is probably whether or not you're spending your own money. Life being what it is, if you're in a big company and got a blank check from the boss to buy desktop computers, IBM has at least a psychological advantage with its PCs. But if you're a small-business owner sticking to a tight budget, or a home computer buyer with some serious computing inclinations, the Tandy 1000 might well be the best computing buy around today, especially if it soon matches recent price cuts by IBM and Apple dealers.

Tandy has changed radically in the past year by embracing MS-DOS for their new computers, and perhaps as much as 90% compatibility with the PC*jr* with its latest computer model. The Fort Worth corporation thus serves notice with the Tandy 1000 examined here that if there's going to be a computer-maker shakeout, Tandy aims to do the shaking.

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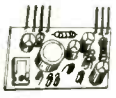

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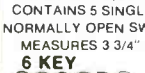

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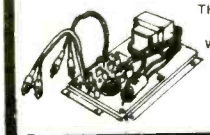

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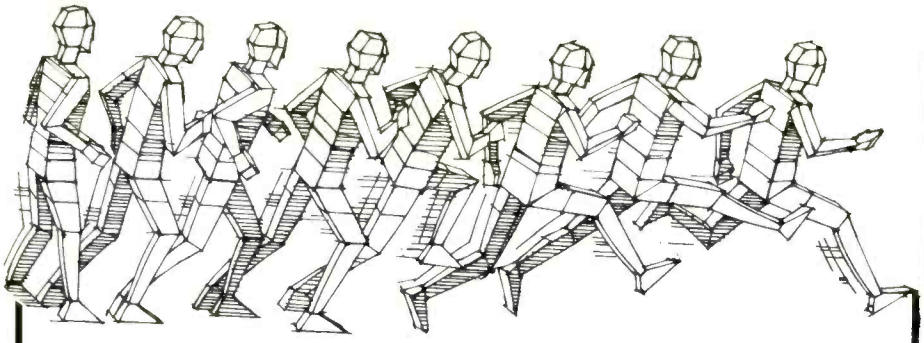
31	32	33	34	35



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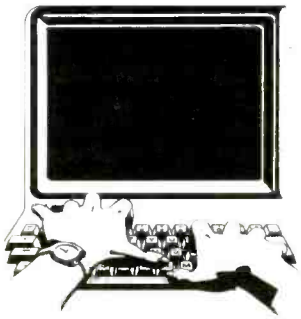

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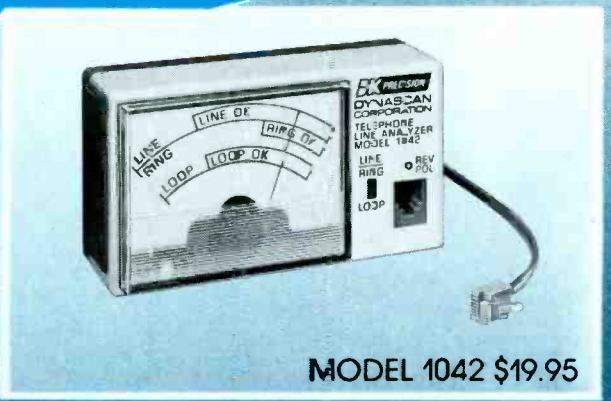

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R-11

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Simplicity of operation is enhanced by a band-spread type tuning control. Electronic band switching, with LED band indicator, along with a tuning meter to indicate received signal strength, combine to provide you with superior listening capability. Safety Hold-Release switch prevents accidental station loss. Large front mounted speaker provides excellent sound quality. Tone switch adjusts for high, low and voice transmission.

Optional HS-7 micro-head phones allow for private listening pleasure.

All this along with a record output jack, external antenna terminal and a rugged and attractive carrying case make the R-11 portable receiver the perfect travel companion!

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