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THE MAGAZINE FOR ELECTRONICS & COMPUTER ENTHUSIASTS

● 1986 ELECTRONICS PRODUCT PREVIEW

● HOW TO ADD STEREO SOUND TO TV SETS

Canon's New 8-mm Camcorder (p. 16)

Full Plans to Build:

- An Audio Step Generator
- A Versatile Printer Stand
- A Day/Night Safety Beacon

Product Reviews:

- Canon's New "Canonvision" 8-mm Camcorder
- Oberon's "Omni-Reader" Optical Text Reader
- Tecmar's "MegaFunction" Board

A Versatile Printer Stand (p. 50)

Magnavox's Videowriter Word Processor (p. 22)

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THE MAGAZINE FOR ELECTRONICS & COMPUTER ENTHUSIASTS

APRIL 1986 VOLUME 3, NUMBER 4

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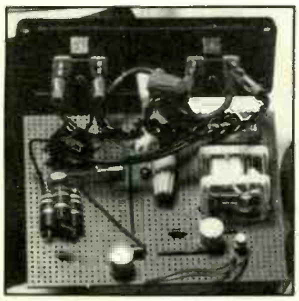

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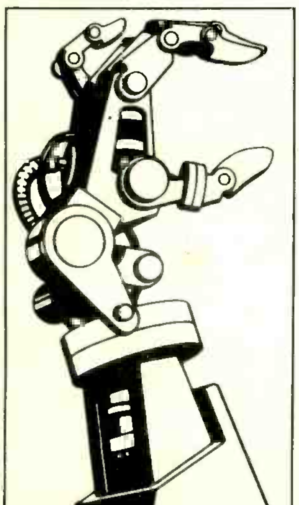

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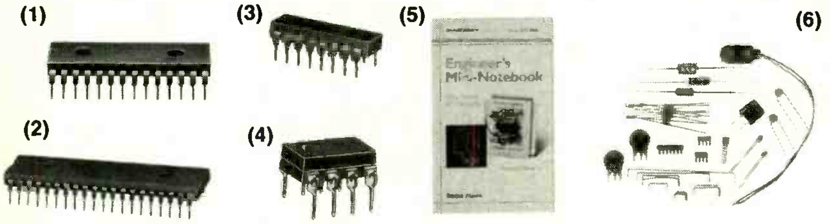

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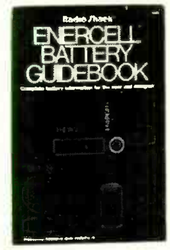

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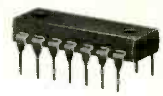

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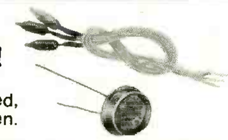

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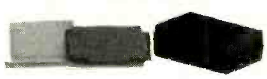

Small enclosure, big value! 1 3/16 x 3 7/16 x 2 5/16". Rugged, yet easy-to-drill molded plastic. Includes board with 483 DIP-spaced, solder-ringed holes, two labels, complete hardware, snap-in rubber feet. #270-291

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Special Purchase!

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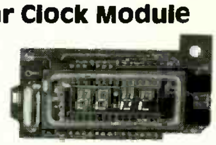

MA3003D-2. Detroit's goof, your gain! Fluorescent display with 1/4"-high digits is easy to read, night or day. Great for vehicles or stationary application—all you need is 12 volts DC. Approximately 1 3/8 x 2 1/8 x 1 1/2". #277-1021

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EDITORIAL

Knowing Too Much

"You can never know too much," say lots of people. Nevertheless, there's a saturation point in gathering knowledge that limits all of us. One can't be "expert" in everything nowadays because information in each specialized field runs too deep.

In *Modern Electronics* we cover the breadth of electronics/computers with various degrees of depth. Readers can pick and choose their major activities from among them, keeping an eye on what's happening with lesser interests. At any given moment, one can then become greatly interested in another electronics/computer area, perhaps piqued by one of our articles or an advertisement, and switch equipment buying habits to a new special-interest attraction. ME's continual coverage in all areas readies readers for a switch to another major interest when the moment strikes, intensifying what one knows.

In some developed countries, people are purposely shut out from becoming involved in expanding high-tech knowhow outside their work place. Consequently, there are always intrepid people in these countries who dare to go underground with a forbidden activity. It might be certain books, video recorders, shortwave receivers, computers, etc.

On the latter, personal computers are just now making their debut in the Soviet Union with a $1,250 model BK-0010. Frankly, I was surprised to learn this since the U.S.S.R. has steadfastly clamped down on any possible spread or exchange of information that the government cannot control. This was cleared up by a recent *New York Times* (January 26) article reporting that very few of the new personal computers were available for sale. Furthermore, printers were not available at all and software was limited. Moreover, the computer was judged to be for professional programmers. Topping this, Soviet telephone lines are filled with too much static to allow reliable data communications with this medium.

In all, then, the U.S.S.R. is preventing its young people from gaining computer literacy. I wonder if the Russian people will go underground with black-market computers much as they did with VCRs and pre-recorded tapes, causing the government to loosen its restrictive policy in this area. Foreign broadcasts are still jammed, though; direct-telephone dialing from the U.S. was stopped a few years ago; and only authorized persons can use a photocopy machine in the U.S.S.R.

So here is a case where government edict makes sure that one cannot know too much. Take a moment and think about how fortunate we are that such restrictions are not imposed on us here in the United States.

Art Salsberg

LETTERS

The Old Team

•To see the "old team" running "Modern Electronics" was a real pleasure, as I was a subscriber to "Popular Electronics" for many years.

David Botto
Dorset, England

Experimenter's Project Works

•I very much liked the article in your July '85 issue called A Multi-Function Two-Transistor oscillator ["Electronics Notebook" column]. I have tried all the circuits on a breadboard and they all function well. The author, Forrest M. Mims, mentions other uses. I hope in the future to see these circuits published.

I especially like the clarity of your material and the paper it's printed on.

Wallace G. Kennedy
Ozone Park, NY

CoCo Errata

•My "CoCo Testlab" article in the February issue looks great! However, in Fig. 1, *IC1* should be 6821 (the correct number is given in the Parts List)—not the 6812 shown. I note also that the pin holes in all IC pads in Fig. 2 are filled in.

One final note: Kit No. ME-1 includes all parts, pc board, software on tape and *instruction manual.*

Jim Barbarello

It's almost impossible to "hold" such holes in mass printing.—Ed.

COMPUTER MAJORS DOWN. Along with decreased computer sales, fewer college freshmen chose computers as a major in fall 1985 than in the past two years. According to a survey by the American Council on Education and the University of California/Los Angeles, only 4.4% of new freshmen chose computer careers in contrast to 6.1% in 1984 and 8.8% in 1983. That's a 50% drop. Engineering, too, has been hit, though not as hard. Engineering registrants dropped to 10% of entering freshmen as compared to 10.4% in the previous year. Business and teaching were the gainers.

TWO-VCR FAMILIES. Seventeen percent of all videocassette recorder purchases in 1985 were made by current owners of VCRs, according to a market survey made by RCA Consumer Electronics. The company estimates that more than 25% of new VCR sales in 1986 are expected to be made by second-time VCR buyers. Research indicates that the second VCRs are being bought with innovative features such as extended programmability, stop action, audio dubbing, hi-fi stereo sound, etc.

DEMO DISK PROMO. Maxell Corp. has launched a floppy-disk promotion campaign that includes a trial Computerized World Atlas software program with the purchase of a 10-pack of Maxell MD-2 5¼" diskettes. The bonus program displays a 3D representation of the globe that can be rotated and enlarged or decreased. Typing in the name of a city provides information on more than 2,5000 cities, such as population, distances between cities, and geographic location. There's a catch, though. The program can be loaded and used for only three 40-minute trials before it locks to prevent further use. It will cost the owner $69.95 to get the unlocking code. Should the user not wish to take this route, he still has an eleventh disk free. Maxell also launched another 10-pack promotion with Citibank. Here, a free demonstration disk, Citibank's "Direct Access" program for personal computer banking service, is packaged. Along with the free disk, Citibank offers purchasers a free trial period for its use.

1985: A VIDEO BANNER YEAR. VCR sales in 1985 topped 11.8-million units, jumping 55% over 1984's 7.6-million units sold to dealers, according to the EIA's Consumer Electronics Group. VCRs are now said to be in 30% of American households. Color TV sales, too, set a record with almost 17-million sets sold to dealers, beating the 16.1-million figure posted in 1984. Projection TV sales rose 36.1% to 265,645 units in 1985.

HI-TECH HOTEL CHECKOUT. Don't you hate waiting on a checkout line at a hotel? The Sheraton Hotel people evidently empathize with their guests. They've installed Express Center video consoles in their hotels in San Digeo, Anaheim, Miami, Toronto, and Washington, DC to change all this. Guests simply insert their credit card into the machine, touch the appropriate screen prompt, and they receive an itemized receipt in less than 30 seconds. In the Sheraton Park Central in Dallas, guests can use a keyboard attached to the TV set in their room. It takes only a few keystrokes to review one's itemized hotel statement and arrange billing on a credit card.

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There's no stopping the incredible boom in consumer electronics. Soaring sales, new and improved products, entirely new technologies have opened up new opportunities for the trained technician as never before.

The $25 billion consumer electronics industry is creating a whole new servicing and repair market at home. This year, TV sales alone are expected to hit 16.2 *million* units. That's $5.5 billion dollars. Every day, sales of home VCRs, a product barely conceived of ten years ago, reach 20,000 units. Every day!

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.

IC Tester/Logic Monitor

A compact, hand-held combination comparator tester for most 5400 and 7400 series TTL ICs and logic monitor for 5-volt devices in 14-, 16- and 18-pin DIPs has been introduced by B&K-Precision. The Model 550 instrument tests standard TTL, Schottky (S), low-power Schottky (LS), advanced Schottky (AS), advanced low-power Schottky (ALS), high-speed (H) and fast (F) families. Tests are performed in-circuit.

The instrument compares the logic states of an IC under test with those of a known-good reference IC. If all logic states are equal, a "Good" indicator lights; if not, a LED lights for each pin where logic states are not equal. Switches are provided for standard configuration ground and V+ on 14-, 16-, 18- and 20-pin TTL ICs and for individual pin selection for nonstandard configurations.

When used as a logic monitor, the 550 indicates the logic state of each pin. This function continuously monitors each pin to show both changing and constant logic states. $395 includes 20- and 16-pin IC clips, table of testable devices and instruction manual.

CIRCLE 36 ON FREE INFORMATION CARD

Multi-Play CD Player

Pioneer Electronics' new Model PD-M6(BK) is said to be the world's first multi-play Compact Disc player for home use. The CD changer's six-disc magazine loads via a slot in the front panel. An internal mechanism then pulls individual disk-bearing trays into play position. Surprisingly, the PD-M6 is only about the same size as a typical single-disc player.

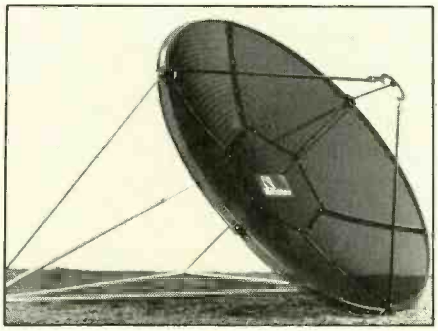
Front-panel and wireless remote controller keys access an array of play options and directly accesses any selection in the magazine. A 32-step memory allows the player to repeat a full programmed sequence, one track, just one or all six discs. Alternatively, the player's microprocessor can randomly choose selections to be played.

Updates on disc and track numbers, elapsed time of track being played and total playing time on a disc appear in the player's fluorescent display panel. The display is also used to check programming and to show selections remaining during programmed play. $499.95, includes remote controller, six-disc magazine and tray for single-disc play.

CIRCLE 37 ON FREE INFORMATION CARD

Movable Satellite TV Antenna Mount

Stoll Corp.'s (Sidney, OH) new SpaceMate AZ-EL Patio Mount does not require permanent installation and can easily be moved from



one location to another. It is designed to accommodate the company's SpaceMate 6-ft perforated aluminum paraboloid antenna. Supplied with detailed do-it-yourself assembly and satellite-aiming instructions, the 7-lb. unit eliminates the need for professional help. All tubular aluminum construction and steel hardware are claimed to make the Patio Mount durable enough to withstand any environmental elements.

CIRCLE 38 ON FREE INFORMATION CARD

Manual Desoldering Tools

Now available fromn A.P.E. Corp. is a complete line of handpumps for

manual desoldering. The pumps are equipped with antistatic tips to protect static-sensitive ICs and other components, while the pump mechanism is designed to minimize recoil to protect delicate circuitry from mechanical damage. There are five models in the line: DP-1 features all-metal construction and an antistatic tip; DP-2 is antistatic and conductive with conductive tip; DP-3 is a large-capacity plastic tool; DP-4 is spring actuated on the return and is all plastic; and DP-5 is spring actuated, conductive and antistatic with an antistatic tip. Less than $13.

CIRCLE 39 ON FREE INFORMATION CARD

High-Performance X/K-Band Radar Detector

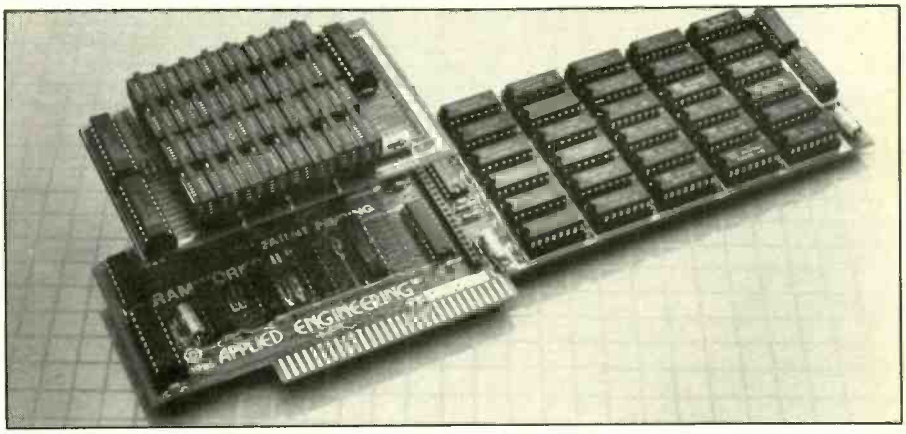
Controlonics' "Spectrum 2" triple-conversion superhet X- and K-band radar detector features different audible and visible indicators to inform you of the band detected, as well as single-button control.

A single-digit numeric display in-

dicates signal strength and brightens and dims with changes in light. Its decimal point tells whether a signal is on X (off) or K (flashing) band. Its audible alarm generates different tones for the X and K bands. A Whistler's Filter Mode minimizes triggering by intrusion alarms, and a variable filter sets triggering threshold as needed. Mute Mode silences the audible alarm near microwave transmissions and automatically restores normal operation when you leave the area. Dark Mode turns off the display completely, without affecting the audible alarm, for discreet nighttime use.

"Spectrum 2" measures only 4.874" × 2.375" × 1.18". It comes with power cords and mounting hardware. $329.95.

CIRCLE 40 ON FREE INFORMATION CARD



3M Memory Expansion Card

Need more memory for your Apple IIe? If so, you can add 3M bytes of additional RAM to your computer with a Ramworks II board from Applied Engineering. A piggyback board that is less than half the size of the 1M-byte Ramworks II main board holds an additional 2M bytes of memory storage capability, using 64 256K dynamic RAM chips mounted in small in-line packages. In addition to the main user RAM storage space, Ramworks II provides a built-in 64K printer buffer that frees your computer for other uses as a long document is being printed.

When plugged into an Aple IIe, the Ramworks II system produces an on-screen desktop message that reads: "2,277K avail." for users of the Appleworks program. $1699 for full 3M; $389 for 1M Ramworks II without piggyback board.

CIRCLE 41 ON FREE INFORMATION CARD

Compact Video Battery

A powerful, compact rechargeable nickel-cadmium battery pack from RCA offers 12-volt video equipment users longer operating time than is possible from the built-in battery. The new Model AVO20 Portable Power Pack measures 6.75"×5"× 1.25" (about the size of a paperback book) and weighs only 1.75 lb., making it small enough to fit in a coat pocket. It can alternatively be strung from a shoulder via its carrying strap or be hung from a belt via its retractable clip.

A warning LED lights when the battery's power is getting low. Recharge to full capacity is then ac-

complished overnight. A self-resetting circuit breaker is built in to pro-

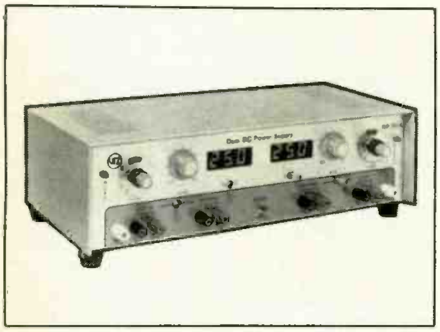
NEW PRODUCTS . . .

vide overload protection, so there is no fuse to replace. Finally, a universal connector allows the power pack to be used with any 12-volt dc product for which the manufacturer makes available an optional dc power cable, including TV receivers, VCRs, video cameras, camcorders and computers. $114.95.

CIRCLE 47 ON FREE INFORMATION CARD

Dual Power Supply

Two fully independent power supplies with separate digital numeric panel meters are featured in VIZ Test Equipment's new Model WP-707A dual dc power supply. Each meter can be switched to monitor both the output voltage and current of either supply simultaneously or indepen-



dently. Each supply has its own set of controls (including circuit-breaker resets) and output connectors.

Maximum output from each supply is 25 volts dc. However, the two outputs can be connected in series to provide a summed output of up to 50 volts dc at up to 2 amperes.

CIRCLE 43 ON FREE INFORMATION CARD

Speech Synthesizer For C-64

A speech synthesizer that can automatically speak text as it is entered and spell words on command is now available for the Commodore 64 computer from Votrax, Inc. Votalker C-64's capabilities include a screen echo that allows words, numbers, punctuation and other symbols to be spoken as they are printed on the screen. Equipped with an SC-01A speech chip, the unit is said to have an unlimited vocabulary. It has a SPEAK command that can be used with numbers, phrases and complex expressions, and pitch, volume and

rate controls to create natural-sounding speech. A MODE command offers three types of text vocalization: "conversation" reads text in a natural manner with appropriate pauses at punctuation marks; "verbatim" reads text and pronounces symbols; and "character" spells each word and pronounces numbers and symbols. Votalker C-64 is fast and easy to use because there is no software to load. All programs and enhancements are in ROM and are accessed with a single key. $99.95.

CIRCLE 44 ON FREE INFORMATION CARD

Portable Micro-Disk Drive

Portability is the main feature of the new battery-powered Tandy 200/

Model 100 disk drive that measures only 6⅛″W × 4⁵⁄₁₆″D × 2″H and weighs a mere 1¾ lbs. The drive can store 100K of data on a 3½″ diskette. Included operating software on diskette lists the files on the disk and provides format, save, load and other functions. Data transfer is at 19,200 baud.

The drive will not initiate a new function if the battery is low, but it will finish the job in progress when a battery-low condition is sensed. A battery warning indicator comes on when the battery's charge gets low, and a separate indicator lights when the disk is being accessed. Four AA cells or an optional ac adapter are required for operation. You initialize the drive by typing a simple three-line BASIC program.

CIRCLE 45 ON FREE INFORMATION CARD

Desoldering Braid

Philips ECG is now marketing a line of Swiftwick desoldering braid in 5- and 25-ft.-length spools. It is available in the five most popular widths, ranging from 0.03″ for fine to 0.13″

for heavy desoldering jobs. The spool labels are color coded for easy identification of each size.

Swiftwick is a sensitive copper braid that is produced through a patented vacuumization process that yields a high-speed reaction wick that sucks up solder safely and quickly.

CIRCLE 46 ON FREE INFORMATION CARD

Canon's Canonvision Model VM-E1 8-mm Camcorder

Giant camera maker Canon U.S.A. has added an 8-mm camcorder to its videocassette portable line, joining a growing number of manufacturers entering models with this format.

Canon's new Model VM-E1 is a luxury-class unit that has virtually everything one could want in a portable VCR if you include a few of its options. The camcorder weighs in at 4.4 lbs without battery and measures a moderate 5⅝"W × 13⅛"D × 5⅞"H. Its suggested retail selling price is a heavy $1500, though, with an added $200 for an accessory kit that includes a power adapter, audio/video/r-f playback adapter, as well as an optional remore-control unit and other items.

The Goodies

The VM-E1's sections are easily assembled (and disassembled). That is, the main body has a mounting shoe that holds an electronic viewfinder, an accessory shoe for mounting a carrying handle and neat "rails" at the rear of the unit to accommodate a choice of two Canon battery packs.

Equipped with a ½" Saticon™ camera tube, an f/1.2 power zoom lens system and a macro mechanism, there is not much else one could want in terms of the camera working end of the unit. Of course, focus is automatic (defeatable).

In keeping with Canon's camera-making heritage, this is really a "system" when one considers some options: wide-angle and telephoto converters to go beyond its 8.5-51 mm focal length, filter sets, a character generator, shoulder brace, microphone boom, car battery adapter, chest pod, system carrying case, and the like.

The built-in electronic viewer provides a 0.7" black-and-white playback picture for viewing live recordings and prerecorded tapes while being used as a portable. An electret unidirectional mic is located at one end, while the viewer is located at the opposite end with an eyecup and diopter adjustment ring for the user's convenience.

Most of the controls are on the left side of the camera body. On the right side there is a single stop-start button and the 6× zoom lens T/W controls for two fingers and the thumb to manipulate.

In addition to having automatic focus, as well as being able to switch to manual if you wish to, there is a "one-shot" focus setting in the manual mode that will lock in the focus automatically for you and not change should a large object (say, a person) suddenly cross in front of the viewing area.

Furthermore, white balance is automatic and held in memory for an hour or so. There's a memory button, too, that will enable one to automatically go to a selected portion of the tape, as well as fade in-fade out control of both picture and sound. It can be used for a three-second fade.

To its features add an LCD window that displays all operating functions being used, warnings such as a "dew light" should condensation be a problem or a weak-battery indication, a well as the usual rewind/playback/fast forward, et al, controls. As you can see, this is no stripped-down model.

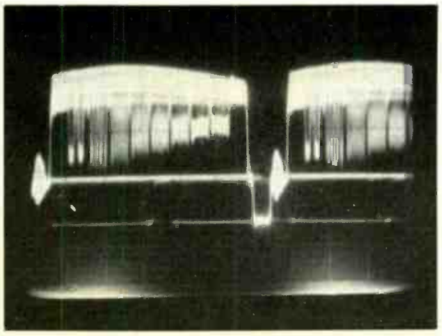
Lab Testing

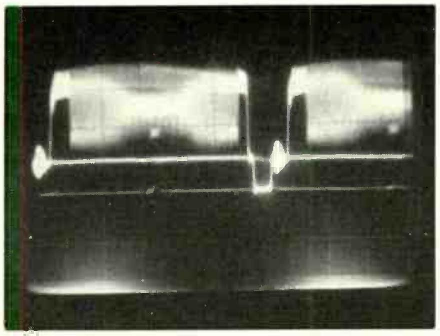
Laboratory tests tell a lot about the new Canon 8-mm model, though not all, of course. With charts developing standard signals as defined by the Electronic Industries Association (EIA), Tektronix and Hale Charts, analysis by the numbers should be quite accurate, though.

As the photogragphs published here show, the Canon's high-frequency response is excellent, extending to at least 3 MHz. This is better than many VHS and Beta VCRs. [Why Canon specs the model at 300 lines with a parenthetical "camera section," which is very roughly 3.75 MHz, makes one wonder.—*Ed.*] Equally fine is its measured 400 lines of vertical resolution, as measured on Tektronix' circular chart.

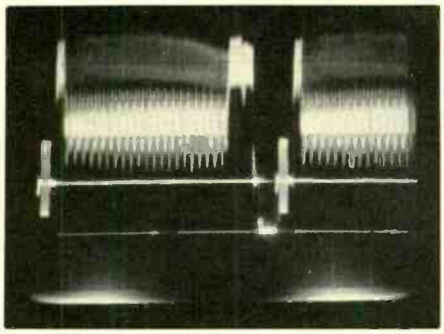
However, Tektronix' I and Q chroma evaluation chart, which excites colors between 400 and 800 kHz (depending on partial chart exposure) did not produce exceptional lavenders or deep blues. Moreover, the Hale color chart, with its three NTSC primaries and complements, wasn't well represented in yellows and reds. Following this, the crossed bandolier of 9 gray-scale steps sags in the middle, while the upper portion has more amplitude than the lower portion.

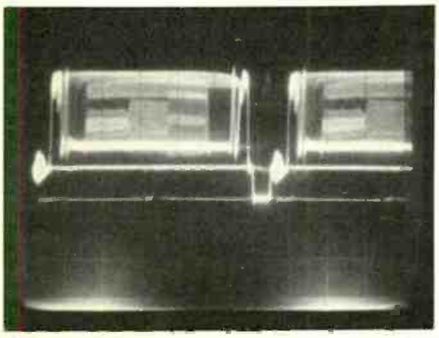
Sensitivity was fine at the 19-lux





Good horizontal (high-frequency) resolution, left, measured an easy 3 MHz. Vertical resolution at 400 lines, right, was also very good.





The Tektronix color chart (at the left) reveals that better indoor color reproduction is to be desired, but outdoor results are quite acceptable. The Hale color chart (at the right) indicates improvements needed for yellow and red indoor reproduction.

Canon Model VM-E1 Camcorder Laboratory Analysis

Camera tube	½" Saticon
Low-light sensitivity	19 lux
Lens	f/1.2 6× zoom with macro
Record/play time	120 minutes maximum
Recommended tape	metal particle (MP)
Tape speed	9/16 ips
Stop/start time	0.5 second
Rewind time (90-minute tape)	3 minutes (approx.)
Video S/N	40 dB
Video high-frequency response	3 MHz
Video vertical resolution	400 lines
Grayscale tracking	fair
Color tracking (indoors)	fair
Audio S/N at 2 kHz	48 dB
Audio frequency response (mono)	5 Hz to 10 kHz, −3 dB
Power consumption at 117 V ac (Play/record)	5.57/9.32 wrms

Note: All responses measured through RU-E1 r-f baseband outputs.

Test Instruments: Tektronix Models 7L5 and 7L12 spectrum analyzers; Hameg Model HM605 oscilloscope; B&K-Precision Models 3020 function generator and 1653 ac power source; Data Precision Model 945 multimeter; RCA Model FLR2622T TV receiver/monitor; Tektronix Model C-5C camera; Kodak P6-120 MP videocassette; Technics Model SA-350 stereo receiver with Jensen speaker systems.

claimed. Video signal-to-noise ratio, though, at 40 dB, was not as good as the specified 47 dB, although the figure measured is par for the course.

As for audio, our examination revealed a maximum useable range to about 10 kHz in contrast to Canon's 14-kHz claim.

User Comments

This camcorder exhibits many unusual assets, not the least of which is a fine sense of physical balance and unusually good handling ease. The zoom worked smoothly and is easy to control. The control clusters make it all so simple. For example, if you want a one-shot focus scene while in manual or complete fadeout of picture and sound, touch two buttons over the lens and all is done. After you've completed a scene and are still in the pause/record mode, momentary contact of the review button is all that's needed to replay at least five seconds of all just-recorded material. And should you wish to see it all, simply press the play mode and enjoy it right through the viewfinder.

I found the liquid-crystal display, which also incorporates an electronic tape counter with memory, to be highly visible, as these displays go.

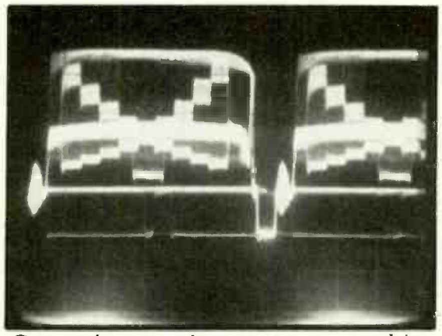
One does have to be somewhat careful of white balance, I learned. The green lamp in my viewfinder never stopped blinking indoors, regardless of flood lighting, but the recorded signal, exposure line indicator and battery/tape-end indicators worked like a charm.

Insofar as color pictures played back, there are always tradeoffs. For example, when a camcorder possesses relatively high definition, outdoor colors are quite acceptable to the eye. Indoors on test patterns, however, finds deep blues, purple and red to be affected, even under standard blue floodlights in daylight mode. And does a little sag among gray-scale steps make that much difference to the eye of the beholder?

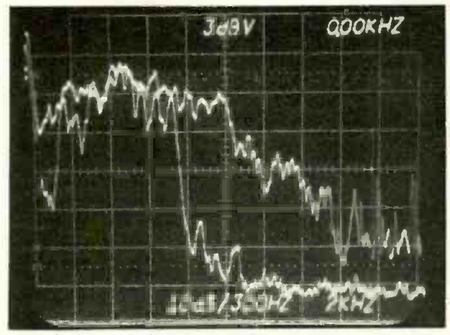
Also, very high signal-to-noise video measurements often translate into narrower bandwidths (less detailed pictures), but better low-light color. So you either accept marginal definition and probably a better quality of low-light color or fairly good definition and a loss of some color,

PRODUCT EVALUATIONS . . .

Canon's Model VM-E1 continued . . .



Grayscale trace shows some sag and its top is exaggerated, but this was not more than was expected.



Audio reproduction at 2 (upper tace) and 0.5 (lower trace) kHz/division is not especially smooth and shows no more than 10 kHz usable frequency response.

R-f unit has a vhf output and separate video/audio inputs and outputs.

especially in poorly illuminated indoor scenes. The Canon falls more into the latter category.

The model's macro function is surely a competent performer. With it, it is easy to get sharp closeups to as near as 3/16", all while watching through the viewfinder. It's a great feature to have if you're a stamp or coin collector, or a flower or insect enthusiast.

In our judgement, the VM-E1 and accessory-kit combination is quality merchandise at a competitive price. It's good equipment all the way.—*Stan Prentiss.*

Counterpoint

C'mon Stan. How may $1,700 buyers are out there who are "live" recordists? Yes, this is a competitive price, but, hopefully, there will be lots more competitors coming up who will drive the price down.

On top of this, the model does not appear to be an all-round great performer, based on the "trade-offs" you yourself cited. And I don't get digital hi-fi stereo sound so that one can use the camcorder as a good stereo/high-fidelity deck, or a timer, nor are there special effects functions available.

Furthermore, why didn't you mention the octopus of wires and contrivance that must be attached to the camcorder in order to make it a "home" unit after schlepping it around and using it on battery power? Just think: you need Canon's CA-E1 compact power adapter that has to be plugged into an ac power outlet, its RU-E1 unit that has to connect between it and the camcorder, another RU-E1 line (VHF Out) to connect to a separate Canon antenna selector, and two more connection lines from the selector that goes to the standard TV set's VHF input and to the antenna (with a 300-ohm to 75-ohm adapter, to boot). Then add a wired remote-control line and you've likely missed whatever you might have wished to record from TV in the first place.

Anyone going through the foregoing hookup hassle for a non-permanent setup, which a portable unit like this camcorder has to be considered, would have to spring for an 8-mm playback deck to avoid it all, as well as buy some costly accessories. A permanently connected "cradle" would be much better.

So my conclusion is not quite as enthusiastically positive as yours, though the model is nice enough. I think it's too much (cost) for not quite enough in terms of performance and built-in functions (primarily digital sound).

—*Art Salsberg.*

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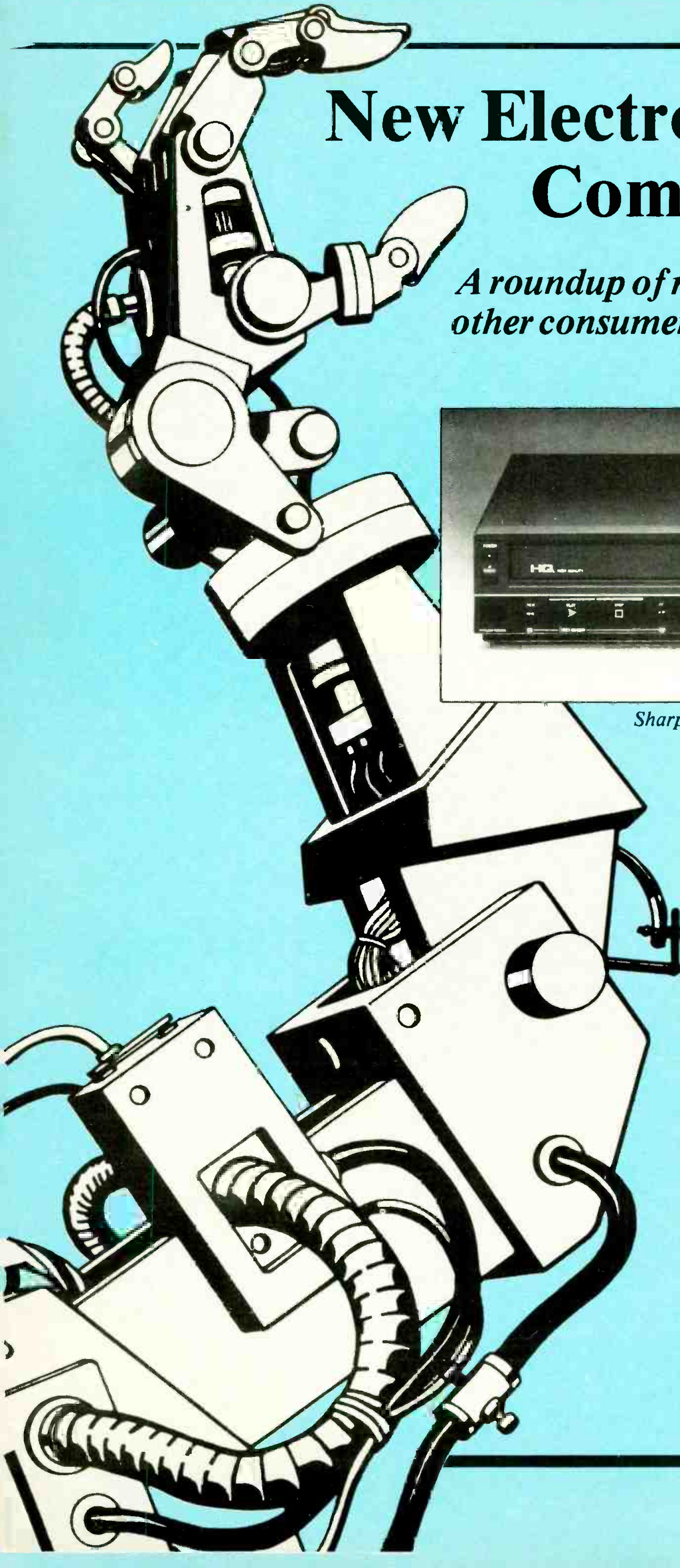


New Electronic Products Coming Up

A roundup of new video, audio and other consumer electronics models

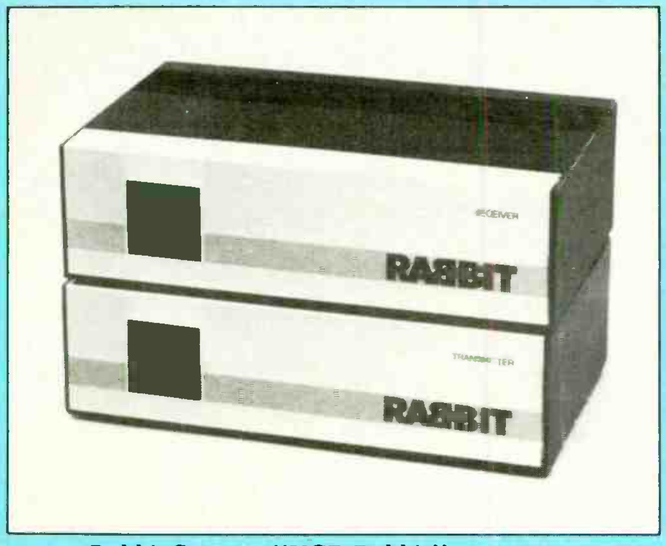
Sharp Model VC-685U "High Quality" VHS VCR.

By Joe Desposito

Just as records are made to be broken, electronics products are made to be enhanced, refined, and otherwise improved so that this year's products are better than last year's, and next year's are even better again. What are the enhanced, refined and improved products that mark the year 1986? And what are some of the trends in electronics that are influencing products that will appear in 1987 and beyond? A recent industry gathering showcased the current crop of leading-edge electronics products and gave hints of what is to come in the near future.

Digital Invades Video

Though television receivers are as common as bathtubs in U.S. households, products that attach to them and even the receivers themselves con-



Rabbit Systems "VCR Rabbit" accessory.

Panasonic "Pocket Watch" 3.5" LCD color TV set.

tinue to make technological advances. Take, for instance, VCRs. This year you will be seeing a new feature available on most high-end video recorders. It is called HQ for high quality.

The HQ feature boosts signals during recording so that the edges of objects in pictures appear cleaner. The process is called white-clip expansion. Additional circuits reduce noise, which helps eliminate the grainy, snowy look of some video pictures.

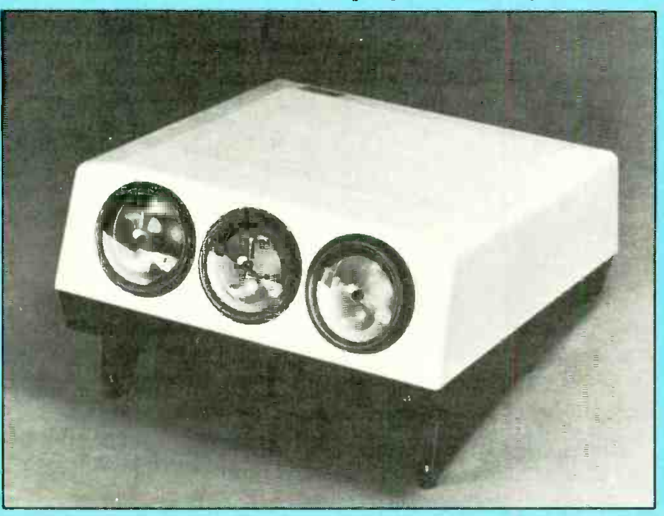
For those who can't get enough of the fare that VCRs offer, there is a device available that allows you to multiply the number of units in your home. It is called, appropriately enough, the VCR-Rabbit and is manufactured by Rabbit Systems (233 Wilshire Blvd., Santa Monica, CA 90401). The VCR-Rabbit consists of a transmitter that is placed on the VCR and a receiver that is placed on the receiving television. Mini-thin wire is used to connect the transmitter to the receiver(s).

Why not a wireless version? The original Rabbit *was* a wireless version, but it did not meet FCC approval. A remote-control version of the product retails for $79.95, while a standard version costs $49.95. Additional receivers are $39.95 and $29.95, respectively.

Television receivers continue to improve, both small screen and big screen. Panasonic's (One Panasonic Way, Secaucus, NJ 07094) Pocket Watch is a slim-line 3"-diagonal LCD color TV that weighs less than a pound. The display features 240 × 372 pixels and a thin-film transistor active matrix system. The transistors allow for subtle variations in hue and color intensity.

Technological innovations in the Pocket Watch include multi-gap color

Kloss Video Novabeam 100 projection TV system.



Sanyo 8-mm Model VM 8 camcorder.

LCD panel, triangle color formation, and black matrix, which dramatically improve contrast and overall picture quality. And, of course, there is an audio/video input jack for the VCR crowd. Suggested retail cost of the Pocket Watch is $299.

In his never-ending battle to bring genuine theatre-quality video into the home, Henry Kloss has developed the new Novabeam 100 Projection TV. The unit comes in three screen sizes: 5, 6.6 and 10 feet (diagonal).

The Novabeam 100 is the first consumer video product to employ Faroudja Processing. The video processing circuit, invented by Yves Faroudja, is said to restore much of the original detail lost in recording or broadcast of video material without introducing visual side effects such as ghosts or outlines.

The Novabeam 100 also contains an improved version of the Novatron, Kloss Video's (640 Memorial Dr., Cambridge, MA 02139) patented projection tube that uses a high-speed (f/0.7), telescope mirror to put the picture on the screen.

If you do a double take the next time you look at a normal-size television, it may be due to the two pictures on the screen. This feature can be found on the new digital TVs that are available from several manufacturers. With a digital TV, it is possible to press a button and have a window appear on the screen. This lets you peek at what is happening on another program source. For example, you can bring up a window on the late night news while watching a movie from your VCR. Another typical digital feature allows you to freeze a frame in the window.

Where there are VCRs and TVs, you are likely to find video cameras. And the new cameras on the market give a clear indication that the 8-mm tape format is here to stay. Six manufacturers—Sony, Sanyo, Canon, Goldstar, Samsung, and Aiwa—have introduced new 8-mm camcorders.

Two of the most interesting video products may not show up in the marketplace for another year or so. Both are from Toshiba (82 Totowa Rd., Wayne, NJ 07470). The first is a digital VCR. The digital M-6900 has 1.15 megabits of RAM, which is used to store images. Conventional VCRs achieve special effects such as freeze-frame and slow-motion through the repetition of an intermittent play/stop movement of the tape against the head. This results in bar noise and an unstable screen image.

The M-6900 uses an analog-to-digital converter to select and store images in its memory. The stored images are then reproduced on a real-time basis. The result is a noise-free, vivid picture. Besides freezing frames from a video tape, it can also freeze frames from broadcast television. Of course, once you deactivate the freeze mode, you'll find that you've missed some of the program you've been watching.

The other product is a television receiver that improves the quality of the picture by using a noninterlace scanning technique. Conventional TVs use

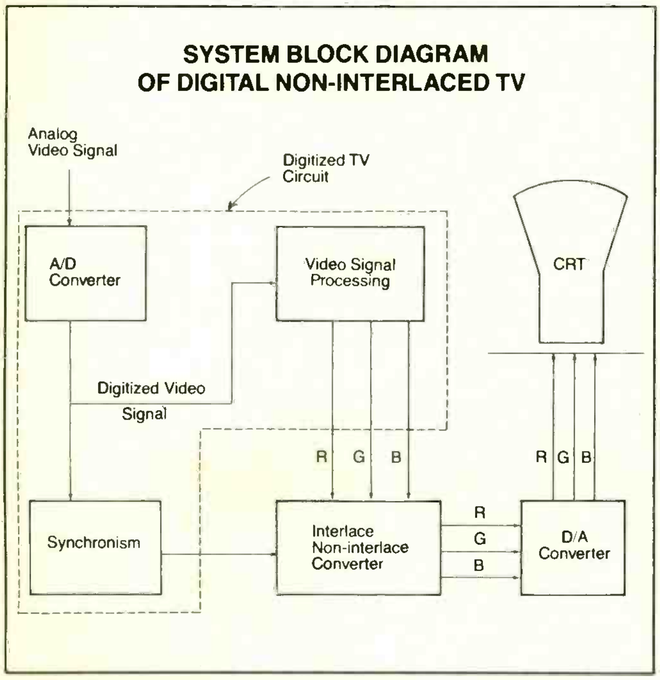
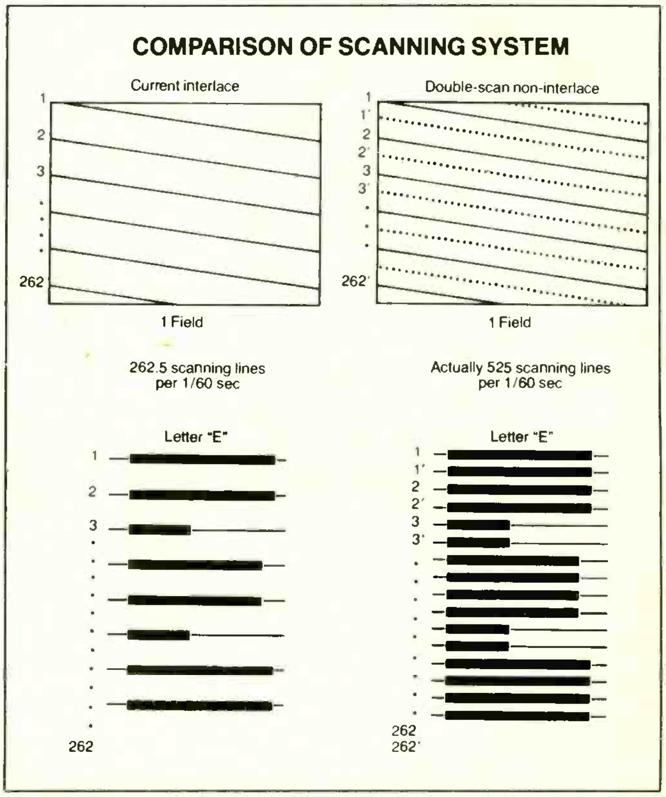


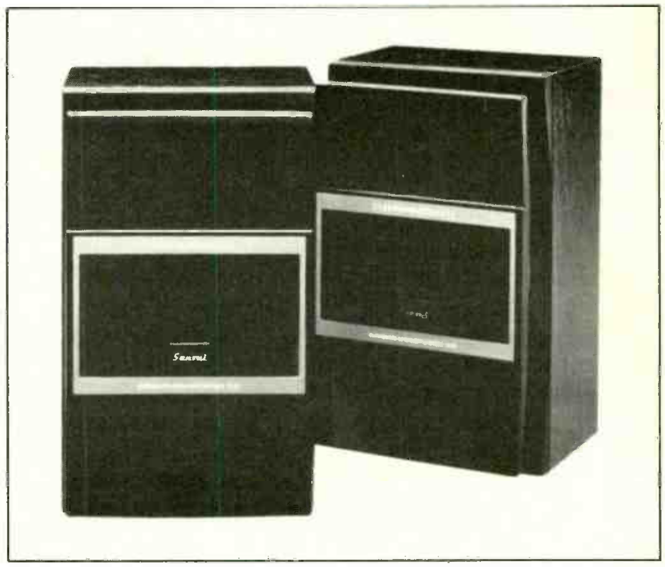
Fig. 1. Analog signal is converted into digital form.

Fig. 2. Digital signal is converted back to analog form to provide full-resolution 525-line scan.



Discwasher "Video Starter Kit."

Sansui Cinemasound adjustable-reflector rear speakers.



the interlace method, which displays 262.5 (of 525) scanning lines of video information every 1/60th second. By using digital circuitry (Fig. 1), the analog broadcast signal is converted into a digital signal in which the horizontal deflection frequency is doubled to complete the missing scanning lines per field. Then this enhanced filled-in signal is converted back to analog to be viewed on the screen. Thus, rather than 262.5 lines, the viewer now sees the full 525 lines every 1/60th second with minimal flicker (Fig. 2).

Toshiba's enhanced television works with ordinary broadcast signals, and it displays an improved picture, but there is still high-definition TV waiting in the wings in case television standards are ever changed in this country. NEC's High Definition Television has a 20-MHz bandwidth, scans 1125 lines, and has a 3:5 aspect ratio. The effect is so stunning that it looks like you are viewing a real life scene through a window.

No discussion of video would be complete without mention of the accessory products that all owners of video equipment need. The one I like best is a video starter kit from Discwasher (4309 Transworld Rd., Schiller Park, IL 60176). It provides all the necessary cables and switches that you usually need but don't purchase when you buy your video recorder. Instructions for hooking the VCR to cable systems and a video head cleaner are also included in the package, which retails for $29.95.

The Sound Around Us

Special sound effects have been recorded on VCR tapes for years, but you need a decoder to hear them. You are probably familiar with "Surround Sound" if you frequent theaters with 70-mm Dolby sound systems. It gives you a realistic effect, such as in Rocky IV, when you actually feel like you are at the big fight.

To achieve the surround sound effect in the home you need a special decoder as well as extra speakers placed to the left and right of the listener. One company among others that markets such a decoder is Surround Sound, Inc. (14025 Panay Way, Marina Del Rey, CA 90292). Its SSI-720 is a full logic Dolby Surround decoder that incorporates the same type of logic steering and automatic calibration circuitry found in Dolby theater systems.

A Dolby Stereo encoded movie actually contains not two, but four channels—left and right front, plus a center front channel and a monaural special effects rear channel. The SSI-720 decodes all the available Dolby Stereo information on tapes and discs, including the Dolby B encoded rear channel. The SSI-720 retails for $599.95.

Nady Infrared wireless stereo headphones system.

The surround or rear speakers are used primarily for ambient sound and thus do not require the same input wattage or output level as the front speakers. Typical surround-sound speakers are Sansui's (1250 Valley

Brook Ave., Lyndhurst, NJ 07071) S-10 speakers, for $150 per pair.

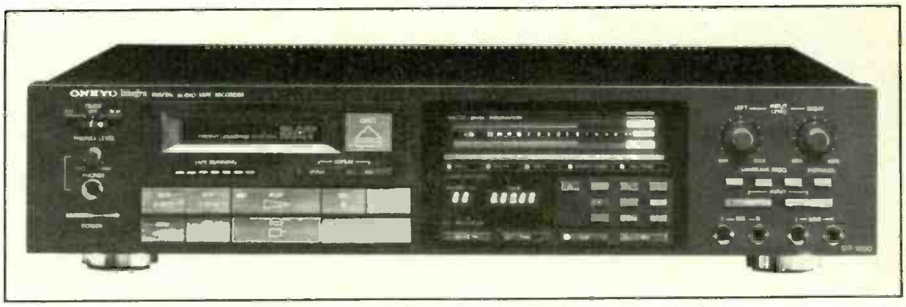
Rather than have speakers all around, some people prefer to cuddle up on the couch with a pair of headphones. A new product from Nady Systems, Inc. (1145 65th St., Oakland, CA 94608) lets you do this and cut the cord as well. Nady's infrared cordless headphones let you move around the room free of the restraining effects of a headphone cord.

Besides the headphones, there is an infrared stereo transmitter that plugs into any stereo or tape deck's headphone jack. An infrared signal is transmitted to a sensor on top of the cordless headphones. Suggested retail price of the system is $119.95. System range is about 25 feet and any number of headphones ($59.95) can be used with the transmitter.

One product that attempts to solve the problem of stolen audio—in cars, that is—is something called the DriveMan from Clandestine Car-Audio (P.O. Box 733, Sudbury, MA 01776). If your car has been broken into once too often, you can install the DriveMan under your dashboard hidden from view, this car-sound device makes a prospective car-radio thief think you do not have anything worth stealing. To use it, you need to connect the output of a Walkman/Discman type personal stereo system to the input on the DriveMan. The DriveMan will then boost the audio output to drive the car speakers.

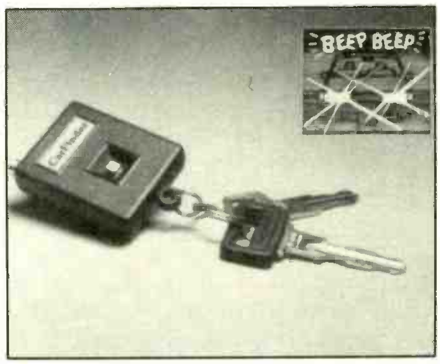
Two important new audio products may debut before the year is over. One of them is a new tuner by NAD (675 Canton St., Norwood, MA 02062), which has a decoder for FMX broadcasts. FMX is the system that was jointly developed by CBS and the National Association of Broadcasters. The FMX extended-range FM stereo system features a 20-dB reduction in noise, improved stereo reception at greater distances, and 90-dB S/N ratio in strong areas.

Another important new audio product is Onkyo's (200 Williams Dr., Ramsey, NJ 07446) DT-1000 digital audio tape recorder. Its R-DAT (rotary digital audio tape) format allows the use of a cassette two-thirds the size of a standard audio cassette, with up to two hours recording and playback time possible. Rotary head scanning, similar to video recorders, provides for large amounts of information to be carried on a very narrow tape width.



Onkyo Model DT-1000 digital audio cassette deck.

The DAT system offers the ability to record at a 48-kHz sampling rate, which is a theoretical increase over the compact disc. It parallels the resolution provided by professional studio equipment that record using the same 48-kHz sampling frequency.

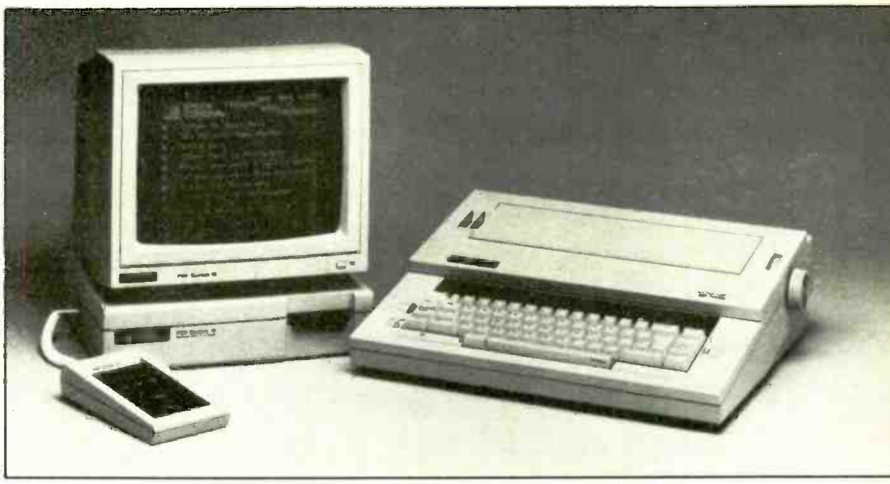


DesignTech Model 007 "CarFinder."

For Your Car

There are a bevy of helpful electronic items for automobile owners that are newly marketed. Among them is CarFinder, which enables you to quickly locate your parked car up to 750 feet away. It includes a 1.4-oz. keychain transmitter and an under-dash receiver. Just push the keychain button and your car's horn honks and its lights flash. Retail price for this is $99.50. (DesignTech, 941 25th St., NW., Washington, DC 20037.)

Willas "TaleLights" rear-window message panel.



Smith Corona Personal Word Processor.

Magnavox Videowriter with built-in thermal printer.

Another automobile device that might well appeal to a lot of people is TaleLights (Willas USA, 8933 Quartz Ave., Northbridge, CA 91324). This is a multi-message signboard that mounts in a rear-window area. It displays in large red letters one of 15 messages. Six are activated automatically (STOP, HAZARD, REVERSE, STOLEN and right and left turn arrows). Driver-activated messages are: HELP POLICE, BACK OFF, HIGH BEAMS, THANKS, CHILD IN CAR, OOPS, SORRY, HI CUTIES, and LET'S PARTY.

What Type of Speller Are You?

It wasn't long ago that typewriters were classified as electric rather than electronic. But today's new electronic typewriters are providing more and more benefits to users. Foremost among thses (whoops!) is the spelling checker. Almost all the major brands of electronic typewriters, including Royal, Smith-Corona, and Olivetti, include this feature as an integral part of the typewriter or as an optional add-on accessory.

The spelling checker beeps whenever you type something that isn't in a dictionary of approximately 80,000 words. Most Models also allow you to insert words that you commonly use, such as proper names. These words then become part of the dictionary.

One group of electronic typewriters has gone beyond spelling to word processing. These are the computer-compatible typewriters from Smith Corona (65 Locust Ave., New Canaan, CT 06840). These typewriters can be connected to Smith Corona's Personal Word Processor (PWP), which is a separate unit that has a 24-line by 80-character 12″ display monitor, microwafer tape drive, 64K RAM, and built-in word processing software. Suggested retail price for the PWP typewriter is $499.99.

And speaking of word processors, someone has finally manufactured a low-cost dedicated word processor. It is from Magnavox (1111 Northshore Dr., Knoxville, TN 37919) and is called the Videowriter. The Videowriter looks like a typical transportable microcomputer except that it has a built-in thermal transfer printer (which works with standard paper when you insert a ribbon cartridge).

The Videowriter features an amber screen that displays 18 lines of 80 characters, a 3.5-disk drive, a dedicated word processing keyboard, and built-in word processing software and 50,000 word dictionary. Suggested list price of the unit is $800.

Answering the Calls

Most telephone answering machines have features that have been around for a few years. But some new products have added twists to the usual array of features. An entire line of products from Record-a-Call (19200 S. Laurel Pk. Rd., Compton, CA 90220) feature a one-button system to perform all the standard answering machine tasks. For example, if you have messages waiting, a press of one button will play all the messages and then rewind the tape to the beginning to ready the machine for new messages.

Ease-of-use is also evident in the answering machines from Phone-Mate (325 Maple Ave., Torrance, CA

90503). If you've ever forgotten (or never learned) how to use your answering machine in remote mode, you would appreciate Phone Mate's remote voice menu feature. A computer voice presents options such as saving, replaying, erasing messages, or recording a new greeting. A touch of a button on the telephone keypad activates the command. The digitized voice is also used in normal operation to time and date stamp messages.

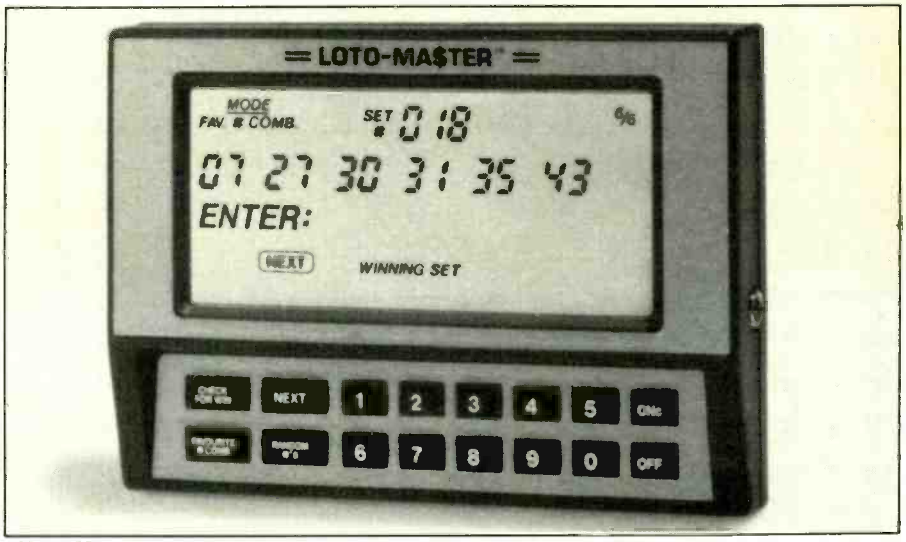
What does the future look like for answering machines? Code-A-Phone has a prototype of what answering machines might be like in a few years. The answering machine is completely solid-state and needs no tapes. Rather, the user's outgoing announcement and incoming messages are encoded on a microchip. A unique feature of the machine would be the ability to skip from the middle of one message to the beginning of the next instantaneously at the touch of a button.

One phone that has a special way of anwering, although it is not an answering machine, is a voice activated speakerphone from Ameriphone (1140-F N. Kraemer Blvd., Anaheim, CA 92806). A simple "Hello" answers the phone up to 10 feet away. And the phone automatically hangs up when the conversation is over.

A Calculated Change

Though electronic calculators seem to stay the same year afer year, there are always some changes that take place. Take the Casio (15 Gardner Rd., Fairfield, NJ 07006) graphic computers for example. These scientific calculators employ an enlarged display area so that graphs may be displayed on the screen. For instance, if you wanted to plot a sine curve or parabola or other curve, you could enter the function and its argument into the calculator and obtain a picture of the curve on the display. The FX-6000G and FX-7000G graphic computers retail for $59.95 and $69.95, respectively.

A custom-calculator that could make you a millionaire is the Loto-Master from CVOS (160 Graveline, St. Laurent, Quebec, Canada H4T 1R7), a lottery number combination selector. Though I don't understand how it "improves players' chances," it does seem like a useful device for players like myself who always pick terrible numbers.



CVOS "Loto Master" personal lottery computer.

Paper Software

If you are tired of the same old precautions associated with floppy disks and need to change, why not try the Softstrip from Cauzin Systems (835 S. Main St., Waterbury, CT 06706). You'll only have to worry about ripping it. The Softstrip is a piece of paper that is a lot like a bar code, but with a lot more information crammed into the same space. A strip can hold up to 5,500 bytes in a ⅝" by 9½" space. If a program or data uses more than 5500 bytes, several Softstrips can be linked together.

A special Softstrip reader is needed to download the information into a computer through an RS-232 interface. If the idea takes hold, you may see Softstrips appearing in many of your favorite computer magazines and books. The reader retails for under $200.

On the conventional software front, a quite sophisticated drawing program has appeared for the Commodore Amiga. Called Aegis Draw, it allows you to create structured drawings with detailed precision and, of course, in color. It is from Aegis Development (2210 Wilshire Blvd., Suite 277, Santa Monica, CA 90403).

Another program of theirs is Aegis Animator, also for the Amiga. The program allows you to create different shapes on the screen and animate them in various ways. You can also create detailed backdrops using the Aegis Images paint system that is included with the animator. The product can be used both as a creative tool and a business tool.

A Concluding Note

After reading about all of these products you may want to start a youngster on his way to a career in electronics. Naturally, there is a new way to do this, too. A product call Bloc-Tronic lets you build electronic circuits by attaching electronic blocks together. Each block contains an electronic component, such as a wire, resistor, capacitor, etc. By combining the blocks with larger system blocks such as an IC-amp, you can build a functioning electronic device. ME

Reading by Computer

Optical data entry is explored, and the Oberon "Omni-Reader" that scans copy and inputs the data to a computer is examined

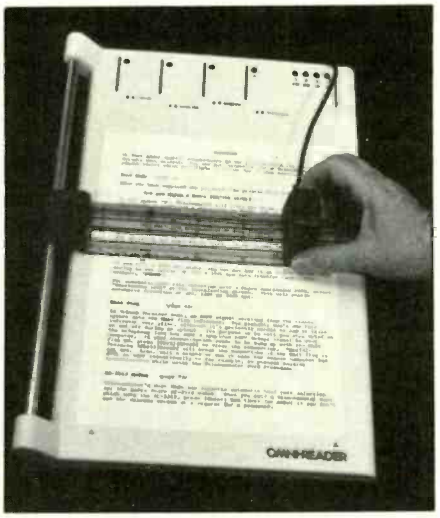
By John Richards

Although the modern business office uses a computer to "crunch" much of its routine facts and figures at lightning speed, except for rare exceptions the data itself is input to the computer manually by a typist pecking away at the keyboard.

The exceptions to the typist spending the entire workday transferring data into the computer from a previously prepared—and usually typewritten list—are mainframe installations equipped with an *optical character reader*, or OCR, a device which in a matter of a few dozen seconds can scan a printed document and convert the printed characters into electrical signals that the computer can process into a disk file, merge with existing files, or utilize as a real-time substitute for keyboard entry.

In the simplest of terms, the OCR device, or *scanner* as it is more commonly known, consists of a motor-driven photodetector that scans a document line by line at a fixed rate. The output of the photodetector is a varying voltage representing the individual characters on the printed page. Generally, an A/D (analog to digital) converter converts the photodetector's output to digital for processing by a microprocessor (actually a computer) built into the scanner. Also within the scanner is either ROM or RAM programmed with digital representations of the various typefaces (fonts) used for both conventional printing and typewriters.

Usually, the programming is done



To store a document in your personal computer, you place it on an Omni-Reader and sweep the read head across each line of text or characters. This enters the data into your computer just as if you typed it in from the computer's keyboard.

in ROM for the commonly used fonts, such as Times Roman for printed materials; Pica, Elite, Prestige Pica, Letter Gothic, Judicial, Delegate, and Artisan for typewriters; and even the OCR font, which is specially designed for optical scanning (it's the typeface usually used to imprint your account number on personal and business checks).

The scanner's microprocessor matches the photodetector's electrical signals to the preprogrammed characters sets, determines what the scanned character actually is, and then outputs an electrical signal to the associated computer which the computer recognizes as a character.

Generally, the output from the scanner to the computer is in ACII form because ASCII can be instantly integrated by the computer into any kind or type of text document: a letter, spreadsheet, data file, whatever. For example, assume the scanner's photodetector "reads" the character "A" (without the quotation marks). Whatever kind of signal is generated by the photodetector at is passes over the "A" is interpreted by the scanner's internal microprocessor as the character "A." Actually, the microprocessor has no idea the character is an "A" since it actually works with electrical repesentations. For example, if the microprocessor works in ASCII it will "see" a 41H (decimal 65), which is the ASCII code for "A" when the photodetector scans the character "A."

The microprocessor, in turn, outputs an ASCII code 65 to the main computer. It doesn't make any difference what kind of signal is generated by the photodetector as it scans across the printed "A" character as long as the scanner's output can be understood by the main computer. Some dedicated optical scanners do their own thing because they work with computers that recognize the output of one particular scanner or a common family of scanners. Nonproprietary scanners—that can be connected to almost any computer—generally output ASCII because this is the closest thing to a universal language for computer peripherals.

The usual purpose for using a lot of relatively expensive hardware to

The actual character scanning is done by a photodetector buried within the read-head assembly. Two small lamps on either side of the decoder provide optimum illumination as the photodetector sweeps across a character being read.

convert printed text to our computer signals is to electronically store a document so that the original can be discarded, thereby reducing the amount of physical area needed to store documents tht might be needed for reference at some future time. For example, an OCR device might be used by the local electric utility to electronically file customer complaints, while a student might store electronic copies of his or her research because it's faster to search an electronic file than to wade through boxes of perhaps thousands of loose papers.

The Budget Way

As you might expect, an automated device that can interpret a page of text into electrical codes in a matter of seconds costs *big bucks,* usually upwards of $5000—which is often several times the cost of a commonly used personal computer. For the budget-minded user of personal computers, there's a much less expensive optical character recognition device called the Omni-Reader, from Oberon International Ltd.

Basically, Omni-Reader is a manual version of the automatic optical scanner. In place of the automatic mechanism that causes a photodetector to scan a document there is a photodetector assembly with two control buttons that are positioned and moved by the user. The user presses one of the two buttons to activate the photodetector, sweeps the photodetector assembly across a line of text, and when the button is released the scanner outputs the line of text, in ASCII, to the associated computer. The second button is used to reset the system in the event something goes wrong with the scan. To ensure precise registration of the detector with the line of text, the assembly is secured to a special ruler (more on this later) that also contains a "clock code."

The complete Omni-Reader assembly consists of a plastic cabinet in the shape of a tablet that is slightly larger than a sheet of typing paper. The top surface contains a track that supports a "line ruler" and its "read" head (the photodetector scanner), a set of eight LEDs that indicate the operating modes, and imprints of four command codes which program certain scanner functions simply through movement of the read head. The scanner's own internal computer—the electronic hardware needed for character recognition—and a serial input/output port (I/O) are built into the tablet itself. Along the back edge (the rear when the tablet is flat for use) are connectors for a plug-in power supply and the optical read head; also, two sets of DIP switches. One set of switches determines the serial I/O baud rate; the other programs the serial I/O for either a modem handshake or Xon/Xoff, turns the internal warning beeper on and off, selects either 10- or 12-pitch character recognition, and programs either a "#" or "£" symbol for the relevant ASCII code. ("#" is used in U.S.; "£" is used overseas.)

Omni-Reader is preprogrammed to recognize the typefaces commonly used in business: 10- and 12-pitch Courier, 12-pitch Letter Gothic, and Prestige Elite 12. (According to the supplied manual, it is possible to download a different font, but no further mention is made of the subject. Perhaps the necessary software is for the future.

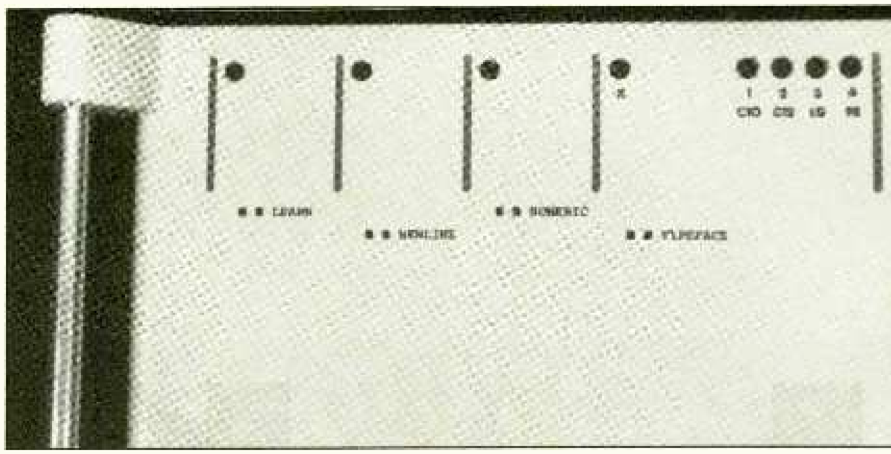
The user-selected font is indicated by one of five of the previously mentioned eight LEDs located across the top of the tablet. The remaining three LEDs show whether the Omni-Reader is in the LEARN, NEWLINE, or NUMERIC modes. LEARN is the mode when downloading a custom font.

The rear edge of the tablet contains, from left to right, a jack for the power supply, a socket for the read head connector, an RS-232 I/O, baud-rate DIP selector, and the DIP selector for 10 or 12 pitch, modem Xon/Xoff handshake, internal beeper on/off and # or £ selection.

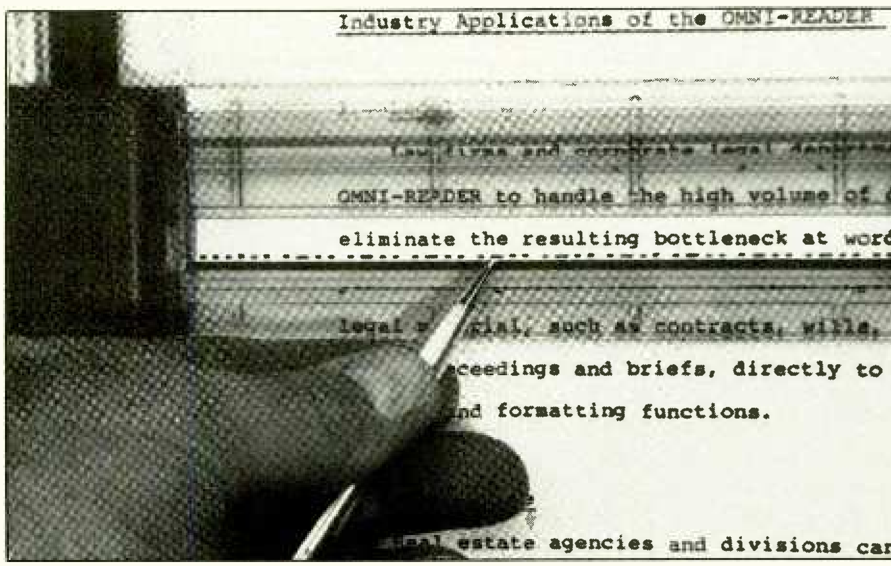
NEWLINE is simply what it implies: when the button on the read head is released at the end of the line a carriage return is inserted so that the next character scanned starts a new line. If the reader isn't in the NEWLINE mode the characters simply append to the previously scanned characters. The NUMERIC mode programs the Omni-Reader to recognize only numeric characters; according to the manual this can speed up numeric entry of numbers.

As in almost everything that's digital there must be some way to clock the signal so that the computer knows what's going on. In the conventional *big bucks* OCR device, the photodetector or the image moves at a fixed or clocked, rate. Hence, the computer can be certain of what's taking place. On the other hand, the Omni-Reader's read head is moved manually, and can take from 0.5 to a couple of seconds to scan the line. Unlike the bar-code reader in your local supermarket, in which the normal tolerance is relatively broad because the photodetector works within a small limited area of thin and thick bars, manual scanning of the Omni-Reader is too wide and too variable; so a way is provided to "clock" the manual scan.

The clock is a series of short and long bars (actually elongated dots) imprinted across the ruler device which carries the read head. These dots are also illuminated along with the characters by two small lamps built into the read head, and the photodetector merges the dots into the pattern seen by the detector. This produces what is best described as a semi-bar pattern consisting of the elongated dots integrated with the "bar" pattern of the characters. Essentially, the read head is "seeing" a pattern of individual bars.



Light-emitting diodes across the tablet's top indicate operating mode(s) and selected character font. LEARN, NEWLINE, NUMERIC, and TYPEFACE functions are determined simply by sweeping the read head across words printed on the tablet.



The pointer indicates the "clocking" marks printed on the bottom edge of the ruler that carries the read head. These marks are read along with the characters and provide the means by which the internal microprocessor can recognize individual characters as the read head scans a printed document.

With The Keyboard

Software provided with Omni-Reader integrates the device's output with that of the keyboard for conventional programs such as word processors, spreadsheets, etc. In plain English, "integration" means that the Omni-Reader's output is in parallel with the keyboard. For example, when word processing, you can type a line of text, then scan any number of lines or pages, and then resume typing; as far as the word processor is concerned all input originated from the keyboard.

It Really Works

Although the Omni-Reader does do what its maker claims, as shown in accompanying illustrations, it takes considerable practice and effort to develop a scanning motion that doesn't drop characters or create typographical errors. Also, it was extremely difficult to generate blank lines without generating "garbage." (For illustrations, we used some printed text supplied with the device.)

Figures 1 and 2 are early attempts to scan the same typewritten copy. In Fig. 1, we had lots of problems with

Fig. 1

```
TEST SHEET:  Read this first and retain for future
reference
OMNI-READER by OBERON INTERNATIONAL LTD
This test sheet, in conjunction with your user manual,
will Drovide all the information you will need to start
using your Omni-Reader.  If you have anY Problems,
consult your manual in greater detail.
uu..=u$- tu$ ...u..uu$ $.. u$-u$-$ uu----.

Before using your Omni-Reader you will need the
following:-

a. A computer system/word processor with a serial
communications port (RS232C or RS423A).
```

Fig. 2.

```
TET SHEET:  Read this first and retain for future
reference

OMNI-READER by OBERON INTERNATIONAL LTD

This test sheet, in conjunction with your user manual,
will provide all the information you will need to start
usino vour Omni-Reader.  If Vou have any problems.
consult vour manual in oreater detail.

1. Before using your Omni-Reader you will need the
following:-
,------a. A computer system/word processor with a serial
communications port (RS232C or RSd23A).
```

Fig. 3.

```
TEST SHEET:  Read this first and retain for future
reference

OMNI-READER by OBERON INTERNATIONAL LTD
.
This test sheet, in conjunction with your user manual,
will provide a+ the infor?tion,you will ne;Y to start
usino Vour Omni-Reader.  If you have anY Problems,
consult your manual in greater detail.
-.
1. Before using your Omni-Reader you will need the
following:-

a. A computer system/word processor with a serial
```

Fig. 4.

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COURIER 10 is used extensively for general office
correspondence.

COURIER !2 is a souare serif desisn inthe Elite familY,
similar to the iO


LETTER GOTHIC 12 is a typeface used mainlv for report
writing, and oeneral

PRESTIGE ELITE !2  is usedmainly for legal correspsndence and
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Fig. 5

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This is a samFie of Pvesti&e Pica 72.
The qufck brown fox, etc.

This is osample oi DccRatc.
Thcquick bvown fox, ett.

Th;:;s a sample of Art;san )2 on !O.
The qu;ck brown tox. etc.

Th!s !s a samp)eof Avt!san )2 on 12, (')!te)
The qu!ck brown (x; etc.

tTs ;? p samPl$of Arc;san 12 on .,
The ou;ck brown fox, ecc.
```

Omni-Reader Test Samples (see text)

line spacing. In Fig. 2, the line spacing is better, but we have a few serious typos and "garbage" when handling the empty lines. Figure 3 was the best we could do using several scanning techniques, as well as a "POOR" reading mode built into the device. We've got the spacing reasonably good—only two extraneous dashes—but a handful of typos.

Using Oberon's own *printed* illustrations, as shown in Fig. 4, the best "reads" were obtained from Courier 10. The 12-pitch fonts produced the most errors.

Although Oberon specifies only four fonts, we couldn't resist trying other typefaces. As shown in Fig. 5, Oberon knows of what they speak because the copy from Prestige Pica, Delegate, and Artisan fonts are almost incoherent.

Conclusions

The real problem with Omni-Reader isn't the few typos it generates—they can be easily corrected from the keyboard; rather, it is its operating speed, which is not just slow, but s—l—o—w. For example, a not-so-experienced typist entered 25 lines (one standard business page) of "almost perfect" copy into a word processor before the Omni-Reader could enter 10 lines, and the reader produced more errors than the typist.

Of course, the relative value of anything is how much it costs for what it does. An Omni-Reader package consisting of optical character reader, RS232 connector cable, software for the IMB PC or Apple MacIntosh, and a training certificate valid for on-site user training is priced at $799. If a few correctable typos are acceptable for that particular application, then $799 is certainly a budget price in today's marketplace. Nonetheless, it is still a handsome investment for a process that has its present shortcomings, though the technology, its promise and its relatively modest price are appealing **ME**

Part 2 (Conclusion)

All About Telephones and How to Repair Them

A look at telephone repair

By TJ Byers

Last month, in Part 1 of this article we examined the telephone system as it exists today and the ways to troubleshoot it. This month, our focus is in how to correct problems that develop within the telephone instrument itself. Before we do this, however, you should know the basic elements that make up the typical telephone.

The modern-day telephone consists essentially of five parts. These are the ringer, the dialer, the hookswitch, the handset and the network. The most frequent failures occur in the ringer and dialing sections. Let's begin our discussion with the ringer section.

Ringer Problems

The basic ringer detects the nominal 86-volt, 20-Hz ac signal the phone company delivers to a subscriber's line when a call is coming in. It does so in a uniquely simple way. A bell-type telephone ringer consists of a coil of wire to which is attached a pivoting metal bar with a clapper at its end. One or two bells are mounted near the clapper. When the low-frequency ac current flows through the coil, the metal bar is attracted by the electromagnetic field, causing the clapper to strike the bell(s) 20 times each second.

A 0.5-microfarad capacitor wired in series with the coil (Fig. 4) isolates the bell coil from the dc portion of the circuit. This capacitor blocks dc but passes the ac that energizes the ringer when a ring signal is present. It's this capacitor that's the most frequent cause of ringer failure, usually by becoming an open circuit. When this occurs, the only remedy is to replace the capacitor. Because the capacitor is an integral part of the terminal board and is not normally accessible the only effective "repair" can be made by jumpering an external capacitor across the proper terminal connections (see Fig. 5). Use a metal-film capacitor rated at 100 or more working volts.

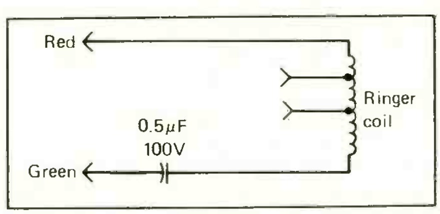


Fig. 4. A 0.5-μF capacitor in series with the coil isolates bell from dc portion of the circuit.

A capacitor rarely shorts, and the coil just as rarely fails. However, if you suspect either condition, remove the coil wires from the terminal board and measure the components with an ohmmeter. Replacement is the only cure if your suspicions are borne out.

Electronic Ringer

Solid-state technology is rapidly making the electromechanical bell ringer a thing of the past. Replacing the bells is the electronic tone ringer (a beeper, a chirper or whatever). Electronic tone ringers can take many forms, but the most common is a piezoelectric transducer driven by an electronic oscillator.

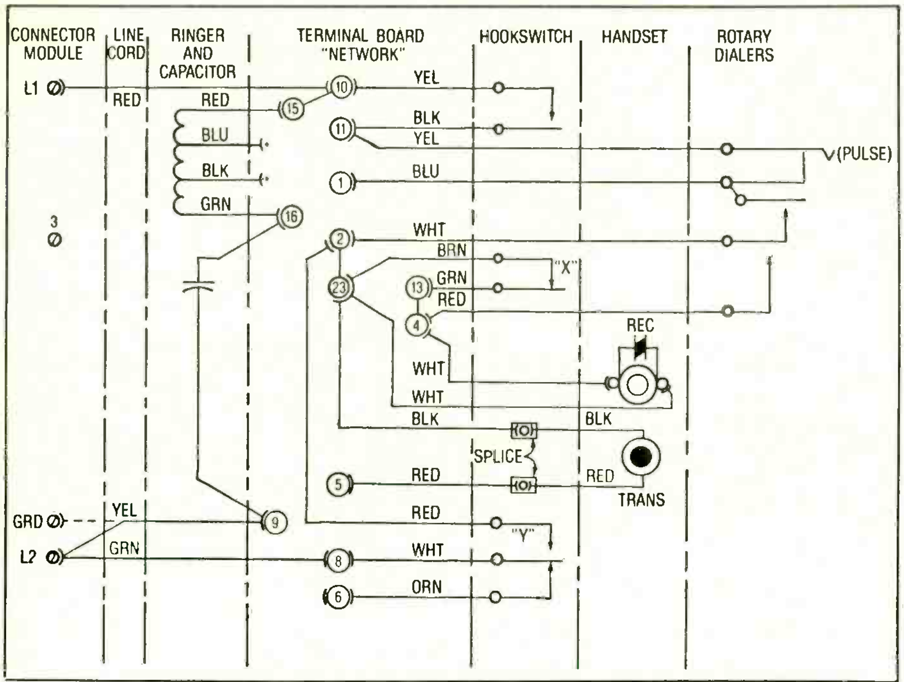


Fig. 5. This is the schematic diagram of a traditional telephone instrument. Included is the terminal board nomenclature.

Integrated circuits are normally used with electronic ringers to detect the ring voltage and drive the piezoelectric element. The Motorola MC34017 is typical of electronic tone ringer chips. As Fig. 6 shows, the MC34017 is a complete ring detector circuit and oscillator in a single 8-pin DIP package. Power for the chip is taken from the telephone line by rectifying the ac ring signal using an internal full-wave rectifier and zener-diode voltage regulator.

To isolate the tone ringer from the voice part of the circuit, the chip uses a series capacitor/resistor combination that connects to the line. The ring tone is set by *C2* and *R2*, while *C3* and *R3* form a filtering circuit that rejects false triggers.

In normal operation, *C1* blocks dc from entering the IC, but when ac exceeding 36 volts appears on the line, current passes through it and into the chip's power supply. Application of power to the internal relaxation oscillator then produces a tone that's buffer fed to the piezoelectric device.

Failure of an electronic tone ringer can often be traced to the transducer or the chip itself. The circuit can be tested by securing the hookswitch in the off position (on-hook) and applying a 60-Hz signal from a Variac, adjusted to 60 volts across the input line. The Variac provides a steady input signal that allows you to take voltage measurements and monitor circuit conditions. Oscillator output can be monitored with a signal trace or substitute transducer. Make sure all tests are performed with the phone removed from service.

Rotary Dialers

Most prevalent of telephone problems are those that occur in the dialer, especially in the case of the mechanical rotary dialer. An amazing achievement of mechanical engineering, the rotary dial is an intricate assembly that rapidly opens and closes a set of contacts connected across the phone line to produce a string of pulses that the phone company interprets as calling numbers.

As you turn the dial, a spring winds and an auxiliary set of shunt spring contacts are activated. The shunt springs short the handset to prevent the pulsing from being heard in the earphones. When the dial is released, a ratchet engages a cam that actuates pulser contacts. Dial speed is maintained at a constant 10 pulses per second by a mechanical governor.

The ratio of time that the pulser contacts are open to being closed is critical for proper dialer operation. This ratio is 61 percent, or 0.61-sec-

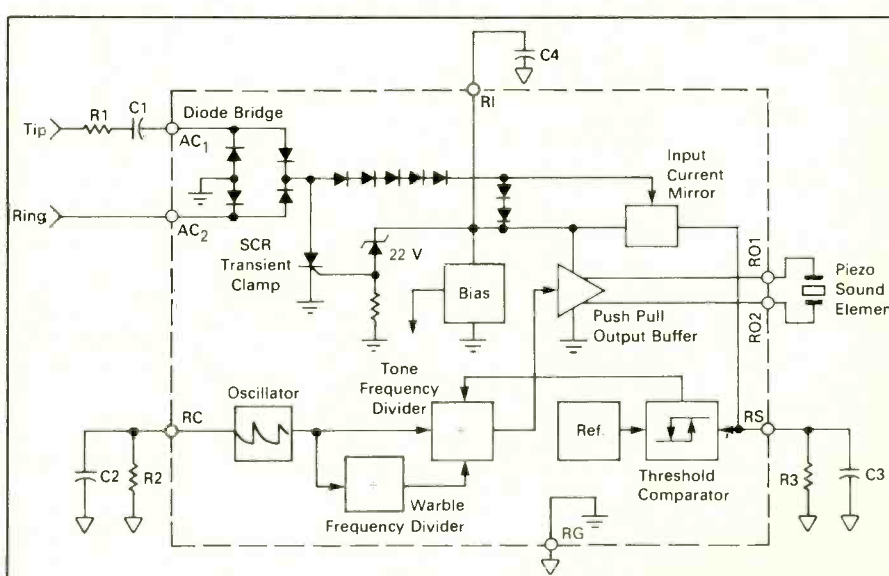


Fig. 6. The MC34017, a complete ring detector circuit and tone generator in a single 8-pin DIP package, replaces the bulky electromenchanical bell.

ond open and 0.039-second closed. Each 100-millisecond (0.100-second) period represents a dial pulse, and each pulse represents a part of a number. The number of pulses in a continuous train is the same as the number of the digit dialed. For example six pulses are generated when the 6 key on the keypad is pressed, and 10 pulses are generated when the 0 (Operator) key is pressed.

Most residential telephones in the U.S. still use mechanical pulse dialers. Since mechanical elements are much less reliable than are all-electronic devices, this explains why dialing problems are the most frequently encountered.

Repairing a rotary dialer is no easy task. Pulse rate and dwell time are determined by spring tension and mechanical spacing inside the dialer. In the case of the pulse rate, the mechanical governor uses spring tension to control "fly-away" weights used to slow down the return of the dial. Too little spring tension on these counterweights, and the dialer pulses too slowly; too much, and it returns too quickly.

Dwell time is determined by the gap between the pulser contact points in relationship to the cam angle. It's set by a procedure very similar to the setting of points in a car and is just as tricky to perform.

Dwell time can also be altered by both contact resistance and contact tension, in addition to the point gap, so check all possibilities. Pulse rate is less critical, and may vary by as much as 100 percent (up to 21 pulses per second) in many exchanges.

Electronic Pulse Dialers

VLSI (Very Large Scale Integration) IC circuits and pushbutton keypads have made the pulse dialer more reliable. In place of the rotating cam and pulser contacts, the new ICs place digital pulses directly on the telephone line electronically.

There are many different types of pushbutton pulse dialers, but all function the same. A representative

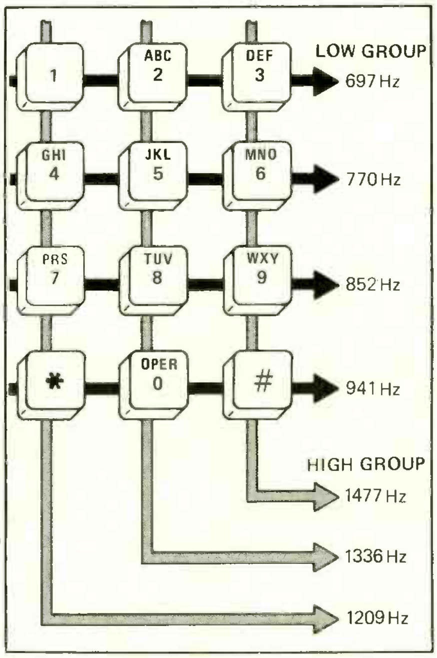


Fig. 7. A block diagram of a typical electronic pulse dialer.

block diagram is shown in Fig. 7. The keypad logic changes a 3-by-4 pushbutton matrix input into a series of output pulses that corresponds to the numeral key pressed. The pulse train is timed exactly the same as the rotary dial, with 61 and 39 milliseconds of off and on times, respectively. At least 750 milliseconds of delay is inserted between pulse streams (numbers) to avoid run-on.

Most of us can punch buttons faster than the dialer can output pulses, though, so the chip contains a memory feature. When a number is entered, it's stored in a memory register inside the chip. As the pulses are outputted, the chip recalls these numbers from memory in the same sequence in which they were entered. This is what makes possible the automatic-redial function found in many modern telephones. Since the telephone number last dialed remains in memory, a single keystroke can recall it. Because of this, most electronically pulsed phones have this feature.

Very little can go wrong with an electronic pulse dialer, other than failure of the chip. Almost all functions are contained within the chip itself—with the possible exception of the power supply.

Digital dialers derive power from the 50-volt telephone line. In most cases, the diodes needed to steer the source voltage aren't inside the chip. They're found as discrete components on the printed-circuit board, usually within easy reach of the hookswitch.

Should one of the diodes fail, strange things can—and do—occur. There are four diodes, usually of the 1N4000 series, arranged as a full-wave bridge rectifier. This configuration doesn't change ac into dc; rather, it steers the positive and negative lines so that the telephone isn't polarity sensitive. So if your automatic pluse dialer isn't working, the first thing to check are the diodes.

Touch Tone Dialing

Touch Tone is a signaling system that's rapidly replacing the rotary dial and holds the promise of expanded services for the future. Technically defined as Dual-Tone Multi-Frequency (DTMF) communications, Touch Tone offers increased speed and the ability to communicate data.

Instead of sending groups of pulses to the central office, Touch Tone transmits pairs of tones to the central exchange, where they're deciphered by special receiving equipment. Because the DTMF tones are in the audio range, two tones are used to distinguish between actual signaling and voice. Tone signaling is based on an internationally accepted standard of frequencies that includes four tones of a lower register and three of a higher frequency. All digits are derived by combining one low group frequency and one high group frequency, as illustrated in Fig. 8. DTMF tones are sent with a minimum duration of 50 milliseconds and interdigit time of 45 milliseconds.

The tone frequencies must be accurate to within 1.5 percent of their stipulated value under all conditions of temperature and voltage through-

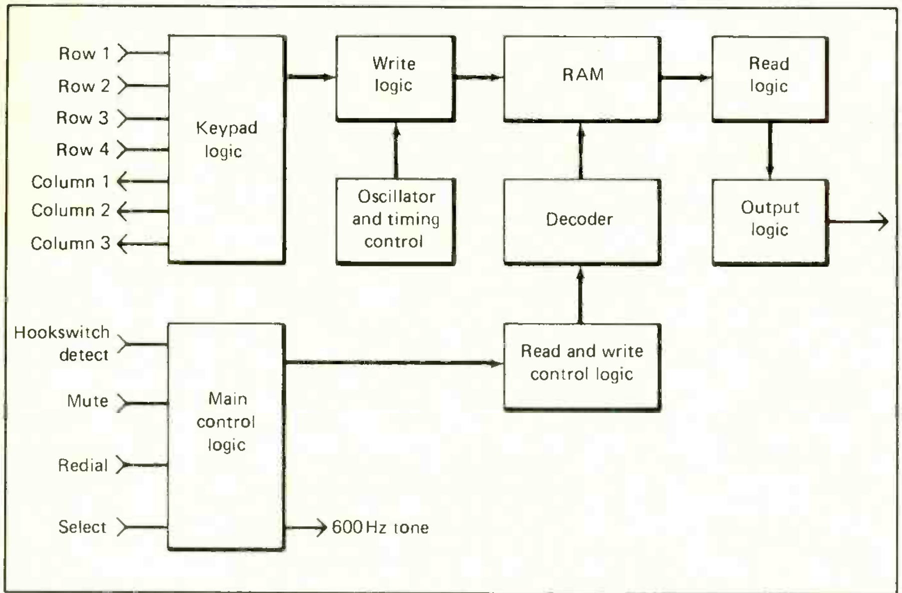


Fig. 8. Touch Tone dialing uses tones instead of pulses for transmitting numbers and data. All 10 digits and two special-purpose keys are represented by combining one low group and one high group frequencies to form a DTMF tone.

out the life of the telephone. Touch Tone dialers manufactured by Western Electric (a subsidiary still retained by AT&T) uses a single trasistor LC oscillator to achieve the stability necessary for DTMF. The inductors used for the oscillator are multitapped for different impedance values.

Touch Tone pushbuttons are mechanically connected to 11 sets of gold-plated contacts. Pressing any one button actuates seven of the 11 contacts, causing a different inductance to be inserted into the oscillator circuit, and a different pair of tones to be generated. Five contacts are sealed in a clear plastic dust cover and seldom, if ever, need servicing. The remaining six are located around the upper perimeter of the Touch Tone keypad, occasionally giving trouble. The trouble usually appears as a single tone instead of the normal two. Repair is simple: clean the contacts, using only nonabrasive chemical cleaners—*never* sandpaper.

The inductors are slug tuned, using a triangular alignment tool. One inductor tunes the high range, the other the low range. Always use a frequency counter when adjusting these coils.

Recently, telephones have been introduced that include all the electronics necessary for a reliable DTMF system on a single chip. Like pulse dialer ICs, the DTMF circuits decode a keyboard input and translate it into dual-frequency tones. Failure of this design can almost always be attributed to power supply, DTMF chip, or keypad, in that order. Use the techniques outlined above for troubleshooting.

Voice Processing Networks

There are three parts to the voice circuit. They are the hookswitch, the handset and the network. The hookswitch is that part of the circuit that determines if the phone is on-hook (out of service) or off-hook (in use) and is the device that actually connects the microphone and speaker across the line. The switch is sealed inside a dust-proof plastic box and seldom causes problems. If problems do arise, they can normally be cured by thoroughly cleaning the contacts with a chemical cleaner.

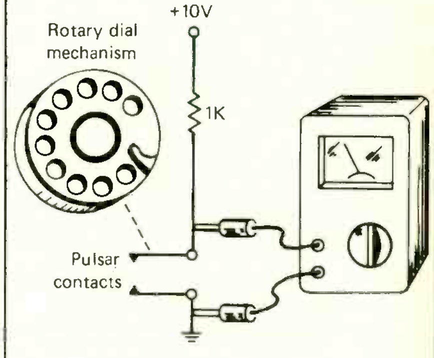
In electronic telephones, the hookswitch may be nothing more than a simple spst microswitch that connects an input transformer (and related circuitry) across the line. A jumper wire or ohmmeter can easily spot a defective hookswitch.

The next component is the handset. Time was when the handset was a unit on its own, apart from the main body of the telephone and tethered with a coiled cord. Today, we see more and more integration of the telephone itself into the handset, as witnessed by the trend in one-piece telephones.

Other than occasional failure of a microphone or speaker, little can be said about this part of the telephone. Traditional handsets have removable cups that allow for easy replacement of defective elements. One-piece designs must be dealt with accordingly. More and more, electret mike ele-

(Continued on page 91)

Measuring Rotary Dial Dwell Time



Schematic of electronic telephone.

The ratio of the time the pulser's contacts are open to the time they're closed is easily measured using a power supply and a multimeter as follows. Connect a 10-volt power supply in series with the pulser's contacts and a resistor shown above and monitor the voltage across the contacts. The voltage displayed by the meter is proportional to the dwell time, with a 10-volt reading representing 100%. Any fractional part of 10 volts gives a percentage reading that requires only proper location of the decimal point. For example a 6-volt reading translates to 60%, a 5.5-volt reading translates to 55%. Ideally, the reading should be 6.1 volts, which translates to 61%.

An Audio Step Generator

This project takes the tedium out of making frequency-response tests on audio equipment

By Jack Cunkelman

Running a frequency-response check with an audio signal generator can be quite a chore. A signal generator being the kind of instrument it is, you spend a lot of time just adjusting level controls. The greater the number of points to be plotted in a test, the more time you spend on monitoring signal levels and making adjustments. The Audio Step Generator described here is an ideal way around this problem. It automatically selects a series of frequencies and maintains a constant output level, letting you concentrate on the frequency-response test instead of on the test conditions.

Using a combination of analog and digital techniques, the Audio Step Generator automatically steps through 10 frequencies of your choice while maintaining an output level that is constant within 0.5 dB over the entire 20-Hz to 20-kHz range. In addition, sine-wave signal distortion is good enough to suit the needs of most users who do not require laboratory precision.

About the Circuit

The Step Generator is built around function generator integrated circuit *IC1* in Fig. 1, selected for this application because of the ease with which the frequency can be changed. Ordinarily, function generator chips do not produce low-distortion sine waves. However, the XR2206 chosen for *IC1* here provides a 0.5% distortion figure, which is acceptable in all but critical applications. Potentiometers *R1* and *R2* are used to adjust distortion of *IC1* to a minimum.

While it is possible to generate a sweep frequency output from a function generator, the ability to determine the frequency at any given instant is lost by doing so. Hence, it was decided that 10 discrete frequencies that could be stepped through would be used. Capacitor *C1* and the resistor connected to pin 7 of *IC1*, which we will refer to as R_X but is actually identified in Fig. 1 as *R9* through *R18*, determine the frequency of oscillation from the formula $f_O = 1/(R_X \times C1)$, with f_O in Hz, R_X in ohms and *C1* in farads.

Though the value of either R_X or *C1* can be varied to change the frequency, it is easier to fix the value of the capacitor and vary that of the resistor in steps. The Table lists various frequency and resistor values needed to generate these frequencies. Trimmer potentiometers or fixed resistors can be used for R_X, depending on the frequency accuracy you require. A Mylar or polystyrene capacitor for *C1* will provide maximum stability. If you use a 5% tolerance capacitor, the frequencies will be more accurate when using fixed resistors.

When pin 9 of *IC1* is open, R_X determines the frequency of oscillation. Grounding pin 9 makes *R6* the frequency-determining element. This feature is used to provide a SET LEVEL position in the project to permit setting initial levels before starting a frequency run, using *S1* to switch this function on and off.

Various values for R_X are switched in with the *IC3, IC4* and *IC5* CMOS switches. The switches are turned off and on by divide-by-10 counter *IC2*. Two NAND gates in *IC6* are wired as an oscillator to drive counter *IC2*. This oscillator sets the rate at which the frequencies are switched. The pulse output rates of this oscillator are determined by the *R7/C5* time constant. Using an audio taper for potentiometer *R5* permits the rate adjustment to be spread out over the

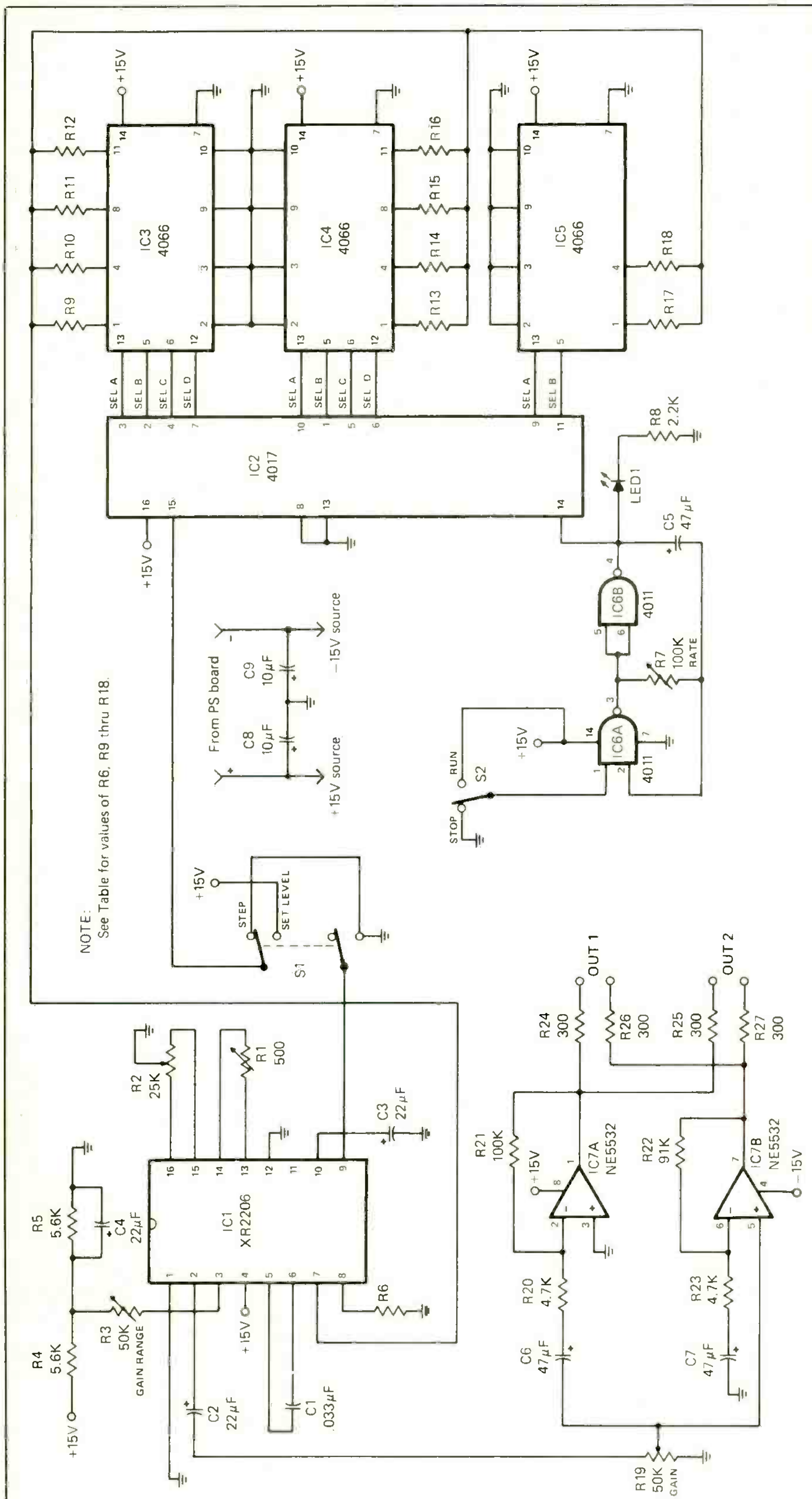


Fig. 1. Schematic diagram of main analog circuitry that makes up the Audio Step Generator. IC1 is a commonly available function generator IC chip.

PARTS LIST

Semiconductors
D1 thru D4—1N4005 rectifier diode
IC1—XR2206 function generator
IC2—4017 counter
IC3 thru IC5—4066 CMOS switch
IC6—4011 quad NAND gate
IC7—NE5532 dual op amp
IC8—7815 +15-volt regulator
IC9—7915 −15-volt regulator
LED1—Light-emitting diode

Capacitors
C1—0.033-µF, 5% Mylar
C2 thru C4—22-µF, 25-volt electrolytic
C5 thru C7—47-µF, 16-volt electrolytic
C8,C9—10-µF, 25-volt electrolytic
C10,C11—2200-µF, 25-volt electrolytic

Resistors (¼-watt, 10% tolerance)
R4,R5—5600 ohms
R6—See table
R8—2200 ohms
R9 thru R18—See table
R20,R23—4700 ohms
R21,R22—100,000 ohms
R24 thru R27—300 ohms
R1—500-ohm trimmer potentiometer
R2—25,000-ohm trimmer potentiometer
R3—50,000-ohm trimmer potentiometer
R7—100,000-ohm audio-taper potentiometer
R19—50,000-ohm audio-taper potentiometer

Miscellaneous
F1—¼-ampere slow-blow fuse
S1—Dpdt switch
S2,S3—Spst switch
T1—30-volt, 500-mA center-tapped transformer Printed-circuit board, perforated board and solder posts, or large solderless socket (see text); sockets for ICs; panel-mount, bayonet-type fuse holder for F1; suitable chassis box (LMB No. CR864 or similar); control knobs (2); output connectors; line cord with plug and strain relief; machine hardware; hookup wire; solder; etc.

entire range of the pot. When pin 1 of *IC6A* is high, the oscillator is enabled. Pulling pin 1 to ground disables oscillation. This is the RUN/STEP function. Its condition is determined by the setting of *S2*. When power is on, the frequencies are changed each time *LED1* goes from off to on.

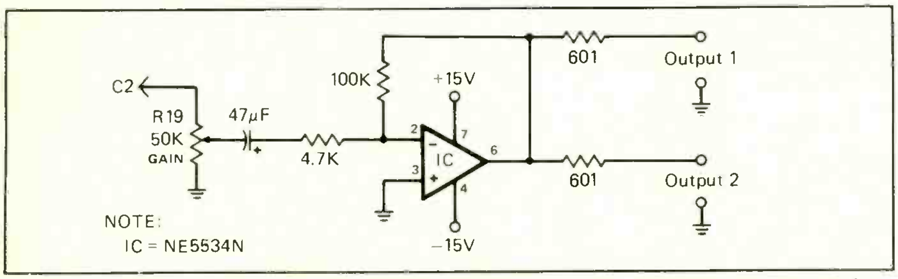


Fig. 2. This alternate output circuit provides outputs that properly match 600-ohm unbalanced inputs.

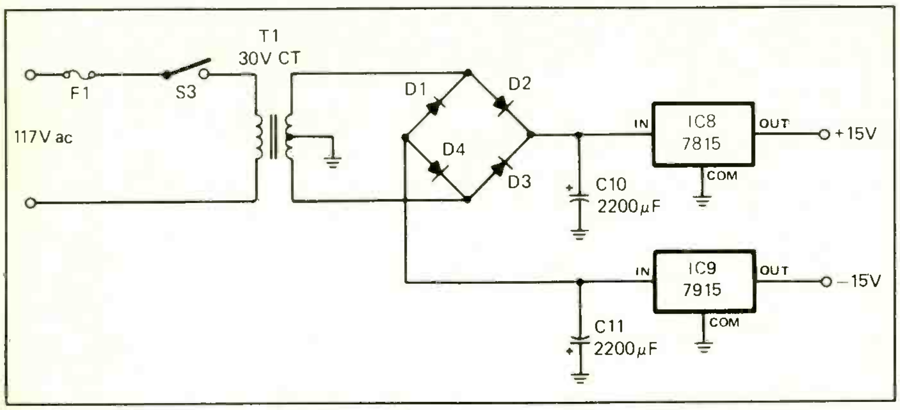


Fig. 3. This is the schematic diagram of the power supply used with the Step Generator's circuitry.

The output from this oscillator is fed into the clock input of counter *IC2*. The counter advances each time the clock pulse goes from ground to positive. As the counter advances, each of the 10 outputs is made positive, one at a time, in step fashion. The reset pin is normally at ground by setting *S1* to the STEP position. Throwing *S1* to the SET LEVEL position resets the counter to 0 and "sets" the function generator to its fixed frequency position. Thus, going from SET LEVEL to STEP always starts at the same spot.

The outputs of counter *IC2* drive the control terminals of analog switches *IC3, IC4* and *IC5*, which in turn switch in various values for R_X. When a control pin is made high, the switch is on. (The analog switches have an on resistance of approximately 100 ohms.)

Output buffer amplifier *IC7* contains a pair of high-performance operational amplifiers that provide balanced 600-ohm outputs. Inverting amplifier *IC7A*'s input and output are 180 degrees out-of-phase, while buffer *IC7B*'s input and output are in-phase with each other. Using one output from *IC7A* and one from *IC7B* yields a balanced output. Output impedance is fixed at 600 ohms by *R24* and *R26* for OUTPUT 1 and by *R25* and *R27* for OUTPUT 2. With two outputs available, you can check both channels of a stereo amplifier simultaneously.

In Fig. 2 is shown a scheme to derive two *un*balanced outputs. Only one amplifier is needed in this case. Output impedance is determined by the values of the resistors in series with the output. These values can be changed as needed.

As shown in Fig. 3, the power supply for the project is relatively simple. Its 30-volt center-tapped transformer feeds a four-diode bridge whose output is filtered by two capacitors and is regulated at +15 and −15 volts with separate IC regulators. (A 24-volt center-tapped transformer and 12-volt regulators could be used, but maximum output from the project would be less.)

Construction

There is nothing critical about construction. Just be sure to keep the ac line and power supply proper as far as possible from the analog circuits. Any reasonable method of wiring the project can be used—a printed-circuit board of your own design, perforated board and solder or Wire Wrap hardware or even a large solderless breadboarding socket.

It is a good idea to socket all ICs except the regulators. As you wire the project, referring to Figs. 1 and 3, be sure to observe proper orientations for the ICs and polarization of electrolytic capacitors and diodes.

Fig. 4 shows the Step Generator's analog cirlcuitry wired on a 4″ × 4″ perforated board with the aid of appropriate mounting/soldering hardware. The power supply section (Fig. 5) was assembled on a separate 4″ × 2″ perforated board. Because current drain is quite low, no heat sinks are required for the regulators.

The project fits nicely into an 8″ × 6″ × 4½″ chassis box. This size box assures ample front panel area for the controls, switches and LED, as well as enough interior space to insure isolation of the power supply from the main analog board.

Machine the chassis box as required. Drill holes for the controls, switches, output connectors and LED on the front panel, and the power supply board, power switch, power transformer, fuse holder and line cord on the rear panel. The analog board mounts on the floor of the box, as far forward as possible without interfering with the front-panel components.

Mount the power supply board on with 6-32 machine hardware and spacers. Mount the power trans-

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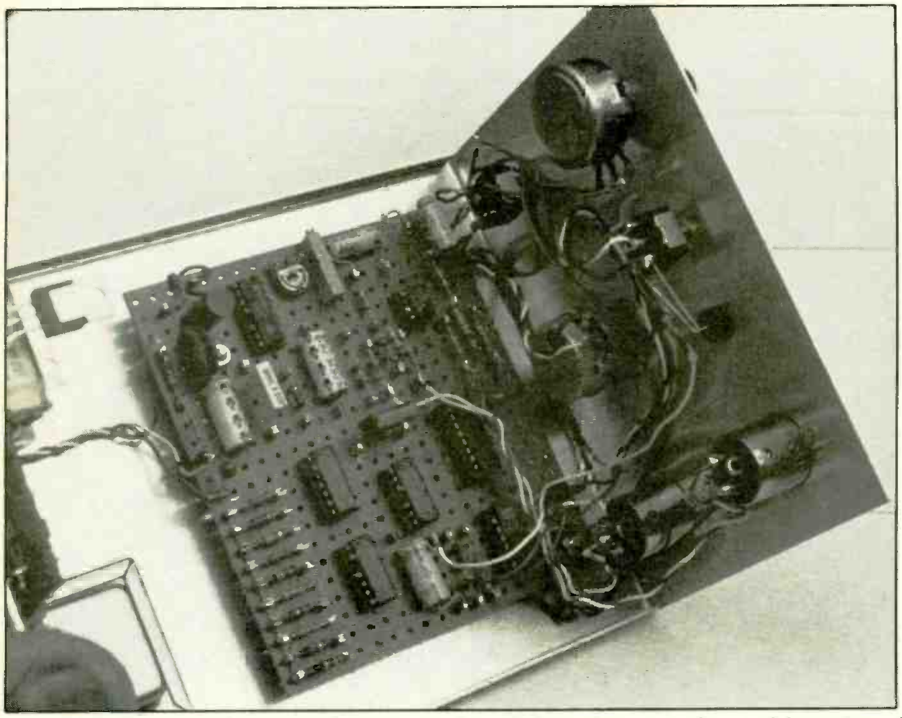

Fig. 4. This view shows analog circuit board layout on perforated board and front-panel component mounting details. ICs are in sockets.

Resistor Values			
Frequency (Hz)	**Value (ohms)**	**Frequency (Hz)**	**Value (ohms)**
20	1.515M	8k	3637
40	757.42k	10k	2880
80	378.64k	12k	2375
100	302.88k	14k	2014
400	75.607k	16k	1743
800	37.728k	17k	1632
1k	30.153k	18k	1533
2k	15.000k	19k	1444
4k	7425	20k	1365
6k	4900		

Resistor values for some typical frequencies. Select 10 frequencies that best suit your needs. The values shown in this table were selected for a 0.033-μF value for timing capacitor *C1*.

former and the fuse holder. Use a strain relief to secure the line cord in place about 4″ from its free end inside the box. Alternatively, line the remaining hole with a rubber grommet and pass the line cord through into the box and tie a knot, leaving about 4″ of wire inside the box.

Connect and solder one of the transformer's primary leads to one lug of the power switch and a short heavy-duty stranded hookup wire from the other lug of the power switch and one lug of the fuse holder. Connect and solder one line cord wire to the remaining lug of the fuse holder. Though Fig. 3 does not show it (the photo in Fig. 4 does), you can use the second pair of contacts of a dpdt switch to make and break the lower line in the transformer primary circuit simultaneous with the make/break action of the fused line. If you do, connect and solder the other line cord wire to one lug of the second switch section and the remaining transformer primary lead to the other lug. Otherwise, twist together the line cord wire and primary lead and screw onto the connection a wire nut.

Mount the front-panel components and the analog circuit board on the floor of the box. Referring to Figs. 1 and 4, carefully wire the controls, switches and LED into the circuit. When you are finished wiring the project, carefully go over all your wiring, particularly in the power supply, to make sure that everything is okay before you power the project.

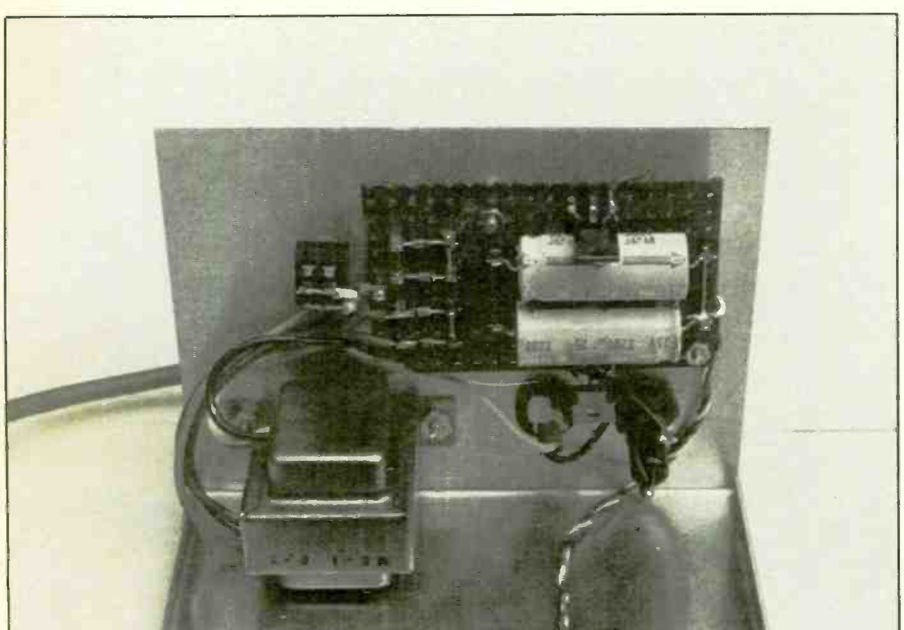

Fig. 5. Power supply board, transformer, fuse holder and power switch mount on rear panel. Secure the line cord as explained in the text.

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SSSD = Single Sided Single Density; SSDD = Single Sided Double Density; DSDD = Double Sided Double Density; DSQD = Double Sided Quad Density; DSHD = Double Sided High Density; TPI = Tracks per inch.

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S1 to the SET LEVEL position. Connect an oscilloscope probe to the top of GAIN control *R19*. Plug in the Step Generator's line cord and turn on the power. While observing the oscilloscope display, adjust *R1* and *R2* for minimum distortion of the sine wave; *R1* adjusts for symmetry and *R2* adjusts for shape. You want a waveform with good rounding and symmetry. (If possible, use a distortion analyzer to adjust for minimum distortion. It should be possible to get the distortion down to 0.5% with trimmer potentiometers *R1* and *R2*.)

Move the scope's probe to one of the outputs of the buffer amplifier. Turn GAIN control *R19* fully clockwise and adjust *R3* until clipping is evident; then back off until clipping just disappears. This is the maximum output point. It should be about + 22 dBm with a + 15- and − 15-volt power supply.

Operation of the Audio Step Generator is relatively straightforward. With *S1* in the SET LEVEL position, adjust the output level of the Generator to the level the device under test normally sees at its input. Then set *S1* to STEP and use *R7* to set the RATE at which the generator steps through the frequencies. With STOP/RUN switch *S2*, you can stop the Generator at any frequency and then continue on. Whatever frequency is selected will be positioned between the highest and lowest frequencies to serve as a marker so that you can tell where the Generator is oscillating **ME**

Resistor Calculation

To calculate resistor values for a given frequency more accurately, you must obtain a more accurate value for timing capacitor *C1*. The following computer program will do this for you and then calculate the resistor values for any 10 frequencies you choose. For this procedure, you will need a good ohmmeter and a frequency counter (or oscilloscope). The program was written to run on an Apple II.

Your first objective is to accurately determine the value of *C1* as follows:

(1) Connect the frequency counter or oscilloscope to the Step Generator's input. If you are using a scope, set its sweep to external and apply a 60-Hz signal to the external input from a 6.3-volt filament transformer or other convenient signal source.

(2) Temporarily substitute a 250,000-ohm potentiometer for *R6* on the Step Generator's main board. Connect either outer lug of the pot to one of the resistor connections and the wiper lug to the other resistor connection.

(3) Set the Step Generator to its SET LEVEL mode and adjust the potentiometer for a reading of 240 Hz on the frequency counter. If you are using a scope, the displayed Lissajous pattern should resemble two connected figure 8s lying on their sides when the pot is properly adjusted.

(4) Making sure not to disturb the potentiometer's setting, disconnect it from the circuit and measure the resistance between its wiper and the selected lug. Make a note of your reading, since it will be used later by the computer program to calculate the value of timing capacitor *C1*.

```
]
]LIST

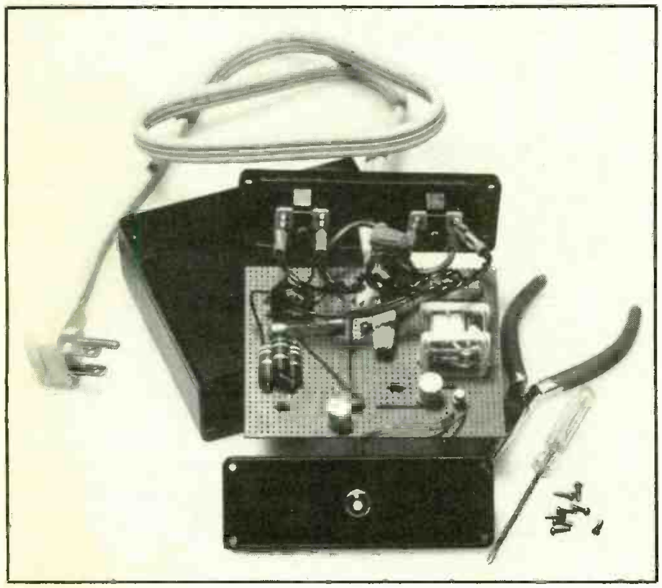
10  HOME
20  REM  ** STEP GENERATOR
30  REM  ** RESISTOR CALCULATION
40  INPUT "DO YOU WANT TO CALCULA
     TE THE EXACT        CAPACITANC
     E VALUE OF C1 (Y OR N) ?";A$

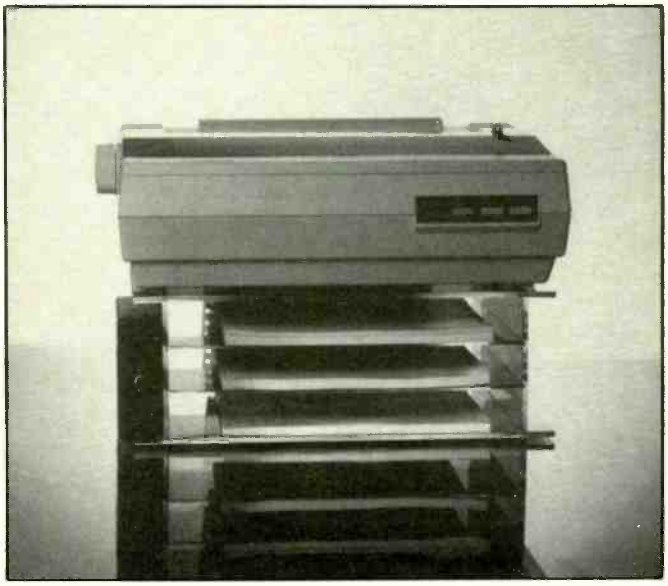
45  PRINT
50  IF A$ = "Y" THEN 90
60  IF A$ = "N" THEN 70
65  GOTO 40
70  INPUT "ENTER THE VALUE OF C1
     (UF)";C
75 C = C * 1E - 6: PRINT
80  GOTO 130
85  PRINT
90  INPUT "INPUT RESISTANCE MEASU
     REMENT OF TEST POT (OHMS)";R

95  PRINT
100 C = 1 / (R * 240)
120  PRINT "EXACT VALUE OF CAPACI
     TOR C1 IS "C" UF "
125  PRINT
130  PRINT "INPUT THE 10 FREQUENC
     IES YOU WANT TO    CALCULATE
      RESISTOR VALUES FOR (HZ)"
140  FOR Z = 1 TO 10
145  PRINT Z;
150  INPUT F
160 R = 1 / (C * F)
170 F(Z) = F:R(Z) = R
180  NEXT Z
200  INPUT "DO YOU WANT PRINTER O
     UTPUT (Y OR N)";P$
210  IF P$ = "Y" THEN  PR# 1: GOTO
     240
220  IF P$ = "N" THEN 240
230  GOTO 200
240  HOME
250  PRINT  TAB( 5)"FREQUENCY"; TAB(
     20)"RESISTOR VALUE"
270  PRINT
280  FOR Z = 1 TO 10
290  PRINT Z;
300 R(Z) = R(Z) - 150
310  PRINT  TAB( 7)F(Z); TAB( 22)
      INT (R(Z)) / 1000"K OHMS"
320  NEXT Z
330  PRINT
340  PRINT  TAB( 10)"FOR C ="C *
     1E6"UF"
```

A Versatile Printer Stand

This build-it-yourself printer stand provides three paper "trays" and features optional "smart" power and printer-selector switches





By Bill Green

There are a host of convenience features that one can add to personal computer systems to make use of these machines more efficient. A good example is modifying the typical printer/stand setup. At the grass-roots level, having to individually turn on and off power for each item in your computing system can be frustrating. So can juggling cables to switch from one printer to another. Finally, if you routinely use different papers and forms, changing from one to another can be an aggravating chore.

The projects to be discussed here can overcome these problems. The "Versatile Printer Stand" described solves the paper-changing hassle. Furthermore, it can be equipped with a "smart" switch that automatically turns on/off power with the flip of the power switch on just your computer. Finally, you can add either a parallel or serial switch that will allow you to select either of two printers without having to unplug and plug in cables. Naturally, the last two devices can be used alone.

Smart Power Switch

Shown in Fig. 1 is the complete schematic diagram of the Smart Power Switch. This power controller can be used with any system containing two or more components that are usually switched on and off simultaneously. This might be a computer/printer/modem combination or a stereo receiver/tape recorder/VCR combination or whatever. (It can also be used as an add-on accessory to the "Computer System Power Controller" featured in *Modern Electronics*, Nov. 1985.)

The Smart Switch is designed to control ac line power to a slave ac outlet when the equipment plugged into the master outlet is turned on and off. It does so automatically, relieving you of the need to individually turn on and off each device in your system. Pushbutton switch *S1* can be used to select between the Smart and Bypass functions. In the latter function, the Smart Switch is bypassed, requiring that you individually turn on and off any items plugged into the *SO1* and *SO2* ac receptacles.

Note in Fig. 1 that there are four diodes (*D1* through *D4*) connected in series with master receptacle *SO1*. When the computer or other device plugged into *SO1* is off, little or no voltage is dropped by these diodes and, hence, the rectified voltage at the base of *Q1* is not of sufficient magnitude to turn on the transistor.

When the device plugged into *SO1* is turned on, however, enough voltage is dropped by *D1* through *D4* to turn on *Q1*. This returns the low end

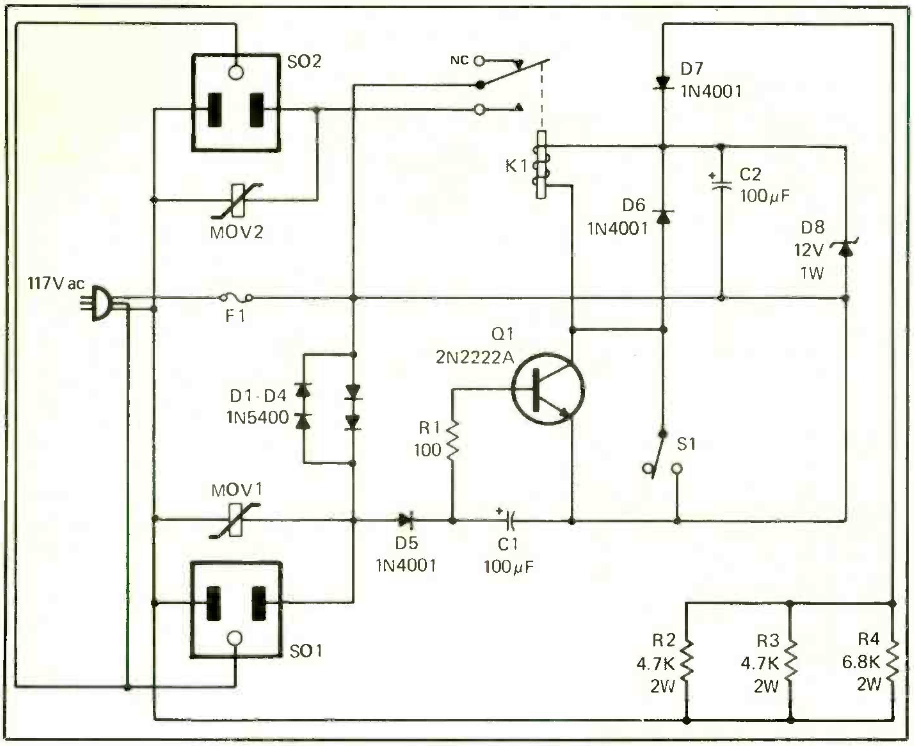


Fig. 1. This is the schematic diagram of the Smart Power Switch. Turning on/off the device plugged into SO1 automatically turns on/off any device plugged into SO2.

of relay *K1* to ground applying 12 volts to the relay's coil and closing its lower contacts.

With *K*'s contacts closed, ac line power is applied to slave receptacle *SO2*. Resistors *R2*, *R3* and *R4* form one side of the ac line and in series with rectifier diode *D7* and zener diode *D8* supply the 12 volts dc for *K1*. (Note: These three resistors can be replaced with a single 2000-ohm, 6-watt or more resistor.)

Fuse *F1* protects the circuit and should be selected to accommodate the total load expected to be drawn by the devices plugged into the master and slave receptacles. Of course, you must make sure that this load does not exceed the amount of power that can be safely handled by *K1*'s contacts. If you wish, you can substitute an appropriately rated circuit breaker for the fuse. Finally, *MOV1* and *MOV2* are included in the circuit to provide spike protection for any devices plugged into *SO1* and *SO2*.

You can assemble the Smart Switch on a printed-circuit board of your own design or a piece of perforated board and use solder posts to make the interconnections, using point-to-point wiring. If you install the project in a metal case, be sure to insulate it well to protect users from electrical shock. Also, be sure to use a 3-conductor grounded ac line cord and receptacles and to properly phase the cord and receptacles.

Two-Way Printer Switch

Here you have a choice of a parallel or a serial switch. The parallel ver-

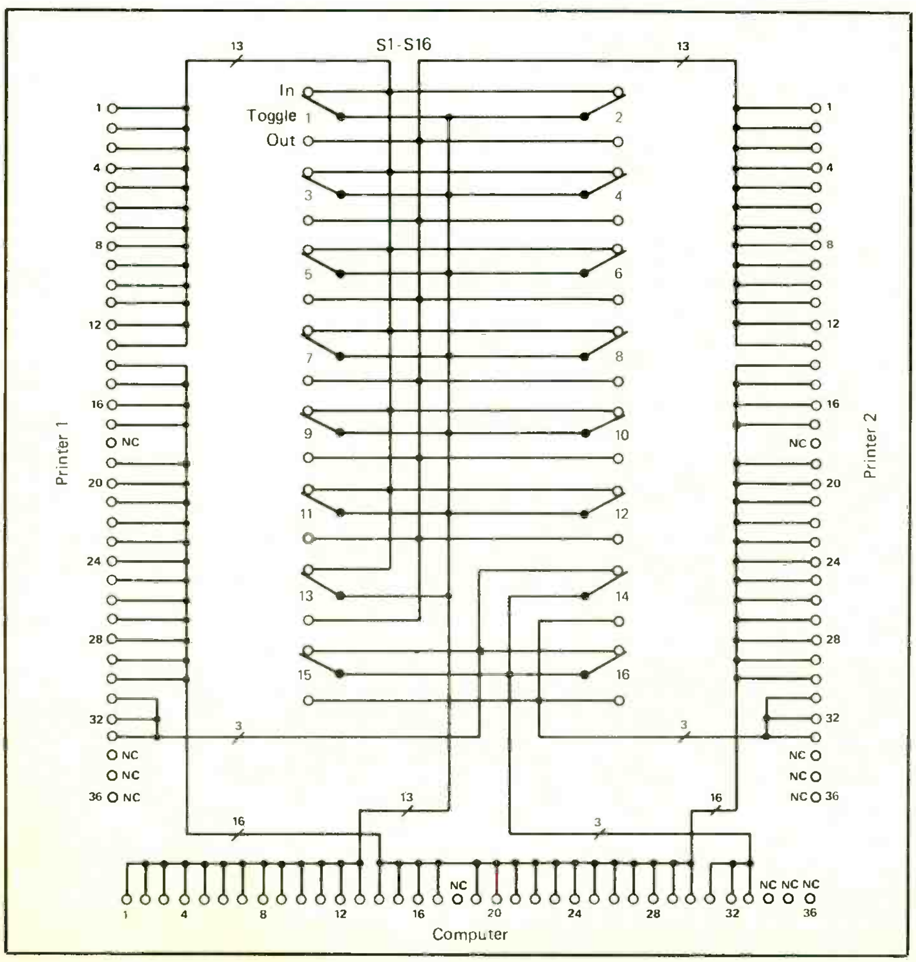


Fig. 2. Use this wiring diagram to assemble the printer switch for Centronics-compatible parallel printers.

sion is built around standard 36-pin Centronics-compatible connectors, the serial version around 25-pin miniature DB-25 connectors with flat ribbon cable and a 2-position pushbutton switch with 16 poles. The wiring diagram for the parallel version is shown in Fig. 2; that for the serial version is shown in Fig. 3. A case to house the two-way connector/switch circuit is optional.

Refer to Fig. 2 or 3, depending on whether you have parallel or serial printers, for all wiring details. You may have to modify the wiring to make it conform to your computer's and printers' wiring arrangements.

The Printer Stand

The printer stand shown in the lead photo is made from ¼″-thick clear Plexiglas or Lucite, though if you are handy with tools and have a power router, it can be fabricated from ½″-thick plywood or particle board, using ¼″-thick plywood or Masonite for the shelves. Dimensions for the various members that make up the stand are shown in Fig. 4 for both the Plexiglas/Lucite and wood versions, the latter in parentheses.

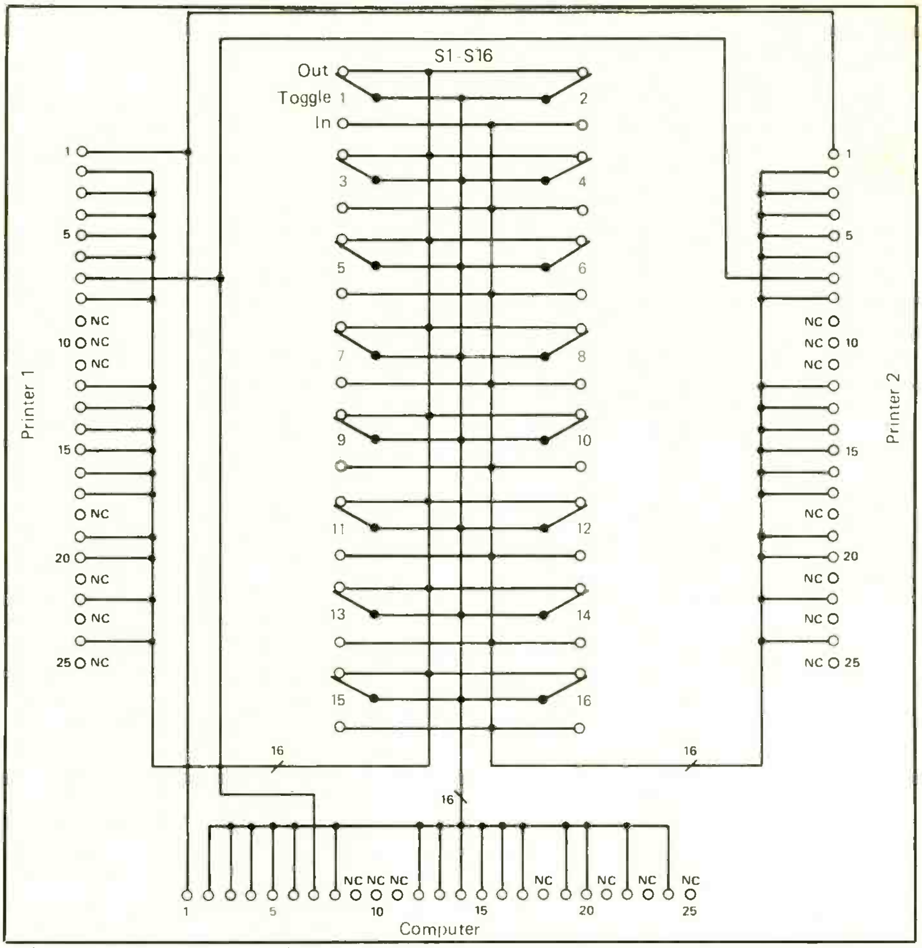


Fig. 3. Use this wiring diagram to assemble the 2-way printer switch for series printers.

PARTS LIST

Smart Power Switch
C1,C2—100-μF, 16-volt electrolytic capacitor
D1 thru D4—1N5400 rectifier diode
D5 thru D7—1N4001 rectifier diode
D8—12-volt, 1-watt zener diode
F1—Fuse (rating to suit load; can be replaced with circuit breaker—see text)
K1—12-volt dc relay with 10-ampere contact rating (Radio Shack No. 275-218B or similar)
MOV1,MOV2—130-volt MOV
Q1—2N2222A npn transistor
R1—100-ohm, ¼-watt, 10% tolerance resistor
R2 thru R4—2000-ohm, 6-watt, 10% tolerance parallel resistance (see text)
S1—Spdt push-push switch (Radio Shack No. 275-1555 or similar)
SO1,SO2—3-contact chassis-mount ac receptacle
Misc.—Suitable enclosure (Radio Shack No. 270-286 or similar) (see text); 3-conductor ac line cord with plug; printed-circuit board or perforated board and solder posts; machine hardware; hookup wire; solder; etc.

Printer Switch
3—Centronics 36-pin IDC connectors for parallel version (or 25-pin miniature DB-25 connectors for serial version)
1—2-position, 16-pole pushbutton switch
9 ft.—36-conductor (parallel version) or 25-conductor (serial version) ribbon cable
Misc.—Suitable enclosure; machine hardware; hookup wire; solder; etc.

Printer Stand
2—15″ × 11″ × ¼″ acrylic sheets (or 15½″ × 11″ × ½″ sheets plywood or particle board)
2—11″ × 5″ × ¼″ acrylic sheets (or 11″ × 5¼″ × ½″ sheets plywood or particle board)
2—12¾″ × 11″ 4 ⅛″ acrylic sheets (or 12¾″ × 11″ × ¼″ sheets plywood or particle board)
4—Self-stick rubber feet
1—tube acrylic cement (or wood glue and finishing nails)
Glass tinting film (or DAP and paint)
(Items in parenthesis are for wood version of printer stand only; see text.)

Note: The following items are available from Alpha Electronics, P.O. Box 1005, Merritt Island, FL 32952: printer-stand kit (includes all acrylic, but not wood, materials cut, polished and slotted, plus acrylic cement and rubber feet) for $49.95 until May 1, 1986 ($69.95 thereafter) + $6.00 P&H in U.S.; 2-position, 16-pole switch for 2-way computer switch for $18.00 + $2.00 P&H in U.S. Florida residents, please add sales tax.

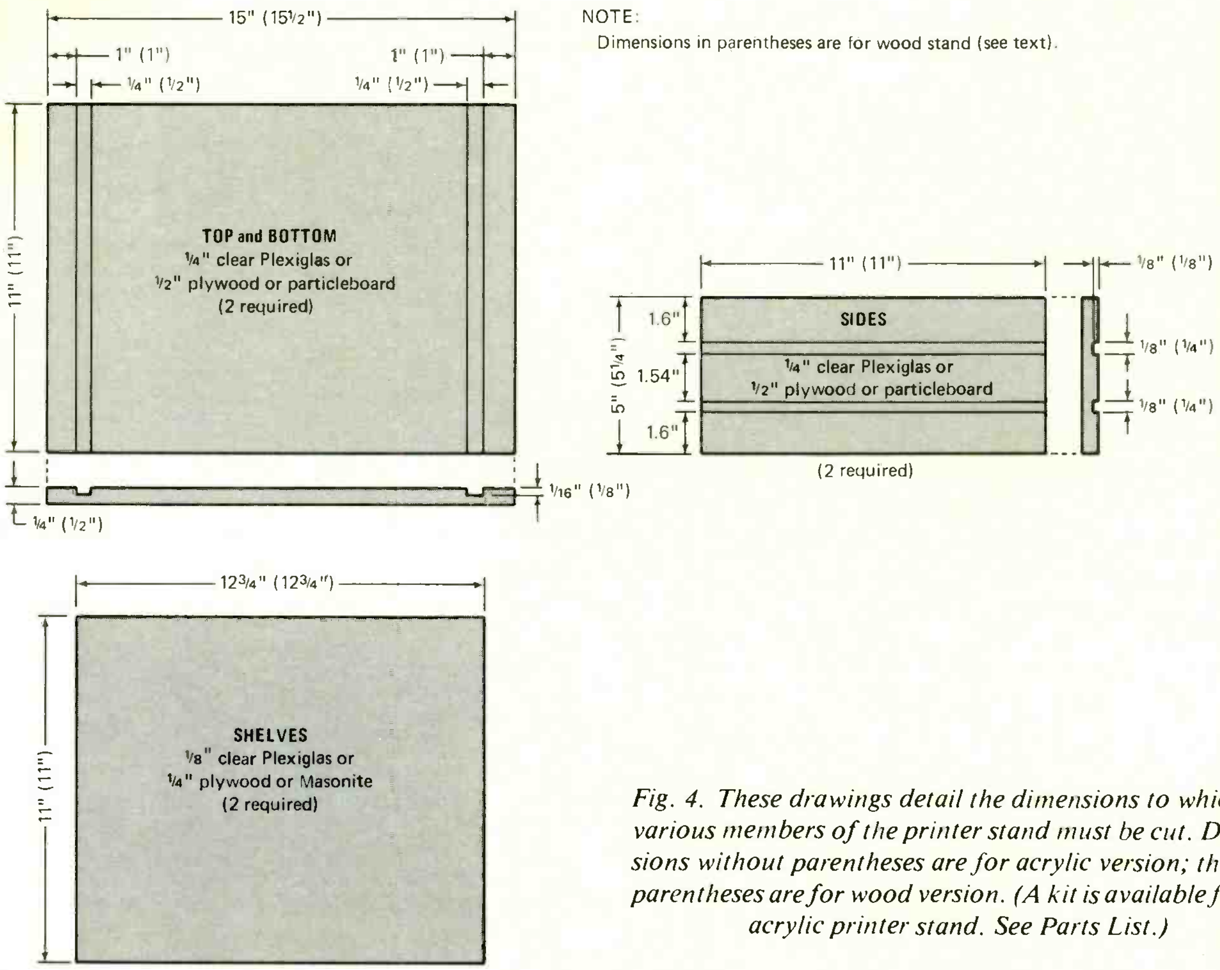


Fig. 4. These drawings detail the dimensions to which the various members of the printer stand must be cut. Dimensions without parentheses are for acrylic version; those in parentheses are for wood version. (A kit is available for the acrylic printer stand. See Parts List.)

Plexiglas and/or Lucite are available from a number of sources. These include plastics suppliers, glass companies, many hardware stores and home-improvement centers. Most places that sell this material will cut it to order for a fee. You can, however, easily cut it yourself, with a scribing tool or a table saw equipped with a carbide blade. (*Caution:* If you decide to cut or machine sheet Plexiglas or Lucite yourself, always wear safety glasses.)

Refer to Fig. 4 for cutting instructions. If you are using the plastic material and cut it to size with a saw, you must polish the edges. The slots you must cut in the top, bottom and side panels are cut with a ⅛"-wide carbide-tipped blade, using a single pass for the ⅛" slots and two passes for the ¼" slots.

After all panels are cut to size, run a thin bead of acrylic cement (available from the same source from which you obtained the sheet plastic and some hobby shops) down both slots on the bottom of the stand. Set the side panels, with the slots facing inward, into the slots, and use a triangle to square the sides with the bottom panel. Allow the acrylic cement cure for at least 10 minutes.

Place the top panel on a flat surface, slotted side up, and run a thin bead of cement down both slots. Invert the bottom/side assembly and lower it onto the top panel, aligning the side edges with the slots in the top panel. Push the assembly home and allow the cement to cure for at least 10 minutes. Then mount four adhesive-backed rubber feet on the bottom panel, spacing them about 1" in from each corner.

Finally, insert the two shelves into the stand. At this point, if you wish, you can apply glass tinting film to the stand or spray it with a paint that suits your taste.

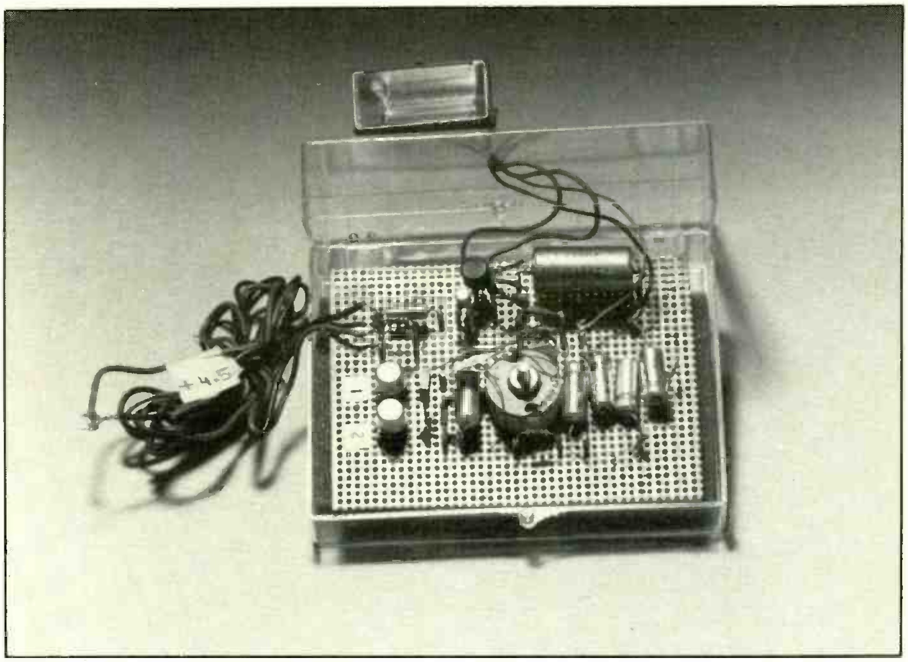
Assembling the wood version of the stand is accomplished in much the same manner as for the plastic version. Before assembling the panels, sand them for a smooth finish. Then perform the steps in the same sequence as above, except use wood glue and finishing nails in place of the

(Continued on page 96)

A Day/Night Safety Beacon

Based on electronic photoflash circuitry, this portable safety device can be seen by oncoming traffic both day and night

By Anthony J. Caristi



One can't be too careful when it comes to safety, especially when exposed to highway or road dangers while traveling. The portable Safety Beacon to be described here will come in handy as a safety device for a disabled automobile, a bicycle or other vehicle. Unlike ordinary warning lights, its piercing flashing light, based on electronic flash circuitry, can be easily seen day or night from a long distance. It commands attention, while not "blinding" oncoming traffic. On a bicycle or motorcycle, it can be left on continuously to alert automobile drivers.

Its built-in battery makes it completely independent of any other power source for full portability. Powered from three fresh C-size cells, it will provide about 100 hours of operating time. Current drain is far less than that required by a common three-cell flashlight. To further enhance the Safety Beacon, you have the option of using rechargeable nickel-cadmium cells to even eliminate the bother or having to periodically replace the spent cells. And if you wish to operate the project from a 12-volt automative electrical system, a simple modification is all that's required.

How It Works

A xenon flashtube like those commonly used in many types of cameras is the heart of the Safety Beacon. Power for flashing the tube is provided by a simple dc-to-dc converter that steps up the low battery potential to about 250 volts dc.

Xenon flashtubes produce light when a capacitor charged to a relatively high voltage is suddenly discharged through them. The energy expended in the flashtube is proportional to the voltage and capacitance. In this project, this energy is low (about 0.333 watt-second) to assure long flashtube life and to produce a bright but not blinding flash.

In the dc-to-dc converter shown in Fig. 1, you must wind the transformer identified as *T1*. Note that *T1* has three separate windings. In this circuit, *Q1* and *Q2* are forced into oscillation by positive feedback to their bases from the upper winding labeled 1/2/3.

Due to the relatively high turns ratio between the primary (4/5/6) and secondary (7/8) windings of *T1*, the switching action of *Q1* and *Q2* induces a high voltage into the secondary circuit. This voltage is passed through the *D1/D2/C3/C4* voltage-doubler circuit. Here, each capacitor is charged to about 125 volts, and the sum of the charges (250 volts) is fed to flashtube *FT1*.

Although a high voltage is present across *FT1*, the flashtube won't conduct (flash) until it's triggered by a very high potential of (4000 volts or more) applied to the "trigger" electrode. (The trigger voltage is not dangerous because it has no current behind it.)

Autotransformer *T2*'s primary is

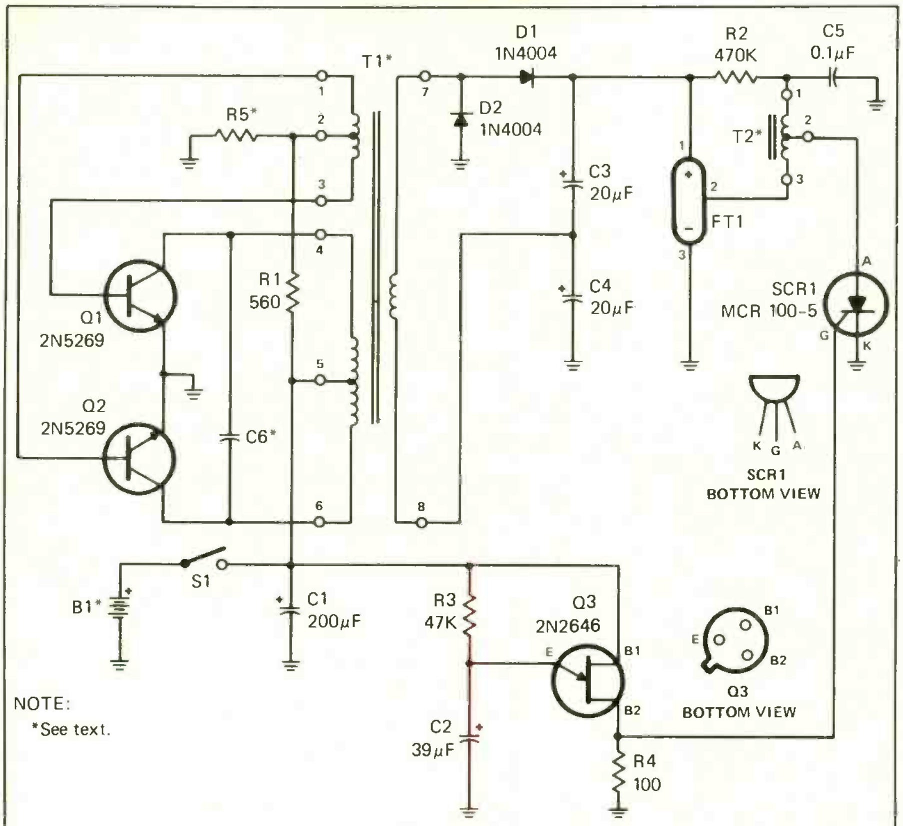


Fig. 1. This is the project's overall schematic diagram.

PARTS LIST

Semiconductors

D1,D2—1N4004 rectifier diode

Q1,Q2—2N5296 or similar transistor

Q3—2N2646 or similar unijunction transistor

SCR1—MCR 100-5 (Motorola) or similar silicon-controlled rectifier

Capacitors

C1—200-μF, 15-volt electrolytic

C2—39-μF, 10-volt electrolytic

C3,C4—20-μF, 150-volt electrolytic

C5—0.1-μF, 300-volt Mylar or ceramic

C6—0.22- or 0.0047-μF, 100-volt disc (see text)

Resistors (¼-watt, 10% tolerance)

R1—560 ohms

R2—470,000 ohms

R3—47,000 ohms

R4—100 ohms

R5—68 ohms (12-volt units only—see text)

Miscellaneous

FT1—250-volt flashtube (Radio Shack No. 272-1145 or similar—see text)

S1—Spst slide or toggle switch

T1—Hand-wound transformer on TDK P22.5 Z52H pot core (see text)

T2—Trigger transformer (Triad No. PL-10 or similar) Printed-circuit board or perforated board and solder posts; transistor sockets; heavy-duty stranded hookup wire for power leads; suitable enclosure; hookup wire; No. 30 and No. 36 enameled wire; machine hardware; solder; etc.

Note: The flashtube and trigger transformer are available as Cat. No. 3RS0430 from Hi Tek Sales, 119R Foster St., Peabody, MA 01961. The following are available from A. Caristi, 69 White Pond Rd., Waldwick, NJ 07463: pc board for $6.75; pot core/bobbin for T1 for $6.75; 2N2646 transistor and MCR 100-5 SCR for $2.75 each. Add $1.00 S&H.

the winding between terminals 1 and 2. To generate repetitive flashes, unijunction transistor *Q3* is connected as a very-low-frequency relaxation oscillator, via *C2, R3* and *R4*.

When power is applied to the circuit and *C2* charges to about half the battery voltage, *Q3* suddenly conducts from emitter (E) to base 1 (B1). This dumps the charge stored in *C2* into *R4*. Capacitor *C2* then begins to recharge, and the process is repeated once every 4 or 5 seconds, as determined by the *R3/C2* time constant.

A capacitive-discharge circuit is made up of *T2, C5* and *Q4*. Charging of *C5* to 250 volts is accomplished through *R2*. Though *T2* is also connected to *C5*, current can't flow in the transformer primary because silicon-controlled rectifier *SCR1* isn't yet triggered into conduction.

When *Q3* switches on, the regulating voltage spike that appears across *R4* is also applied to the gate (G) terminal of *SCR1*. This causes the SCR to switch on and suddenly apply the 250 volts stored in *C5* to *T2*'s primary. The *C5/T2* primary (LC) circuit dissipates the charge as a burst of oscillation.

Since *T2* has a step-up ratio, when the charge on *C5* is being dissipated, the energy at the secondary is at least 4000 volts. This potential, applied to the trigger electrode of *FT1*, causes the flashtube to conduct, allowing most of the energy stored in *C3* and *C4* to be converted into heat and light. It's this conversion that produces the flash. The cycle repeats for as long as power switch *S1* is closed and there's sufficient voltage in *B1* to excite the circuit. The repetition rate is 4 or 5 seconds.

Construction

Begin construction by fabricating transformer *T1* (see box for details). Once the transformer is ready, wire the circuit on either a printed-circuit board or on perforated board using solder posts. The pc board (see Fig. 2 for the actual-size etching-and-drilling guide) is recommended if you want a very compact project. Other than this, since there's nothing critical with regard to layout, either method can be used with success.

If you use a pc board, refer to the diagram in Fig. 2 for component

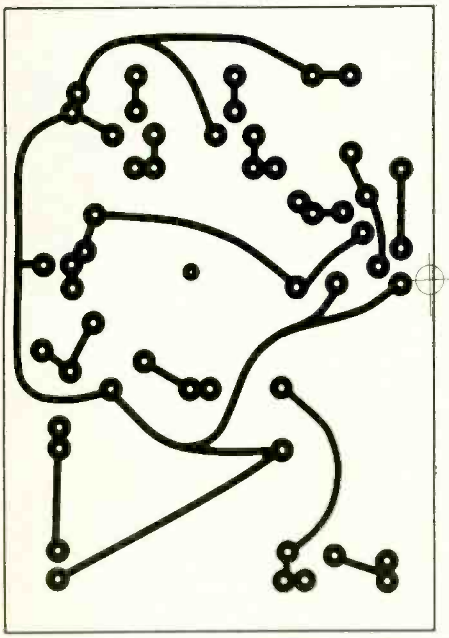


Fig. 2. Etching-and-drilling guide.

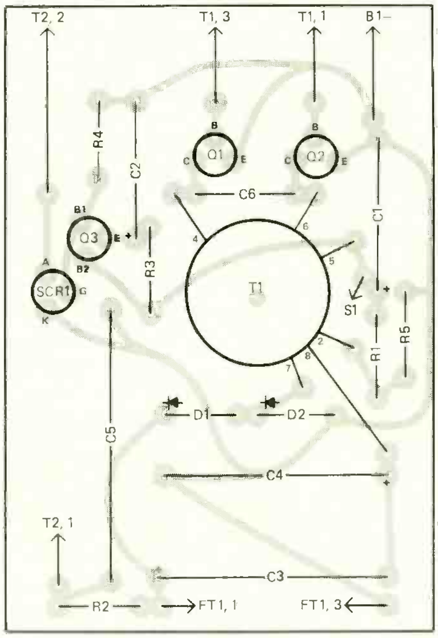


Fig. 3. Components-placement guide.

placement and orientation. If you go the perf-board route, you can use the same layout shown in Fig. 3, but you'll have to refer back to Fig. 1 for wiring details and leave extra room for wiring. Regardless of the wiring method you use, pay careful attention to the polarization of the diodes, electrolytic capacitors and battery, and to lead designations for the transformers, flashtube, transistors and SCR. Also, it's a good idea to use sockets for the transistors and SCR to simplify servicing the circuit should this ever become necessary and to facilitate the steps in the checkout procedure.

When mounting *T1* on the circuit board, be very careful to avoid overtightening the hardware, or the very

Winding The Transformer

The only component the Safety Beacon calls for that isn't readily available from the usual parts sources is transformer *T1* in Fig. 1. Though you must wind this transformer yourself, the task isn't particularly difficult. The materials you need are readily available and consist of a pot-core/bobbin assembly (see Parts List for type and availability), some No. 30 and No. 36 enameled wire and thin tape.

Wind the 1/2/3 feedback turns (see Fig. 1) first. This winding consists of 10 turns of enameled wire with a tap at the fifth turn. Wrap exactly 10 turns of wire onto the pot core's bobbin and add 7" to this amount. Clip the wire and unwind it from the bobbin. Fold the wire exactly in half.

Carefully scrape away, down to bare wire, ¼" of the enamel coating from both ends and centered at the fold. Scrape away ¼" of enamel from both ends of another 3" length of wire and twist one end of it together with the bared wire at the fold. Solder the center-tap connection and wrap it with insulating tape.

Now, starting 3½" from one end, wrap exactly 10 turns of this wire around the bobbin. Use pieces of tape with the numerals 1, 2 and 3 on them to identify the beginning, center tape and end wires, respectively. When you're finished winding this coil, you should have two leads that measure 3½" and one that measures 3" in length. Remember the direction in which you wound this coil (draw an arrow pointing in this direction on the bobbin). Wrap a couple of turns of thin, preferably Mylar, tape over the feedback coil.

Next comes the primary winding, which must be "bifilar" wound. That is, two lengths of wire used to make this coil must be wound at the same time to achieve the tightest possible coupling between the two coil halves. (Tight couplings minimizes voltage spikes that appear across *Q1* and *Q2*.)

The 4/5/6 primary winding in Fig. 1 consists of 13 double turns of wire if the project is to be powered from a 4.2-to-4.5-volt source or 27 double turns if it's to be powered from a 12-volt source. Cut a 48" length of wire for the 13-turn or 96" wire for the 27-turn primary. Fold the wire exactly in half and remove ¼" of enamel from the ends and center fold exactly as described above for the feedback winding.

Starting at the center-tap lead and holding the wires together, wind the correct number of turns on the bobbin in the *same* direction as you wound the feedback coil. Label the ends of this winding with numbers 4 and 6 tags and the center tap with a number 5 tag. Then wrap a couple of turns of thin tape over the winding.

The 7/8 secondary winding in Fig. 1 is made up of 240 turns of No. 36 enameled wire wound in either direction. Be sure to accurately count the turns as you wind the wire onto the bobbin, since the number of turns will determine the dc potential that will be applied to the flashtube. When winding is done, secure the coil with a couple of layers of thin tape. Then scrape away ¼" of enamel from both wire ends and label these wires with the numbers 7 and 8.

Place the bobbin assembly inside the pot core, arranging the winding leads so that they don't obstruct assembly. Then secure the two halves of the pot core with a couple of layers of tape. You can now install the transformer on your Safety Beacon's circuit board, referring to Fig. 1 for wiring details.

brittle core may crack or shatter. Also, place a fiber washer between the head of the screw and the core.

The flashtube and trigger transformer can be obtained from the source given in the Parts List, or you can salvage them from the electronic photoflash of an old camera. If your trigger transformer has isolated windings (separate primary and secondary leads), simply connect one primary wire to the low potential side of the secondary and attach these to the "hot" or + side of *C5*.

The value of *C6* will be different for a 12-volt than it is for a 4.5-volt unit. Use a 0.0047-microfarad capacitor for a 12-volt power source, a 0.22-microfarad capacitor for a 4.5-volt source. This capacitor *must* have a rating of at least 100 working volts. Also, for the 4.5-volt supply unit, omit *R5*; use 68 ohms for a 12-volt supply unit.

Power for the Safety Beacon can be from three common C or D cells connected in series to provide 4.5 volts. Alkaline cells, of course, will provide longer operating life than will carbon-zinc cells. If you prefer, you can use three rechargeable Ni-Cd cells to provide 4.2 volts. *(Caution: Do not use more than 4.5 volts to power the low-voltage unit.* To do so will dramatically shorten flashtube life and will result in excessive voltage being applied to the circuit's components). Current drain from the battery is about 100 milliamperes, which provides an operating life of 100 hours from one set of C cells.

Checkout

Before placing your Safety Beacon into service, you must check it out for proper operation. All you need for this procedure is a dc voltmeter with at least a 1-megohm input and the ability to measure 10 to 300 volts.

Remove *Q1* and *Q2* from the circuit. Connect the voltmeter across *C2*, with the positive probe touching the positive lead of the capacitor. Set the voltmeter's range selector to a position that will allow you to read 10 volts. Apply power to the circuit; the voltmeter's indication should slowly rise to a little more than half the input voltage and then suddenly drop to almost zero. This rise and fall should repeat every 4 or 5 seconds as *Q3* oscillates. If you don't obtain the proper indications, check the *Q3/R3/C2/R4* circuit and especially for proper lead connections for *Q3* in its socket. Do *not* proceed with checkout until you obtain an indication that *Q3* is oscillating.

Turn off the power. Then plug *Q1* and *Q2* in their sockets. *Caution: High voltage is present in this circuit. Therefore, for the remainder of this procedure, make ure you don't touch any of the circuitry or the flashtube.*

Connect the positive probe of the meter to the positive side of *C3* and the negative probe to the negative side of *C4*. Set the meter to allow you to read 300 volts or more. Apply power to the circuit; the reading should slowly rise toward 250 volts and, after 4 or 5 seconds, the flashtube should flash, causing a drop in the meter reading to about 50 volts. This sequence should repeat at 4- or 5-second intervals.

If you obtain the proper high voltage but the flashtube doesn't flash, check *Q3* to make sure that it's oscillating at a rate of one cycle every 4 or 5 seconds. Also, check *Q4*'s orientation and the wiring to trigger transformer *T2*. If everything looks okay, you may have a defective flashtube or one not rated to flash with a 250-volt dc potential. If possible, try another flashtube.

If you don't obtain a high-voltage reading across *C3* and *C4*, the most likely cause is the *Q1/Q2* oscillator circuit. The phasing of *T1*'s 1/2/3 feedback winding may be reversed because you inadvertently wound the turns in a different direction from that of the primary. If reversing wires 1 and 3 doesn't help, reconnect the wires to their original points. Review the winding instructions given in the box to determine if you made an error in winding.

If you're satisfied that the transformer is properly wound, check the orientations of *Q1, Q2, D1* and *D2*. If possible, try two new transistors for *Q1* and *Q2*.

Mount the circuit-board assembly in a suitable enclosure. Then decide where and how to mount the flashtube to assure that it will be seen by other traffic on the road. This will require different mounting techniques for different vehicles and situations. If you're using the Safety Beacon in a vehicle whose electrical system is to power it, you'll have to run power heavy-duty stranded leads to it from a convenient tap-off point in the vehicle's electrical system. In any event, make sure that you house the flashtube so that its glass envelope is protected and that its power leads are well shielded to prevent electrical shock. **ME**

Project

Add Stereo Sound To Your TV Receiver

This device readies any TV receiver to use a commercial stereo TV converter for full-spectrum stereo sound reproduction

By Gary McClellan

Stereo TV sound is here! Once you hear it, you'll agree that stereo sound does for the 1980s what color pictures did for the 1960s. The bad news, however, is that ordinary TV receivers can't decode the stereo signal, and those that can are currently quite expensive. The good news is that there are already on the market a number of converters that can provide stereo sound—but only if your set is "stereo-ready."

However, you can ready any TV set to decode stereo through a suitable converter using the simple circuit described here. A stereo-ready capability obviates the need to buy a new set to take advantage of stereo sound. By itself, this project won't give you stereo sound directly (you need a stereo TV converter for that). But it does provide high-quality mono sound directly and prepares your set to use a stereo converter that *will* let you enjoy full-spectrum stereo sound.

Installation doesn't affect normal operation—it enhances it. A built-in squelch circuit mutes annoying interstation noise, and a level control matches the project to the various stereo converters now available to obtain optimum performance.

Installation entails only two solder connections to your TV set. A few adjustments you do by ear then get the system in proper operating order.

Project cost is just $25, which gets you both superb mono sound and stereo-ready capability. Add another $100 to $200 for a stereo TV converter, and you get full-spectrum stereo sound as well.

About the Circuit

This project performs several different tasks in order to make your TV receiver "stereo ready." Its first task is to electrically isolate the TV chassis from your sound system. This is mandatory for both safety and technical reasons. To keep costs down, modern TV receivers no longer have power transformers and, thus, have their chassis "grounded" to one side of the ac line. This being the case, up to 117 volts ac can appear on the chassis, making it a potentially lethal shock hazard if you touch any exposed metal parts that are electrically connected to the "hot" chassis. Therefore, this project ensures full electrical isolation from the TV receiver. It also blocks the TV receiver's 15,734-Hz horizontal sweep signal from entering the stereo TV converter to prevent false triggering that would spoil both mono and stereo sound reception.

The project amplifies and detects the 4.5-MHz sound i-f signal as it comes from the TV set's i-f strip. This amplification is essential because the existing sound detector circuit, lacking the wide bandwidth of the project, would prevent stereo reception. The project also outperforms the sound detector in your TV set by providing more gain at 4.5 MHz and less distortion and provides a squelch circuit to boot.

As shown in Fig. 1, the project taps into the TV set's i-f amplifier section just before the regular sound-detector circuitry. This has little or no effect on the existing circuitry or the set's normal sound. At this point, the

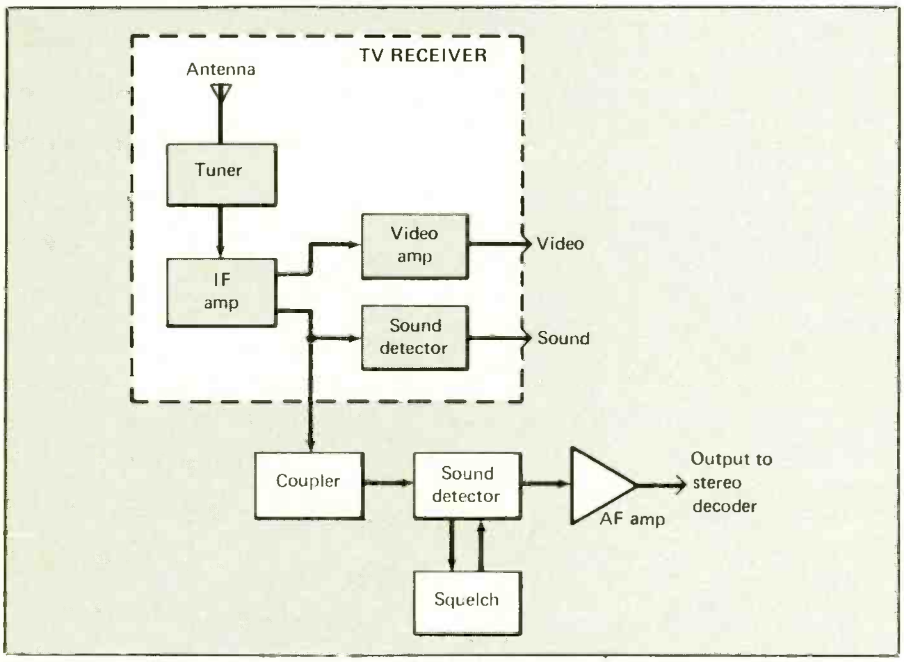


Fig. 1. This block diagram shows the main sections of the typical TV receiver (boxed section), this project's circuit, and the connections to a TV receiver.

low-level 4.5-MHz sound i-f signal goes to a tuned-transformer coupler that drives a simple sound detector.

A "do-everything" CA3089 IC amplifies the signal, detects it and provides an audio output. This low-cost IC provides high signal gain and requires a minimum number of support components.

The squelch circuit controls the CA3089 sound detector IC with a simple two-transistor amplifier circuit that improves the performance of the squelch built into the IC. (The CA3089 was not originally intended to work at 4.5 MHz, after all.)

Finally, a one-transistor audio amplifier boosts the output from the sound detector to a range suitable for the most insensitive TV converter. Up to several volts of audio signal is available for driving a high-impedance load.

Shown in Fig. 2 is the actual schematic diagram of the project. It details the finer points of the Fig. 1 block diagram. Starting with the coupler circuit, the 4.5-MHz sound i-f from the TV set enters at the "IF" terminals. Capacitor *C1* blocks dc from the TV set from appearing across *L1* and upsetting the TV sound detector. Coil *L1* couples the signal into nearby coil *L2*. The latter is peaked by *C2* for maximum output at 4.5 MHz.

Next, in the sound-detector circuit, *C3* and *C4* impedance match and couple the high-impedance tuned circuit into the low-impedance output of *IC1*. This IC internally amplifies the 4.5-MHz signal and outputs it at pin 9. Here, *L3* and *C9* tune the detector to 4.5 MHz and convert the signal into audio. Resistor *R7* "broadbands" the *L3/C9* circuit to reduce distortion and simplify adjustment. (Incidentally, the CA3089 has a quadrature detector that provides less than 0.5% distortion in this circuit.)

Part of the detector signal is tapped off by *R8* and detected by a level detector circuit on pin 8. This is the beginning of the squelch circuit. The detector output is a dc voltage that appears on pin 12 of *IC1*. The squelch circuit consists of *Q1* and *Q2*, which form a noninverting dc amplifier that boosts the signal from SQUELCH control *R2*. The amplifier output is a digital-level signal that controls pin 5 of *IC1*. When this pin goes high (about 5 to 6 volts), audio passes through *IC1*. Bringing pin 5 low (near ground) blocks audio via a switch inside *IC1*. Note that the signal at pin 10 of *IC1* (a 6-volt output from an internal voltage regulator) powers the squelch circuit.

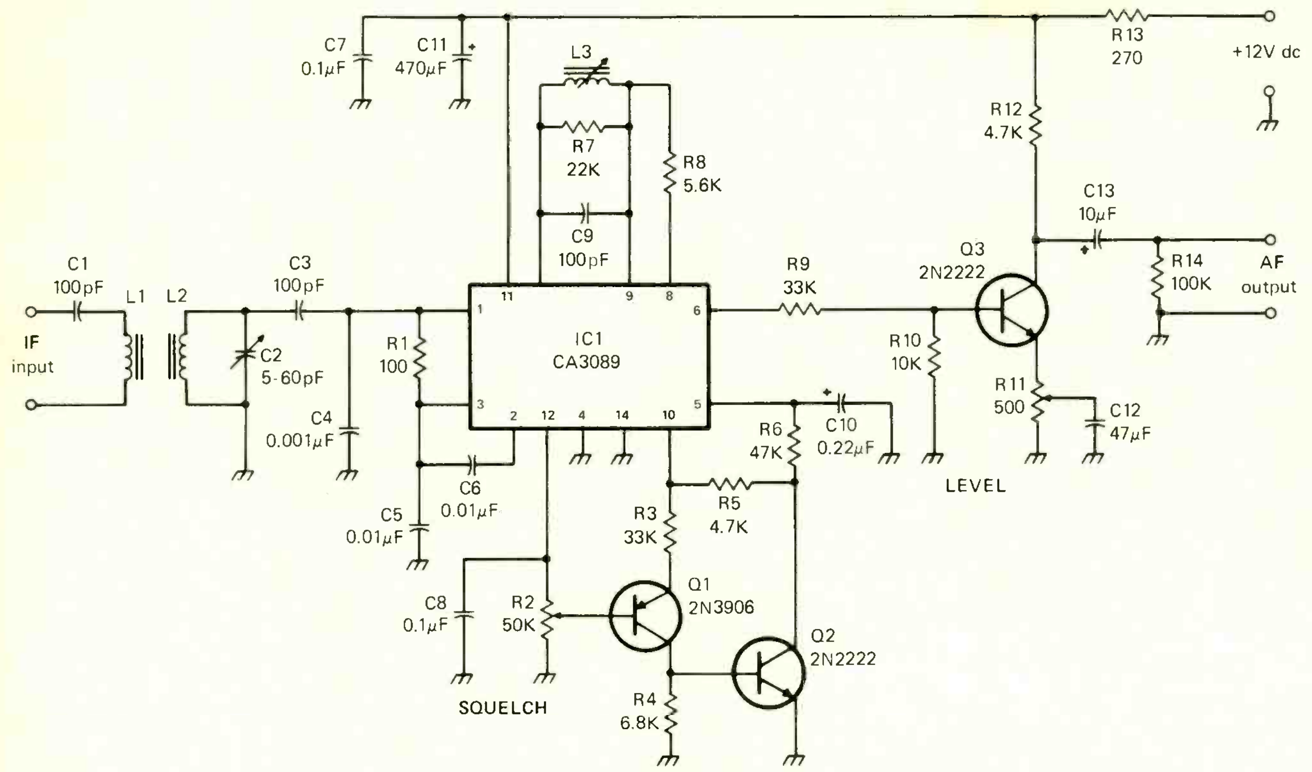
At pin 6 of *IC1* appears the audio output signal. Amplifier *Q3* boosts this signal to several times its original level. At this point, GAIN control *R11* is used to vary the effect of *C12* in the circuit—which is an easy way to get the limited range of gain control required. Note that the audio appears at the "AF" terminals.

Finally, the project is powered by an external 12-volt dc plug-in type transformer that connects to the terminals labeled "DC." A possible alternative to this powering scheme is to tap power from the stereo converter with which the project is used, since only about 20 mA is required.

Construction

A printed-circuit board is mandatory for this project because of the high-gain circuitry involved. This board can be obtained ready to use from the source given in the Parts List, or you can make your own using the actual-size etching-and-drilling guide in Fig. 3. Wire the board exactly as shown in Fig. 4. Be sure to properly orient the components, and keep all leads as short as possible to prevent oscillation. Make sure trimmer capacitor *C2*'s flat side is installed as shown; otherwise, you may have trouble when adjusting this capacitor later.

Start wiring the board by installing the resistors, followed by the capacitors. Then install *L1* and *L2* and push them together. Continue on to the IC socket. When all components have been installed, carefully check the board for missed solder joints, poorly soldered connections and solder bridges. Then carefully check the pc



PARTS LIST

Semiconductors
IC1—LM3089 or CA3089E linear FM system
Q1—2N3906 pnp silicon transistor
Q2,Q3—2N2222 npn silicon transistor

Capacitors
C1,C3,C9—100-pF disc
C2—5-to-50-pF trimmer
C4—0.001-μF disc
C5,C6—0.01-μF disc
C7,C8—0.1-μF, 16-volt disc
C10—0.22-μF, 16-volt radial
C11—470-μF, 16-volt radial electrolytic
C12—47-μF, 10-volt radial electrolytic
C13—10-μF, 16-volt radial electrolytic

Resistors (¼-watt, 5% tolerance)
R1—100 ohms
R3,R7—22,000 ohms
R4—6800 ohms
R5,R12—4700 ohms
R6—47,000 ohms
R8—5600 ohms
R9—33,000 ohms
R10—10,000 ohms
R13—270 ohms
R14—100,000 ohms
R2—50,000-ohm, vertical-mount pc-type potentiometer
R11—500-ohm, vertical-mount pc-type potentiometer

Miscellaneous
L1,L2—10-μH miniature r-f choke (J.W. Miller No. 9250-103)
L3—7-to-14-μH adjustable shielded choke (J.W. Miller No. 9052)
P1—Phono plug
T1—12-volt, 100-mA or more plug-in transformer
16-pin IC socket; 6-ft. RG-174 coaxial cable; 3¾"×3"×2⅛" case (LMB No. CR-332 or similar—see text); 2 ¼" rubber grommets; ¼" aluminum spacers (4); cable clamp; machine hardware; hookup wire; solder; etc.

Note: A ready-to-use printed-circuit board, part No. TV1, is available for $10.00 postpaid (California residents, please include 6% sales tax) from: Mendakota Products, Ltd., Box 2296, 1001 W. Imperial Hwy., La Habra, CA 90631.

Fig. 2. This is the overall schematic diagram of the project.

assembly against Fig. 4 to make sure that all electrolytic capacitors are properly polarized and that all transistors and the IC are properly oriented.

Machine the metal case in which the project is to be installed. You need four mounting holes for the circuit board; separate ¼" holes for entry of the power/output and input cables and near one of them an additional ⅛" hole; access holes for the VOLUME and SQUELCH controls; and four final holes in the case's top for mounting the project to the rear of your TV set. Label the VOLUME and SQUELCH control access holes and INPUT, OUTPUT and POWER cables.

Install ¼" rubber grommets in the holes through which the power and input cables will enter the case. Pre-

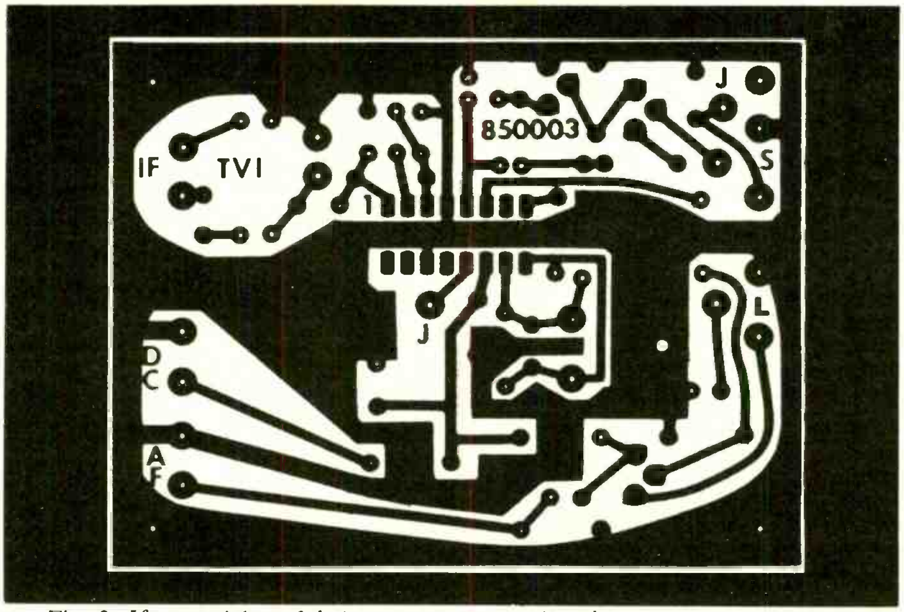


Fig. 3. If you wish to fabricate your own printed-circuit board, use this actual- size etching-and-drilling guide.

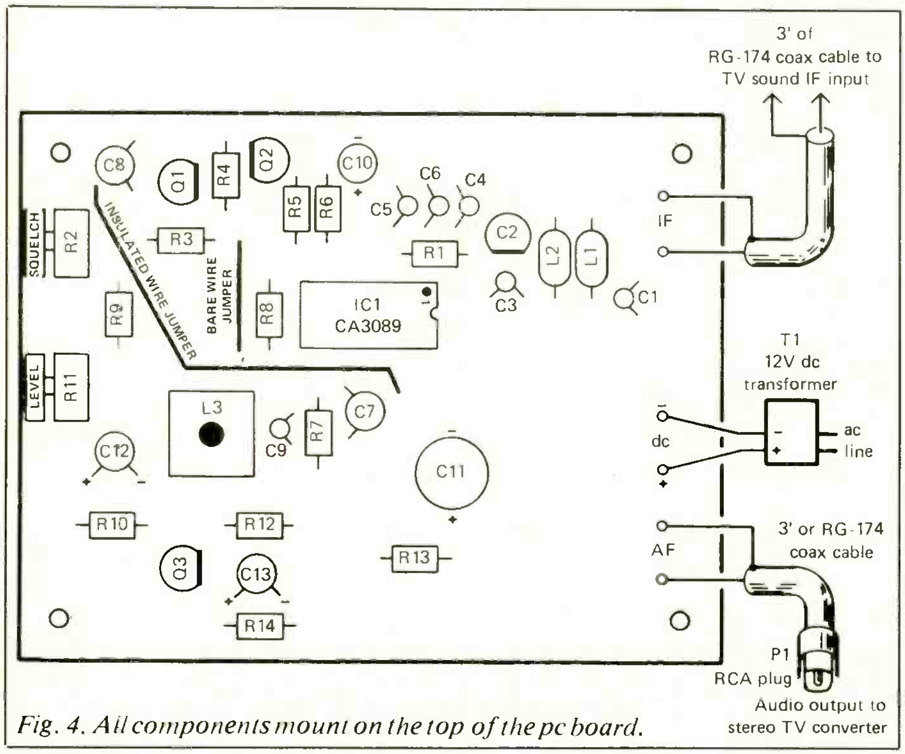


Fig. 4. All components mount on the top of the pc board.

pare the board-end of the cables. Then pass their prepared ends through the grommet-lined holes and solder the conductors to the appropriate pads on the board (see Fig. 2 for details). Before soldering the power leads to the + and − DC pads on the board, plug the 12-volt transformer into an ac outlet and use a meter to determine the polarity of the leads. Disconnect the transformer from the ac line and solder the conductors to the appropriate pads.

Mount the circuit board on the floor of the case, using four ¼ " spacers and 4-40 × ½ " machine screws, nuts and lockwashers. Place a cable clamp around the INPUT, OUTPUT and POWER cables and fasten them to the wall of the case with 6-32 × ⅜ " machine hardware, leaving slight loops in each to relieve tension. The cable clamp serves as a strain relief that prevents the cables from being torn loose from the board.

Prepare the free end of the OUTPUT cable by removing 1 " of outer insulation, separating the shield back to the insulation, clipping ⅜ " from the inner conductor, and removing ¼ " of insulation from the inner conductor. Connect and solder to this end of the cable a standard phone plug. Prepare the free end of the RG-174 coaxial cable in like manner, but do not clip the inner conductor to ⅜ " in length. Tightly twist together all the fine wires in the braided shield and sparingly tin with solder. Do the same with the fine wires in the inner conductor. (Note: if you have coaxial cable with a foil shield, trim the shield—not the wire that parallels the inner conductor—back to the cutoff point on the outer conductor. With this type of cable, you must solder-tin the inner-conductor wires only.)

At this point, a few preliminary checks should be performed with the aid of a multimeter, preferably a DMM if you have one. Set the meter to its ohms function and highest range. Connect one test probe to the INPUT cable, shorting it across both cable conductors. Touch the other lead to first one and then the other contact on the OUTPUT phono plug, to an unpainted area inside the project's case and finally to one and then the other prong on the transformer. Then touch the test probes to the INPUT cable's conductors. If while performing these tests you obtain a reading of other than infinity, immediately check your wiring and correct the problem before proceeding.

As a final test, set your meter to its dc voltage function and set the range

Why No Converter Project

Some readers may be wondering why we are not providing construction details for a complete stereo TV converter. There are good reasons for not doing so. The primary reason is that the components needed to make such a converter are very difficult to obtain, because stereo TV uses an integral noise-reduction system. This effectively prevents utilization of low-cost FM stereo decoder chips. A special stereo TV decoder chip, like National Semiconductor's LM-1884 or Panasonic's AN-6291 noise-reduction chip must be used. Unfortunately, both are so new that they are not available through regular electronics parts distributors.

A second reason for not including plans to build your own stereo converter stems from the fact that stereo TV converters are complex and require many adjustments to be made to get them working properly. A special stereo TV alignment generator is required for alignment, without which you would not be able to align "by ear" as you can with an FM radio stereo decoder. Making matters worse is the fact that this instrument is not yet on the general market—even if you did not mind paying the price for it just to build your own stereo TV converter.

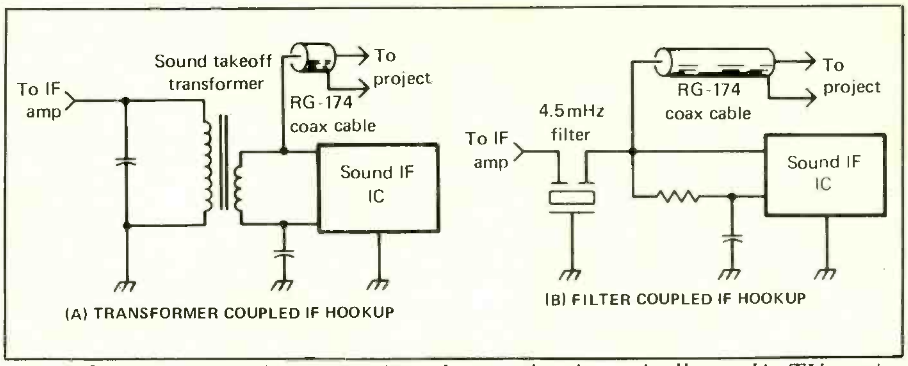


Fig. 5. Shown here is where to tap into the two circuits typically used in TV receivers. Check your set to determine which circuit it has, and then use the appropriate schematic to make the connections to the project.

to read 20 volts. Plug *T1* into an ac outlet and touch the meter's positive probe to pin 11 and negative probe to project ground. If you don't obtain a reading between 11.5 and 13 volts, once again check for wiring errors and, if you don't find any, one or more bad components.

Making the Connection

You're now ready to connect the project to your TV receiver. This entails connecting the INPUT cable to the sound i-f section inside your set, after which you mount the project on the set's rear panel with 6-32 × ⅜" machine hardware.

Keep firmly in mind that there are dangerous high voltages present inside your TV set, even with the power turned off. In and around some of the circuits, some of these voltages are potentially lethal. So before doing anything else, disconnect the set's power cord from the ac line. If at all possible, wait several hours before removing the back panel from the set. When you do remove the back panel, keep as far away as possible from the picture tube area and the high-voltage power supply. Even after hours without power, these areas may still have enough voltage in them to give you a nasty jolt.

Figure 5 shows how the connections are actually made to your TV set's sound detector circuit. Note that some sets use a transformer (circuit A), while others use a 4.5-MHz ceramic filter (circuit B). If you can do so, obtain the schematic diagram for your TV receiver. If you can't, you may have to seek out the help of a professional TV technician.

It's up to you to determine exactly where in your particular set to make the INPUT cable connections. Regretfully, there are so many different models of TV receivers on the market that we can't give you more than very minimal assistance in this article. You might check the inside of your set's back panel for a module or transistor/IC placement label. This will often get you to the right place fast. You can then remove the module or access the foil side of the board.

Your first step is to locate the transformer or filter. Then pass the free end of the cable through a hole in the back panel (you might have to drill it) and connect the shield to the coil's shield in a transformer set, or to the center terminal in a filter set. The cabel's "hot" lead then goes to the IC's input point. Before reassembling your TV set, check for shorts.

Once the connections have been made, mount the project top on the back panel of the set and remount the back panel on the TV set. Choose a location as far as possible from the set's horizontal output section and isolated from the metal chassis.

Now take a few moments to make a final safety check. Set your multimeter to its highest resistance range and touch one probe to the shell of the phono plug and the other probe to first one and then the other prong of the TV set's line cord. If you obtain anything but an infinity reading in either case, find the cause and correct it immediately.

Alignment

Setting up the project for proper operation is a quick and easy procedure to perform. You need an audio amplifier (with speaker) and an insulated alignment tool. Do *not* use a jeweler's screwdriver or any other screw-

(Continued on page 96)

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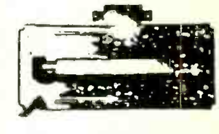

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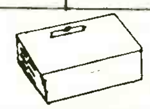

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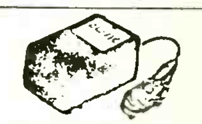

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Components Ass't
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Stk#	Description
CD-180	Ceramic Disk Capacitors 10 pcs of 18 different values. 180 pcs total
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TV-GAME SWITCH
$.65 EACH
OR 10/$4.25

ULTRA-SONIC TRANSDUCER
Don't know what these came out of but this is a doozey of a device. Unit is an aluminum cylinder containing a piezo ceramic with an adjustable coil in parallel. Frequency is 24 khz. Can be used in many ultrasonic circuits.
Stk. #ULT-58 .... $2.25

TOCOM 55 PLUS CABLE TV CONVERTER
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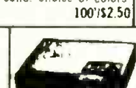

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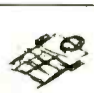

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6.0MHZ	HC18	$1.25
8.0MHZ	HC 18	$1.25
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18.432MHZ	HC 18	$1.25

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7812	12v	1.5 amp
7824	24v	1.5 amp
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7905	5v	1.5 amp
7912	12v	1.5 amp

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Audio Amplifier Experiments

By Forrest M. Mims III

In this era of digital electronics, it's easy to overlook the fact that one of the earliest electronic circuits is still the most widely used. That circuit is the ubiquitous audio-frequency amplifer.

Of the thousands of analog electronic circuits developed over the years, none is as versatile or possesses as much overall importance as the audio-frequency amplifier. Every public address system, radio, tape recorder, television receiver, intercom and transceiver contains at least one audio amplifier. Doctors use audio amplifiers to electronically monitor such physiological functions as respiration, pulse rate and the electrical activity of heart and brain. Scientists and engineers use them to boost the tiny signal levels from accelerometers, strain gauges, photocells and Geiger tubes. Experimenters and technicians use them to troubleshoot audio-frequency circuits (signal tracing) and for general-purpose experimenting.

Since audio amplifiers are so commonplace, it's easy for those people who lack electronic construction skills to perform experiments with them. Of course, experienced experimenters may prefer to build their own custom amplifiers, perhaps including features not ordinarily found in commercial models. In this column, I'll describe several kinds of commercial amplifiers and a do-it-yourself version you can easily assemble. Then I'll describe several experimental applications and suggest others.

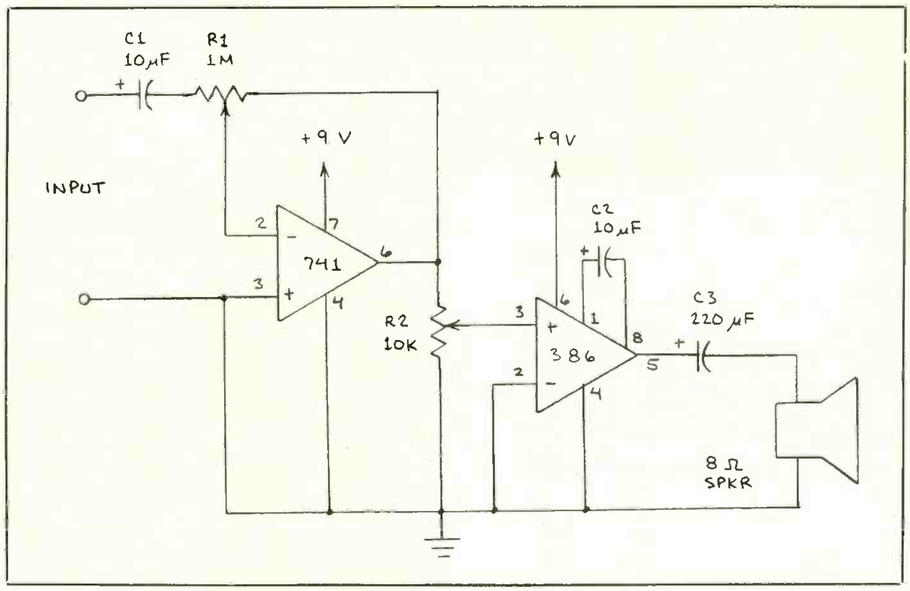


Fig. 1. A do-it-yourself audio amplifier.

Suitable Amplifiers

The experiments to be described and many others can be easily performed with a low-cost commercial amplifier such as Radio Shack's Mini Amplifier-Speaker. This compact battery-powered amplifier, which sells for about $12, has a frequency response of 100 Hz to 10 kHz. It has a sensitivity of 1 millivolt and an output power of 200 milliwatts. The amplifier is equipped with a volume control and separate ⅛-inch phone jacks for the input and output, the latter to an external speaker or earphone.

Some portable cassette tape recorders can also function independently as audio amplifiers. They offer the added benefit of permitting you to record unusual sounds or signals you happen to detect.

Many other commercial amplifiers can also be used. Especially well suited are public address (PA) systems and component amplifiers for home high-fidelity systems. Keep in mind, however, that portable battery-powered amplifiers provide much more flexibility. They also present no electrical shock hazard.

Some amplifiers are equipped with tone controls, but many are not. I've had excellent results by connecting a miniature, battery-powered equalizer between a battery-powered amplifier and an external earphone. The equalizer can substantially reduce the amplitude of both low-frequency noise (such as 60-Hz line noise) and high-frequency noise, emphasizing the audio frequencies to which the ear is most sensitive.

Caution: No matter what kind of amplifier you select, it is essential to use a great deal of caution if you use any kind of earphone to monitor the amplified signal. Sound levels produced by an earphone connected to even a small battery-powered amplifier might be sufficiently loud to cause temporary or even permanent loss of hearing.

When using an earphone, *always* rotate the volume control to the quietest position *before* placing the phone in or against your ear. Then gradually increase the volume to an appropriate level. Always be careful to avoid high input signal levels when the earphone is in or near your ear.

Do-It-Yourself Amplifier

Many readers may prefer to build their own amplifier to perform the experiments that follow. Therefore, before presenting the experiments, I'll begin by describing an easily assembled basic do-it-yourself amplifier.

Figure 1 is the schematic diagram for the amplifier. The input signal is coupled into the inverting input of a 741 operational amplifier. Other op amps can also be used. Gain control *R1* doubles as both the input and feedback resistor. The amplified signal is fed into an LM386 power amplifier through *R2*, which serves as a volume control. The output from the LM386 drives an 8-ohm speaker through *C3*. An 8-ohm earphone can be substituted for the speaker. Capacitor *C2* sets the gain of the LM386 to 200. (Gain can be reduced to 20 by omitting *C2*.)

For best results, keep connection leads of the circuit short and direct to minimize amplifier noise level and the possibility of

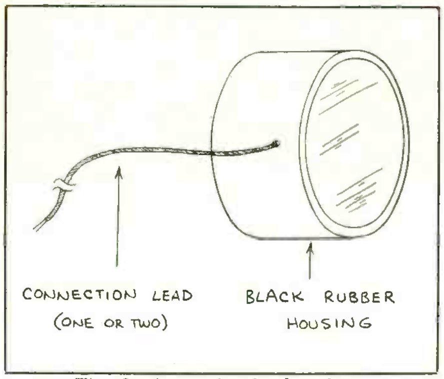


Fig. 2. A surplus hydrophone.

inductive feedback that can cause the amplifier to oscillate at high gain levels. To further reduce the possibility of oscillation, connect a 0.1-microfarad capacitor across the power supply pins of the two integrated circuits.

Underwater Hydrophone

Of the many experiments I've performed with audio amplifiers, listening to underwater sounds has been among the most interesting. When I was a high school student, some of my friends and I used a transistorized amplifier salvaged from a cheap battery-powered PA system to establish a voice link between the deck and the bottom of a local swimming pool. One of us would swim down to the bottom with the microphone while the others remained on top to listen. As you might expect, the words were bubbly sounding, but it was actually possible to understand most of what was being said.

Later, I used this same system to listen to the sounds produced by a captive porpoise. For both experiments, the microphone was a low-cost crystal unit placed inside a mostly waterproof plastic bag.

Recently, my interest in underwater sounds was revived as I was flipping through the pages of Edmund Scientific's catalog and spotted a surplus hydrophone (catalog No. 41,759) for $9.95. I promptly ordered one.

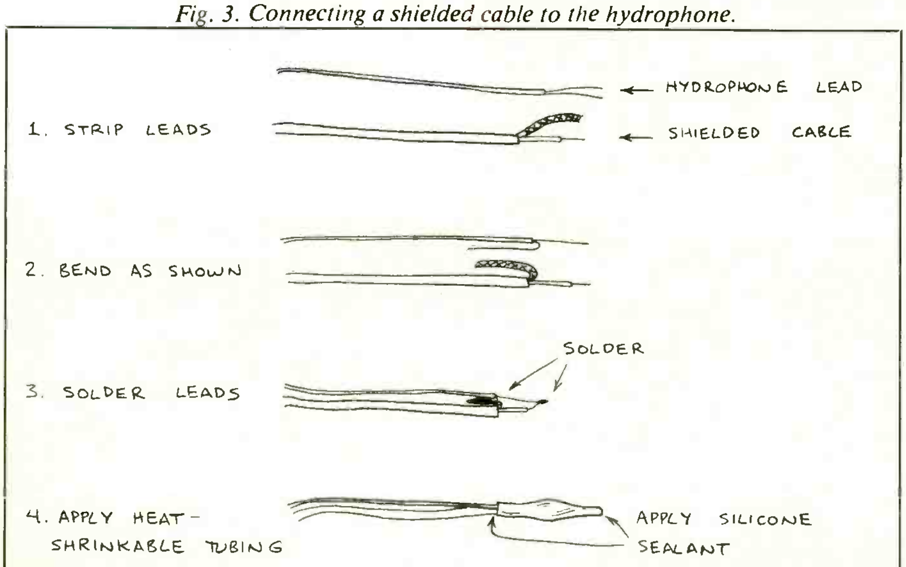
As its name implies, a hydrophone is a microphone specifically designed for underwater use. The Edmund Scientific unit is completely encapsulated in black rubber and plastic and can be used in fresh or salt water to a 300-foot depth. The unit has a low impedance and a capacitance of approximately 15,000 pF. The hydrophone's frequency response ranges from 10 to 6,000 Hz $\pm$4 dB ($\pm$1 dB from 10 to 2,000 Hz). Above 7,000 Hz, the hydrophone's rolloff is at a rate greater than 12 dB per octave.

Figure 2 is a sketch of the hydrophone I purchased from Edmund Scientific. According to the specification sheet, this hydrophone may have one or two pairs of leads. If present, the additional pair of leads facilitates connecting from two to four units in parallel. Indeed, you can buy a string of parallel-connected hydrophones from Edmund for $39.95.

If the hydrophone you receive has an extra pair of leads, it's important to insulate the exposed end of the unused pair to prevent any possibility of inadvertently shorting the hydrophone's output. A small blob of silicone sealant like that used to assembled tropical fish aquariums works well.

The specification sheet supplied with the hydrophone explains how to solder a shielded cable to the hydrophone's leads. To avoid using the tape suggested in the spec sheet, I used a slightly different method. First, I exposed the two strands of bare wire in the connection lead and folded one strand back along the insulated lead. I then placed the exposed conductors at the end of a length of shielded cable alongside the two strands, as shown in Fig. 3.

Fig. 3. Connecting a shielded cable to the hydrophone.



After soldering the hydrophone's exposed leads to the shielded cable, I placed a short length of heat-shrinkable tubing over the connection and shrank it snugly over the soldered wires with the heat from a soldering iron. Next, I coated the entire connection with silicone sealant. Finally, I soldered a shielded ⅛" phone plug to the unused end of the shielded cable.

For best results, the hydrophone should be securely mounted to a suitable handle, rod or pole. Otherwise, the strain placed on the connection lead may cause one or both of the small wires to separate. Edmund Scientific's specification sheet recommends using a hose clamp to attach the body of the hydrophone to the flattened end of a length of electrical conduit (available from a hardware store). The connection leads should then be tied or taped at intervals along the pole.

In some preliminary tests, I've used my hydrophone to listen to the sounds in the spring-fed creek that flows about 1,000 feet from the old Texas farmhouse where these words are being entered into a word processor. This stream is populated by catfish, bass, blue gill, gar and various kinds of turtles and frogs. Though these tests were conducted during January when the creek's inhabitants are much less in evidence, I could hear a cacophony of pops, crunches, gurgles and the like. Even when the hydrophone was submerged in some of the deeper holes (8 to 10 feet), the sound of a twig tossed in the water could be clearly heard. Rain produced a static-like sound.

When the weather warms up, I plan to spend a good deal of time exploring the creek with my hydrophone. I also plan to take it out on some nearby lakes and to dip it in the waters of Corpus Christi bay on the Texas gulf coast. Finally, I plan to use the hydrophone in conjunction with a miniaturized electronic insect simulator. The latter device is a piezoelectric buzzer driven by an oscillator whose frequency rate can be altered. If the results from these experiments are interesting, I'll report on them in a future column.

Caution: For your own protection, *never* use a line-powered amplifier around water. To do so may result in a dangerous or even fatal electrical shock. The hydrophone experiments described here should be conducted with a battery-powered amplifier only.

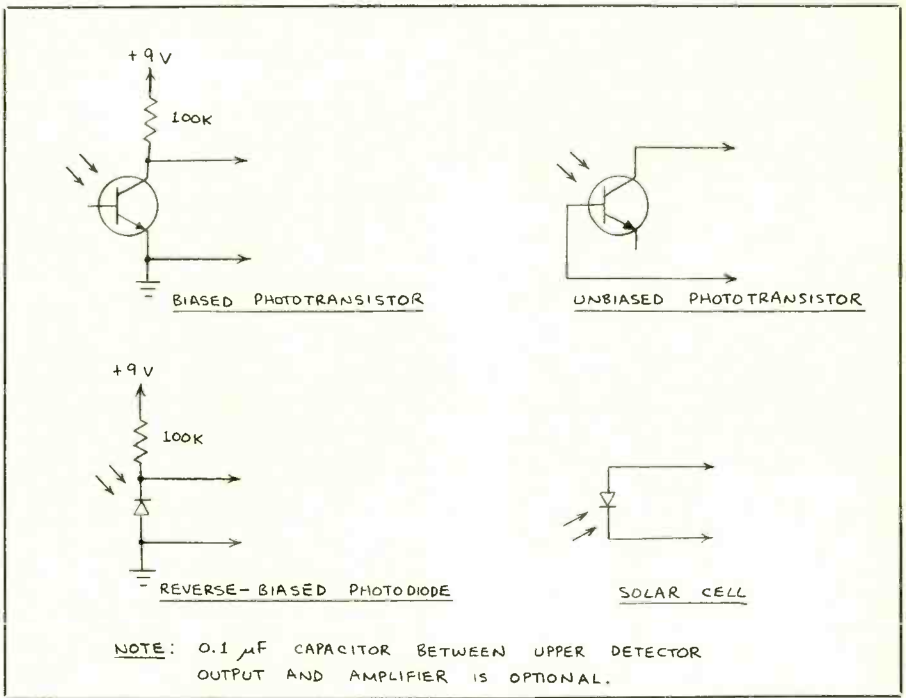


Fig. 4. Light-sensor/amplifier combinations.

Light and Lightning Detection

Another fascinating application for an audio amplifier is to monitor various light sources by means of a low-cost solar cell, photodiode or phototransistor connected to the amplifier's input. Figure 4 shows various ways each of these devices can be connected to an amplifier.

You can use any of the various photodetector/amplifier combinations in Fig. 4 to transform into sound the pulsations or intensity fluctuations of any light source that is modulated at an audible frequency. For example, positioning the detector in the shadow of a hovering humming bird will cause the speaker connected to the amplifier to emit a tone that corresponds to the frequency of the bird's wing beats. A similar effect can be observed by positioning the detector so that it can receive flashes of sunlight reflected from the wings of flying insects.

You can also use any of the basic arrangements in Fig. 4 to monitor electrically or electronically modulated artificial light sources. All light sources directly powered by 60-Hz line current are modulated and will therefore cause an audio-frequency tone to be produced by the photodetector/amplifier combination. Multiplexed light-emitting diode (LED) displays will elicit a similar effect.

If the light source emits invisible near-infrared, a lightwave receiver is particularly handy. It can determine whether or not the source is activated and is illuminating a given area. I often use a photodiode/amplifier arrangement as an optical-fiber continuity checker. The emission from a near-IR LED pulsed at an audible frequency is injected into one end of the fiber and the photodiode monitors the opposite end. Of course the continuity of short lengths of fiber can be visually checked with a visible source.

Some applications for a light-sensing amplifier are less obvious. For instance, the tungsten filaments in some car and truck headlights will vibrate when the vehicle rolls over a rough surface. This causes the filament to move in and out of the focal point of the lamp's parabolic reflector. The result is that the beam from the light is intensity modulated. The gong and bell-like sounds that result when these intensity fluctuations are detected by a light-sensitive amplifier are quite distinctive. You can produce a similar sound by striking the end of a flashlight with a pencil while illuminating a detector connected to an amplifier.

Of the many applications for a light-sensing amplifier, my favorite is lightning detection. An ordinary AM radio indicates the presence of lightning by producing crackling and popping sounds. A light-sensing amplifier responds to lightning by producing similar crackles and pops. The major difference is that the light-sensing amplifier is directional. It can also detect lightning that is obscured by clouds and is, therefore, not ordinarily visible to the human eye. For best results, try detecting lightning at night. Be sure to avoid placing yourself in a location that might be vulnerable to a lightning stroke!

Simple Photophone

On February 19, 1880, Alexander Graham Bell and his lab assistant, Sumner Tainter, became the first people to speak over a beam of light. For this historic demonstration they directed a beam of reflected sunlight through a pair of comb-like grids made by scratching parallel lines in the silver coating of two small glass mirrors. One grid was mounted in a fixed position, the other attached to the diaphragm of a modified telephone microphone. When voice energy was directed against the diaphragm, the grid to which it was attached moved back and forth in response to the signal. This caused a representative fluctuation in the sunlight passing through the two grids. The fluctuating light was detected by a homemade selenium light detector designed by Bell.

Professor Bell called his pioneering lightwave communicator the "photophone." In the first version, described above, the detector was separated from the grids by only a few centimeters. Soon afterward, Bell and Tainter were talking over beams of sunlight at distances of hundreds of feet. For many of these experiments they used a transmitter so simple it can be assembled by a child.

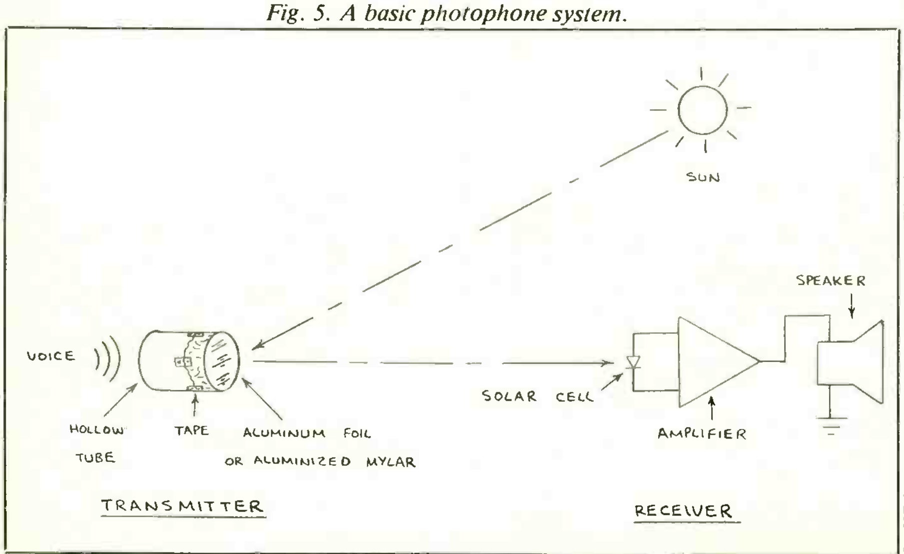
Figure 5 shows construction details of a modern version of one of Bell's photophones. Bell's version used a very thin glass mirror attached to the end of a speaking tube. The mirror became alternately convex and concave in response to the pressure of sound waves, causing the divergence of the beam of sunlight reflected from the mirror to vary accordingly. Consequently, the intensity of the beam at a distant point was amplitude or intensity modulated by the spoken words.

There are many ways to fashion a transmitter for a do-it-yourself photophone. The one shown in Fig. 5 is made by attaching a sheet of aluminum foil (shiny side out) to one end of a hollow tube. The tube can be cardboard, plastic or metal. The foil can be attached with tape or a rubber band. Aluminized Mylar provides a smoother, flatter surface than aluminum foil, projecting a narrower beam than that reflected from an aluminum foil transmitter. Unfortunately, aluminized Mylar is partially transparent and, therefore, has less reflectance than aluminum foil.

The receiver for a homemade photophone can use any of the light sensors mentioned above. For best results, however, use a silicon solar cell. The large surface area of this detector provides excellent collection efficiency without requiring an external lens. Since the photophone is designed to be used in daylight, it's important to increase the signal-to-noise (S/N) ratio by installing the cell in one end of a hollow tube. For best results, spray the inside of the tube with flat black paint or line the tube with black construction paper.

To use the photophone, simply reflect a spot of sunlight toward the detector. While holding the transmitter as still as possible, speak into its open end. The person at the receiver end should then hear every word you speak. The quality of

Fig. 5. A basic photophone system.



voice reproduction will be influenced by the dimensions of the transmitter and the amount of ambient sunlight reaching the solar cell. For best results, the sun should be behind the receiver and the receiver should be in a shady spot.

You can easily experiment with the basic photophone concept presented in Fig. 5. For example, add an equalizer to the output of the amplifier to enable the receiver to enhance the quality of the received signal. Or try different-size transmitter tubes and reflective materials to see which combination works best.

I've made many kinds of photophone transmitters and receivers. The smallest transmitter is a 1" length of 1"-diameter aluminum tubing. An ultrathin glass mirror is cemented to one end. I've even made transmitters by taping a flat sheet of aluminum foil or aluminized Mylar over a circular opening cut in a flat piece of cardboard.

As for receivers, I've used many different kinds of detectors and amplifiers. The most ambitious uses an 18"-diameter glass parabolic reflector installed in a wood cabinet assembled for the purpose. A folding-arm assembly permits a solar cell to be placed at the focal point of the mirror when the cabinet is opened. A transistor amplifier and speaker are installed inside the cabinet. For complete construction details, visit a library and find the February 1976 issue of *Popular Electronics* (pp. 54 through 61).

An experiment Otis Imboden and I once conducted will give you an idea of the versatility of the photophone concept. Otis is a photographer for *National Geographic* magazine who often photographs both gas and hot-air passenger-carrying balloons. When the two of us were in Albuquerque, photographing a hot-air balloon competition, I showed Otis some of my photophone equipment. Being an innovator, Otis suggested using as a photophone transmitter one of the large foil-covered reflectors he brought along to brighten up the passengers in the baskets of hot-air balloons he was photographing. I gave a receiver to the pilot of a tethered balloon, and Otis managed to speak to her by means of sunlight reflected from his giant photophone transmitter. Though I don't know if it was ever tried before, the combination of those two technologies could have been used to establish ground-to-air communications a century ago.

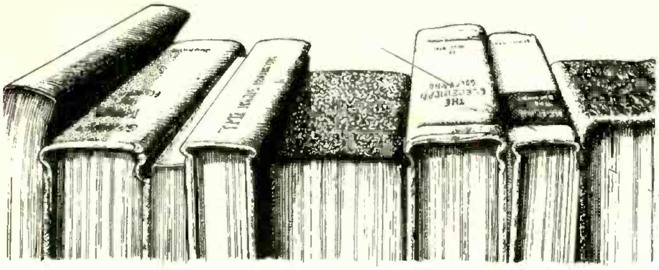
How much range will a photophone system give? A simple system using a solar cell receiver will easily give a range of up to a few hundred feet. For more range it's necessary to use a lens at the receiver or to do as Bell did and use a focused beam of sunlight to provide light for the transmitter.

In any case, it's very important that the person at the receiver end wear dark sunglasses and avoid staring at the bright reflection of sunlight from the transmitter. Staring at the beam for even a second or so will cause a scotoma, a temporary after image that leaves a blind spot in the field of vision. Staring at the reflected sunlight for more than a few seconds may cause temporary or even permanent damage to the retina of one or both eyes.

Going Further

Many electronics books describe applications for audio amplifiers. I've described several applications in *The Forrest Mims Circuit Scrapbook* (McGraw-Hill, 1983). A much better source is Calvin R. Graf's *Listen to Radio Energy, Light and Sound* (Sams, 1978). Cal's book describes dozens of experiments you can perform with a battery-powered amplifier. **ME**

BOOKS



Designing Electronic Circuits by Robert G. Middleton. (Prentice Hall. Hard cover. 351 pages. $29.95.)

As electronics design-type books go, this one is a good cut above what is usually available. It does not overwhelm the reader with unnecessarily heavy text detail and it provides wide coverage. Essentially, this handbook of procedures and reference data gets you immediately down to the task of designing discrete-transistor circuits. Limiting mathematics to basic algebra, the book focuses on practical circuit design procedures through terse text, formulas and liberal use of schematics and other diagrams.

Each of the 13 chapters in this book tackles a different amplifier topic—basic amplifiers, audio preamps, driver and power amplifiers, tuned amplifiers, wide-band amplifiers, and basic MOSFET amplifiers, to name just a few. Each successive topic builds on previous topics to provide unified coverage.

An interesting feature of this book are the more than 60 BASIC programs (written for the IBM PC and compatibles but with information in an appendix that tells you how to convert them for the Commodore 64 and Apple II computers). You key in these programs and then have a computer do most of the preliminary design calculations. The computer-aided design programs are a nice touch that we would like to see more of in electronics books. In sum, this is a practical, valuable book for anyone interested in designing circuits.

Pocket Digital Multimeter Techniques by Homer L. Davidson (Tab Books. Soft cover. 360 pages. $22.95.)

The omnipresent digital multimeter (DMM) is usually the most versatile instrument one can own. This book focuses on its many uses, emphasizing quick and easy methods to troubleshoot almost any electronic device. For example, in addition to making garden-variety voltage, current and resistance measurements and simple continuity tests that can be conducted with the DMM, you are shown how to make critical measurements and how to use these to pursue a realistic repair procedure.

To demonstrate what can be done with a DMM, each chapter deals with troubleshooting of a different electronic product. Among the products used as illustrative examples are a variety of TV receiver types, portable and table-model radios, AM/FM-stereo receivers, stereo amplifiers, 8-track and cassette decks, car and truck radios, and telephones. Within each chapter is a list of the most common problems that may occur in the product under discussion, plus several case histories that help illustrate how to isolate the cause of a problem, make certain tests, locate and repair problems. In fact, a significant part of this book deals with symptom/cause/correction of electronic circuit problems, noting voltage and resistance differences. Thus, the book is really a troubleshooting guide using a DMM or any other type of multimeter, rather than a pocket DMM in particular. The title of the book is therefore inappropriate. Nonetheless, the book itself is a veritable course on examples of what can go wrong in a circuit and how to troubleshoot with only a multimeter.

Faster Than a Reading Bullet

By Art Salsberg

```
MENU - DISK TWO

Lesson 3: Idea Clustering
   A) Introduction to Clustering
   B) Idea Clustering Practice
   C) More Clustering Practice

Lesson 4: Preliminary Pacing Patterns
   D) Single Line-pacing
   E) Double Line-pacing

Lesson 5: Advanced Pacing Patterns
   F) The Z-pattern
   G) The S-pattern

Cumulative Graphs/Exit

   H) Graphs
   Z) Exit MicroSpeedRead
```

Fig. 1. Sample menu.

```
1. The main idea of this article
   is that

 A) Godunov is no longer inhibited in
    what he says.
 B) Godunov's life has changed
    dramatically since he defected
    from the Soviet Union.
 C) Godunov is leaving ballet to start
    an acting career.
 D) artistic freedom is not possible
    in the Soviet Union.
```

Fig. 2. Sample comprehension test.

With so much to read and so little time to do it, anything to speed up the process would be very helpful. That's where "speed reading" courses come in. To many people this conjures up Evelyn Woods' speed-reading seminars, popularized during President John Kennedy's administration, which is going stronger than ever today.

I had taken a compulsory speed-reading course many years ago when I studied electronics. It was called the "Harvard Speed Reading" course and used audio-visual methods that were very effective. Doubling one's reading speed after completing the course was commonplace. Many students, including me, greatly exceeded this modest increase.

Examining CBS Software's *MicroSpeedRead,* a $125 four-disk program with an accompanying softcover user's manual (over 200 pages), revealed that the same basic teaching principles were used as in my audio-visual course many years ago. Accordingly, it should certainly have the potential for significantly increasing a user's reading speed. The program is designed for use with an IBM PC or compatible that uses DOS 1.1 or higher, an IBM PCjr (requiring DOS 2.1 and its BASIC cartridge), and Apple II+/IIe/IIc computers. Only one disk drive is needed.

The disk operating system must be loaded first, followed by loading of BASIC. Then the program disk is substituted. There are ten lessons in all, with the first lesson enabling you to estimate your present speeds. Note the plural, *speeds.* You will find that there is a standard reading speed, a reading speed when you're pushing for greater speed, and skimming and scanning speeds.

Pressing the space bar to start and stop the computer's automatic scoring of your reading speed when you read material in the manual gives you a clear indication of how fast (or slow) you read when starting the speed-reading course.

Remaining lessons develop your reading speed and comprehension abilities, followed by refining your skills through practice. High reading speed is useless unless you retain what you read, of course. So the little exams that follow check you out on reading retentivity.

The video display challenges you by moving from sentence to sentence in varying speeds that you choose or by limits you set on how long text remains on screen. You'll be startled at first by your inability to read or comprehend much at the higher speeds you'll want to try your hand (eyes) on at the start. But if you stick with the course, I'm confident that all but the really high speeds will be handled quite well.

It's a case of practice makes better, aided by neat reading tips for speeding your way through articles and books. This type of speed reading, or any other type, is not designed to provide one with great reading pleasure. You don't chew words

(Continued on page 90)

HARDWARE HACKER

New electronic memory chips, a new microprocessor chip, the UART defined & some circuits, how drawings are made

By Don Lancaster

We'll once again start out with our usual reminder that this is your column and you can get solutions to many of your "Hardware Hacker" questions per the phone and address in the ending box.

Since there's lots of exciting new hacker components this month, let's just jump right in.

What's new in electronic memory?

So much is happening so fast it is hard to keep up. Let's look at three new developments:

First, if you check the ads right here in *Modern Electronics,* you will find 256K dynamic RAMs available for a mere $3 each, give or take a few cents. That's almost *one millicent* per bit!

What utterly boggles the mind is that if "they" keep increasing memory size and keep reducing the per-bit price at the same rate "they" have for the past 14 years, you will have the equivalent of the 5-billion neurons in the human brain on a single chip for under a dollar before the end of the century!

Second, Apple has a new RAM card that holds a full megabyte of memory and fits either a II+ or IIe. The card automatically supports both the DOS 3.3 and ProDOS operating systems. You can use as many cards as you need, up to a total of seven or eight megabytes. Plus the 64K or 128K you started out with.

I've started using this card and I like it very much. It is destined to become *the* primary standard for Apple add-on memory cards. Why? Because it (a) comes from the "company," and (b) does *not* use awkward and ungainly bank switching. Instead, the entire card is readable from one single address that auto-increments.

I have put together a disassembly script and a few utilities that make this card more understandable and far easier to use. Write or call if you need more on this.

Third, Both NEC and OKI have some new memory modules out that show outstanding potential for the advanced hardware hacker.

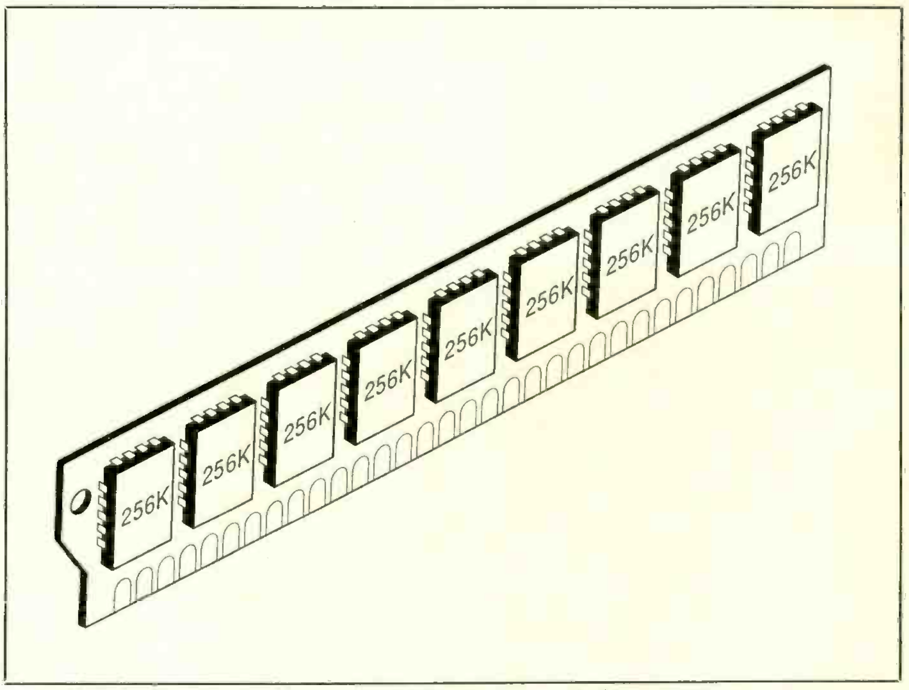


Fig. 1. A module with nine 256K RAM chips costs $24 in single quantity.

As Fig. 1 shows, these modules consist of a fancy printed-circuit board and nine 256K dynamic RAMs in a small plug-in unit. The ninth RAM can be used either for error testing or as a spare that gets jumpered if another RAM chip fails.

Besides being much smaller than traditional DIP packaging, these new modules are removable and contain internal supply bypass capacitors. They are almost certain to become the RAM of choice for the next generation of microcomputers.

OKI will sell you *two* 256K × 1 modules and a special double socket for only $48 in singles. That's right at the magic millicent per bit figure. Its called the DRAM SIMM Sample Set, and is available right now. Before you get all excited, though, note that these are strictly for advanced hackers only. There are serious hassles involved in using any dynamic RAM. You have to know where the address lines are going to come from to address an entire 256K block of words. You have to know how you are going to refresh the RAM chips to keep the memory alive. And, you have to know how to handle address pin multiplexing where one package pin is used at different times for either a column address or a row address.

Nonetheless, these RAM modules should drop into a Macintosh with a minimum of hassles or rework. More information on dynamic RAM appears in my newly reprinted *Micro Cookbook,* Volume I (SAMS #21828).

Any new micros this month?

I just ran into a really exciting new microprocessor chip that should be ideal for almost any small controller, trainer, or data gathering use. This chip has hacker written all over it.

Its called the Mitsubishi M50734 and sells for $12 in single. It is built-in CMOS and speaks 6502, so it should be really easy to use with Apples, Commodores, Ataris, and the rest of the 6502 gang. Internal bank switching is used to create a double-sized 128K address space.

No RAM or ROM inside, but my oh my, the ready-for-use peripheral circuitry stuffed into this beast. How does 40 I/O lines, a Centronics port, nine timers, a multiple input A/D converter, some stepper motor drivers, a pulse position modulator, and a two-way UART serial communications channel interface sound? If that's not enough for you, there are enough pins on the package that you can also use it for an emergency cheese grater.

Obvious uses for the M50734 include data recorders, hydrophonic garden timers, cable TV intelligent taps, solar-powered pump interfaces, general robotics, weight scales, cattlefeeder setups, student trainers, hot-tub pump cyclers, cotton-picker tooth setter, numeric machine controls, etc.

It might even be possible to drop this dude and an adapter directly into the 65C02 socket on an Apple IIc or IIe and run everything else out of a humongous new I/O connector. Stay tuned to this column for more details.

The beauty of being more or less Apple compatible is that the full resources of the Apple become available for design, debugging, and testing of what you want to do. No costly ROM masks or emulation software is needed, and the design process is fast and fun by using standard assemblers, debuggers, printers, disk drives, etc.

Two minor gotchas. The 64-pin, 70-mil shrink DIP package is oddball, so sockets may be very difficult to find. In addition, there are not enough pins to go around, so they used Motorola style pin multiplexing on the data/low address lines. At worst, this means you have to add a 74HC373 address latch to your final circuit.

You'll find lots of information on programming 6502-style chips like the M50734 in my two *Micro Cookbooks* SAMS #2128 and 21829).

Tellyawhat. Let's have us another contest. A free *SAMS* book to the best 10 uses for the M50734. The overall winner gets an all expense paid tinaja quest for two (FOB Thatcher, Arizona), plus some possible cash type money if their entry is good enough to become a *Modern Electronics* feature or construction article.

What is a UART

There are two different ways of sending data between two points. With parallel data communications, all bits in a data word are simultaneously sent using as many lines as there are bits. Parallel data communication is very fast but need lots of wires. On the other hand, serial data communication needs only a single wire to get from point A to point B. All bits are sent down the line one at a time in a specific order. Serial data communication is much slower than parallel, but it needs only a single channel.

In general, parallel data communication is used inside or near computers, while serial data links are used between computer systems, particularly over long distances. Consider the absurdity of needing eight separate telephones at both ends to send 8-bit data words.

There are lots of times when you want to convert from parallel data to serial or vice versa. For instance, a lap or handicapped keyboard would best have its data sent to a computer in serial form. Some computers, such as the Apple IIc, output data *only* in serial form. You might like to convert to parallel outside the computer to drive a parallel dot-matrix printer or a power controller full of relays or solid-state power switches.

Some electronic circuits do not have a microprocessor in them. Except for the simplest of computers, the main microprocessor in a microcomputer cannot be expected to sit around all day to generate slow serial code or wait until new serial input data arrives. The micro almost always has better things to do. Instead, there are many special ICs that convert data from serial to parallel and back again as needed. They are cheap and easy to get.

These special circuits are called UARTs, short for Universal Asynchronous Receiver Transmitters. The "asynchronous" in the name means that any amount of time can go by between successive transmissions or receptions.

There are two basic types of UARTs. A hardwire UART is used when there is no microcomputer involved at its end of the communication channel. Two examples of hardware UARTs are the Intersil IM6402 and IM6403. With hardwire UARTs, the data formats are set by physical jumpers, and the input and output data appears on individual lines.

A Peripheral style UART is intended for use with a controlling microprocessor. The Rockwell 6551 is a typical example. With a peripheral UART, the data format and sometimes the data rate is settable by software. Input and output parallel data is usually routed directly to the data bus on the controlling micro.

Figure 2 shows the usual format of a serial asynchronous code. This was originally called the Teletype code. Very often this code is sent from system to system by using RS-232C standard levels and pinouts. Note that a code and a standard are two totally different things.

You always start with a start bit that tells the receiving UART that a new character is to arrive. Remember that with asynchronous communication, a random amount of time can go by between individual transmissions. The actual code bits then follow in sequential order. starting with the LSB, or least-significant bit. After the code bits a minimum of one or two stop bits is sent, followed by as many more stop bits as you need to wait until the next transmission.

The speed of transmission is set by the baud rate. The baud rate is defined as how fast the bits come out of the pipe. Popular

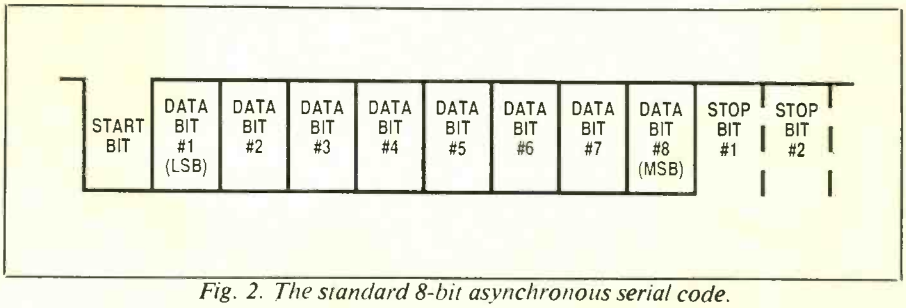


Fig. 2. The standard 8-bit asynchronous serial code.

baud rates include 300 baud for modems and 9600 baud for printers. You can roughly relate baud rate to cps (characters per second) by dividing by 10. Thus, a 300-baud modem link maxes out at 30 cps.

Most UART circuits need input reference frequencies that are far higher than the communication baud rate. Among other reasons, this lets the receiver circuit sample only the very center of a received data bit for minimum noise. Often, but not always, the system baud rate reference will be 16 times the actual transmission and reception baud rate.

While eight data bits are usually the norm, five or seven are sometimes used. It is also possible to use an optional error-checking parity bit, although this is not done too much in local microcomputer use. The parity bit forces all of the ones in a word to an even number; if an odd number was received there was an error. Odd parity can also be selected.

It is extremely important that the baud rate, number of data words, number of stop bits, and parity (if any) agree between sending and receiving ends. Since both baud rates must agree to better than one-percent accuracy, crystal control is normally used at both ends.

Show me some UART circuits.

The Intersil IM6402 is a good choice for a modern hardware UART. This one is available from Digi-Key $6.90, (part no. NT5000-ND) among other dealers. The IM6402 is pin-compatible with earlier UARTs, but needs only a single +5-volt power supply.

As with earlier hardware UARTs, the IM6402 needs an external 16× baud rate that is input to the transmitter on pin 40 and input to the receiver on pin 17.

The number of data, parity, and stop bits is programmed by jumpering pins 34 through 39 to ground or +5 volts. Making all of these +5 volts gives you eight data bits, no parity, and two stop bits. Consult the data sheet for any of the other combinations if you need them.

Naturally, you should *never* use *any* integrated circuit without the data sheet and any available ap notes on hand and these should be thoroughly understood before you do use a given UART.

In general, the "top half" of a hardware UART is used to transmit, and the "bottom half" to receive.

The IM6403 is a variation on the IM6402 that has some interesting advantages. Instead of a pair of 16× baud rate inputs, you can hang a crystal directly on the chip and generate your own internal baud rate. Unfortunately, many popular baud rates need higher-frequency crystals that require higher supply voltages, preferably +9 or +10 volts, or the baud rate generator will not oscillate reliably.

Figure 2 shows a UART transmitter that is set to 4800 baud, uses a cheap crystal, and runs off a +5-volt supply. A transmitter accepts parallel data in and outputs serial data. Pins 34 through 39 are shown programmed for eight data bits, no parity, and two stop bits. The inverter on the right

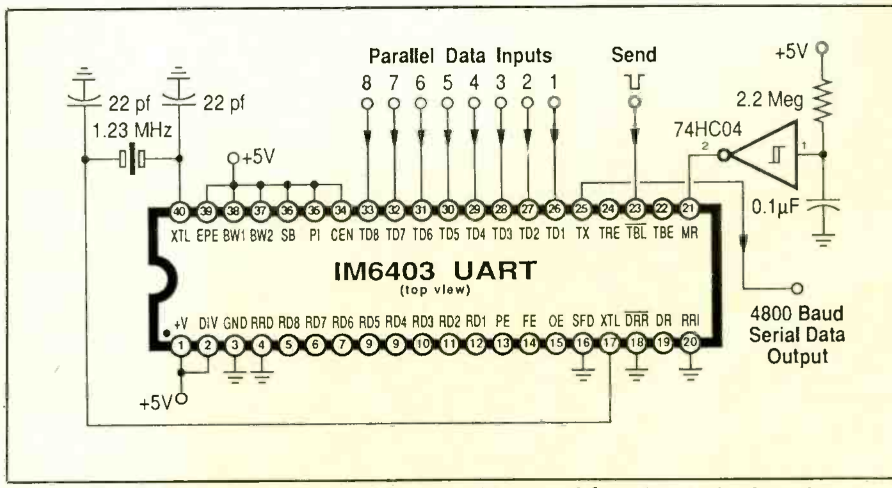


Fig. 3. Typical UART transmitter could be used for a laptop keyboard.

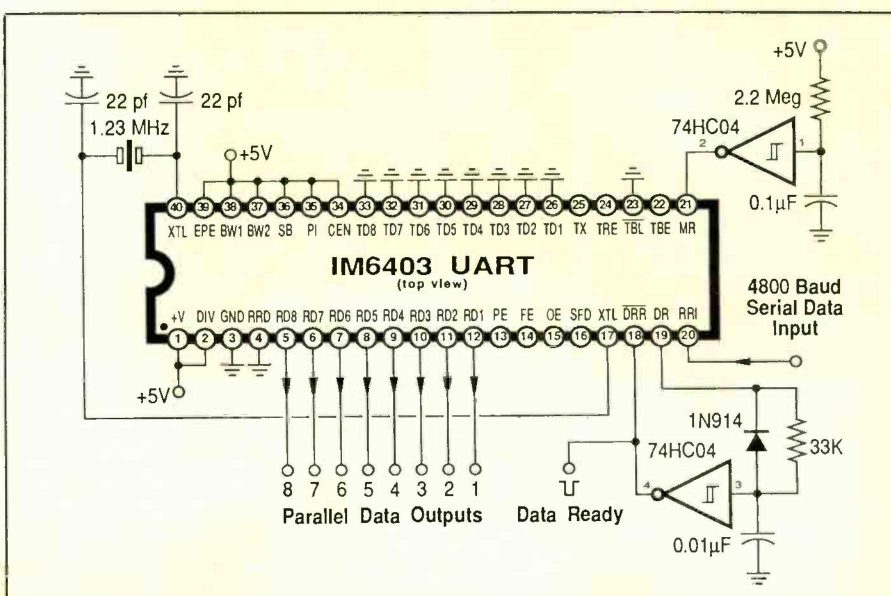


Fig. 4. A UART receiver used to drive a parallel dot-matrix printer.

is one way to do a power-on reset. Any other scheme that briefly brings pin 21 high after power-up will work as well.

One possible use for this circuit is a lap or handicapped keyboard.

Figure 4 shows a UART receiver that accepts serial input data and outputs parallel words. One obvious use would be for a dot-matrix printer adapter for the Apple IIc personal computer.

That bottom inverter requires some careful explanation. In most fancy UART systems, you need full handshaking to make sure that each received character gets used once and only once. To do this, the DR or data ready pin goes high when data is received. When the rest of whatever the UART is driving accepts that character, it resets the UART by bringing the DRR or DataReady Reset line low.

For some simple UART uses, you instead want to just say "here is the data" and immediately get ready for more data. The bottom inverter does this, outputting a brief negative pulse every time a new character is ready to be received.

Thus, you use this inverter when you do *not* want or need handshaking. Note that the UART will hang after one character if you do not pull the IC's pin 18 low.

How are figures for this column drawn?

All four figures in this month's Hardware Hacker (and all those that have appeared in this column during the past few months) were "drawn" on an Apple IIe using the stock and popular ProDOS Applewriter word processor. The figure drawing process is sped up and helped along by some utility routines I have put together on my own. These figure textfiles are written in a special yet easy-to-use *Postscript* language. The Postscript text files are printed on a Laserwriter printer. The images are then photographically reduced to their final page size.

Note than the quality of these images is vastly better than anything that's currently available from *any* screen-oriented graphics routine on *any* microcomputer. This happens because an exact text description is far and away the most powerful, most flexible, and most exact way of wringing the ultimate performance out of the Laserwriter.

With the right utilities, exact text descriptions of electronic figures can actually be done faster and much more compactly than by using screen graphics programs.

For instance, Fig. 4 took about 12 minutes to "draw." The final Postscript file ended up pretty much the same size and with just about the same complexity as an ordinary business letter.

Let's quickly sum up some of the key secrets of my new schematic drawing utilities:

First is a gray rubber grid that lets you stretch or squash the drawing to the size you need. Normally, one unit of the grid is defined as the space between adjacent pins on an IC package. You can turn the grid on and off as needed. Unlike screen graphics grids, you can easily use fractional grid values. No matter how fine the grid or how nervous the programmer, horizontal and vertical lines always stay that way.

Second is the use of *opaque symbols.* A symbol is something like a resistor, an IC or an inverter. Whenever these symbols are put down, they erase and then overwrite whatever happens to be under them. Thus, you could put down one *continuous* wire first, and then drop a resistor on top of it. This is far faster and easier than worrying about exactly where each connection to each part of each symbol has to go. Symbols can later be slid along a wire for best final appearance.

Third is the use of action points. Rather than define the position of a symbol from its corners, you define it from a logical connection point instead. The action point of a resistor would be its center. The action point of an IC pictorial is the center of pin one, and so on.

Fourth is the use of an automated DIP pictorial generator. To draw a complex 40-pin integrated circuit, you use a special routine. All you have to tell this routine are the number of pins, the name of the chip, and two strings of callouts as needed for the top and bottom pin rows. Thus, an entire DIP pictorial is drawn with a few dozen keystrokes! Complement bars are easily added when and as needed with a companion routine.

Fifth is the use of slide-under wiring. Since the symbols are all opaque, they will position themselves on top of any wires and will completely erase any wire under them. By putting the wire descriptions early in the textfile and the symbols late in the textfile, all of the wires will magically stop at the exact edge of each symbol. Usually, you put your symbols down first, and then slide the wires under them. This mind-boggling trick is done simply by entering wire descriptions above the symbol callouts in your textfile.

Sixth is the use of predefined symbols. To show a resistance omega, you just type the word "ohms." To show a capacitance mu, you just type the word "micro," and so on. Things like arrowheads, clock pulses, and connection dots are similarly handled. You do not have to define these in the textfile for a particular schematic; they are already predefined in the preloaded schematic utility routines.

Seventh, and finally, is the use of self-breaking wires. Note the white space in Figs. 3 and 4 every time a horizontal wire ducks under a vertical one. This gets handled automatically by drawing a fat white vertical wire and then redrawing a thin black vertical wire on top of the white one. Special adjustments are made to keep from erasing portions of the wire endpoints. You can pick no breaks, vertical breaks, or horizontal breaks per your drawing style.

These same ideas will work very well for quick and simple printed circuit layouts. More on this some other time.

I'd be most happy to send you some free listings of these utility routines, along with a few mind-boggling demos.

Just call or write. **ME**

NAMES AND NUMBERS

Adobe Postcript	**Digi-Key**	**OKI Semiconductor**
1870 Embarcadero S120	701 Brooks Ave. South	650 North Mary Avenue
Palo Alto, Ca 94303	Thief River Falls, MN 56701	Sunnyvale, CA 94086
(415) 852-0271	(800) 344-4539	(408) 720-1900
Apple Computer	**Mitsubishi**	**Rockwell International**
20525 Mariani Avenue	1050 East Arques Avenue	3310 Miraloma Avenue
Cupertino, CA 95014	Sunnyvale, CA 94086	Anaheim, CA 98203
(408) 966-1010	(408) 730-5900	(800) 854-8099
Intersil	**NEC Electronics**	**SAMS**
10710 N. Tantau Avenue	401 Ellis Street	4300 West 62nd Street
Cupertino, CA 95014	Mountain View, CA 94039	Indianpolis, IN 46206
(408) 996-5000	(800) 632-3531	(800) 428-SAMS

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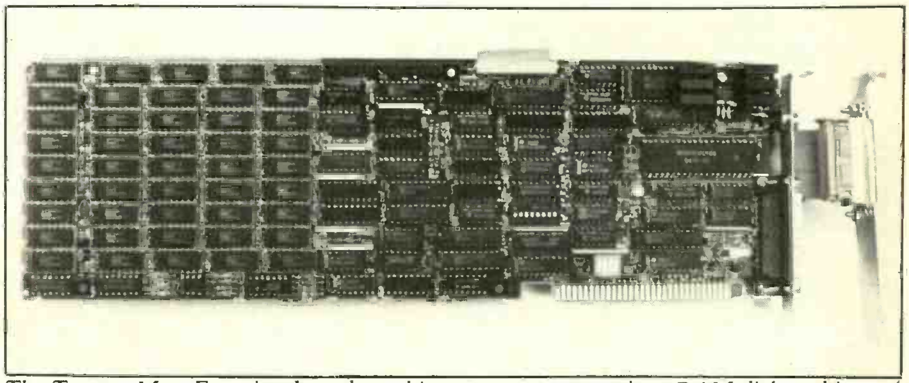
First Impressions: Ashton-Tate's Framework II Integrated Software package; Tecmar's MegaFunction Memory-Expansion, RAM-Disk and I/O Board

By Eric Grevstad



The Tecmar MegaFunction board combines memory expansion, RAM disk and input/output ports on a board that takes up one slot.

Before tackling this month's other topics—an expansion board with something extra and an editorial on DOS enhancements—I must face conflict-of-interest charges. I'm going to give a rave review to a program from Ashton-Tate, whose publishing arm produced Jim Heid's and my beginner's book about the Tandy 1000.

Having confessed the connection, I'm not sure how to prove my objectivity except to say that the company's dBase III and MultiMate are not my favorite database and word processor. Also, I'm mad that Ashton-Tate wouldn't give advance information so the software section of our book, not mentioning this new product, is outdated. The product is Framework II, and it's the single best computer program I've seen.

A Splendid Success

Other programs still haven't matched Framework's concept of handling three-dimensional frames, containing and combining multiple files, instead of two-dimensional windows onto separate files. And its elegantly easy commands—pull-down menus, ample on-line help, and Select, Move, and Copy functions that work for everything from word processing text to spreadshet cells and disk files—almost belie its tremendous power.

Still, by its 1984 debut, the market was already losing the notion of giant integrated packages as the only software anyone would ever need. A buyer taking a casual glance at Framework might have thought it built mainly around two less popular functions, its outline processor and FRED, a sort of half-spreadsheet, half-dBase programming language, while its rival Symphony carried a mighty Lotus spreadsheet (though its other applications were and are inferior).

Framework II represents a new marketing approach as well as a complete technical upgrade. Instead of "Colossal product that overflows 512K machines," it's modestly billed as "word processing, spreadsheets, and more." Snazzy packaging and a fine series of manuals lessen the intimidation of the four-volume, eight-disk bundle. FRED's moved into the background and improved applications have taken center stage.

The word processor still has much of the cut-and-paste ease and fancy onscreen formatting of Microsoft Word, but now boasts mail merge, visible page breaks (hear that, Word?) and a fast, flexible spelling checker.

The spreadsheet runs faster and allows bigger worksheets, as do new versions of 1-2-3 and Multiplan, by not wasting memory on empty cells. It creates smaller files, too—a 7,500-byte Framework 1.0 spreadsheet translated to a 3,000-byte Framework II file. (I can now endorse the program for 384K systems as well as larger ones, but still urge a hard disk over floppies.) Spreadsheet or data base graphs, drawn with three keystrokes, come in seven flavors, from bar and pie to high-low-close charts, and both text and numeric applications support custom libraries of macros and abbreviations.

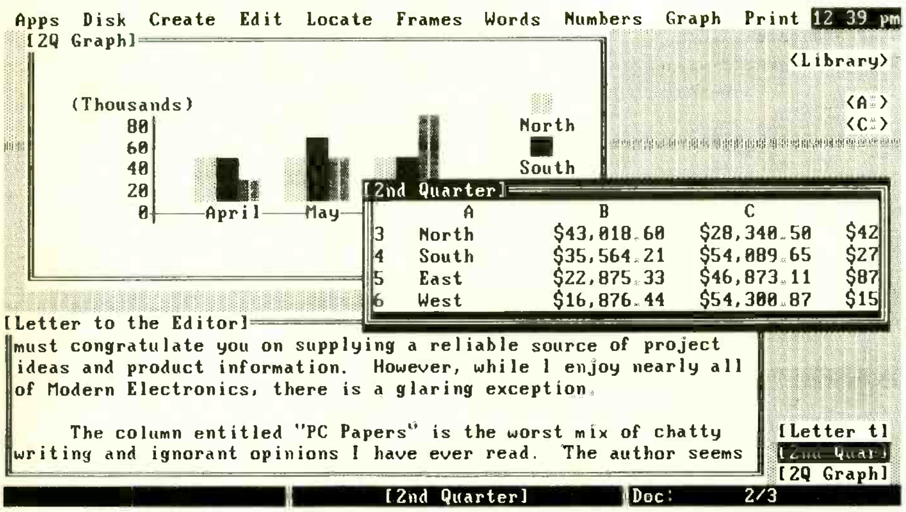
Framework II's spreadsheet-style data base is more modest, lacking relational abilities and making you sort one field at a time, but I found it faster and easier to use than PFS:File. Ashton-Tate supplies a menu option for users who want to add dBase III to the Framework desktop; you can add other programs if you write a short FRED routine, or simply run them from a DOS access gateway without leaving Framework. One program that was clumsily tacked on before, the communications package Mite, is a finely enhanced, integrated, menu-driven part of Framework II.

If that's not enough, Framework II handles more imports and exports than Hong Kong harbor. Besides its own and ASCII files, the program reads and writes dBase, MultiMate, IBM DCA, WordStar, and 1-2-3 (version 1A) formats; FRED will let you add three other files. There are minor quirks with this software—a Lotus file doubles in size from .WKS to .FW2 style, despite losing its macros, graph, or data base info, and I had to edit the file that imports WordStar files, changing its default header ("here is left header") and page length (five lines).

But that, and a copy-protection scheme that can prove fatal if you try the DOS hard disk Backup and Restore commands, are my only complaints. (At least you can start work without a key disk, change your hardware setup any time, and uninstall the program to change computers.) Otherwise, Framework II is spectacular: a smooth integrated package as good as six stand-alone programs, worth its $695 price but under $400 from mail-order dealers. It could genuinely be the only software you'll ever need.

The Phantom Disk

Let kiddies swap floppies and AT owners argue who's got bigger hard disks; real

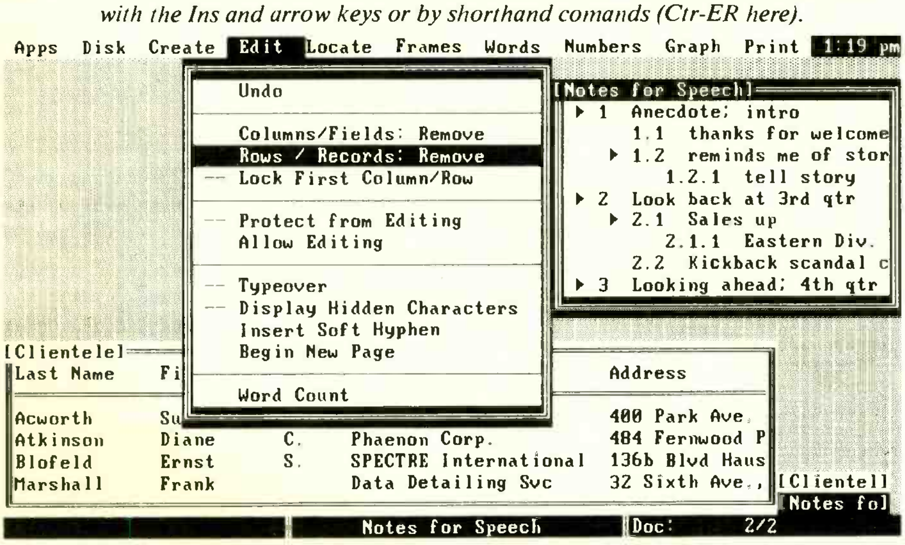


Framework II's desktop, showing graphics, spreadsheet and word-processing frames. My screen printout program missed on-screen underlining of "Modern Electronics."

riverboat gamblers use RAM disks. The fastest Winchester can't match an electronic drive's speed; the craziest lunatic can't deny the danger of storing programs where a neighbor's turning on a hair dryer might annihilate them.

But if you're like me, once you've tried a RAM disk you can't resist loading programs in seconds. Even so, there's the nuisance of having to refill the thing each morning, as well as its subtracting workspace from your system. To solve those problems, check out Tecmar's MegaFunction board—a card that combines the usual clock/calendar, serial, and parallel ports with 1.25 MB of memory, plugged into a floor-mounted adapter that keeps your RAM disk intact, even if the computer's off, as long as the wall socket stays live.

Outline and database frames share screen with a Framework II pull-down menu, reached with the Ins and arrow keys or by shorthand comands (Ctr-ER here).



Besides DIP switches to disable or assign DOS numbers to its RS-232C and printer ports (the latter, if used, covers a second expansion slot), the $895 board includes switches that specify either a 1268K RAM disk or a smaller disk and 384K of system memory. Installed in a 256K PC, XT, or compatible (it won't work with AT or early PC1 motherboards), MegaFunction yields a 640K system plus a 760K RAM drive, which can turn a PC into a mini-XT by booting DOS with no floppy required. RAM maniacs can add a $795 daughterboard for another two megabytes.

The board worked well in my Tandy 1200 HD, accepting unprotected software, DOS subdirectories, and Norton Utilities checks just like a regular drive—the difference, of course, being its fast DMA (direct memory access) response time. Its 5-volt, phone-sized ac adapter grew slightly warm but survived numerous accidental kicks beneath my desk, retaining the RAM drive and directories while the Tandy slept.

On the other hand, it seemed hostile to copy-protected software. PFS:File's installation program said "Cannot access target drive," and the Tecmar's presence crashed Framework II, which recognized and read conventional (part of main memory) RAM disks. According to the tech support engineer I called MegaFunction organizes its tracks and sectors differently than a physical drive. Too, the MegaFunction board might give a false sense of security, lulling users to skip backups—though it's vulnerable to power failures 24 hours a day, not the eight hours or less a software RAM disk is in actual use. (A $295 backup battery supports the board for one hour.)

All told, the MegaFunction might be fun if you don't already have an upgrade board, and particularly if you lack a hard disk and want to load DOS faster. If you've already got a card and don't need another clock or serial port, you can get above-640K RAM disks plus workspace for the newest programs with an expanded memory unit like Intel's Above Board. It'll need reloading every morning, but what's an AUTOEXEC.BAT file for?

Heaven Can Wait

Now I'll take off my reviewer's hat; I considered writing an April Fool item for this issue, but decided to write a sage opinion or editorial instead (*How can you tell the difference?—Ed.*) Specifically, I want to clarify last month's remark that a DOS menu like Bourbaki's 1dir might eliminate the need for graphics interfaces like Microsoft Windows. "Even if Windows weren't an upcoming standard," I hear you mutter, "how can you ignore its support of multi-tasking? Shells like 1dir can't run programs concurrently.

First, let me go on record against Microsoft by stressing the key word in my phrase "no need for *graphics* interfaces." I think pull-down or pop-up menus like those of Framework II or Alpha Software's Keyworks are a splendid way to run software, with or without a mouse. But such programs get along fine without graphic icons. Graphics take more memory than ASCII characters, and many video cards can't show them.

As for multi-tasking, I'll change my casual dismissal to a partial one. When you think about it, background processing is a boon for printing and communications, and possibly for huge data base sorting jobs.

Otherwise, what people need aren't concurrent programs but co-resident ones—applications waiting, if not running, in the background, for use without having to quit one program and load another. This is why I'm a fan of simple switcher utilities like Awesome Technology's Multiple Choice (reviewed December 1985), which allow DOS access or cut-and-paste date transfer in much less memory than TopView or Windows.

For true multi-tasking, you'll need two things: a more powerful processor than the 8088, which leaves PC and XT owners out, and a version of DOS that supports multi-tasking and memory above 640K, which the AT still lacks at this writing. Without one of the expanded memory cards that switch banks of RAM past a 64K access frame, even a three-megabyte AT is only a 640K machine.

The obstacles may fall to DOS 4.0 by the time you read this, or possibly not for a year or more. Meanwhile, 8088 machines are becoming cheap appliances like VCRs or toaster ovens, and you can improve them cheaply with switchers, speedup boards (see February 1986), or expanded memory, supported by a growing number of applications. Some of the latter (Framework II, Windows) allow the more homely trick of virtual memory, swapping your least recently used material to a hard disk.

Someday soon we'll all have 20 megabytes of RAM and everything will be memory-resident (witness the promise of Borland's Turbo Lightning data retrieval system, now primarily a spelling checker). But right now you can get 90 percent of the power that 90 percent of users will ever need. If the PC didn't have all the keen software, I'd take my conservative viewpoint even further and endorse the Apple II.

Why, look what just came for next month's column: Windows. Stay tuned and see if I eat my words. **ME**

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Top Shortwave Programs

By Glenn Hauser

Each year, *Review of International Broadcasting* conducts a listener survey under the auspices of Dr. Kim Andrew Elliot, who is also Chief of Audience Research at the Voice of America. Part of last year's survey has now been published. It ranks programs by the percentage of respondents who listen to each edition (thus evening the odds between programs that are broadcast daily and weekly, for example). This summary is restricted to the top 20.

First, the number of top 20 programs per station: BBC, 6; Radio Netherlands, 3; Radio Canada International, 2; CBC, 2; Radio Sweden, 2; Radio Australia, 2; WRNO, Swiss Radio International, HCJB, and Radio Moscow, 1 each.

Eight of the top programs are in the DX or media news category; five more involve listener-participation, such as mailbag shows. Clearly, shortwave listeners are very partial to programs produced with their own interests in mind. Of the remaining seven, two are straight news, and the other three are news-in-depth programs. One has to go down to No. 24 for a purely entertainment program, BBC's "Play of the Week," something which requires an hour to a sesquihour of attention, surpassing all kinds of lighter entertainment in the ratings.

Here, then, are the top-twenty shortwave shows among North American listeners:

(1) 38.0 SWL Digest, R. Canada International
(2) 29.9 World News (BBC)
(3) 29.5 World of Radio (WRNO)
(4) 29.1 Media Network (Radio Netherlands)
(5) 16.4 Shortwave Merry-Go-Round (Swiss R. International)
(6) 15.6 Letter from America (BBC)
(7) 11.6 Happy Station (Radio Netherlands)
(8) 9.5 Waveguide (BBC)
(9) 9.2 DX Party Line (HCJB)
(10) 8.5 Sweden Calling DXers (R. Sweden International)
(11) 8.0 Sunday Morning (CBC)
(12) 7.8 Radio Newsreel (BBC)
(13) 7.2 Letterbox (BBC)
(14) 7.0 Twenty-Four Hours (BBC)
(15) 6.3 Moscow Mailbag, (Radio Moscow)
(16) 6.2 As It Happens (CBC)
(17) 6.1 Talkback (R. Australia)
(18) 5.5 Listeners' Corner (Radio Canada International)
(19) 5.3 News (Radio Australia)
(20) 5.1 Shortwave Feedback (Radio Netherlands)

Radio Club Historics, Memorabilia, and You. A researcher and radio enthusiast seeks to write biographical sketches of prominent Dxers of the past, and radio club histories, primarily the Universal Radio DX Club (URDXC), Newark News Radio Club (NNRC), the early American SWL Club (ASWLC), and the early North American Shortwave Association (NASA). Club bulletins from the early days, radio magazines of the '30s and '40s, old photos of DXers and club officials are difficult to find, as are SWL cards of the '50s and '60s, and pre-1965 *World Radio TV Handbooks.* If you are willing to donate to donate or sell such material for historical preservation, indexing, and eventual publication of histories in the DX press for the mutual benefit of everyone, please respond to: Stephen Bohac, R.D. #4, Box 750-A, Branchville, NJ 07826.

Now, a roundup of radio news, mostly shortwave.

Anguilla. Most people consider 1610 kHz to be mediumwave now. But aside from a few flea-powered travelers' information service outlets around airports, parks and highway construction, the Caribbean Beacon has the channel to itself, just about the only remaining "clear-channel station" in the true sense of the word. John Demmitt in Pennsylvania noted stronger signals than usual one night; it turned out they had raised power to 50 kilowatts. This U.S.-backed gospel station still has a Caribbean flavor in its local announcements; give it a try any time after darkness until 0500 UTC. But in the mornings, The Caribbean Beacon uses 690 kHz instead. While there's a fair amount of domestic interference, Cuba has vacated the channel for reasons of its own (see below). Within a few years, U.S. mediumwave stations will take over 1610 and other frequencies up to 1700 kHz, so now's the time to go for The Caribbean Beacon.

Brazil. The external service from Brasilia was rumored to be facing a shutdown last year, but it seems to have pulled through. Adam Simms received a letter direct from the station saying the reports was unfounded. Listen at 0200 UTC on 11745 kHz. But there are plenty of changes elsewhere on the Brazilian shortwave bands. In addition to last year's reshuffling of stations on the 49-meter band, a similar realignment has been arranged for the 31-meter band, effective date unknown; so report Antionio R. da Motta and Claudio R. Moraes in Brazil.

Canada. Labour contracts are up for renewal again this year at the CBC. That's foreboding news for those who remember a series of strikes that distrupted Radio Canada International news, programming and transmissions during previous labour disputes several years ago. Meanwhile, Austin Kelley in Chicago reports that Radio Japan has been asking its monitors to check RCI transmissions. Both RCI and Radio Japan could benefit greatly by a relay swap—none too soon for North American listeners who rarely have good reception from Tokyo.

Colombia. A new station is Ecos del Putumayo, in Puerto Asis, a remote jungle town. Henrik Klemetz in Ecuador heard it irregularly on 5353 kHz around 1100 and 2300 UTC, with a strong signal. It's a fair bet this one is unlicensed.

Cuba. A new station ostensibly for tourists in Cuba appeared on 1160 kHz, Radio Taino, "tour radio from Havana." While mostly in Spanish, there are English announcements every half hour, and English news capsules scattered throughout the day. It's probably a 75-kilowatt transmitter, but the Cubans restricted it to daytime hours only (1200-2300 UTC), except during hurricane emergencies and special occasions, when it stayed on until 0500, interfering with U.S. stations, notably KSL in Salt Lake City and WJJD in Chicago. This came less than a month after south Florida's most powerful AM station, WGBS, 710 kHz, merged with WNWS, 790 and sold the 710 facilities to a virulently anti-Castro group, Radio Mambi, WAQI (pronounced "aqui," not "wacky"). Within four days, three or four Cuban stations moved onto or near 710 kHz, formerly free of Cubans, in an obvious attempt to block WAQI reception in Cuba. With 50 kilowatts during the day, a saltwater path, and 50 kilowatts directional toward Cuba at night, WAQI had the capability of covering Cuba far better than radio Marti, 1180, which received far more publicity and no increase in jamming. The Cuban programming, and sometimes jamming on and within 5 kHz of either side of 710 kHz, not only blocks Radio Mambi in Cuba, but also disrupts reception of WOR, beyond the New York metro area.

Curacao. Radio Earth is proceeding with plans to set up its own shortwave transmitter on this island, which has commercially supported the operation from the outset. An application has been filed, a transmitter purchased, and sites investigated, for an airdate of June at the earliest, with the callsign PJQ. Besides carrying "The World," Radio Earth's main program, which is also on WHRI, the new station will broadcast many other features and relay overseas shortwave stations badly in need of improved North American reception.

Ecuador. HCJB has begun broadcasting in Chinese—not for China, but for some 2-million Chinese in the Americas it wants to reach with the Christian gospel, daily at 2200-2230 UTC on 11960—subject to change because radio Canada International was already there. John Norfolk and Kraig W. Krist note that the Saturday edition of "DX Party Line" has returned to its 2130 UTC time slot, on 15270 and 17790, again conflicting with the most popular shortwave program, RCI's "SWL Digest." Fortunately, both programs have additional airtimes. HCJB is undoubtedly the easiest Ecuadorian to pick up; if you'd like more of a challenge try for the unlincensed Radio La Voz de la Juventud, from somewhere in the province of Loja, perhaps Higuerones or Catacocha, towns mentioned in ads. Henrik Klemetz found that it is likely to broadcast Sunday nights only, varying around 6581 kHz.

COMMUNICATIONS . . .

Jamaica. We've been hearing JBC Radio One on a new frequency of 850 kHz during hours of darkness. Ron Schatz says channel 1 is registered for a relay at Old Harbour, southwest of Kingston.

Nicaragua. This country has become rather paranoid about "intrusion" of foreign broadcasts, something which is actually completely natural and unavoidable in a small country next to others. On an anti-communist TV program in Miami, former Nicaraguan government communications minister Mario Cordero charged that the Sandinstas are setting up to two powerful new transmitters of their own, one about 100 km northwest of Managua, and the other in a remote coastal area lacking roads near Puerto Cabezas on the Caribbean. We assume these will be mediumwave.

Saba. There has been a radio station on this Netherlands Antille for a year or two, which has escaped official notice, but has been heard by visitors to nearby St. Maarten, such as John Schmid—it's Voice of Saba, on 1410 kHz.

St. Kitts. Another small Caribbean island is well-known among mediumwave DXers, thanks to the powerful Radio Paradise, 835 kHz, another U.S.-backed gospel outlet. But now it's made short waves too, due to a third harmonic on 2475 kHz, heard during the evening hours by Bob Hill in Massachusetts.

San Andres. This Colombian island off Nicaragua amounts to a separate radio country well-known to hams, but not to mediumwave and shortwave DX listeners, since its radio stations are usually mixed in with Colombian mainlanders. Radio Morgan (probably named after the pirate Henry Morgan) has made a surprise appearance on 2522.8 kHz, the second harmonic of 1261.4 (nominal 1260 kHz), during the evening. We found it fascinating listening, with its mixture of Spanish and Caribbean English. Also on the air from the island is Radio San Andres, 910 kHz, seldom heard in the USA; but we picked it up during the daytime on a visit to Costa Rica.

Sweden. After decades as a Tuesday fixture, "Sweden Calling DXers" moved to Wednesday on Radio Sweden International. Complicating the picture was an advanced start to the next UTC day's programming, so that it appears on the 2300 UTC Tuesday, and 1400 UTC Wednesday broadcasts, the latter on 15345. Once a prime source for shortwave DX news, that now is secondary to information about computers, satellites, etc.

U.S.A. KCBI, Dallas, has added "World of Radio" to its schedule, Fridays at 2100 UTC on 11790, and Sundays 1830 on 11905.

WHRI, Noblesville, Indiana, went on the air toward the end of last year. After several frequency changes to avoid interference, this schedule emerged: 1100-1300 on 5995, 1300-1500 on 11850, 1500-1700 on 15105, 1700-1900 on 15355, 1900-2100 on 11865, 2100-2300 on 9770, 2300-0100 on 11775, 0100-0300 on 9745, 0300-0600 on 7400, 0600-0800 on 6100, 0800-1100 on 7355. Part of these are directed northeast, part directed to the southeast. There may have been further changes in March.

Radio Earth quickly moved from KCBI to WHRI, where it could broadcast at its preferred prime time, 10 pm EST (0300 UTC year-round), six nights a week, on 7400 kHz.

KVOH, Simi Valley, California, experienced delays in transmitter delivery, but hoped to start testing by early March. NDXE, Opelika, Alabama, continues a major advertising campaign without any transmitters and continual target date delays; they've been predicting July 4, 1986. Meanwhile, the FCC points out that they do not plan to authorize such an N-prefix callsign for a broadcasting station. This won't necessarily keep the station from going by those letters—the call letters just won't be official. **ME**

SOFTWARE FOCUS

(from page 74)

and sentences as you might when reading for pure enjoyment. But in the business and educational world of reading, this is not generally necessary. And that's where speed reading comes in.

A key consideration in this training program is learning not to read every word. If you do, you'll limit yourself to a fraction of your reading speed potential. Instead, reading in "idea clusters" is the core of the training presented in *MicroSpeedRead*. The program operated flawlessly, though I wish that one could press "Escape" in the middle of sections should one wish to quit a part and move swiftly to another. But since I'm talking about only seconds of time perhaps wasted, this is really a minor criticism.

MicroSpeedRead is a most useful computer program for anyone who would like to improve his reading productivity. Average reading speed is 250 words per minute, by the way, while 500 wpm is considered to be only "good." Do you measure up well? **ME**

Telephones *(from page 39)*

ments are supplanting the carbon mike, particularly in electronic telephones, so be alert to it.

The final element is the speech network itself. Because the telephone is a current operated device, it's sensitive to all resistive influences—including those in the link itself. The amount of current flowing through your telephone depends on the resistance of the wires connecting your telephone to the exchange. The farther you are from the battery, the higher the line resistance, and the less current available to you. This creates the effect that the current in short loops is relatively high, tending to make voices too loud, while in long loops the current is relatively low, forcing users to raise their voice.

To counteract this effect, the telephone contains automatic compensation circuits that adjust the current through the transmitter and receiver so that performance on a very long line is equal to that on a short line. Inside the traditional telephone instrument is a network of coils, resistors, and capacitors that make up the equalization network.

At the heart of the this network is a variable resistor called a varistor that works in a manner just the opposite that of a resistor. Larger current flowing through it, increases its resistance, while smaller current, reduces its resistance. Placing a pair of varistors in series with the line, causes the negative-resistance characteristics of the varistors to stabilize current flow and minimize the effects of line resistance. Should you note any problems with this network, replacement of the entire network is recommended.

In the electronic telephone, a special circuit called an automatic gain control, or agc, compensates for line resistance by sampling the incoming signal and adjusting the gain of the electronic amplifier accordingly. Troubleshooting the network and amplifier portion of an electronic telephone is similar to repairing any electronic instrument. Voltage measurements and signal tracing are a must. ME

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CIRCLE 35 ON FREE INFORMATION CARD

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VIDEO

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PAY TV and Satellite Descrambling. 73 pages. 5th edition. Schematics and theory for most systems including Fantasy, Anik, etc. $12.95, MDS Handbook $9.95. Product catalog $1. Shojiki Electronics Corp., 1327 E. Niagara St., Niagara Falls, NY 14303. COD's. 716-284-2163.

DESCRAMBLER Manuals, Sinewave, Gated pulse, SSAVI, $4.00 each, all three $10.00, DNX, 6690 7 Mile, S. Lyon, MI 48178.

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MISCELLANEOUS

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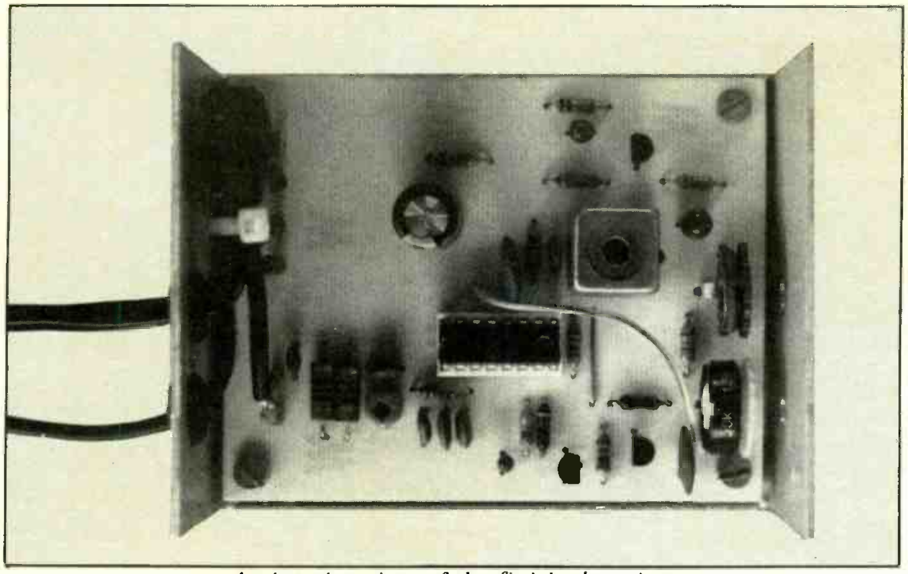
Add Stereo Sound To Your TV Receiver *(from page 64)*



An interior view of the finished project.

driver with a metal shank for the alignment procedure.

If you already mounted the project on the back panel of your TV set, dismount it now and set SQUELCH control *R2* fully counterclockwise (minimum resistance) and VOLUME control *R11* to midposition. Plug the project's OUTPUT cable into the audio amplifier. If the amplifier has a treble control, set it for full cut.

Turn on your TV set and tune in a channel that's transmitting a stereo program. Carefully adjust fine tuning (if your set has this control) for optimum picture and sound quality. If your fine tuning is sloppy, you'll misalign the project slightly and will have to readjust the fine tuning for the other channels.

As you turn up the volume on the audio amplifier, you'll probably hear a noisy, distorted program. Adjust *C2* and then *L3* for maximum volume. Either of the two peaks you may find while making this adjustment is fine. Carefully adjust *L3* for maximum volume, and then touch up *C2* for minimum audible noise.

Tune the TV set to an unused channel. Adjust the SQUELCH control to slightly past the point where the rushing noise just disappears. Then tune to an active channel and note that the sound comes on.

At this point, you should be getting excellent sound. This will be particularly noticeable if you're using a good-quality amplifier and speaker system. You may at this time be satsified with obtaining high-quality monophonic sound and stop here until you're ready to invest in a stereo TV converter. If so, connect a 0.01-microfarad capacitor across the OUTPUT cable to restore the treble to its normal range.

In Closing

Once you're satisfied with the results obtained with this project, it's time to add a stereo TV converter. There are many such converters on the market. If you want one with a built-in power amplifier to drive an extra set of speaker systems, you might consider Sony's Model MLV-1100. On the other hand, if you prefer to use your present stereo system, you can try Sears' No. 564.54390450 stereo adapter. Both converters work well with this project and are reasonably priced, especially the Sears unit at less than $100.

To obtain stereo sound, connect the converter as indicated in the instructions supplied with it. If necessary, adjust VOLUME control *R11* for dependable, quiet stereo reception. Note that this is a very broad adjustment. Then sit back and enjoy great stereo sound. **ME**

A Versatile Printer Stand *(from page 55)*

acrylic cement. When the stand is fully assembled and the glue has set for about 24 hours, you are ready to paint it.

If you wish your wood stand to have a very smooth, professional finish, first rub onto all exterior surfaces a thin layer of Dap. This is a premixed plaster-like material that comes ready-to-use in a can. It dries white like plaster, but the color is immaterial, since you will be applying a paint, rather than a stain, finish. Allow the Dap to dry a couple of hours. Gently rub down with very fine (No. 000) emergy cloth to smooth the surface. Spray on a primer coat of paint and allow it to completely dry. Then spray on a coat of the color paint you plan to use for finishing (an enamel or gloss acrylic paint is best). Once again, allow the paint to completely dry. Then gently rub down the paint with fine steel wool (No. 000) and spray on the final finishing coat.

The Plexiglass/Lucite version is available in kit form, cut, slotted and polished (see note in Parts List). **ME**