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MAY 1981 VOLUME 19, NUMBER 5

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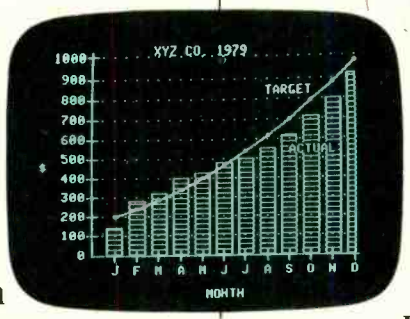

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Input/Output	8 expansion slots	4 expansion slots plus built-in: disk interface RS-232 interface Silentype™ printer interface clock/calendar
Disk Drives	Add-on one to six drives	One drive built-in, plus interface to support three more drives
Languages	BASIC Fortran 77 Pascal Assembly Pilot	Enhanced BASIC Fortran 77 Pascal Assembly
Typical Configuration Pricing	CPU, 48K RAM, single disk drive, B&W Monitor (9"), Silentype™ printer, and BASIC. **$2875.00***	CPU, 96K RAM, integrated disk drive, B&W Monitor (12"), Silentype™ printer, SOS, Enhanced BASIC. **$4865.00***

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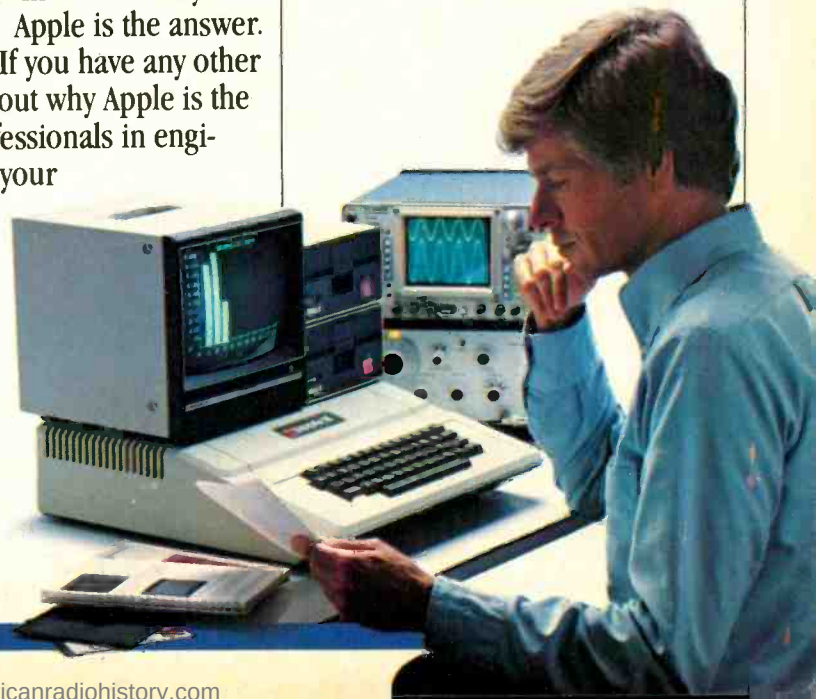

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EDITORIAL

The Video Guerilla Army

Early one morning several months ago, I, as one of a large group of other journalists, was invited to a demonstration/opening in the electronics department of Macy's department store in New York. What we saw and heard that day was essentially Sony's concept of futuristic video/audio/electronic games systems. These ranged from a projection TV of dimensions sufficient to virtually surround the viewer, to elaborate combinations of video and audio, to setups that let one play life-size (more or less) electronic games.

While I was duly impressed by the technological tour de force inherent in the demonstration, it was hard to repress a lingering skepticism. (Perhaps this is an occupational disease of journalists.) Would people really want to immerse themselves in video to this extent? Could a TV, however futuristic, glorified, and graced by ancillary hardware, serve as the principal focus of an environment, or perhaps of a new life-style? Quite frankly, I had my doubts.

My skepticism suffered an initial, though hardly disabling, blow when I visited a model solar house built under the sponsorship of the Copper Development Association at a location in southwestern Connecticut. The building ("dwelling system" might be a better term) used electronic controls for its heat collection and management and even included an array of photovoltaic cells that produced enough electricity to run the circulating pumps for a limited time. All of this was supervised by an Apple computer that also amassed statistics on the overall system operation.

But there was a second microcomputer, too. This one, much as in the demonstration at Macy's, was hooked up to a large, rear-projection TV (a General Electric model, in this case), with an audio system included as well. What was most interesting was that the architects had made it all fit right in. The system belonged where it was and was comfortable to be around. While, granted, the house was a "hang-the-cost" venture, an important point had been made.

What finally turned me from skepticism and convinced me that the phrase "video revolution," however hackneyed, refers to a real phenomenon was information from you, who read POPULAR ELECTRONICS. Fully 15% of you now own a video cassette recorder, as compared with 1.8% of the households in the U.S. Equally impressive in terms of the limited availability of product, 1% of you already own video disc systems. Furthermore, almost a third of the readers who have VCRs use them with cameras, most of them color cameras.

All of this amounts to quite a showing of video activism. Clearly, whatever thrusts are being made in this suddenly ebullient area must have a phalanx of PE readers in the lead. We've always thought you were a special bunch of people—but you keep surprising us anyway.

Hal Rodgers

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

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

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

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

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

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

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

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

"...unusually good for any receiver."

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

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

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

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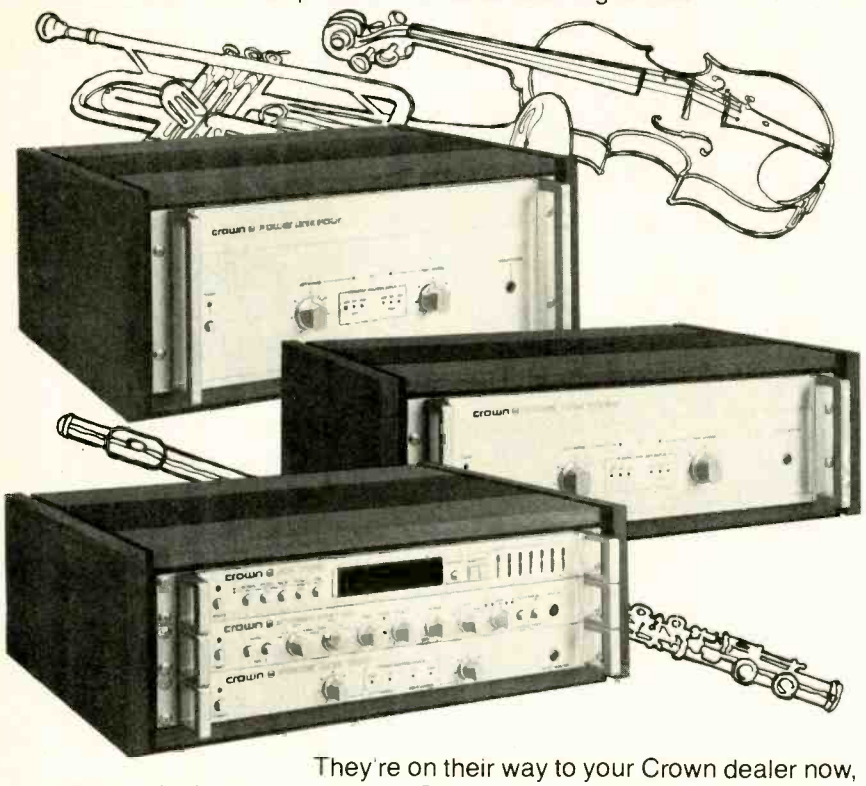

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LETTERS

Reading AC Ripple on DVMs

In our use of the Beckman Series 300 Digital Multimeters ("PE Tests Beckman Tech 310 DMM," March, p 44) we found that they are indeed handy to use but they do not have the ability to read ac ripple on a dc power supply. There is no dc blocking capacitor in the ac voltage measuring circuits so that a dc voltage will be displayed equally well on dc and ac voltage scales. Beckman suggests adding an external capacitor, which works fine but is unhandy. We cured the problem by building a switched probe with a 0.1-μF capacitor in series.—*Lawrence Page. Bradenton, FL.*

The solution used here is the conventional approach. When selecting the series capacitor, keep reactance in mind since low-frequency response is determined by this value. Also make sure the voltage of the capacitor is suitable for measured dc plus ac peak.—Ed.

The Toy Gun

The Ad*Zap wireless TV commercial killer (February, p 44) is a great idea. I get angry with commercials too. But pulling a toy gun and shooting the TV with infrared light is not a good way to kill commercials. An individual who pulls the toy gun and shoots at the TV when angry with the commercials may also find it easy to pull a real gun and shoot when angry with something or someone. Let's keep the transmitter in the box, not in the toy gun.—*Oral T. Sezer, Milwaukee.*

Video Information

Having read several of your reviews of new TV sets, I ask that you include information as to the following: (1) the set works (or does not work) well with a microcomputer or video games in both (or either) color and black and white; and (2) the set has (or does not have) easy-to-plug-in features which allow connection to a microcomputer. I don't expect that any color TV will ever be on a par with a really fine monitor. However, there should be some measuring stick by which we can compare.—*W.N. Coxe, Jr., Baton Rouge, LA.*

The information you want is there. The minimum bandpass for video monitors is at least 6 MHz, so using a TV set as a substitute is marginal at best. The bandwidth of an NTSC video signal (~ 4.5 MHz) permits a display of about 16 lines of 40 characters each. Since you would normally connect to the TV antenna terminals, the bandwidth given in the report applies. If this is 3 MHz or less, the set is not good for a computer display. Horizontal and vertical overscan of more than 15% would also cause problems.—Ed.

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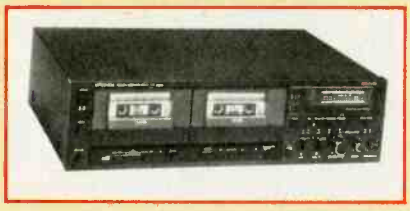
NEW PRODUCTS

Additional information on new products covered in this section is available from the manufacturers. Either circle the item's code number on the Free Information Card or write to the manufacturer at the address given.

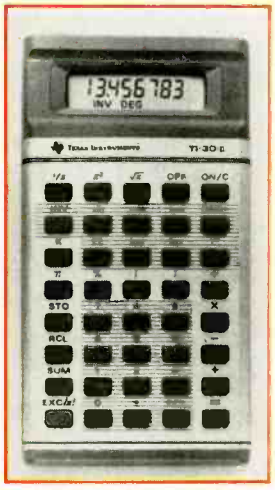
Optonica Dual-Cassette Deck



Separate cassette wells, one containing a record head, the other a play head, are used in Optonica's Model RT-6605 cassette deck. Each head, thus, can be optimized for its task. The triple-layer sendust recording head has a 3-micron gap for high recording sensitivity, while the triple-layer sendust playback head's 0.8-micron gap is said to provide extended frequency response. Dubbing and editing capabilities are built in, and a dubbing level control facilitates copying from one tape formulation to another. Other features include: metal-tape capability, output level control, peak level display with peak hold, bias-adjustment control, timer standby mechanism, and double Dolby noise reduction. Specifications: wow and flutter, 0.045% wrms; frequency range, 20 to 21,000 Hz (metal tape); and S/N 70 dB. $550.

CIRCLE NO. 88 ON FREE INFORMATION CARD

TI LCD Slide-Rule Calculator



Texas Instruments' new Model TI-30-II slide-rule calculator offers all the basic functions of the TI-30 student calculator plus x-factorial, degree/radian/grad conversions, and a constant memory. It has a liquid-crystal display with an eight-digit mantissa and two-digit exponent (internal accuracy is 11 digits). In addition to the standard arithmetic operations, the calculator can handle powers and roots, trig functions, and percentages. A four-key memory and 15 levels of parentheses round out the TI-30-II's features. User-replaceable miniature batteries provide up to 1000 hours of operation. $20.

CIRCLE NO. 87 ON FREE INFORMATION CARD

Ungar Portable Desoldering System

The new Hot Vac 4000 desoldering system from Ungar contains a built-in vacuum pump and can be used anywhere ac power is available. Solder melted by the long-life tip is removed by vacuum action and retained in a built-in solder reservoir, which can be easily emptied even when the heater is at operating temperature. Tip temperature is adjustable over an approximate 500° to 1000°F range, allowing the tool to be used for a variety of tasks. The temperature-sensing heater is said to provide instantaneous temperature recovery and transient spike suppression, making the tool safe for use with MOS and other sensitive components. Tips of various sizes are included.

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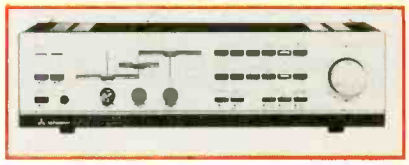
Mitsubishi Stereo Preamp



Mitsubishi Audio's Model DA-P30 dual-monaural preamplifier offers wide dynamic range, high slew rate, selectable capacitance loading, and a built-in moving-coil head amplifier in the phono section. LEDs in its SPEAKERS, PROGRAM, and RECORD selector buttons identify operating conditions. Docked with the DA-A30 power amp, the DA-P30 performs speaker switching via built-in relays. The equalization section has bass, midrange, and treble controls, featuring continuously variable turnover frequencies in overlapping ranges from 33 Hz to 20 kHz. Each channel has its own power supply. Specifications: phono overload, 380 mV for MM, 16 mV for MC cartridges; S/N 81 dB for MM cartridges; channel separation, 75 dB; slew rate, 200 V/μs. Size is 18½"W x 9½"D x 5⅜"H, and weight is 15.7 lb. $450.

CIRCLE NO. 89 ON FREE INFORMATION CARD

MFJ Police/Fire Converter

Connected in the antenna line of any 2-meter (synthesized or vfo) transceiver, the Model MFJ-311 Police/Fire Explorer from MFJ Enterprises extends coverage to the high-band police and fire frequencies. Rigs that cover 144 to 148 MHz can be made to receive 154 to 158 MHz, the band to which virtually all vhf high-band police and fire activities are assigned. A pushbutton switch turns the converter on and off. In its OFF position, the converter is bypassed, allowing transmissions with very low insertion SWR. Even if the switch is left in its ON position during transmit, the converter will withstand up to 25 watts without damage. Size is 4"W × 3"D × 1"H. The unit comes with a mounting bracket for mobile installation. $49.95 plus $4 shipping and handling. Address: MFJ Enterprises, Box 494, Mississippi State, MS 39762.

Acoustic Test Signal Generator

Hall Engineering's Model ATG-301 acoustic test signal generator is said to eliminate guesswork when adjusting equalizers, optimizing speaker placement,

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STOP BURGLARS BEFORE they enter your home

Protect your family with this new micro-computer burglar alarm "FREE" for 30 days.

Burglars seek easy targets. Few have the daring or the knowledge to challenge the new Perim-A-Tron™ Home Security System. No other burglar alarm under $2,000 can give you more protection...or match it for features that will give you and your family safety and peace of mind. For starters, it is wireless, installs in minutes, and is portable should you ever move.

Perim-A-Tron's™ 20 button keyboard gives you protection a $2,000 commercially installed system can't beat. Includes powerful remote horn.

THE BRAIN VS. THE BURGLAR

Perim-A-Tron's™ central console, or "BRAIN", employs a microprocessor, making it the **most advanced security system available for consumer use.** With Perim-A-Tron™ on duty, small sensors monitor doors and windows ready to signal the "Brain" from as far as 250 feet, in the event of a break-in attempt. The "Brain" processes each signal instantaneously and sounds not only a self-contained 85db internal alarm, but also a second 95db remote siren to augment the inside alarm or for placement outside to alert neighbors and police.

The Perim-A-Tron™ is so easy to live with that pets can come and go through partly-open windows or sliding glass doors without triggering it, yet so vigilant that an intruder will set it off before he can enter.

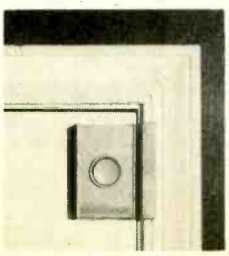
THOUSANDS OF OPTIONS

Perim-A-Tron's™ micro-computer lets you choose from thousands of three digit disarm codes. **Only you know your code.** But if your son's friend receives a "demonstration", you can easily change the code again ...and again. You need no specially coded key which can be lost, misplaced, or stolen. The system even has two separate channels, each with its own distinct alarm sound. This feature allows you to zone your system. For example: Channel 1—house, Channel 2—garage, or Channel 1—doors, Channel 2—windows.

HOW IT WORKS

Operating the system is simplicity itself. When leaving, a light on the console tells you that you've armed the system properly, and have from 5 to 45 seconds to leave the house. This variable delay feature, not found on some expensive commercial systems, is selective so that it can apply only to frequently used doors. All other openings would be set for instant alarm. Upon returning home, you have ample time to turn the system off, thereby avoiding a false alarm.

If a break-in attempt occurs while you're away, an alarm memory light on the console tells you so. What's more, after sounding for 10 minutes and scaring away the intruder, the system shuts off automatically and resets itself.



This photo shows a transmitter & magnet installed. If a break-in attempt occurs, separating the two, the transmitter sends a signal to the console which sounds an alarm to scare away the burglar. Installation takes only a few moments & doesn't even require a screwdriver.

A CONSTANT GUARDIAN

Leave Perim-A-Tron™ in Test Mode during the day and it will signal when anyone leaves or enters. This thoughtful signal will not operate the remote horn but gives a 2½ second warning on the internal speaker only.

If power fails (or is cut-off), the console has a battery back-up. And each battery powered transmitter/sensor will signal at the console if the battery runs low.

The Perim-A-Tron™ system is **highly resistant to false alarms because it is not sensitive to motion or sound.** Pets can roam at will, curtains can blow in a breeze, you or your children can visit the kitchen for a midnight snack— all without setting off an alarm.

COMING HOME SAFELY

There is nothing more frightening than finding a prowler lurking near your house when you arrive home at night. Our system's EXTRA PROTECTION DESIGN lets you carry a transmitter in your pocket, purse or glove compartment (it's about the size of a cigarette pack). With simple modification, it serves as a PANIC device and will set off the alarm at the press of a button.

COMPARE IT

Hard-wired "commercial" burglar alarms can cost $2,000 PLUS a monthly fee (and you still never own it). Motion and sound detectors cost up to $200 per unit and cover only limited areas. Your home may require two or three of these units and, in most cases, no alarm will sound until AFTER a prowler is inside for 30 seconds or more. Perim-A-Tron™ combines **pre-entry** protection with micro-electronic circuitry to provide the most protection at the lowest cost.

U.L. APPROVED

The Perim-A-Tron™ Home Security System is listed by Underwriters Laboratories as a **burglary protection device,** a rating which goes beyond electrical safety. To earn this listing our alarm was thoroughly tested for critical burglary protection functions such as transmitter range, sound volume, battery back-up, keyboard component life, battery failure warning, and test function. This tough-to-get U.L. listing resulted from the exacting standards engineered into the Perim-A-Tron™.

YOU BE THE JUDGE

We urge you to order just the basic Perim-A-Tron™ system (pictured above) for a 30-day trial period. Use it to protect your family while you sleep and to protect your home while you're away. Then if you're not convinced that the Perim-A-Tron™ is the most advanced, efficient security system available today, return it undamaged for a complete, no-quibble refund—including return postage. You are protected by a 90 day manufacturer's warranty as well as Shelburne's 25 year reputation for satisfied customers.

HERE'S HOW TO ORDER

To order simply send your check for **$229.95** plus $5.65 for shipping and handling to the address below. Credit card holders can speed delivery of their system by using our toll-free number listed below. We will then promptly ship your Perim-A-Tron™ unit complete with easy-to-understand instructions and decals warning that the premises are protected. Additional transmitters are available for $29.95 each, but one is not required for every door and window. Instead, magnetic contacts can be purchased and easily connected to the transmitter, allowing you to cover additional openings for as little as $5 each. The instruction booklet is quite useful in helping you determine the correct combinations to protect your home or office at the lowest possible cost.

Give yourself some peace of mind—order a Perim-A-Tron™ today at no obligation.

Maryland Residents add 5% Sales Tax.

CREDIT CARD HOLDERS
CALL TOLL-FREE:
800-638-6170
from 9am-5pm EST Mon.-Fri.
Maryland Residents Call 363-4304

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110 Painters Mill Road Dept. V-68
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CIRCLE NO. 68 ON FREE INFORMATION CARD

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and making other acoustic tests and measurements. The ATG-301 provides a source of white noise, pink noise, and finite-octave bandwidth pink noise that can be used with a sound-level meter or microphone to provide accuracy of frequency-response measurement said to be equivalent to a 1/3- or 1/9-octave spectrum analyzer. In the bandwidth mode, the center frequency is variable from 20 Hz to 20 kHz, and bandwidths of 1, 1/2, 1/3, 1/5, 1/10, 1/20 octave are available. A unique feature is that correction for sound-level meter or microphone frequency response can be read off the front dial. $299. Address: Hall Engineering, Dept. P-1, Box 506, Martinsville, NJ 08836.

Technidyne Wireless Phone

The "Go Fone" is a new wireless FM telephone system from Technidyne Corp. Its base station plugs into any existing telephone jack and the ac power line and has such items as in-use, power, and lock indicators, a call switch, and telescoping antenna. Base-station receive sensitivity is rated at 1 mV, and transmit and receive frequencies are 1.6 to 1.8 MHz and 49.8 to 49.9 MHz, respectively. Size is 9¼"W x 7"D x 2⅝"H, and weight is 2 lb 14 oz. The carry-along handset measures 7¼"L x 2½"W x 1¼"D, weighs 11 oz, and is powered by four rechargeable NiCd cells. It has an off/standby/talk switch, automatic redial function, low-battery LED indicator, charge jack, belt clip, and telescoping antenna. Communicating range is said to be 300 feet. $249.95.

CIRCLE NO. 93 ON FREE INFORMATION CARD

Gusdorf Video Equipment Cabinet

Gusdorf Corp. has added the Model 1915 video-equipment and software cabinet to its Status Pro Collection. The upper compartment is designed to house up to a 19" TV receiver. Behind the lower compartment's doors are a retractable shelf that allows a video cassette recorder or video disc player to slide out for easy access and a shelf for storage of tapes and discs. The 45¼"H x 30"W x 20"D cabinet is available in pecan finish with Rendura coating protection or walnut. Wide casters are fitted to the bottom for easy mobility. Approximate retail price is $235.

CIRCLE NO. 92 ON FREE INFORMATION CARD

Eico Portable DMM

A new handheld 3½-digit multimeter with liquid-crystal display (LCD) has been introduced by Eico Electronic Instrument Co., Inc. The Model 274 DMM measures ac and dc voltages to 700 and 1000 V, respectively; ac and dc current to 1000 mA; and resistance to 20 megohms. Accuracy is rated at ±0.8% of reading on dcV, ±1% on acV; ±1.5% on both acI and dcI, and 1% on ohms, all ±1 digit. Input resistance is rated at 10 megohms. Other features include: automatic polarity, overrange, and battery-test indicators; automatic zeroing; full overload protection; and separate RANGE and FUNCTION switches. A single 9-volt battery powers the DMM for up to 200 hours. Supplied with 9-volt battery, test probes, spare fuse, and carrying case, the Model 274 retails for $89.95.

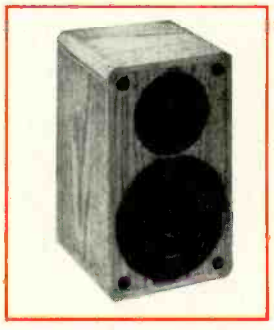
CIRCLE NO. 94 ON FREE INFORMATION CARD

WEB Printer Controller

WEB International's TLEC intelligent printer controller allows an IBM Model 50, 60, or 75 electronic typewriter to be used with a TRS-80, Apple, or Commodore computer for word processing. A Z80 controls the TLEC, which can contain up to 4K of RAM and a ROM that eliminates the need for printer driver software to be loaded or patched to a word-processing program. The TLEC Mark I ($399.95) provides full handshaking and employs text-imbedded command sequences. The Mark II ($449.95) adds proportional spacing and right-margin justification, pitch and check control, intelligent tab, etc. Topping the line, the Mark III ($499.95) adds bidirectional printing capability (almost doubles typing speed); page numbering, titling, and centering; and access to the memory in the IBM Models 60 and 75. Marks I and II can be upgraded to Mark III status at any time.

CIRCLE NO. 91 ON FREE INFORMATION CARD

Audio Electronics Speaker System



The Model AES-60 is the smallest model in a new line of PC (Phase Coherent) speaker systems from Audio Electronics Systems, Inc. The woofer in this two-way system has a solid, flat diaphragm that is said to eliminate the cone breakup encountered with paper-cone woofers. Due to its construction, the woofer is claimed to act like a true piston whose phasing and coherence precisely match the waveforms of the soft-dome tweeter used in the system. The 6" woofer/1" tweeter system has a rated frequency range of 40 to 20,000 Hz and a nominal impedance of 8 ohms. Sensitivity is rated at 86 dB SPL

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"No one else gives you as many functions in a handheld DMM.

Now you can move up to Fluke."

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

With a suggested U.S. price of only $249 and features you won't find in any other handheld DMM, the D 804 is an exceptional value. Here's why.

Logic level and continuity testing: A real time-saver for troubleshooting passive circuits in pcb's, cables, relay panels and the like. The D 804 has a switch-selectable audible tone and visual symbols to indicate continuity or logic levels.

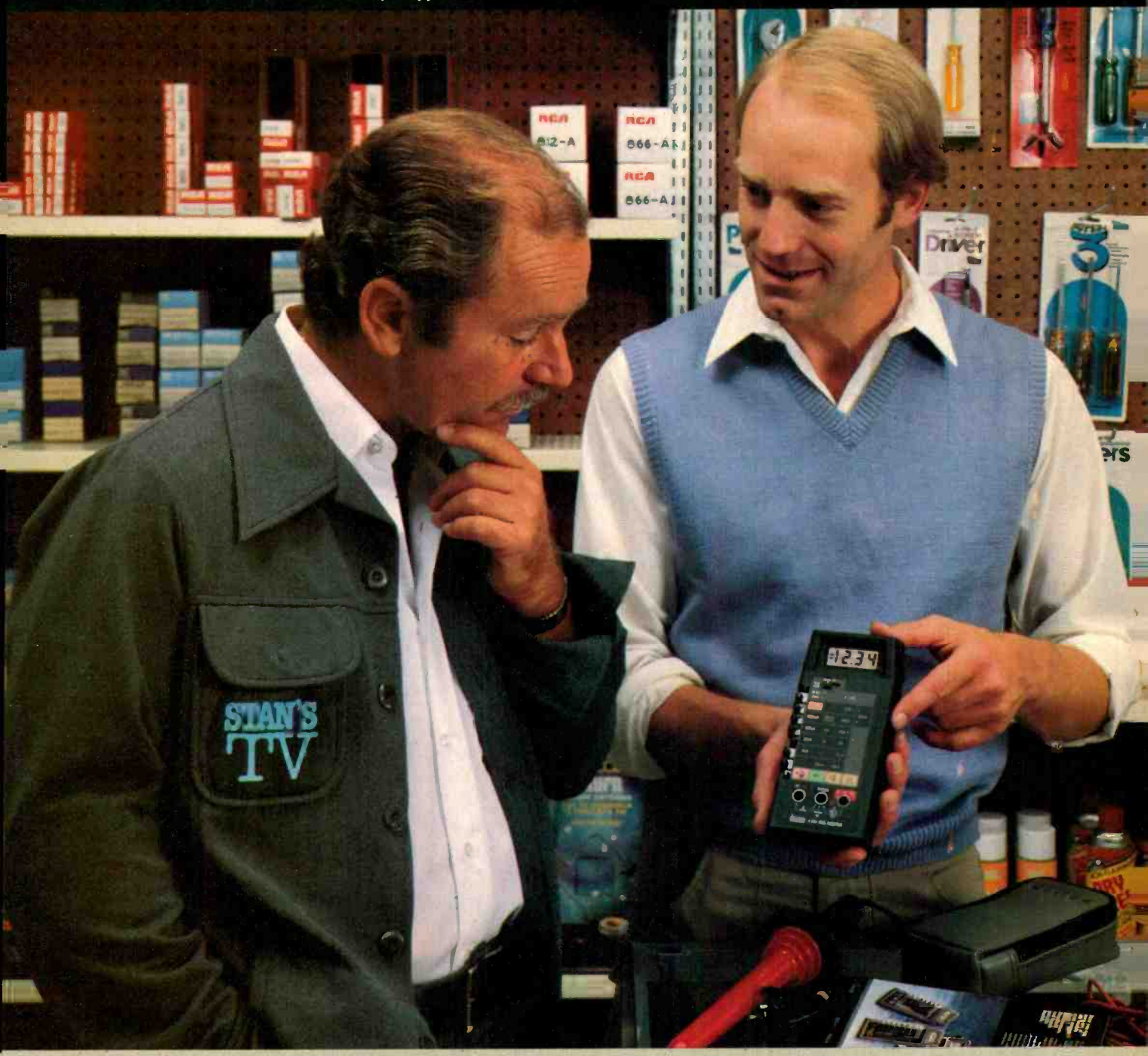
Direct temperature readings in °C: Used with any K-type thermocouple, the D 804 delivers fully-compensated readings in °C from -20°C to +1265°C, for checking heating and refrigeration systems.

Peak hold feature captures transients: A short-term memory in the D 804 captures and holds the peak reading of a motor starting current.

And more: 0.1% basic dc accuracy, conductance, 26 measurement ranges, battery, safety-designed test leads and a one year parts and labor warranty. A full line of accessories is also available to extend the measurement capabilities of your DMM.

Ask your dealer about the powerful, versatile D 804 and the rest of Fluke's new Series D line of low-cost digital multimeters.

From the world leader in DMM's. Now we've designed one for you.



*Suggested U.S. list price

For technical data circle no.
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If your dealer doesn't carry Series D Multimeters yet, call this number. We'll be happy to tell you who does. 1-800-426-9182

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For a FREE demo!
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CIRCLE NO. 5 ON FREE INFORMATION CARD

for a 1-watt input at 1 meter distance. Recommended input power is 25 to 125 watts. The oak enclosure measures 13¼"H x 8"W x 8"D. Sold only in pairs, the AES-60 is priced at $150 per unit.

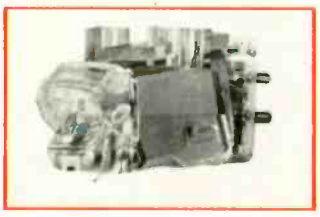
CIRCLE NO. 95 ON FREE INFORMATION CARD

Heath Security System Kits

The Heath Company has added two new security systems to its kit line. The Model GD-3510 security light control ($139.95) uses a passive infrared sensor to detect changes in temperature, accompanied by motion, in a 25-ft-square area. It can turn on lights and/or other electrical devices, to a 500-watt maximum, and can be adjusted to prevent false triggering. Safeguards prevent the system from triggering false alarms during daylight or because of temperature changes without motion. The Model GD-1800 Delta Minuteman II ($189.95) uses ultrasonic sound to protect up to 300-sq-ft areas. The control unit/detector runs the system, powers several accessories, and can initiate a telephone call through an optional GD-1156 dialer. The GD-1800 is hard wired to its accessories and can be set up to handle closed-loop systems.

CIRCLE NO. 90 ON FREE INFORMATION CARD

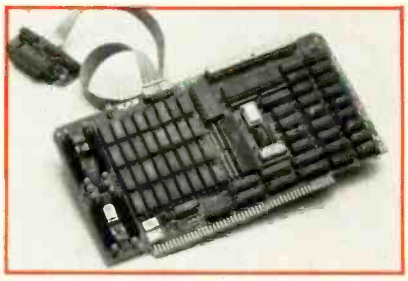
ADC Phono Cartridge



The Astrion is a new hand-crafted phono cartridge from ADC. Its cantilever is a laser-etched solid sapphire shaft whose high "stiffness-to-mass" ratio is said to provide better transient response than that of conventional types. The stylus is a hand-polished, extended elliptical (0.0015" x 0.00025") nude diamond. The moving assembly is mounted in a unique Orbital Pivot system that is said to have no restrictive armature wires, adhesives or governors. Specifications: frequency response, 20 to 20,000 Hz ±1 dB; stylus force, 1.2 ±0.2 grams; channel separation, 30 dB at 1 kHz, 20 dB at 10 kHz, with tracking capability of 30 cm/s from 3 to 10 kHz and 21 cm/s from 400 Hz to 3 kHz. $185.

CIRCLE NO. 96 ON FREE INFORMATION CARD

MuSYS Offers S-100 Multiprocessing



MuSYS Corp.'s Net/80 single-board microcomputer operates as a slave processor for networks loosely coupled to an S-100 bus. It comes with 64K bytes of RAM, single-level interrupt, console serial port, and parallel port for communicating with the S-100 master CPU. Each slave operates independently, except for resource queuing in the master CPU. The master controls the slaves completely and can reset or interrupt each at any time. Transfer can be performed with Z80 block I/O instructions at near-DMA speeds, while retaining protection and validation capability for the master. A bootstrap ROM, supplied with each slave downloads system software into RAM and then switches out of address space to make available the entire 64K of RAM. An expansion bus on each slave allows access to additional peripherals. The system is CP/M compatible. $1395.

CIRCLE NO. 97 ON FREE INFORMATION CARD

Platt Zipper Tool Case

Platt Luggage, Inc., has recently introduced a handy item of interest to electronics engineers, technicians, and hobbyists—a compact zipper tool case. The 13" × 10" case is available as Model 650-Z-T in 1½" thickness and Model 655-Z-T in 2½" thickness. Either case contains 29 pockets for storage of such small tools as pliers, wire strippers, screwdrivers, socket wrenches, alignment and burnishing tools, etc. Address: Platt Luggage, Inc., 2301 S. Prairie Ave., Chicago, IL 60616.

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Akai Mini Video Monitor

Akai's Model RC-V10U "Peek-A-View" is a miniature remote video monitor designed for use with the company's ActiVideo video cassette recorder. Equipped with a 1½" TV screen and pause control, it allows you to hear and see whatever is taped when something else is being viewed, and to remove unwanted material from a recording at the push of a button. The device can be used both indoors and outdoors for instant playback of home movies wherever you happen to be. Power for the Peek-A-View is supplied by the ActiVideo VCR. $169.95.

CIRCLE NO. 98 ON FREE INFORMATION CARD

Enhanced-Legibility Dot-Matrix Printer

Epson's new dot-matrix printer, MX-80, features a full character set in up to 12 print modes, some of which approach correspondence-quality printing through multi-strike and/or multi-pass techniques. There's a choice of four print densities and 40, 66, 80, or 132 printing columns. A snap-out disposable print head simplifies replacement when it reaches its life expectancy of 50-to-100-million characters. The MX-80 prints bidirectionally at 80 cps and is driven from an eight-bit parallel input, with RS-232 and IEEE488 options. Paper width range is 4" to 10" with an adjustable tractor-type pin feed. Dimensions are 4.2"H x 14.7"W x 12"D. $650.

CIRCLE NO. 99 ON FREE INFORMATION CARD

Harada CB Antenna

Harada has announced availability of a new manual antenna for CB radio. Model CM-51 has a center-loaded, single-mirror mount, as well as a completely shielded weatherproof loading coil and heavy-duty flexible spring. The two-section stainless-steel mast extends to 28". An 8' cable is supplied with the antenna. $26.

CIRCLE NO. 100 ON FREE INFORMATION CARD

Our ADC Integra phono-cartridge's overhang adjustment VS their nuts, bolts and hassles.

As your tonearm sweeps a record, the angle the stylus makes with the record groove constantly changes. The result? Offset angle distortion. It's an old problem. That's why it took a new kind of cartridge to solve it... our ADC Integra. Unlike conventional cartridges, the ADC Integra is a carbon fibre integrated headshell/cartridge with overhang dimension adjustment. There are no more nuts, no more bolts and that means no more hassles. To minimize offset angle distortion all you do is release the adjustment locks. Adjust. Then relock. It's incredibly simple. We've even included a tracking angle gauge. So it's also incredibly accurate. Because we know even an error as small as 2° can more than double cartridge distortion. Impressed? We thought so. But the most impressive feature of our new overhang dimension adjustment is that it is available in three different ADC Integra models. One for every kind of budget. All for one kind of sound... devastating. If you'd like to hear more call Audio Dynamics Corp. toll-free (800) 243-9544 or your ADC dealer.

ADC
A BSR COMPANY

CIRCLE NO. 2 ON FREE INFORMATION CARD

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ENTERTAINMENT ELECTRONICS

The TV Connection

By Ivan Berger

JUDGING by the number of jacks and connections, the backs of some TV sets are beginning to resemble those of hi-fi systems. Once limited to two screw terminals for the antenna lead and, sometimes, an audio jack (so you could turn your TV set into a phonograph), most of today's sets have two pairs of screw terminals (for uhf and vhf), plus a connection for 75-ohm coaxial cable for vhf input. As viewers have begun to demand better sound, while refusing to pay more for it, some sets have sprouted audio output jacks to feed hi-fi systems. (That's actually a revival—premium sets like Conrac and Fleetwood had such outputs in the fifties, and Heathkit color sets have had them since the beginning.)

Panasonic's Model CT-5511 5-inch home monitor.

The back of RCA's new VEM575 19-inch monitor receiver, though, looks like the apotheosis of connectors. In addition to the r-f jacks, there are four each for audio and video: audio and video output jacks carrying the signal from the tuner, a second pair of jacks for video input 2 and its accompanying audio, and two pairs, bridged together, for the video and audio of input 1. A switch on the front of the set lets you select broadcast or cable signals or the output of your VCR, video disc, game or computer.

The obvious advantage of this arrangement is its flexibility: you need only flip a switch to decide what to watch—no need to mess with cables or buy an accessory switcher. Less obvious is the fact that you get a better picture. Going directly from your VCR's or disc's video output to a video input jack gives you a picture that is about 3 to 6 dB less noisy than if you first fed that signal through your VCR r-f modulator then to your TV tuner. Even broadcast pictures will be improved a bit if you're far from the station. Fed through a VCR (the usual connection), off-the-air signals become 3 to 4 dB weaker. In a fringe reception area, that can make a big difference.

That explains the input jacks, all right; but what about the output and "bridging" jacks? The tuner audio output jacks can be used to feed a hi-fi system. The video output jack can be used with a VCR that has no tuner of its own (home VCRs all have tuners, but professional ones rarely do) or to supplant a VCR's tuner with a better one (assuming that the tuner in your set *is* better). The video output jack can also be used to feed a monitor that lacks a tuner, to feed a video digitizer so you can store or modify the image in your computer . . . and so on. It's not so much an obviously useful feature as it is one that's cheap to provide and potentially useful.

And the bridging jacks? They're in parallel with the input 1 jacks, so you can "loop through" to feed the video 1 signal to another VCR for dubbing, to another set, or wherever else you choose. When you're not looping through, you have to switch in a 75-ohm terminating resistance. To loop through, you switch out the resistances on all but the last piece of equipment in the string.

The RCA model is the most elaborate home monitor, but it's not the only one. JVC has a 5-inch model, the 610-US, with one set of inputs and only tuner outputs—no loop-through. Panasonic just introduced a similar 5-inch model, the CT-5511, at the Winter Consumer Electronic Show. V.A.M.P. offers 13- and 19-inch monitor receivers, too. You'll also find direct video and audio inputs in some projection television systems like the Heathkit and Hitachi.

Actually, home-set manufacturers like Sony, Panasonic, Toshiba, Sharp and Zenith have long had monitor receivers in their lines—but you'd never see or hear of them at ordinary TV dealerships. They're sold, instead, through audio-visual and professional video dealers, who also handle brands unknown in our home market, such as N.E.C. and Ikegami.

Professional monitor receivers differ in one obvious respect from those sold for home use: in addition to the jacks so far described, you'll often find an eight-pin plug for video and audio inputs and the tuner outputs. Professional VCRs (including industrial VHS and Beta models and U-Matics) will either have a matching jack or come with a cable for it, so you can hitch and unhitch them with a single plug instead of several. Often, such monitors will also use BNC, uhf or other heavy-duty jacks for video

(Continued on page 20)

At left is RCA's ColorTrak Video Monitor Model VEM575. Above is a veiw of the input and output jacks located on the rear panel.

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Low-Cost Computing Starts at Radio Shack With TRS-80™ Model III.

16K Model III
$999
26-1062

32K Model III as shown complete with two disk drives
Only $2495
26-1063

(And Never Stops!)

Radio Shack's new TRS-80 Model III gives you all the features you want to start out with at prices you can afford. What's more, you get the flexibility you need for low-cost expansion. If you're serious about microcomputing, Model III is the best computer to start with—and to grow with!

The "Extras" Are Built In. Why pay extra for features that are standard on Model III? You get a 65-key keyboard complete with a 12-key datapad, a 12" high-resolution monitor, and even a parallel printer interface. All at no extra cost!

Includes Powerful BASIC. Model III BASIC language in 14K ROM provides a full 64-character by 16-line screen format, as well as a 32-character mode. You also get upper and lower case characters, special graphics characters, a program line editor, 500/1500 baud cassette operation, real time clock, and firmware for an optional RS-232 interface.

And since Model III BASIC is software compatible with our popular Model I Level II BASIC, you can choose from a wide variety of ready-to-run programs.

Room to Expand, Too. Model III is tough to outgrow. Expand with up to 48K of RAM, and four 175K double-density disk drives (two internally). For office use, start with our 32K two-disk Model III desktop business computer and expand with printers, software and much more.

Why Pay More? Dollar for dollar, the TRS-80 Model III is your best buy in personal computers. And it's available at 6100 Radio Shack stores and dealers and 130 Computer Centers—with 135 service centers nationwide. Get a demonstration today!

Retail prices may vary at individual stores and dealers. Special order may be required.

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At CIE, you get electronics career training from specialists.

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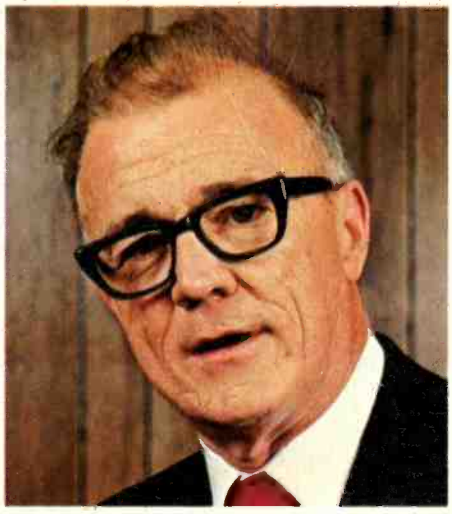

John E. Cunningham

Special Projects Director
Cleveland Institute of Electronics

www.americanradiohistory.com

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

I believe he was right. Today is the age of specialization. And I think that's a very good thing.

Consider doctors. You wouldn't expect your family doctor to perform open heart surgery or your dentist to set a broken bone, either. Would you?

For these things, you'd want a specialist. And you'd trust him. Because you'd know if he weren't any good, he'd be out of business.

Why trust your education and career future to anything less than a specialist?

You shouldn't. And you certainly don't have to.

FACT: CIE is the largest independent home study school in the world that specializes exclusively in electronics.

We have to be good at it because we put all our eggs in one basket: electronics. If we hadn't done a good job, we'd have closed our doors long ago.

Specialists aren't for everyone.

I'll tell it to you straight. If you think electronics would make a nice hobby, check with other schools.

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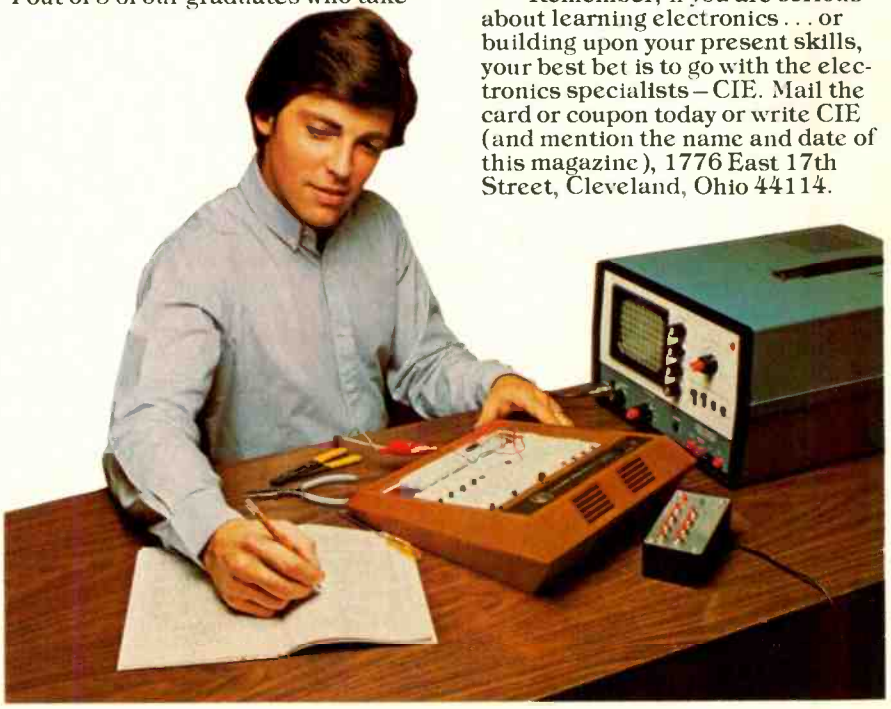

Pattern shown on oscilloscope screen is simulated.

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(Continued from page 14)

connections, rather than the RCA jacks most used in home gear. When you're working professionally, it's vital that plugs stay put.

Not all monitors are monitor receivers, either. That phrase is used only for monitors with built-in tuners. Many professional monitors (and some sold for home computer use) have video (and, in some cases, audio) inputs, but nothing else. Without external video sources, their screens will remain blank.

They may also remain blank if you use the wrong kind of video source. All VCRs and video disc players, all home games, and most computer video output devices put out "composite" signals—an NTSC color signal, plus sync—and most monitors have composite inputs for them. But some color devices and professional monitors have RGB connections—separate jacks for each of TV's three primary colors (red, green, blue). And I've heard of monitors with separate picture and sync inputs. You're unlikely to encounter such systems, but it never hurts to check.

Cable-ready is another term you'll see on some new TV-set spec sheets. It designates a set that connects to multichannel cable systems with no converter. Such systems need converters because they use channels outside the regular vhf (54-88 and 174-216 MHz) and uhf (470-890 MHz, though frequencies above 800 are now used for other services) bands. Cable channels A through I use "mid-band" frequencies (120-174 MHz) and channels J through W use "super-band" frequencies (216-300 megahertz).

Since these TV channels aren't broadcast (their frequencies are used by other radio services), sets usually can't receive them. But with 23% of U.S. households on the cable now (according to the National Cable Television Association), there's a market for sets that can pick those channels up. Most of these are frequency-synthesis sets which either substitute cable channels for uhf (most cable systems convert uhf channels to other frequencies) or add them on as channels 84-99.

Again, there are advantages to using the new connections in preference to traditional ones. Many cable systems charge less to users who require no converter boxes. With channel selection made at the set, not at the cable box, you can use remote control. And eliminating the box removes one more piece of clutter in your room.

Just buying a cable-ready set doesn't necessarily ensure that you won't need a converter, though. Some cable-ready sets get only the midband channels—not enough, if your local system uses the super-band ones, too. And there are no firm frequency standards for these special channels—a set that tunes them in on one cable system may not on another. Some sets (certain Zenith models come to mind) have an adjustment for this, but with most, check for compatibility before you buy. Pay-movie and similar services such as Home Box Office, Cinemax and Showtime, still need a box to decode their scrambled signals. ◇

AUDIOPHILE RECORDINGS

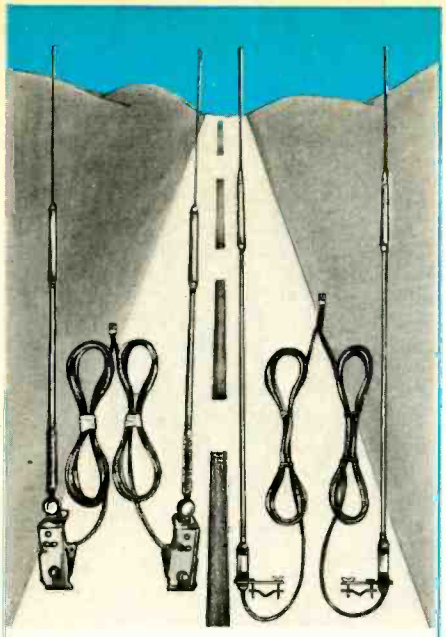
JOHN KLEMMER: ***Touch***. Mobile Fidelity Sound Labs MFSL C-006. This is the first Mobile Fidelity musicassette to come into our possession, and to call its quality astonishing might be just a little bit of an understatement. Each cassette is a real-time dub from the original master, recorded onto BASF chromium dioxide. Dolby B noise reduction is used as well.

The sound we experienced from this tape was extremely clear and clean, with saturation and the other ills common in the medium notably absent. At the end of the music, it is possible to hear reduction of residual hiss in two stages: first, presumably, when the faders on the mixing board are shut down and again when the feed to the duplicator is turned off. This suggests that the hiss level on these cassettes is lower that that of either the master tape or the original mixing board. Most impressive!

Klemmer's music is cool, "laid-back," and full of delicate shadings. Where other saxophonists occasionally roughen the tone for emphasis or give the inherently "honky" low tones free rein, Klemmer's sound is pristine, limpid, and well controlled at all times. Rather than demanding attention, this album captivates it—and with elegance. —*Harold A. Rodgers.*

BEE GEES: ***Spirits Having Flown***. Nautilus NR17. Nautilus calls this a "Super Disc." It is neither a digital recording nor a direct-cut disc, but rather a remastering of a high-quality analog tape of recent vintage. The remastering, however, is performed at half-speed (16⅔ rpm) and with lavish engineering care. Production, using the highest quality vinyl and stamping methods, is on a par with the remastering, and the result justifies the "Super Disc" appellation. There is not a hint of audible surface hiss or any distracting "pops" or "ticks."

The sound is wide-range with good, solid, yet musical bass—no one-note juke box thump here. Try *Stop (Think Again)* on the second side for some crystalline cymbals in the rhythm section. One more point: if you hear any flutter, it's just the Bee Gees doing their thing.—*Ed Buxbaum.*



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Audio Product of the Month

CHOSEN BY THE EDITORS OF POPULAR ELECTRONICS

JBL Model L112 Three-Way Speaker System

THE Model L112, a three-way design based on all-new drivers and crossover components, is JBL's finest bookshelf speaker. Its 12" woofer operates in a ported enclosure, crossing over at 1.1 kHz to a 5" cone-type midrange driver and at 3.7 kHz to a 1" dome tweeter. The particle board enclosure is veneered in genuine American black walnut, whose grain is enhanced by an oil/wax finish. Dark brown grille cloth stretched on a welded metal frame and held in place by plastic snaps is designed for minimum interference with the acoustic characteristics of the drivers. Under the grille is a control panel with continuously variable level adjustments for the midrange and high-frequency drivers.

The input connectors resemble insulated binding posts with holes into which the stripped ends of the connecting wires are inserted to be locked in place by a 90-degree clockwise rotation of the connector end.

Model L112 measures 24½"H x 14¼" W x 13" D, and weighs about 50 pounds. The speakers are manufactured in mirror-image pairs, with their middle-and high-frequency drivers slightly off the vertical center line of the front panel. Either one can be used at the left or right position. Suggested retail price is $450 each. *(Continued on page 24)*

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(Continued from page 22)

General Description. Nominal impedance of the L112 is 8 ohms, and it is recommended for use with amplifiers rated from 10 to 300 watts per channel. The unit is said to deliver 89-dB sound pressure level at 1 meter with a 1-watt input.

An unusual design feature, the Symmetrical Field Geometry (SFG) woofer magnetic system, has been incorporated into all current JBL speakers. The development was spurred by the increasing difficulty of procurement (and the high cost) of the Alnico magnets JBL had used exclusively. JBL studies had shown that ceramic (ferrite) magnets caused more second-harmonic distortion in the acoustic output than did Alnico. This was caused in part by an asymmetrical distribution of magnetic flux on the two sides of the magnetic gap through which the voice coil moved. The SFG magnetic system employs specially shaped pole pieces, plus an aluminum flux stabilizing ring (acting as a shorted turn). Current induced in the ring creates a flux opposing the flux changes caused by interactions between the voice coil and the magnetic structure and reduces second-harmonic distortion. Third-harmonic distortion is not affected.

The L112 woofer cone is coated with a material that gives it the optimum mass and damps its response at higher frequencies. The cone is driven by a 3"-diameter edge-wound copper voice coil, working in conjunction with a 10½-lb magnetic system. Enclosed in a sealed subchamber to isolate it from the woofer, the midrange driver has a stiff 5" paper cone driven by a ⅞"-diameter voice coil. The tweeter has a lightweight phenolic dome coated with aluminum by a vapor deposition process.

Midrange and tweeter level controls are calibrated in terms of the decibel change each provides in its operating frequency range. The "0 dB" mark corresponds to a flat acoustic output in an anechoic chamber, and the adjustment range for each driver is from +3 to −12 dB, plus a fully off position.

Laboratory Measurement. The frequency response curve for the JBL L112 was generated by combining measurements made in the reverberant field of a normally furnished room (from 100 to 20,000 Hz) with close-miked woofer response measurements from 20 to 1,000 Hz. Middle- and high-frequency response was measured with a sweeping warble-tone sine-wave signal and heavy recorder pen damping to smooth out the effects of room resonances and standing waves.

Low-frequency response was measured separately at the woofer cone and at its port opening. After adjustment for the relative areas of the two sources, the curves were combined to simulate the anechoic response of the speaker woofer system.

Reverberant field measurements were made with the microphone on the axis of the left speaker (at a 12-foot distance) and about 30 degrees off the axis of the right speaker. The difference between the raw response curves at high frequencies is an indication of tweeter directivity, principally in the horizontal plane. We average the two curves and correct them for the known room response (which was obtained with the aid of calibrated speakers whose acoustic power output response was accurately known) before combining the low- and high-frequency curves.

Combined frequency response of the JBL L112 was uniform and smooth, varying only about ±3 dB from 45 to 20,000 Hz. Maximum woofer output occurred at 70 Hz; effective acoustic crossover between the cone and port radiation was at 45 Hz. The 12" woofer does not maintain flat response in the upper part of its range (about 1000 Hz) but our combined measurements suggest that the midrange driver continues to work well below its crossover frequency. Overall system output is quite uniform from 100 to 1,000 Hz.

Horizontal dispersion of the tweeters was very good. There was typically a difference of 2 to 4 dB between the left and right speaker curves throughout the entire tweeter operating range, but this was fairly constant with frequency.

Midrange level could be varied between +2 dB and about −12 dB with respect to a 0-dB reference level. The control affected system response to some degree between 300 and 8,000 Hz. The tweeter control started to work at about 2,000 Hz, with a range from +2.5 dB of boost to virtually infinite attenuation above about 5,000 Hz.

Low-frequency distortion was measured with the same technique as was frequency response, at nominal power inputs of 1 and 10 watts. Although we did not plot the second and third harmonic components separately, their combined value measured less than 0.5% from 100 to 60 Hz and only 3.6% at 35 Hz at 1 watt input. Increasing the drive to 10 watts made only a moderate change in distortion, which was 1% or less down to 60 Hz and reached 6.3% at 35 Hz.

Sensitivity of the L112 was almost exactly as rated, and we measured an acoustic sound pressure level of 90 dB at 1 meter when we drove the speaker with 2.83 volts (1 watt into 8 ohms) of random noise in an octave centered at 1,000 Hz. System impedance minima were 6 to 7 ohms between 30 and 40 Hz, 100 and 150 Hz, and at about 2,000 Hz. The lowest impedance in the audio range was 5 ohms in the band from 7 to 10 kHz. Bass resonance was at 62 Hz, with an impedance peak of 25 ohms; there were also impedance peaks of 19 ohms at 600 Hz and 9 ohms at 3,800 Hz.

User Comment. We preferred the JBL L112 with its level controls set to 0, which gave the best subjective balance in our room as well as the flattest measured frequency response. The sound was as smooth and uncolored as the very flat measured frequency response suggested it would be. This speaker seemed to be equally "at home" with classical orchestral and vocal music as with popular music. We installed the speakers against the wall, with the tweeters at the ear level of a seated listener, and found it to be an effective arrangement.

Summarizing, the JBL L112 is a fine-sounding wide-range speaker system with low distortion. It is sensitive enough to be driven by a 10-watt amplifier yet rugged enough to absorb the full music program output of a 200-to-300-watt amplifier. It is solidly constructed and is as handsome as a simple rectangular box is likely to be. Though somewhat larger, heavier, and more expensive than a typical bookshelf system, the L112 surely merits its place at the top of JBL's offerings in that category.

—Julian D. Hirsch

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the Toshiba CA-944 19" Color TV Receiver

TOSHIBA's Model CA-944 19" color-TV receiver is handsomely packaged in a wood-grain cabinet with contrasting silver trim. It features a deluxe "Comput-R-Tune" control panel for one-button access to any of 12 user-programmed vhf and uhf channels. Picture adjustment is performed by automatic fine tuning (aft), automatic color balance (abc), and "Color Pilot" systems. Picture quality can also be adjusted to taste with an auxiliary picture sharpness control. Finally, a "Tomatic Eye" senses ambient light and adjusts picture brightness accordingly. A CATV jack is provided, but there are no facilities for tuning CATV channels.

The CA-944 measures 24 7/8"W x 16 3/4" H x 15 3/4"D and weighs 47 lb. Suggested retail price is $549.95.

General Information. This set is built around a "Blackstripe"® picture tube, four large integrated circuits, and 18 transistors. It also has an analog tuning system that uses discrete voltages for selecting the various vhf and uhf channels. This system is one of the more unusual tuning arrangements we've come across. Dc voltages and amplifiers are used throughout, and there are some interesting automatic fine tuning (aft) applications. Touch switches are used to transfer voltage functions for both channel tuning and U/V switching. At the same time, dynamic aft from the receiver maintains the local tuner oscillators precisely 45.75 MHz above the incoming video carrier.

As each of the 12 channel-selector switches is engaged, voltages are generated to tell the tuning system which channel and its corresponding tuner have been selected. As each channel is selected, a positive pulse passes through diode *DB01* (Fig. 1). This excites *QB61* and *QB62* emitter-follower and inverter stages and n-channel FET *QB01*. Transistors *QB61* and *QB62* invert this positive pulse and momentarily turn off the audio, while the FET is positively biased, turning on source/drain current and defeating aft.

Normal aft voltages are received through board terminals 15 and 16. They are then heavily filtered and routed to the bases of *QB04* and *QB02*. Transistor *QB03* serves as a constant-current generator for *QB61* and *QB62* and is biased from the +180-volt supply that is further dropped across *RB21* and zener-regulated by *DB02* at approximately 32 volts.

Inputs to buffer amplifier *QB05* come from *DC01* through *DC12*. As input voltages change, *QB05* supplies an active load for the collector of *QB06* and base of *QB07*. Changing aft inputs to the base of *QB06* are inverted and dc

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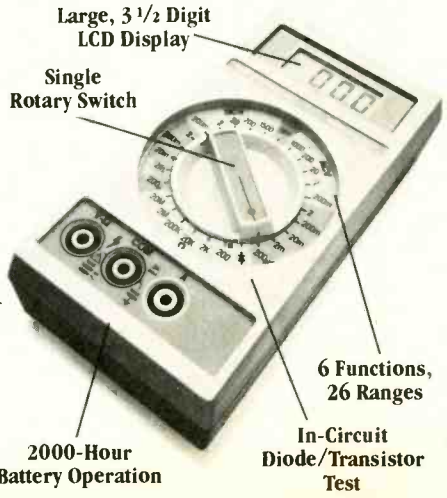

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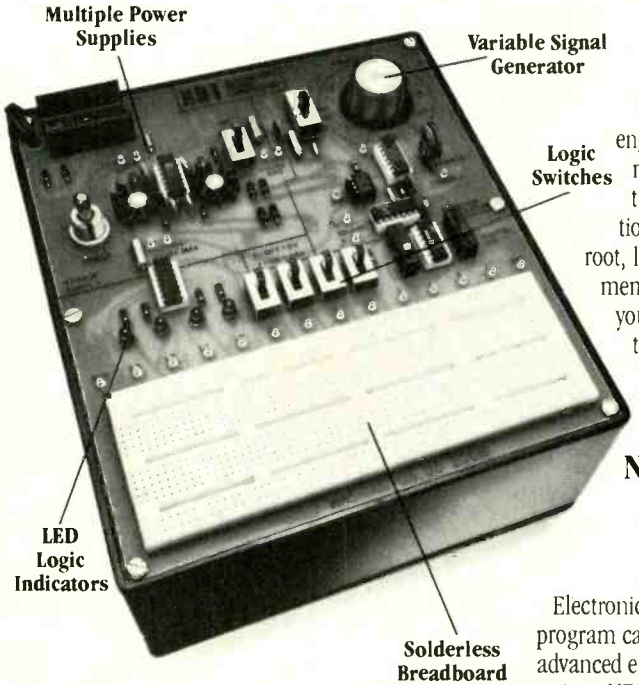

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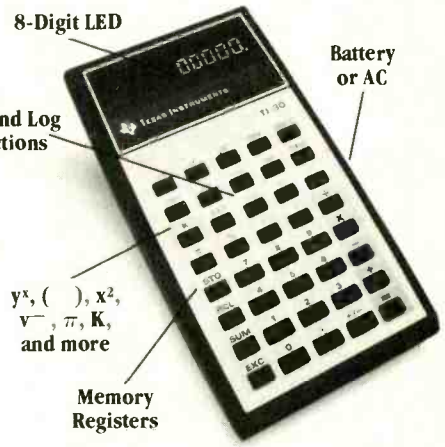

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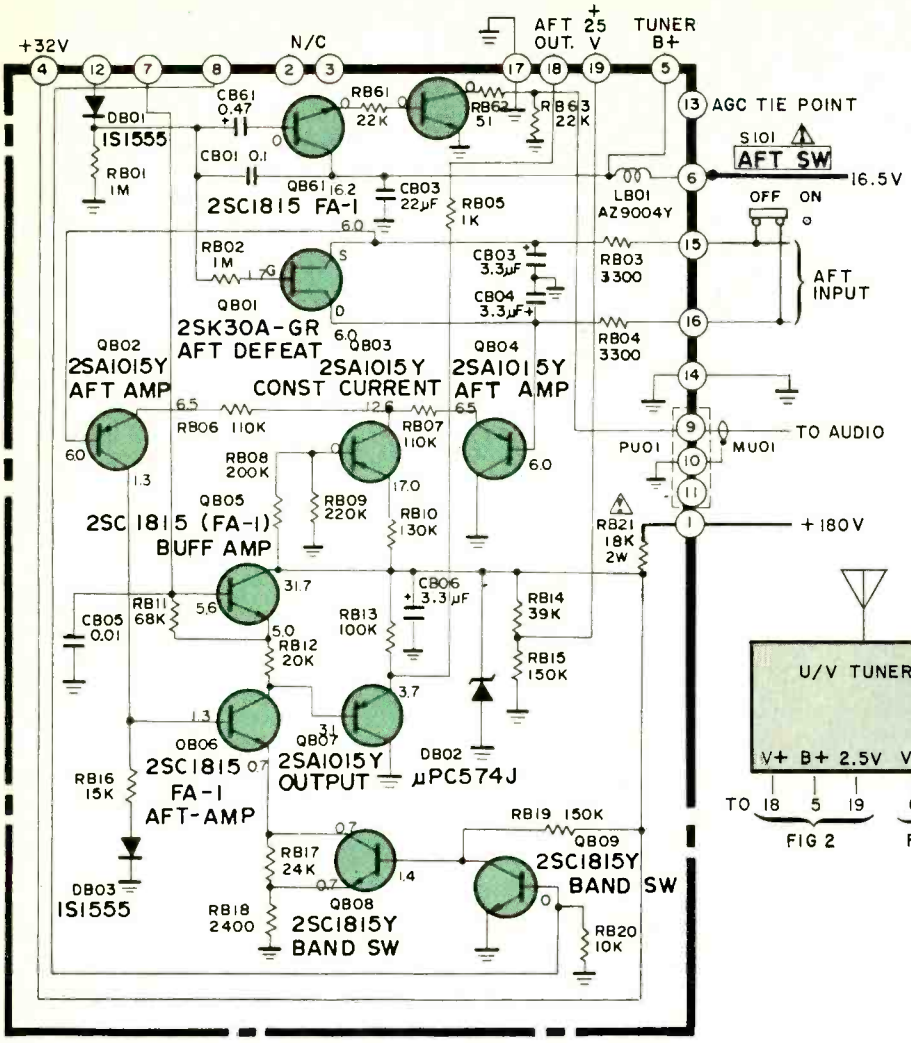

Fig. 1. Schematic of the Tuner Control Board, including dynamic aft, band switching and dc operating voltages.

coupled through *QB07*, whose output is then delivered to aft voltage terminal VT on the U/V tuner.

The only change in the above routine is when the uhf is engaged. At this point, band switch *QB09* conducts, reducing bias at the base of second bandswitch *QB08* to zero. This removes emiter/collector bypass current and restores *RB17* to the emitter circuit of *QB06*. As its emitter impedance rises, *QB06*'s collector voltage rises, *QB07* conducts less, and positive voltage from the 32-volt source increases across *RB13*. This places additional dc potential on the VT tuner port but maintains aft control.

The regulated supply delivers a stable 123 volts, principally for the deflection circuits and audio outputs. Other dc operating voltages are obtained from taps on the flyback transformer (FBT).

Ac from the power line passes through a fuse and the r-f line filter and is ground returned to the chassis. When the POWER switch is closed, full current passes through the degaussing network until a temperature-dependent resistor heats up and stops current flow. The ac is half-wave rectified, and operating voltage reaches the collectors of a Darlington regulator, which is biased by a current-limiter transistor stage.

Should an overcurrent condition exist, the current-limiting stage conducts harder and reduces the voltage at the input to the Darlington regulator. This lowers the output of the regulator until the overcurrent condition is cleared or the limiter shuts down the regulator altogether. When voltage changes occur, an error amplifier, whose emitter is supplied with a reference current, is biased more or less heavily, depending on the direction of the change. The changing collector potential from the error amplifier reaches the Darlington regulator, which controls current flow and, hence, output voltage for the +123-volt bus.

Although three of the four ICs in the set are hardly unusual, the chroma/luminance processor is. It is supplied with composite video and color burst by the video i-f, agc, and aft detector circuits in *IC101* (Fig.2). No i-f alignment is needed for this setup, and there is only a single shunt bandpass coil (*L102*) across the output of surface acoustic wave filter *Z101*. Otherwise, only aft detector coil *L103* and 4.5-MHz trap *Z201* require alignment. Traps and other usual devices never need tuning.

While it might appear that limiter coil *L171* implies a synchronous video detector, a basic 3.5-MHz output on the other side of the 4.5-MHz sound trap indicates otherwise. This coil is just part of the aft detector to which it is connected and must be adjusted for best overall

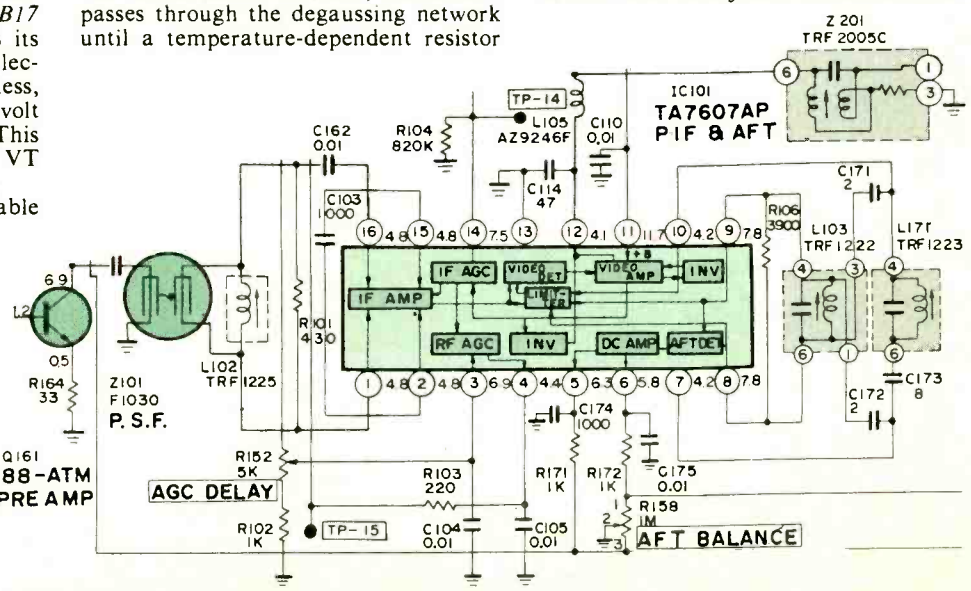

Fig. 2. Effective SAW and video i-f integrated filter circuits improve S/N.

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Unshackled

You're free at last from phone cords and extra monthly service charges.

Here's a phone that uses your own phone number and requires no installation.

You're out for a walk. About halfway around the block, you hear a pleasant beeping sound. To the amazement of those nearby, you reach in your pocket, extract a small 12 ounce object, and answer your telephone.

The sound quality is so good that except for the occasional sound of a passing car, nobody would suspect that you weren't sitting at home in your living room as you talk to them.

The new 700ft extended range cordless telephone by Universal Security, works perfectly on all push button or rotary dial phone systems, both at home and at the office.

You don't need a special phone number. There is no operator involved as there is in mobile phones. You plug this phone in just like any regular extension phone and there are no phone company monthly charges.

DO YOU HATE YOUR PHONE?

If you're inundated with phone calls all day, consider the new found freedom you'll experience with this cordless phone. It's so comfortable to use, you will reach for it first, even before you reach for your own desk phone.

Imagine for a moment that you are seated at your desk talking on the phone. As you talk, get up and stretch or go sit in a more comfortable chair.

Step out of your office and hand your secretary a note, or even walk right out of the building to the lunch truck or a nearby restaurant. The person you are talking to will never know.

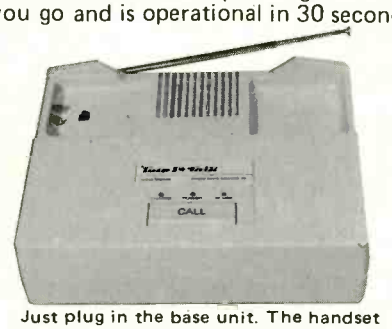
You can place or receive calls within an area about equal to 12 football fields depending on environmental conditions. While you're talking, you can walk to a colleague's office to confer, or make a trip to the shipping department to check on a client's order in person.

The sound is crisp and clear. It is both static and drift free. There are no push to talk buttons. It's just like a normal phone. Plus, you can even control the volume. If you dial a busy number, the phone will remember the number and redial it for you automatically with the touch of a single button.

HOME AND OFFICE

Use your cordless phone at the office during the week, then just 'throw' it in your briefcase before you leave work. You can use it all weekend at home.

Simply plug in the AC plug and the modular phone plug at the office or at home. The cordless phone goes where you go and is operational in 30 seconds.



Just plug in the base unit. The handset goes where you go.

YOU'LL LOVE IT AT HOME

Imagine walking the dog while talking on the phone. If you're needed at home, you can even be paged.

Think of the convenience for your wife, of being able to talk on the phone while keeping track of the children. She can check on them in the yard or down the street.

Consider the security of being only seconds away from the police or fire department. You can instantly call a doctor or anyone, anywhere. It's a superb personal security device.

Just walking from room to room, or up and down stairs cord-free is a real thrill. You can take a bath, mow the lawn or order a pizza from anywhere.

When your phone arrives, why not make a call from the living room or garden. It's a great combination of posh luxury and life saving utility.

NO INSTALLATION

If you can plug in a lamp, you can install your new cordless phone.

At the office, with multiline phones, we offer the phone octopus for $9.98. (It's a $24 value) You simply insert it at the cable junction by your phone and you can select between 3 different lines.

You can of course call the phone company and they'll put a jack in for a one time charge of about $15.

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To order your cordless Tote and Talk risk free with your credit card, call our toll free hotline, or send your check for the special sale price of only **$189** plus $3 for postage and handling-Item 9112 Add $9.98 for the Multiline octopus. Item 9113 (CA res add 6% sales tax.)

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aft response. When video is neither synchronously nor full-wave detected, demodulation is by a single diode or a transistor. This usually means additional filtering is required to remove envelope "tweets" that inevitably result. Surface-wave filter *Z101* and its input preamplifier feed the i-f and thereby enhance the receiver's signal/noise ratio.

Toshiba handles the TA7608CP chroma/luminance IC a little differently from its immediate competition. A variable sharpness control is added to the emitter of the discrete transistor picture corrector, which serves as both an inverting amplifier and part of the manual and automatic-brightness limiter circuit. This RLC control traditionally rounds off some of the high frequencies, smoothing out picture response in the process, sacrificing some detail.

Composite video from i-f *IC101* enters the TA7608CP analog chip, which is simultaneously gain-enabled by a contrast amplifier and inverted for the usual chroma 3.08-to-4.08-MHz bandpass filter before entering the first chroma amplifier. Chroma and burst then go to the second chroma and burst amplifiers. Both amplifiers are pulse-gated from the flyback transformer so that the chroma amplifier operates during the 52-μs line scan time and the burst during the 11-to-12-μs horizontal blanking interval. Burst amplitude controls gain of the second chroma amplifier, while its phase determines the frequency output of the vco's 3.58-MHz subcarrier regenerator and subsequent visual effects of tint (hue).

Gate inputs into the killer amplifier, along with connections to R − Y and B − Y demodulators, cut off the chroma amplifier when only a monochrome signal is incoming. When chroma reaches them, the two demodulators are gated by approximately 80° phase-shifted CW sine waves from the 3.58-MHz vco oscillator via the lower matrix. Fully demodulated color information from the R − Y and B − Y outputs is resistively combined by the upper matrix and delivered via direct coupling to the luminance/chroma output amplifiers to the cathodes of the CRT.

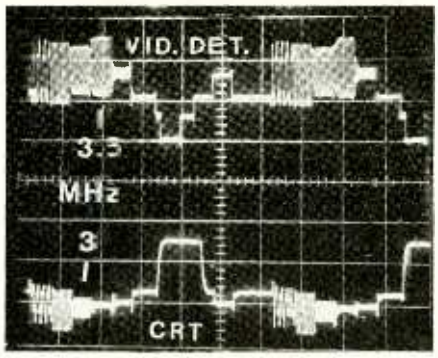

Fig. 3. Multiburst test patterns at video detector and CRT cathodes.

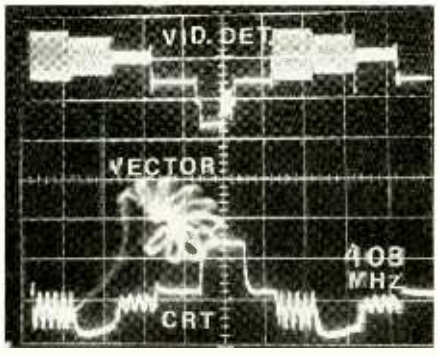

Fig. 4. Swept chroma and vector patterns at video detector and CRT.

Meanwhile, video information from the contrast amplifier passes through the luminance delay line. It is then pedestal (black-level) clamped and routed to the IC video amplifier. It then goes to the final discrete video amplifier and the RGB mixing stages. In the mixing stages, luminance and chroma are combined and routed to transistors that directly drive the CRT.

About the only other unusual thing this Toshiba receiver does is tie certain inputs into a "Fail Safe" board that prevents excessive high-voltage from causing ionizing radiation to be emitted. Inputs to this board are rectified voltages from windings on the flyback transformer. The filtered output goes directly to the X-ray circuit in the sync IC, which kills the horizontal oscillator when an overvoltage exists.

Test Results. We noted that 4.08-MHz swept information (Fig. 4) at the video detector and CRT is at a lower amplitude than is usually the case. Also, even though the vector pattern is relatively symmetrical and free of crossovers, there was some high-frequency jitter present, which affects color rendition to a degree. Otherwise, we see no evidence of peaking transients in either the i-f or luminance amplifiers.

On the plus side, we noted comfortable 3-MHz bandpass at the CRT (Fig. 3). Low-frequency response was excellent on both sides of the squared-off tip of the sync pulse during the horizontal blanking interval, and burst is well-defined on the back porch of the blanking pulse. Finally, we measured a large 67-dB swing before agc clipping.

Comments. Channels are easily and accurately accessed. Any channel selector button can be preprogrammed for whatever U/V station you desire in your area, except CATV frequencies. (Channel numerals are supplied for user insertion in the blank spaces near each button, and an LED comes on when a given channel is selected.)

Horizontal overscan of only 10% is great, allowing you to see almost all of the transmitted picture. Furthermore, convergence is virtually perfect. While there is a slight amount of pincushioning on the right side of the screen, you aren't likely to notice it. Picture resolution and definition were generally very good, and color reproduction was about average. We especially like both sharpness and brightness actions, the manual controls for which are located on the top-rear of the set's cabinet.

In terms of our test results, actual viewing performance, and serviceability, the CA-944 is a first-rate product. It certainly merits serious consideration if you're in the market for a color-TV receiver.—*Stan Prentiss*

TOSHIBA MODEL CA944 RECEIVER LABORATORY DATA

Parameter	Measurement
Tuner/receiver sensitivity (min. signal for snow-free picture):	vhf (Ch. 6): −9 dBmV uhf (Ch. 30): −7 dBmV
Voltage regulation (line varied from 105 to 130 V):	Low voltage: 123-V supply—95% 16.5-V supply—96% High voltage: 23-kV supply—95%
Luminance bandpass at CRT:	3 MHz
Luminance bandpass at video detector:	3.5 MHz
S/N at CRT:	40.1 dB
Convergence:	99.9%
Horizontal overscan:	10%
Agc response (before sync clipping or black level shift):	67 dB
Audio bandpass (3 dB down):	110 Hz to 2.8 kHz
Dc restoration:	≥89%
Auxiliary earphone audio output Z at 1 kHz:	12 ohms
Pincushion/barreling:	1%
Power requirement (signal applied):	75 W

Note: Instruments used in these measurements are: Tektronix/Telequipment D66, D67A oscilloscopes; Sadelco FS-3D-VU f/s meter; Data Precision 245, 1350, 1750 multimeters; B&K-Precision 1248, 1250 color-bar generator; Sencore VA48 (modified), CG169, color bar and signal generators and PR57 power supply; and Winegard DX-300 amplifier.

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The Bearcat 350 will revolutionize scanners just as plain English computers revolutionized the computer industry a few years ago. All because of this simple fact: We find it easier to deal with words than with numbers.

How it works.

Programming the Bearcat 350 for numeric and alphabetic capabilities is deceptively uncomplicated. First to program the frequencies numerically you stop the scanning action.

Then you press the alpha-numeric key. Next you program in the frequency number in the usual manner. Touching the "enter" button locks the frequency in the Bearcat 350's memory bank.

To enter the same frequency source using words or abbreviations simply press the alpha-numeric key again. Your unit is ready to be programmed by frequency name.

"Type" in the word or abbreviation for the frequency source. Press the "enter" button again. Your Bearcat 350 is ready to receive frequencies by number or name. It's as easy as that.

More than words.

Even without the alpha-numeric capabilities, the Bearcat 350 would be an unbelievable advancement in no-crystal scanning.

Its complex synthesized technology gives it the capability of receiving every local public frequency automatically. You will be able to receive low, high, UHF, UHF-T public service bands, the 2-meter and 70 CM amateur (Ham) bands, plus the AM aircraft band.

The Bearcat 350 scans up to 50 channels in five banks—10 channels per bank.

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It took Bearcat Scanners, the leader in scanner radios, to give you these impressive features in the Bearcat 350: patented selective scan delay, direct channel access, scan speed control, automatic squelch, patented track tuning circuitry and front mounted speaker. And look at these extras: two digital display panels, AC/DC operation, counter on each channel to determine which are most active, priority, and attractive die cast metal cabinet. See your Bearcat Scanner dealer today. Ask about the incredible Bearcat 350. Your perception of scanner radios will never be the same again.

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CIRCLE NO. 18 ON FREE INFORMATION CARD

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Popular Electronics Tests
The Fluke D811 True RMS Multimeter

CERTIFICATE OF CALIBRATION

LOCKHEED ELECTRONICS COMPANY, INC.

FLUKE's Model D811 True RMS Multimeter is a general-purpose, battery- or line-powered instrument designed for both bench and field use. Its companion, the Model D810, is similar in all respects, except that it is line-powered only. Features of the Model D811 include ability to measure rms values of ac voltage and current, even on nonsinusoidal waveforms; 3½-digit large (0.5") LCD display; autozero and autopolarity; basic dc accuracy of 0.1%; transient protection to 6 kV; seven functions and 31 ranges; conductance function to make measurements equivalent to resistances as high as 10,000 megohms (200 nS or nanoSiemens); three ranges for diode/transistor tests; and three ranges for low-power ohms. Accuracy of the basic instrument is guaranteed for one year.

Model D811 measures 8½"W x 2½" H x 10"D and weighs 3 lb 6 oz with batteries installed. The suggested retail price is $299.

General Description. The entire front panel, containing the LCD display, 10 function/range pushbuttons, and power on/off pushbutton, is recessed under an extending "lip" to protect these elements from damage in the case of an inadvertent fall to a hard surface. The probe connection is also unique in that the Y8008 Touch-Hold Probe is terminated in a 4-pin connector that can be plugged into the three (mA, COMMON, V/Ω/S) front-panel connectors and a polarizing hole. If desired, conventional banana-jack terminated test leads can be used in these input connectors. With

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the Y8008 connector inserted, the probe tip function is dependent on the setting of the various pushbuttons. The probe comes with a variety of tip attachments, and a pair of conventional test leads is provided. The 10-ampere input has its own banana-plug connector.

The *dc voltage* function provides five ranges from 200 mV to 1 kV with an accuracy of ±0.1% of reading plus one digit on all ranges. Overload protection to 1 kV dc or peak ac is provided on all ranges, the input resistance is 10 megohms on all ranges, normal-mode rejection is greater than 60 dB at power-line frequency, and common-mode rejection is greater than 90 dB at dc and power-line frequency.

The *ac voltage* function provides five ranges from 200 mV to 750 volts. Rated accuracy from 200 mV to 200 volts is 0.5% +2 digits from 45 Hz to 10 kHz; 1% + 2 digits from 10 kHz to 20 kHz; and 5% + 3 digits between 20 kHz; and 50 kHz. On the 750-volt ac range, accuracy is 0.5% +2 digits from 45 Hz to 1 kHz. Overload protection extends to 750 volts rms, 1 kV peak, not to exceed 10^7 volt-Hz, except for 10 seconds maximum on the 200-mV and 2-volt ranges. The input impedance is 10 megohms with less than 100 pF shunt capacitance. Common-mode rejection is greater than 60 dB at 60 Hz.

The *resistance* function provides six ranges from 200 ohms to 20 megohms. Accuracy is rated at ±0.2% reading +1 digit on the four lower ranges and ±0.5% reading plus 1 digit on the upper two ranges. Overload on all ranges is 500 volts dc or rms, while the open-circuit voltage is less than 3.5 volts on all ranges. Three diode test ranges are provided to forward-bias diode junctions.

Three *conductance* ranges are provided. These are useful for measuring conductances too low (resistances too high) to be resolved by normal measurement techniques. The unit of conductance is the Siemen (S). The 2-mS (1/500 Ω) range measures down to 1 MS (1/1 MΩ), ±0.4% reading +1 digit; the 20-μS (1/50 kΩ) range measures to 10 nS (1/100 MΩ) with the same accuracy as the 2-mS range, while the 200-nS (1/5 MΩ) range goes to 0.1 nS ($1/10^{10}$ Ω) with an accuracy of ±1% reading +10 digits. Overload protection to 500 volts dc or rms is provided on all ranges.

Dc currents are measured in six ranges from 200 μA to 10 amperes. Accuracy is ±0.3% reading +1 digit except on the 10-ampere range where it is ±0.5% reading +1 digit. Overload protection is by fuses except for the 10-ampere range. The voltage burden is 0.3 volt maximum on all ranges except 2 amperes which is 0.9 volt, and 10 amperes where it is 0.5 volt.

Ac currents can be measured via six ranges from 200 μA to 10 amperes. Accuracy on the 200-μA through 200-mA ranges, between 45 Hz and 10 kHz, is 1% + 2 digits; and between 10 kHz and 20 kHz, it is 2% + 2 digits. On the 2- and 10-ampere ranges, accuracy between 45 Hz and 2 kHz is 1% + 2 digits. The overload and voltage burden is the same as for dc current.

Operating temperature is between 0°C and 50°C, with the temperature coefficient less than 0.1/°C times the applicable accuracy specifications from 0°C to 18°C and 28°C to 50°C. Acceptable relative humidity for the instrument extends to 80% at 35°C or 70% at 50°C. Rechargeable NiCd batteries provide from 15 to 40 hours of operation, with a 14-hour recharge time. Low battery voltage is indicated by the sign BT on the LCD display.

Comments. The Fluke D811 was checked by Lockheed Electronics Instrumentation Measurements Lab., against standards traceable to the National Bureau of Standards. The IML found that the D811 met its advertised specifications in all respects.

In using the instrument, we had no problems. We really liked the Touch-Hold Probe and its method of connection to the DMM. Because of its connector, the probe can be left permanently attached to the meter, and there is no need to shuffle test leads to change function. The "hold" pushbutton on the probe—which "freezes" the LCD display—has been very helpful, as we can now store a voltage or resistance measurement and check the value given on a schematic.

The instruction manual (which is as important as any peripheral) is very well written, profusely illustrated, and covers the D811 completely. It even provides the names, addresses and telephone numbers of worldwide Fluke technical service centers.

The D811 is hardly a pocket-size instrument, but it is not large and bulky. Its convenient carrying handle also acts as a variable tilt stand for bench operation. And, a detailed summary of device specifications is printed on the underside of the case.

Other optional accessories include the 801-600 High Current Probe that allows current measurement from 2 to 600 amperes, the 80K-40 High Voltage Probe that allows voltage measurement from 1 to 40 kV dc or peak ac, and 28 kV rms ac, the 81RF High Frequency Probe that allows measurement of signals from 0.25 to 30 volts rms between 100 kHz to 100 MHz, the 80T-150 Temperature Probe for measurements between −50°C to +150°C, or −58°F to +302°F, and the Y8205 Carrying Case made of soft vinyl plastic. The last also has provisions for test leads, the power cord, and compact accessories.

In our view, the D811 RMS Multimeter is an excellent instrument, whose specifications are somewhat better than one would expect of such a reasonably priced instrument. Furthermore, it incorporates several unique features that in practice prove very much worthwhile. We can recommend it, without reservation, to anyone in need of a first-class bench/portable digital multimeter. — *Les Solomon.*

CIRCLE NO. 104 ON FREE INFORMATION CARD

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COMPUTER BITS

By Carl Warren

New Systems for 1981

JANUARY is when manufacturers attend the annual Winter Consumer Electronics Show in Las Vegas to display their new products for the consumer market. This year, there were few really "new" product introductions. Most of the products turned out to be already familiar items in new packages, but there were a number of items worthy of note.

What many of us thought would be a significant entry to the personal-computer market by Commodore Consumer Products Group turned out to be little more than a repackaging concept, with color- and sound-generation capabilities thrown in. The product, the Video Interface Computer (VIC) 20, is a less-than-

Mattel Electronics Computer Backgammon

$300, keyboard-sized unit with 5K bytes of RAM; circuitry that supports eight character colors, eight border colors, and 16 screen colors; and sound generators for development of computer music. It's designed to use the same PETBASIC and graphics functions used in the company's Pet microcomputer. Memory can be expanded to 32K of RAM, and the system can handle disk drives, printer, cassette deck, and game controls.

Mattel Electronics again showed up with its "Intellivision" video-games player/computer system and numerous games. The system consists of a master unit whose primary function is to provide video-game playing capability and a keyboard unit into which the master component plugs. The master unit offers a reasonable display, and the games are better than most. The keyboard component, which has been announced several times before and never reached market, includes a cassette deck and a very weak keyboard. On the plus side, Mattel deserves high marks for its hand-held computer games, particularly computer Backgammon and Baseball. A lot of effort was put into developing these, and it shows.

One machine that is especially interesting is the Bally Arcade from Astrovision. This unique microcomputer uses Bally BASIC and the so-called ZGRASS-32 keyboard, which is designed specifically for developing graphics. Arcade provides a palette of 256 colors by allowing you to define degrees of gray scale and shading. The bandwidth of the typical home TV receiver will be the limiting factor in this system, but I was surprised at the clarity of display in terms of resolution and dynamics of the graphics at the demonstration I

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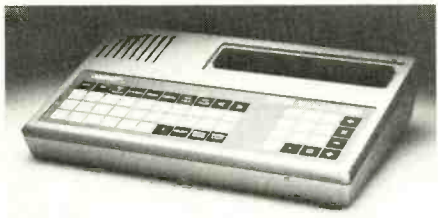
witnessed at CES. I'll pass on pricing and technical details when I get them.

Speak Up. Since 1978, there has been a growing interest in computer-generated speech and speech recognition. Texas Instruments leads in this field with its "Speak and Spell" unit. This year, TI has added the "Speak and Read" learning aids, designed to assist teachers. Speak and Read cartridges available now include "Who's Who at the Zoo," "Sea Sights," and "Dog on a Log." The solid-state plug-in modules retail for $25 each.

TI has also put forth major efforts in communication-mode modules and is aiding outside sources in developing software for its 99/4 microcomputer. Now software developers can use Pascal and a special development system. If you're in the software business and want to develop software for the 99/4, contact TI for details.

Anyone who wants to develop his own speech laboratory would do well to contact Telesensory Speech Systems, which has an advanced speech synthesizer for small computers. The company's Series III speech module can accommodate standard and custom vocabularies of up to 256 words. The module contains the company's own speech synthesizer, vocabulary data memory, on-board speech filter, and audio amplifier. The TTL-compatible board requires a +5-volt supply. Consult Telesensory directly for pricing and technical details and ask for a catalog of all its speech products.

On the subject of speech synthesis, *Giving a Voice to Computers*, by Ed Teja, an expert in voice technology, should be available from Tab Books or through your local computer or electronics retailer for about $10. It will acquaint you with the fundamentals of speech-synthesis and provide basic experiments you can perform. Perhaps the book's most important feature is its list of speech-module manufacturers.



Tiger Electronics Talking Computer

Tiger Electronic Toys Inc. had an interesting item at the CES—a 1500-word vocabulary computer dubbed the K-2-8. The manufacturer characterizes this system as a gap jumper, since it's not limited to 250 words. The system has 15 different learning modes with specific goals for the student to reach.

Other Systems to Consider. If you're in the bulk-mailing business and maintain large mailing lists, you should keep an eye out for the WHIZ from AM International. This specialized mailing-list system consists of an 80 × 24 character video display, Z80-based computer with 64K bytes of RAM, dual 5.25" single-sided double-density floppy-disk drives, and a Dataproducts dot-matrix bidirectional printer.

Mailing-list software for the WHIZ is written in Microfocus CIS COBOL and offers the same facilities found on large minicomputer systems. Price of the basic system is only $8990. Adding an automatic labeler boosts system price to $14,990, which is still $6000 less than what you'd pay for a similar system from another manufacturer.

A new system that hasn't received much attention is the IF800 Model from OKI. It resembles Hewlett-Packard's high-end color-graphics systems and even emulates H-P's clear graphics. Resolution is 640 × 200 dots, each individually addressable. The Model 20 system is currently supported by an extremely powerful version of Microsoft BASIC, COBOL, FORTRAN, and a BASIC compiler. A color display, light pen, and time-of-day clock are all part of the package. I couldn't find out what the system costs or where to buy it, but you can expect it to compete with Apple in price. Look for it in the second half of this year. Additional information is obtainable from BMC International. ◇

MORE INFORMATION

For additional information about the products or services discussed in this column, contact the companies directly.

AM International
1900 Ave of the Stars
Los Angeles, CA 90067
213-556-9639

Astrovision
6460 Bosch Blvd, Suite 215
Columbus, OH 43229
614-885-0130

BMC International (USA) Inc
Union Bank Building, Suite 600
11222 LA Cienega Blvd
Inglewood, CA 90304
213-641-4588

Commodore
Consumer Products Group
761 Fifth Ave.
King of Prussia, PA 19406
215-666-6800

Telesensory Speech Systems
3408 Hillview Ave, Box 10099
Palo Alto, CA 94304
415-493-2626

Texas Instruments Inc.
Inquiry Answering Service
Box 225012 M/S 308
Dallas, TX 75265

Tiger Electronic Toys Inc.
500 North Michigan Ave.
Chicago, Il 60611
312-836-7100

Vitek
1160 Barbara Drive
Vista, CA 92083
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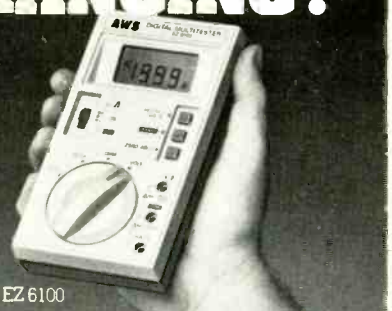

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Level "A" is a complete operating system, perfect for beginners, hobbyists, industrial controller use. $129.95

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

Level "A" With Hex Keypad/Display.

LEVEL "A" SPECIFICATIONS

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

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

System Monitor (Terminal Version): 2k bytes of deluxe system monitor ROM located at F000, leaving 0000 free for user RAM/ROM. Features include tape load with labeling . . . examine/change contents of memory . . . insert data . . . warm start . . . examine and change all registers . . . single step with register display at each break point, a debugging/training feature . . . go to execution address . . . move blocks of memory from one location to another . . . fill blocks of memory with a constant . . . display blocks of memory . . . automatic baud rate selection to 9600 baud . . . variable display line length control (1-255 characters/line) . . . channelized I/O monitor routine with 8-bit parallel output for high-speed printer . . . serial console in and console out channel so that monitor can communicate with I/O ports.

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

HEX KEYPAD/DISPLAY SPECIFICATIONS

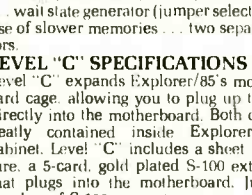
Calculator type keypad with 24 system-defined and 16 user-defined keys. Six digit calculator-type display, that displays full address plus data as well as register and status information.

LEVEL "B" SPECIFICATIONS

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

LEVEL "C" SPECIFICATIONS

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



Explorer/85 With Level "C" Card Cage.

LEVEL "D" SPECIFICATIONS

Level "D" provides 4k of RAM, power supply regulation, filtering decoupling components and sockets to expand your Explorer/85 memory to 4k (plus the original 256 bytes located in the 8155A). The static RAM can be located anywhere from 0000 to EFFF in 4k blocks.

LEVEL "E" SPECIFICATIONS

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

DISK DRIVE SPECIFICATIONS

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

DISK CONTROLLER/ I/O BOARD SPECIFICATIONS

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

DISK DRIVE CABINET/POWER SUPPLY

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

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Please send the items checked below:

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- ☐ **8k Microsoft BASIC** on cassette tape. **$64.95** postpaid.
- ☐ **8k Microsoft BASIC in ROM kit** (requires Levels "B", "D" and "E".) . . . **$99.95** plus $2 post. & insur.
- ☐ **Level "B" (S-100) kit** . . . **$49.95** plus $2 post. & insur.
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  - ☐ Fan For Cabinet . . . **$15.00** plus $1.50 post. & insur.
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- ☐ **32k RAM kit** . . . **$299.95** plus $2 post. & insur.
- ☐ **48k RAM kit** . . . **$399.95** plus $2 post. & insur.
- ☐ **64k RAM kit** . . . **$499.95** plus $2 post. & insur.
- ☐ **16k RAM Expansion kit** (to expand any of the above in 16k blocks up to 64k) . . . **$99.95** plus $2 post. & insur. each.
- ☐ **Intel 8085 cpu Users' Manual** . . . **$7.50** postpaid.
- ☐ **12" Video Monitor** (10MHz bandwidth) . . . **$139.95** plus $5 post. & insur.
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COMPUTER SOURCES

By Leslie Solomon
Senior Technical Editor

Hardware

S-100 D/A Converter. The S-100 compatible SB-64 features 64 output channels, each driving a 1K load, with ±0.4% absolute accuracy from 0 to 10.625 volts. Address decoding allows memory-mapped I/O to any 256-byte sector and IEEE S-100 specs are met. Options include 10 digital outputs, fast 12-bit DAC with 3-microsecond settling time, ± 15-volt tracking regulator with 600-mA output, and 24-bit address decoding. $514. Address: Digital Multi-Media Control, 2338 Patterson #12, Eugene, OR 97405.

DDDS Floppy for Apple. The LCA-22 is a controller board for the Apple II. It is software compatible with Apple DOS and contains 256 bytes of boot ROM. It can control up to four 8-inch, single- or double-sided, single- or double-density disk drives to produce a storage capacity of 4.4 megabytes. Average access time is 200 ms, and DMA is 62.5K bytes/second transfer rate. The board comes with cable, diskette, and documentation. $699. Address: Lobo Drives International, 354 S. Fairview Ave., Goleta, CA 93117 (Tel: 805-683-1576).

Handprint Data Terminal. The Micropad enables hand-written alphanumeric data to be entered in a computer at the time of writing. It consists of a pressure-sensitive writing surface, a microprocessor, and a built-in 40-character display. A conventional ballpoint pen or pencil may be used. Data is converted to ASCII and transmitted via RS-232 or current loop to the computer. Writing area is 168 × 102 mm and is 11 rows by 28 columns. The display is formed on a 7 × 5 dot-matrix, 5-mm high, green display. A DB-25 connector is provided and baud rate is to 1200. Self diagnosis software is provided. It requires an external 21-volt power supply. Address: Micropad Inc., Suite 1510, 35 E. Wacker Dr., Chicago, IL 60601 (Tel: 312-346-4667).

Apple Interface The D109 Universal Digital Interface for the Apple II occupies one slot, and features 32 digital input or output lines, 4 programmable timers, 2 shift registers, full interrupt capability, and optional current drive and isolation. It can take control of the 32 data lines, which can be used as inputs or outputs as dictated by software. The timers can be set from one microsecond to 17 years, and there are 14 different interrupts. Address: Interactive Structures Inc., Box 404, Bala Cynwyd, PA 19004 (Tel: 215-667-1713).

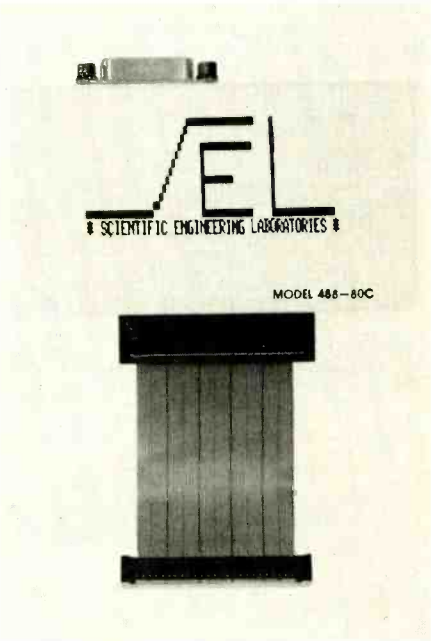
KIM A/D. KIMSET1 gives a KIM the capability of measuring up to 16 channels of analog input with a resolution of eight bits. Consisting of a KIMMOD, AIM16 16-channel A/D converter, MANMOD1 manifold module, POW1 power supply, software, and operating instructions, the system plugs into the applications port. It converts the 16 0-to-5.12-volt analog inputs to their equivalent 0 to 255 digital values. $285. Address: Connecticut microComputer Inc., 150 Pocono Rd., Brookfield, CT 06804 (Tel: 203-775-9659).

Z80 Monitor ROM. Housed in a single 2716 EPROM, and designed to support the SSM CB2-Z80 Microcomputer Board, a new EPROM monitor allows operator to display, substitute, or fill memory; perform hex arithmetic; establish two program breakpoints; set and examine registers; assign I/O devices; input and output from an I/O port; plus other board-level programming. Built-in scanning enables the monitor to review remaining memory and set the stack. Extensive documentation and listings are provided. $89. Address: SSM Microcomputer Products, 2190 Paragon Drive, San Jose, CA 95131 (Tel: 408-946-7400).

SS-50 Bus RAM. The M24SS RAM plug-in is available in 8-, 16-, and 24-K-byte configurations. There is also an 8K-byte kit for expanding the 8K and 16K-byte versions. The boards work with the SS-50 or extended addressing SS-50C bus. The boards may be strapped to reside in any of the sixteen 64K-byte zones of an extended 1M-byte memory space, is organized in 8K segments that may be located at any 8K boundary, and includes a 6800/6809 memory diagnostic. The 8K is $199.95, 16K is $349.95, and a 24K is $499.95. The memory expansion kit is $139.95. Address: Percom Data Co., 211 N. Kirby, Garland, TX 75042 (Tel: 214-272-3421).

Robots. A complete catalog of mechanical and electronic parts for construction of a robot is now available. It includes parts from a number of manufacturers, plus a wide array of other mechanical elements. There is also a robot newsletter. Address: The Robot Mart, 19 West 34th St., New York, NY 10001 (Tel: 212-695-5108).

TRS-80 to GPIB. The Model 488-80C Interface Adaptor enables any Radio Shack Model 3 with a minimum of 16K RAM and Level II BASIC to be used as a GPIB-488 controller with GPIB I/O in BASIC. The machine language program interacts with either



Level 2 or Disk BASIC. An optional relocatable driver program (ML3) is available for assembler level GPIB I/O programming. $225. ML3 is $35. Address: Scientific Engineering Lab., 11 Neil Dr., Old Bethpage, NY 11805 (Tel: 516-694-3205).

Apple Calendar/Clock. The Model 7424 Calendar/Clock Module provides accurate real-time counting for the Apple II. The battery powered crystal-controlled clock counts seconds, minutes, hours, days of the week and month, months and years. It includes three separate jumper-selectable driver programs, space for user-written drivers, and an on-board 1K of EPROM. In addition, 256 bytes of RAM or ROM may be added for custom software. Both 12- and 24-hour formats are available and an interrupt may be generated every millisecond, second, minute or hour. It also allows both interrupt and daisy-chain passthrough. $125. Address: Cali-

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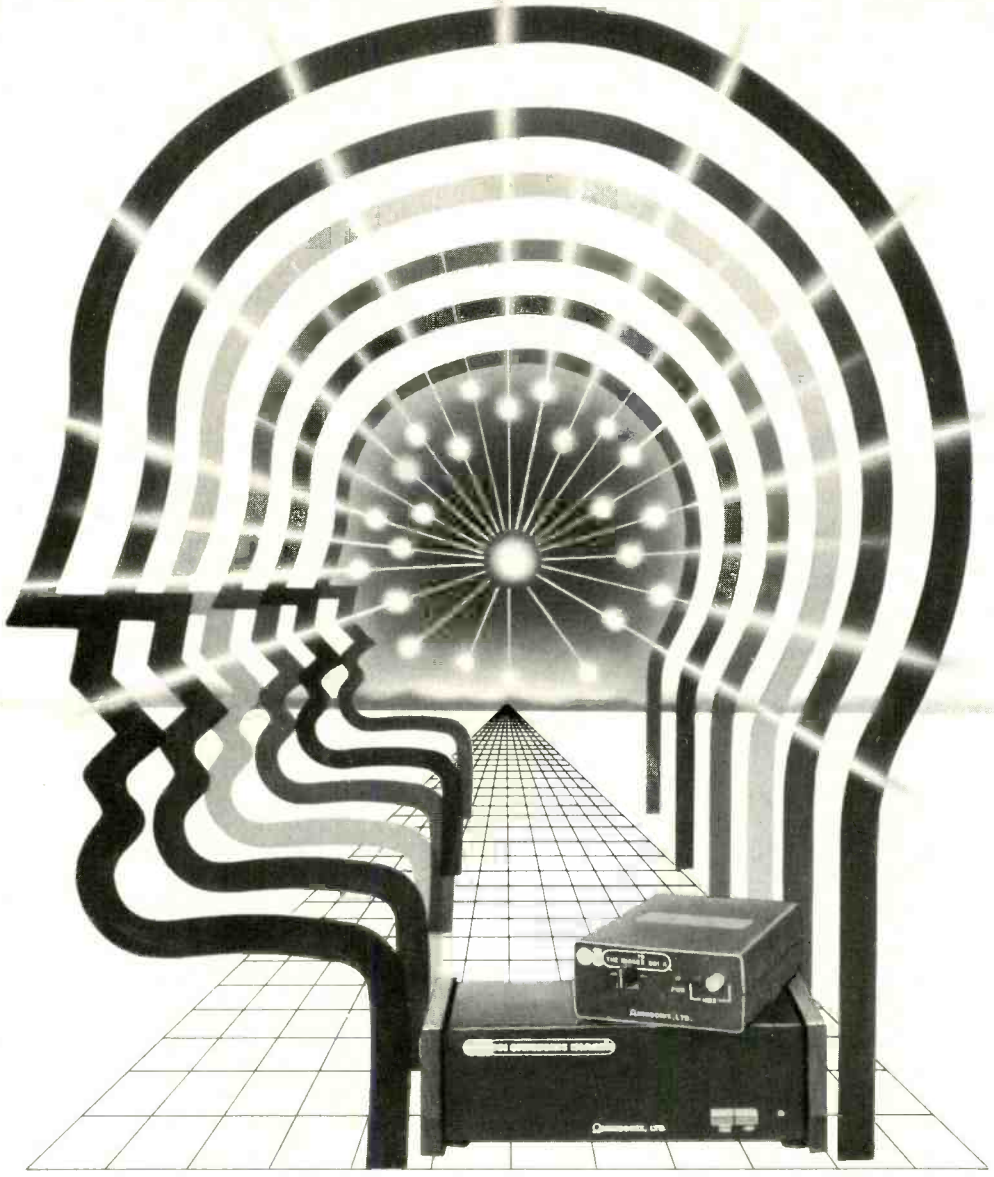
SOUND UNLEASHED



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fornia Computer Systems, 250 Caribbean Dr., Sunnyvale, CA 94086 (Tel: 408-734-5811).

Software

Apple FORTRAN/COBOL. Written for an Apple II using a Softcard, both languages run under CP/M. FORTRAN-80 is a fast and compact compiler that can handle several hundred statements per minute in a single pass and needs less than 25K bytes of memory. It compiles true Z80 machine code which is 2 to 3 times faster than Apple FORTRAN. It supports a double precision, integer X4 and X1 data types and is supplied with an extensive library of floating point, math and I/O routines, and a linking loader. $195. COBOL-80 is ANSI Standard 1974 and includes sequential, line sequential, relative and indexed sequential data files. Full screen I/O and editing and program chaining with parameter passing is provided. Program segmentation allows programs larger than memory size. It includes a linking loader, macro assembler, library manager, cross reference-assembler, and all documentation. $750. Address: Microsoft Consumer Products, 400 108th Ave., NE, Suite 200, Bellevue, WA 98004 (Tel: 206-454-1315)

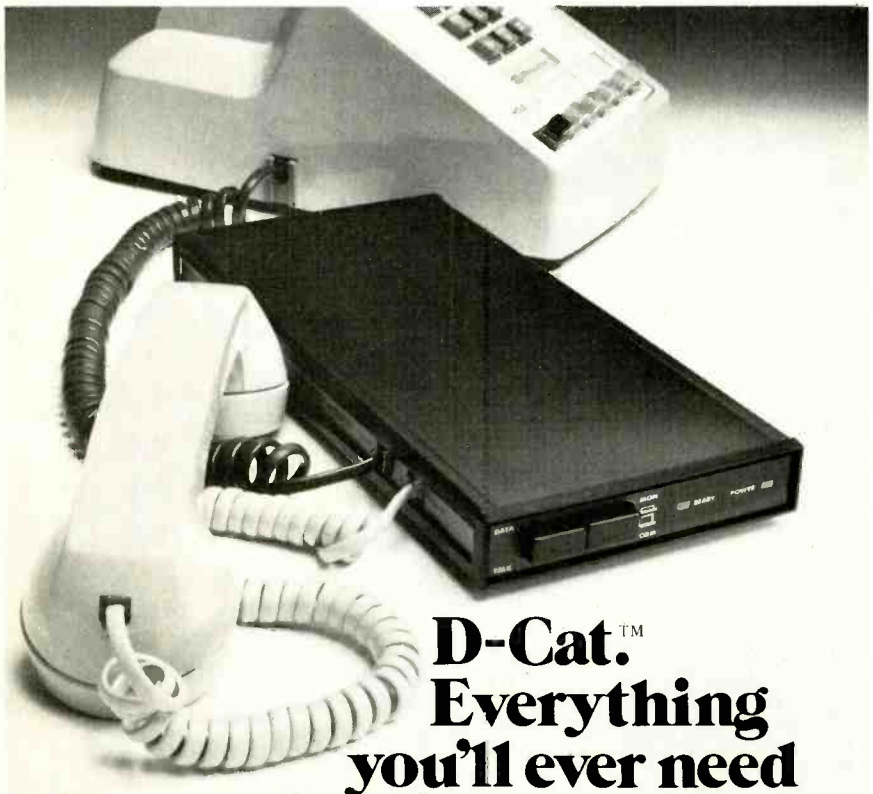
TRS-80 Screen Editor. The Full Screen Editor 1010-20 is compatible with Level II and Disk BASIC for the TRS-80 Model I. The full-screen display can be positioned to see any portion of the program and the cursor can be positioned to any point in the screen. Features include character change/insert/delete, extend line, insert lines, delete line or blocks of lines, copy line or blocks of lines, move lines or blocks of lines, renumber entire program, search program for specified string, global change, and macro key facility. The latter allows redefining the 26 alphabetic keys to represent BASIC keywords or any other character string. $24.95. The EDTASM version (1010-30) for assembly language programming with the same features is also $24.95. Address: Computer Applications Unlimited, Box 214, Dept. 48C, Rye, NY 10580.

16-Bit CP/M. CP/M-86 is an operating system designed for 8086/8088-based microcomputers. This 16-bit product is designed to take advantage of the 8086 address space and speed, while expanding upon the facilities of standard CP/M. It can also function as a slave node in a CP/NET network. MP/M-86 and PL/I-86 will soon be introduced. Address: Digital Research, Box 579, 801 Lighthouse Ave., Pacific Grove, CA 93950 (Tel: 408-649-3896).

Atari 800 Programs. IRIDIS #1 contains four programs for the Atari 800 computer. Clock is an old-fashioned wall clock with chimes; Cap uses the joystick to knock down targets; Logo is a flashy demo of the Atari color registers; and Polygons allows the machine to construct a variety of geometric patterns. $9.95 for cassette, $12.95 for diskette. Address: The Code Works, Box 550, Goleta, CA 93017 (Tel: 805-967-0905).

Apple Utilities. Designed for the Apple II with Romplus board, Renumber/Merge requires 48K, Applesoft in ROM, and will operate with or without Disk II. When activated, it will not interfere with any program in memory. $49.95. Disk Copy/Disk Space consists of two disk utility programs in one ROM. Disk Copy will duplicate a disk with one drive, two drives with one controller, or two drives and two controllers. Disk Space will read track bit map and display number of free sectors and bytes. $49.95. Will operate with DOS 3.2, 3.3, 32K or 48K, Int, FP, LS, II, or II Plus. Address: Soft CTRL Systems, Box 599, West Milford, NJ 07480.

TRS-80 Games. "Space Colony" for the Programma High Resolution Graphic Board is a shoot-em-up game for a 4K, Level II system with sound. $9.95 for Programma Board or standard



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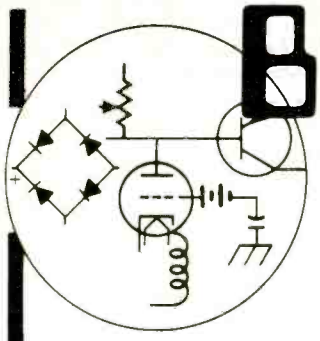

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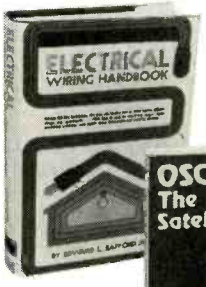

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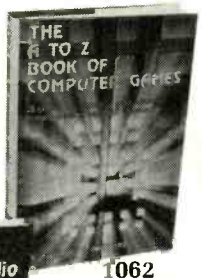

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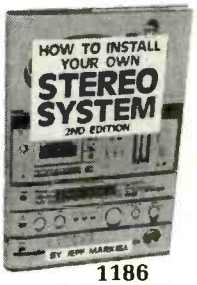

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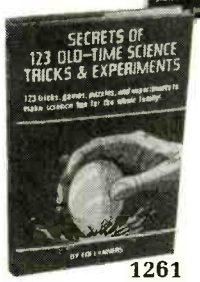

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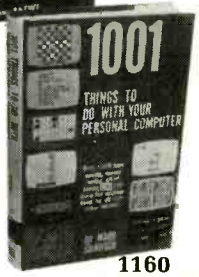

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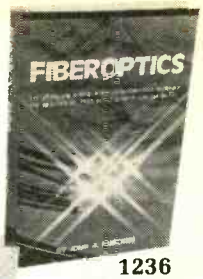

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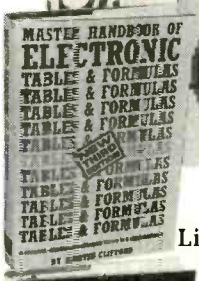

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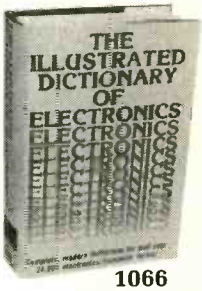

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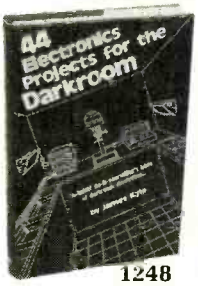

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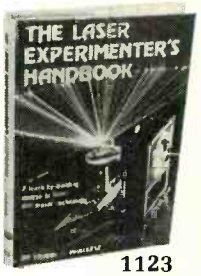

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TI/Source. TEXNET for the TI-99/4 home computer offers all the services of the Source information utility plus new data bases that take advantage of the color, graphics, sound, music, and speech capabilities of the TI-99/4. In addition, it allows users to hear any messages typed on the computer keyboard, or transmitted over the TEXNET system. Address: Texas Instruments Inc., Consumer Relations, Box 53, Lubbock, TX 79408 (Tel: 800-858-4565; in Texas, 800-692-4279).

Apple Communications Package. The Datacom is a data communications package for use with a Hayes Micromodem II for Pascal-equipped Apple systems. The package consists of a diskette and Pascal manual containing two levels of program commands; Datacom Terminal Program for Pascal; and Pascal Micromodem II routines. Software uses English words, simultaneous print while connected, 110 or 300 baud transmission, and auto-dial/auto-answer capabilities. $50. Address: Hayes Microcomputer Products Inc., 5835 Peachtree Corners East, Norcross, GA 30092 (Tel: 404-449-8791).

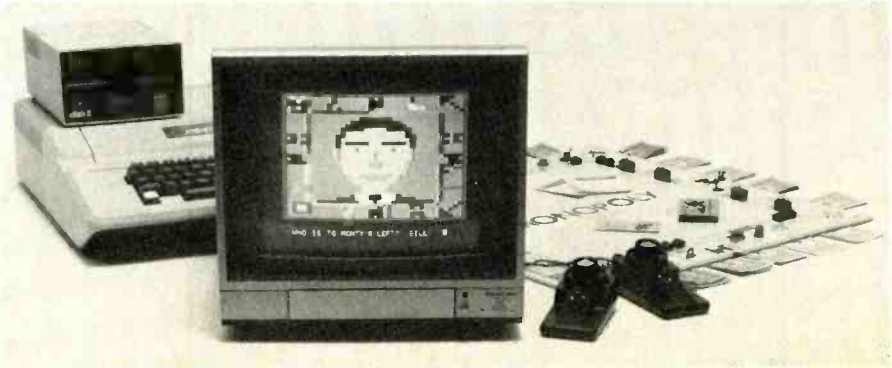
Visicalc Utility. The VU #3 is a modular disk-based utility that accepts data produced by Visicalc through the PRINT-DISK command, and to reorganize and restructure it so that the data can be read by other Visicalc programs. It will also accept Integer and Applesoft data, relocate individual pieces, rows, columns, and blocks of data, or the entire input file. It also allows many input files to be written as one output file, or one input file to be written as many output files. It can write output data for Visicalc, Integer, or Applesoft programs, view input or output files, and correct individual records of the output file. It also allows new data into the output file, which can be overlaid on a Visicalc program as data. $69.95 plus $4.95 p/h. Address: Progressive Software, Box 273, Plymouth Meeting, PA 19462 (Tel: 215-279-4438).

TRS-80 Word Processing. WP-730.4 Word Processor is for use with a TRS-80 Level II with 16K and Line Printer II (Centronics 730 or similar). Features include typing limited by user's ability, same editing capability as TRS-80 Level II, upper/lower-case printout, change line length from 1 to 80 characters, adjustable margins and right justification, expanded printout, centered lines, indented lines, and cassette save. No disk system is required. $35. Address: GB Associates, Box 3322, Granada Hills, CA 91344.

COBOL Course. The Heathkit/Zenith EC-1105 COBOL Programming Course covers both the ANS 74 and ANS 68 versions of COBOL. It teaches the fundamentals of encoding, input characteristics, program hierarchy, identification, environment, data, and procedure divisions. Six practice programs are included. It employs audio-tutorial learning, using text and nine audio cassettes. $149.95. Address: Heathkit/Zenith Educational Systems, Dept. 350-490, Benton Harbor, MI 49022, or any Heathkit Electronic Center.

ET-3400 Users Group. Users of the Heath ET-3400 microprocessor training system now have a user's group and newsletter. Contact ET-3400 Users Group, c/o Charles Van Dyke, 11231 Oak St., El Monte, CA 91731 (Tel: 213-443-2237, CompuServe 70250,463).

Monopoly Program. "Monty Plays Monopoly" turns Apple II and TRS-80 computer into skilled players of the classic Parker Brothers board game. This is not a monopoly game, but a computerized opponent programmed to act as another player, with graphics. As many as seven players (plus Monty) can play at one time. The computer generates the dice throws, and keeps track of each player's position with prompts. Sound effects have been added. $34.95 diskette, $29.95 cassette. Address: Personal Software Inc., 1330 Bordeaux Drive, Sunnyvale, CA 94086 (Tel: 408-745-7841).



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Popular Electronics Tests

Hewlett-Packard HP-85 Computer

HEWLETT-PACKARD calls the HP-85 the "personal computer for the professional." Judging by its base price ($3,250), the cost of peripherals, and the titles of the available software, the HP-85 is intended for accountants, engineers, and scientists—and fairly well-heeled ones at that.

Inside the HP-85's 17.8"D x 16.5"W x 6.3"H, 20-lb package is a fully integrated computing system consisting of : a 5-in. CRT that can display 32 x 16 alphanumerics or 256-by-192-dot graphics; 32-column thermal printer; tape-cartridge storage system; HP's own CPU; 16K bytes of RAM (expandable to 32K bytes maximum); and BASIC in ROM. Additionally, the computer has rear-panel slots for plugging in a comprehensive range of optional items via an HP-IB interface module ($395), which handles up to 14 peripherals.

Among the options available from HP are: a 16K byte memory module ($395): 7225A graphics plotter ($2,050 plus $750 for required personality module); 2631B dot-matrix impact printer ($3,650 plus $150 for high-density print option); and an assortment of 5¼" and 8" double-sided, double-density flexible-disk drives ($1,500 to $6,500). Software is available in cartridge-tape Application Pacs for $95 each and includes such titles as BASIC Training, Circuit Analysis, Financial Decisions, and Waveform Analysis.

For those who wish to configure their own systems, HP has the HP-83, which is identical to the HP-85 but lacks the on-board printer and cartridge-tape system. Price is $2,250. Hewlett-Packard also has, in the works, a less expensive printer that will interface serially with the HP-83 and HP-85; cost of the printer will be about $1,000.

System Hardware. The HP-85 is built around a custom-designed proprietary microprocessor and a powerful BASIC language that integrate the various elements into a unitary computing system. All additions to the system (RAM expansion, ROMs, and peripherals) are accomplished externally, through four plug-in "module ports." Even the roll paper for the printer is loaded into an isolated well in the top of the cabinet.

There's not much to tell about the NMOS microprocessor, except that it is designed to access up to 112K bytes of mixed ROM and RAM. Resident in the HP-85 are 16K bytes of RAM and 32K bytes of ROM. To these can be added an optional 16K byte RAM module and up to six 8K byte ROM modules.

On power-up, the HP-85 goes directly into BASIC, and since there's no way of exiting BASIC, there's no means for entering machine-language routines. However, in the BASIC mode, you have access to all of the system's elements, including peripherals.

The cartridge-tape system is used to load programs and data from the Application Pacs and for storing user written data and programs on blank tapes. This system is completely under program control, using such keys as REW (rewind) and LOAD, which can also be invoked by calls in a BASIC program.

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

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

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

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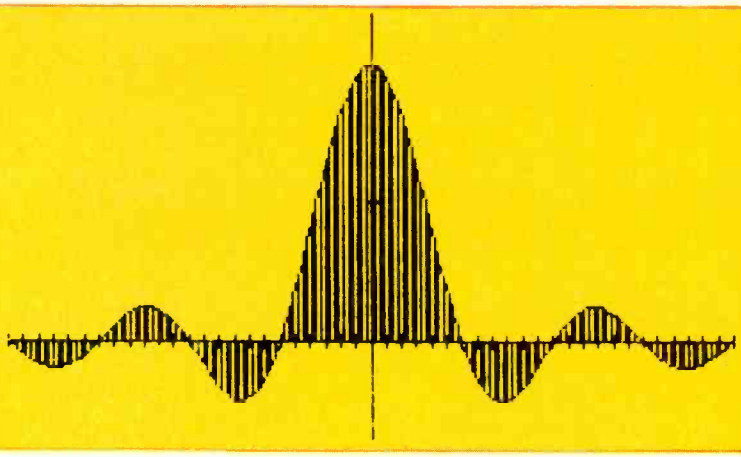
TEST ROUTINE

```
10 REM *FILL SIN (X)/X
20 GCLEAR
30 RAD
40 SCALE -4*PI, 4*PI, -.5, 1.5
50 YAXIS 0, .5
60 XAXIS 0, PI/6
70 FOR X = -4*PI to 4*PI STEP PI/20
80 IF X = -4*PI THEN MOVE X, SIN (X)/X
90 IF X = 0 THEN 130
100 DRAW X, SIN (X)/X
110 MOVE X, 0
120 DRAW X,SIN (X)/X
130 NEXT X
140 END
```



The tape system can store up to 210K bytes of data or 195K bytes of program on a standard 140-foot tape, with up to 42 named files per tape cartridge. This file-naming feature allows you to load either specific programs or to access various types of data in a simple, straightforward manner. Transfer rate is 650 bytes per second, average access time is 9.3 seconds, search speed is 7.8K bytes (60 in.) per second, and read/write speed is 10 in. per second. The system is equipped with a mechanical security system and has provisions for extra security via program control.

The HP-85's keyboard is an impressive, attention-getting feature. This is one of the few microcomputers with a typewriter-style keyboard on which each key is designed to perform a specific function. Virtually every function you can think of is implemented with a specific key. For example, pressing the LIST key causes a program in memory to be listed on the CRT screen. Tap LIST and SHIFT simultaneously, and the listing goes to the printer for hard-copy readout. Touch the COPY key, and all on-screen graphics go to the printer, point by point. All of these functions are called by separate keys, without the need for user-written drivers.

The 92-key board is divided into four major parts: standard alphanumeric/punctuation typewriter board; numeric keypad with arithmetic functions (+, −, *, /, etc.); user-definable special-function keys; and display/system-control keys. Using the keyboard, you can directly access 128 of the HP-85's 256-character set. The remaining 128 characters, which are the same as the first 128 but underscored, are accessed via the CHR$ function.

Hewlett-Packard has reversed standard keyboard convention with the CAPS LOCK key on the HP-85. Normally, pressing down CAPS LOCK locks in the upper-case print mode. On the HP-85, it locks in the *lower*-case mode. The company reasons that the computer will be used more for entry of specialized data and programs than for text editing, in which case, the upper-case mode would be used more often. (Remember, too, that BASIC converts all lower-case characters, except those in strings enclosed in quotes, to upper case. Since upper-case is the "normal" mode for BASIC, this implementation of the CAPS LOCK key is logical, even though it takes some getting used to.)

The HP-85's built-in thermal printer is designed to print 32 alphanumeric (and graphics) characters per second. Much of this speed comes from the fact that printing is bidirectional. While text is printed exactly as shown on the CRT screen, graphics are rotated by 90° to permit creation of long graphs that wouldn't otherwise fit across the 4" width of the roll paper. Since this is a *thermal* printer, it requires special paper, which sells for about $15 per roll.

The Software. HP-85 extended BASIC is often called an enhanced version of the original Dartmouth BASIC. "Enhanced" here simply means that the language has been designed to take advantage of the power of the integrated HP-85 computing system. Containing more than 150 commands and statements, HP-85 BASIC gives you full control over the CRT screen, on-board printer and cartridge-tape system, and all optional HP peripherals.

HP-85 BASIC enhancements allow you to perform a number of things other BASICs usually don't. For example, a unique software security system that operates on four levels, allows you to protect specified data and program files from being listed, edited, duplicated, written over, and even appearing in the catalog. With the CHAIN and COMMON commands, you can write a very long program and break it into small parts that can be called and executed automatically. The only limitation on program length would be the amount of data that can be stored on tape cartridge or optional disk.

Two levels of data precision are available with HP-85 BASIC. With "full" precision, you get a 12-digit mantissa and three-digit (±499) exponent. Using "short" precision, five digits of mantissa and a two-digit (±99) exponent are available. Integer range is ±99999.

HP-85 BASIC also allows user definition of the eight special-function keys to interrupt program execution and direct program flow. Also, you can program a built-in beeper to sound, defining when and how long it will sound and its frequency. This useful feature can be used to signal completion of a desired subroutine, prompt for input, or highlight output. Frequency range of the beeper is approximately 0 to 4,575 Hz.

Another feature of this BASIC is its clock and timer functions. Time is maintained as seconds since midnight, referenced to the year and day of the year. Three timers can be independently programmed to generate periodic interrupts at intervals ranging from 0.5 to 99,999,999 ms (up to 1.16 days).

This isn't just another BASIC interpreter. It's actually an incremental compiler BASIC that checks each line on input for proper syntax. A syntactically correct line of data is interpreted directly to a run-time module and becomes a part of the program being written. If syntax is incorrect, however, an error message is generated on-screen and no entry is made to the program until the error is corrected.

Perhaps more important than input error checking is the method HP-85 BASIC uses for handling data structures, such as arrays. In this BASIC, data is initialized in much the same manner as it is in Pascal and ADA. This means that you can point to any given byte in an array or data set, regardless of where it may reside, even if it's on tape.

Lacking PEEK and POKE statements (they are absent from HP-85 BASIC). the user is barred from access to the processor and, hence, from entry of machine-language routines during programming. Access to the processor really wouldn't help—Hewlett-Packard doesn't provide the instruction set. While omission of PEEK and POKE may represent a major obstacle for the hobbyist, it is consistent with the business applications foreseen by the machine's designers. Professionals who use the HP-85 for business and design applications will rarely if ever need access to the processor. Moreover, just about any task you wish to perform on the HP-85 can be accomplished through BASIC.

For those determined to work in ma-

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chine language, Hewlett-Packard has a Series 80 assembler ROM ($295) that provides limited access to the processor. Plugged into a slot on the rear of the computer, the ROM provides access to many of the entry points used in HP-85 BASIC, including all math routines, high- and low-level CRT control, general I/O routines, etc. Also contained in the Series 80 ROM is an editor that checks for syntax. A comprehensive 400-page manual supplied with the ROM gives full documentation.

Evaluation. It would be unfair—and foolish—to evaluate the HP-85 in direct comparison with such general-purpose computers as the Heath H89, Apple II, or Radio Shack TRS-80. The HP-85 wasn't designed to facilitate machine-language programming, word processing, games playing, etc. In essence, it is dedicated to professional applications where BASIC will suffice. Viewed in this light, the HP-85 is nicely appointed, well integrated, and easy to operate.

We were impressed by the HP-85 BASIC for its power and its relatively high speed. One test of a BASIC is to write the statement 10 GOSUB 10 and observe what happens when it's executed. Most BASICs search through memory for the subroutine and then return an error message like OUT OF MEMORY AT 10 or GOSUB WITHOUT RETURN. HP-85 BASIC, however, returns an immediate error message. The manual gives a good method of checking out HP-85 BASIC. The test routine, shown with its output in the accompanying box, computes and plots a graph. It took 129 seconds to execute, which is acceptable but not particulary fast, since each plot is calculated as it's being drawn.

The system is capable of sharp high-resolution graphics, allowing you to put up to almost 50,000 (256 x 192) dots on-screen, each individually plotted. This being the case, you can design and display any graphics you might need—even create your own character sets. To simplify graphics operations, HP provides special commands that allow you to draw, erase, position labels on axes of graphs, define the limits of the axes, etc. Time, in HP-85 is kept and displayed in an unconventional way. According to the manual, you set time by typing SET-TIME 28800,81076, which represents 8 a.m., March 17, 1981. When displayed, the 28800 refers to the number of seconds since midnight, while 8107 is interpreted in two parts, the first two digits representing the year and the remaining digits the number of days into the year. It would be much better if the date and time could be presented in the format 03/17/81 and 08:00, instead of requiring extra interpretation.

At the present time, the only vendor of software for the HP-85 is Hewlett-Packard itself, which means that the range of available programs is seriously restricted.

However, now that the Series 80 assembly ROM and manual are available to prospective software markets, this situation can be expected to get better.

While Hewlett-Packard offers a Text Editing Pac for the HP-85, it is suitable for occasional or light-duty use. If text editing is something that you need often or for very long, you'll probably be happier with a different computer.

The Bottom Line. With all of its attributes, the HP-85 is a limited computer. If you're in the market for a personal computer for the home, the HP-85 probably won't be your best choice. To begin with, it's considerably more expensive than typical home computers, and every option added boosts the system price even more. But price aside, the HP-85 would be a poor choice for software development or learning advanced programming skills. On the other hand, for the professional who wants basic number crunching, and doesn't much care how the computer goes about providing it, the HP-85 could be excellent.

—Carl Warren

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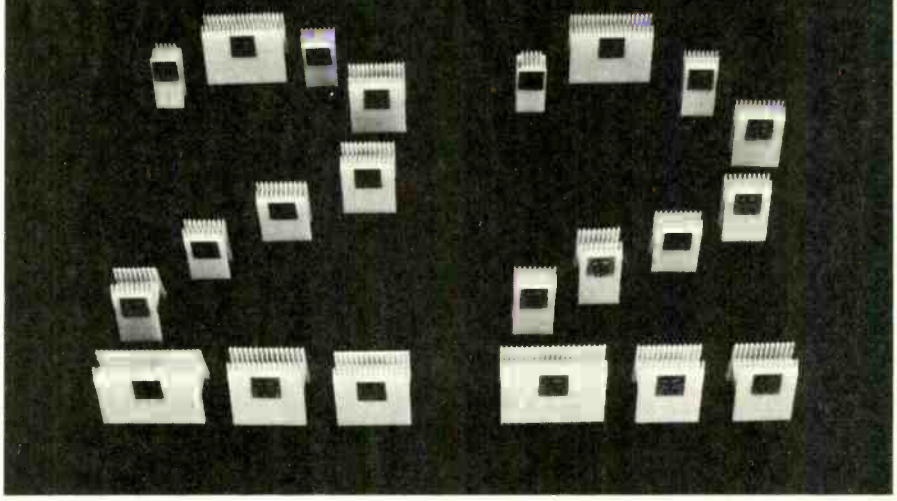

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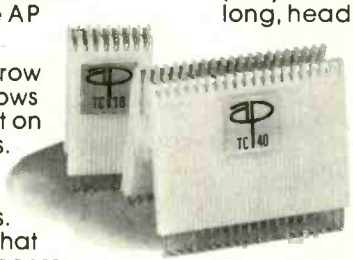

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MAY 1981

TV FROM OUTER SPACE: THE COMING OF DIRECT BROADCAST SATELLITES

BY JOHN J. McVEIGH
Technical Editor

By the turn of the century, a typical American home is expected to contain a highly developed and flexible video installation. This will include a 90-channel, interactive cable link, direct reception from six local broadcasters, a well-stocked video

Artist's conception of a Direct Broadcast Satellite. Courtesy Satellite Television Corporation.

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cassette and disc library with associated hardware, and a compact, rooftop dish antenna and electronics package for Direct Broadcast Satellite (DBS) reception.

That's the prediction of Dr. Elizabeth Young, President of the Public Service Satellite Consortium. She and other experts forecast increased use of video for existing services—notably in entertainment and education—as well as the development of completely new applications such as electronic newspapers, shopping catalogs, and mail deliveries. Direct Broadcast Satellites are expected to play a key role in this video revolution that will profoundly change our way of life. The beginnings of DBS service is not far off—COMSAT is planning to start such a service for the Eastern United States as soon as 1984.

Television From Satellites is, in one sense, nothing really new. As long ago as 1945, Arthur C. Clarke described a global satellite communications system in a paper entitled "Extraterrestrial Relays" that was published in the British magazine *Wireless World*. The basis of this system was the *geosynchronous* satellite. Mr. Clarke had calculated that a satellite placed in a precisely circular orbit approximately 22,300 miles above the equator would have an orbital velocity matching the rotational velocity of the earth. The satellite would thus appear to hang motionless in the sky above a particular position and have a line-of-sight view of approximately one-half of the earth's surface. A system of only three such satellites would offer coverage of the entire planet.

Such satellites, now a reality, receive signals from one earth station and rebroadcast them to (usually) many other earth stations. Because the satellites appear motionless, the earth-station antennas can be aimed at one of them and left in fixed positions. The satellites carry banks of *transponders*—complex electronic circuits that receive signals transmitted from earth stations, shift them in frequency, and amplify them for rebroadcast to other earth stations. In most cases, communications are conducted on microwave frequencies above 3 GHz.

Presently, there are scores of geosynchronous communications satellites in orbit and operation. Most of them (about three-quarters of the total) handle domestic, international, and military traffic. The rest perform scientific, meteorological, or experimental functions. Of those that handle domestic video traffic, only a few can be considered Direct Broadcast Satellites.

Most current video activity consists of the feeding of programs to network affiliates, independent subscriber stations, and cable-television installations. The major networks, the Public Broadcasting System, religious organizations, and distributors of pay-television fare employ transponders on such satellites as the *Comstars*, *Westars*, and *Satcoms* to distribute their programming across the nation. The transponders carried by these satellites have relatively low levels of output power—four or five watts.

Of course, it is possible for an individual to receive signals from the satellites directly. To do this, a relatively elaborate and costly receiving system must be installed. The low signal levels involved necessitate the use of large, high-gain receiving antenna and a quiet, high-gain *low-noise amplifier* (LNA). Also, the received signal must be shifted in frequency and its audio and video components reassembled into a form compatible with standard TV receivers.

A number of companies, including Downlink, Inc., in Putnam, CT; Satelco Division of Thunder-Compute, in Los Angeles, CA; and Third Wave Communications, Inc., in Ann Arbor, MI offer complete satellite television receive-only (TVRO) systems at the retail level. These systems, such as the Third Wave Communications Model TVRO-1 that is shown in Fig. 1, are physically large and expensive—typical costs range from $4000 to $15,000. Accordingly, for the present, DBS television reception is limited to those who can accommodate imposing physical structures and afford relatively substantial expenditures.

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This will change as satellites designed *specifically* to beam television signals to viewer-owned or -leased receiving systems are lofted into orbit and program originators develop organized distribution channels. Efforts along these lines are already underway, both in the United States and Canada.

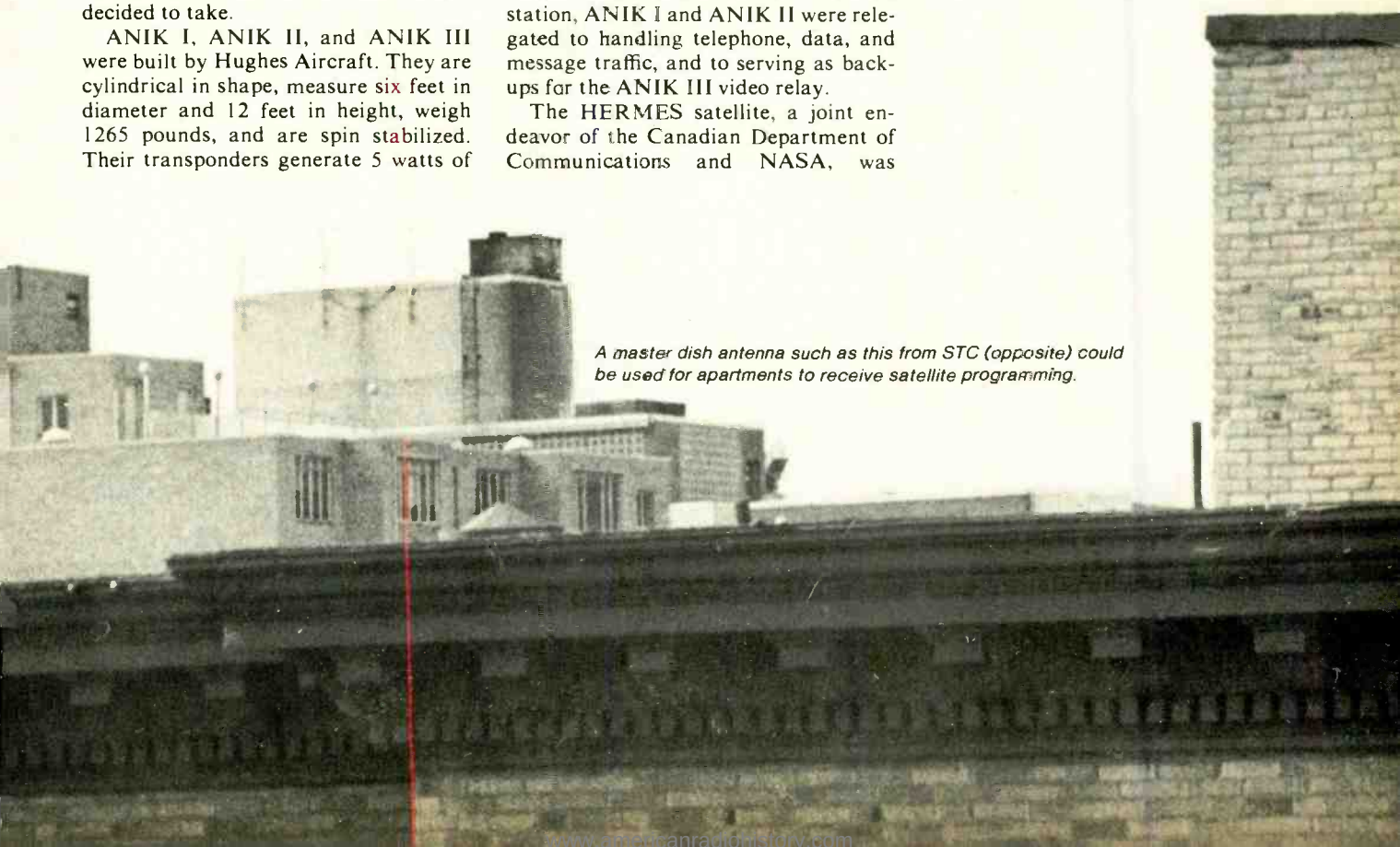
How DBS Began. The first domestic geosynchronous-satellite communications system in the free world came into being in late 1972. A U.S. Thor-Delta launch vehicle placed Canada's Anik I satellite into orbit. This satellite was followed by Anik II, Anik III, and Anik B. (Anik is the Eskimo word for *brother*.)

Canada is a country well suited for DBS systems. Almost 90% of its population lives in a belt that is 100 miles wide and bounded on the east and west by the Atlantic and Pacific Oceans and on the south by the U.S. The remaining 10% lives in scattered settlements in the northern region of the country. These settlements are too remote to receive television signals from stations in the more densely populated part of the country, and most are too small to make conventional broadcast installations economically practical. Hence, the Canadian national government was intensely interested in devising new, alternative methods of providing television programming and essential communications to the northern part of the country. The ANIK system is the route that it decided to take.

ANIK I, ANIK II, and ANIK III were built by Hughes Aircraft. They are cylindrical in shape, measure six feet in diameter and 12 feet in height, weigh 1265 pounds, and are spin stabilized. Their transponders generate 5 watts of output power, and their transmitting antennas have gains of 27 dB. ANIK III is in regular service relaying television programs in French and English to earth stations scattered across Canada. It uses an uplink passband of 5.927 to 6.403 GHz and a downlink passband of 3.702 to 4.178 GHz. When ANIK III went on station, ANIK I and ANIK II were relegated to handling telephone, data, and message traffic, and to serving as backups for the ANIK III video relay.

The HERMES satellite, a joint endeavor of the Canadian Department of Communications and NASA, was launched in January 1976. It was a higher-powered satellite than the earlier ANIKs and carried transponders that functioned in the 12/14-GHz passband (12-GHz downlink, 14-GHz uplink) that future DBS systems will employ. During its 3½-year operating lifetime, it

Fig. 1. The TVRO-1 satellite receiver system made by Third Wave Communications has a 12-ft dish and all the electronics needed for consumer use.



A master dish antenna such as this from STC (opposite) could be used for apartments to receive satellite programming.

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relayed signals to Lima, Peru, and the Australian outback, and performed communications experiments for the United States and Canada in the 12/14-GHz band.

ANIK-B was launched in December, 1978. It carries 12 transponders that operate in the 4/6-GHz band and six that operate in the 12/14-GHz band. Downlink power in the 4-GHz passband is 3 dB greater than that of earlier ANIKs, and the 12-GHz downlink is radiated in the form of four 20-watt spot beams. Approximately 110 earth stations in remote sections of British Columbia and northern Ontario receive signals from ANIK-B and provide them to the communities in which the earth stations are installed. Earth stations for ANIK-B reception cost $3600 each on a small-quantity basis.

Two future ANIK satellites are being readied for launch. ANIK-C, shown in the artist's conception of Fig. 2, is expected to go into orbit this year. It will carry 16 transponders, each with an output power of 15 watts. Most of the earth stations that receive signals from ANIK-C are expected to feed CATV "head ends." This is so because cable is used to a proportionally much larger extent in Canada than in the United States. ANIK-D will carry 24 transponder channels, each of which will be able to carry 960 voice signals simultaneously or one color television signal. The satellite will be carried into orbit by either the U.S. Space Shuttle or an augmented Delta launch vehicle and is expected to have an operating life of at least eight years.

The United States has been conducting an ambitious communications-satellite program of its own. Perhaps the progenitor of the future Direct Broadcast Satellites was the experimental communications satellite ATS-6, shown in Fig. 3. Launched into orbit from Cape Canaveral on May 30, 1974, this sixth in the series of Applied Technology Satellites was the first communications satellite to use a large (30-foot) parabolic transmitting antenna and high-power,

Fig. 2. Artist's conception of ANIK-C satellite in geosynchronous orbit. Primary coverage area is outlined on earth.

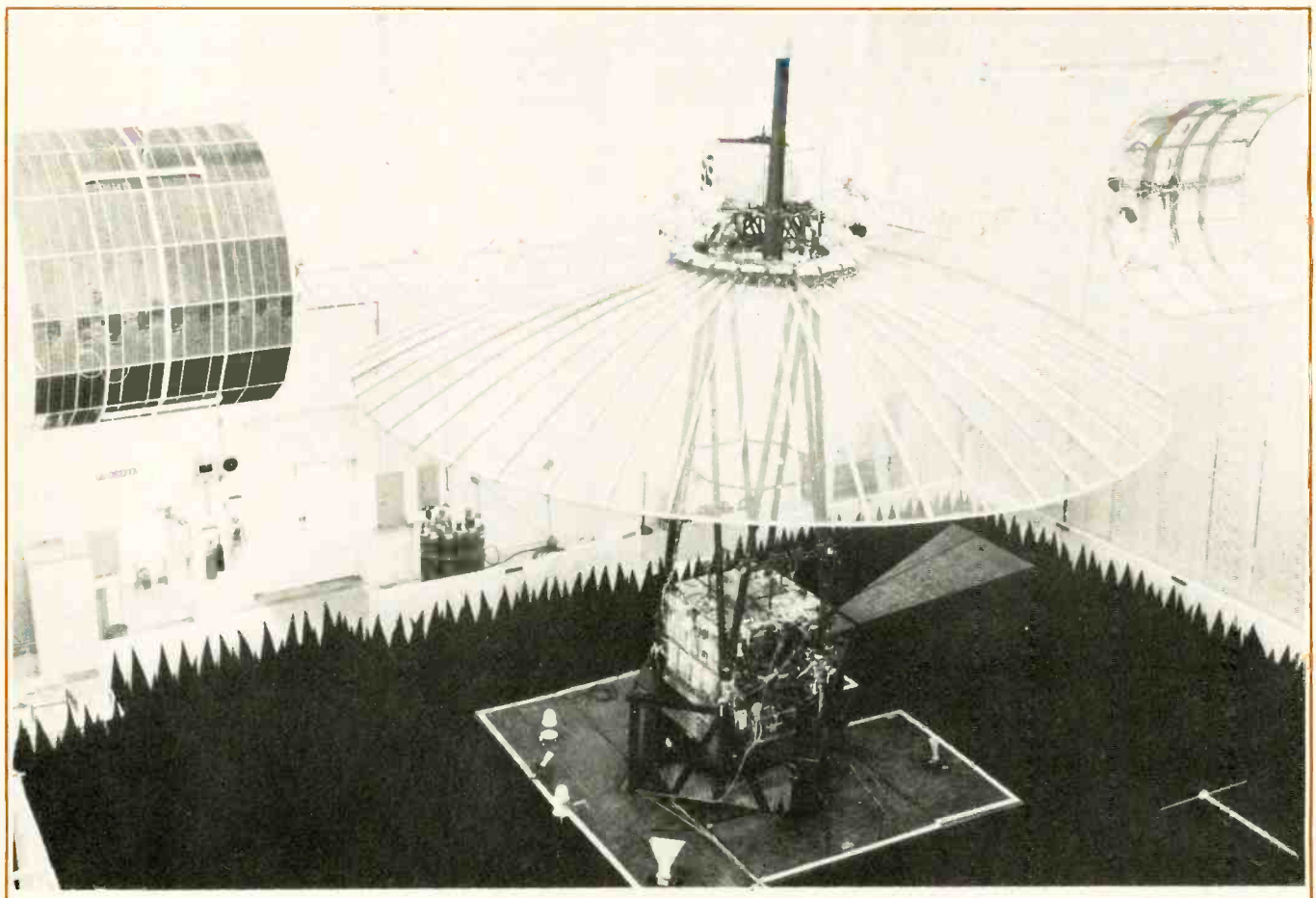

Fig. 3. The ATS-6 experimental communications satellite, the sixth in a series of Applied Technology Satellites, was launched from Cape Canaveral in 1974.

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solid-state transmitters. It was also the first to provide direct television broadcast and duplex video communications to low-cost ground stations.

Transponders onboard ATS-6 transmitted signals in the S and C microwave bands at 2.6 and 4 GHz, respectively, and in the uhf television band at 860 MHz. Among its many accomplishments was to transmit educational television programs to thousands of low-cost earth stations installed in remote villages scattered across the Indian subcontinent. It also provided a multiple-access duplex telecommunications relay link for merchant ships and commercial aircraft. It tracked the manned spacecraft of the Apollo/Soyuz orbital-rendezvous mission, relayed live television programs to earth stations for conventional rebroadcast, and measured C-band radio interference as well as the propagation and signal-handling characteristics of space-communications links in the region between 20 and 30 gigahertz.

The satellite also provided tracking and data-relay information, performed L-band experiments for air-traffic control and marine navigation applications, and assisted in the measurement of signal attenuation of paths between the satellite and various locations in the U.S. These measurements have been used to determine the minimum acceptable power levels for transponders that will be carried by future satellites, including those that will perform DBS functions. ATS-6 was powered down on August 2, 1979 because of attitude- and orbital-control thruster failures, but it was briefly reactivated on November 24 of the same year for particle measurements that were performed in conjunction with other satellites.

The Future. DBS systems are expected to come into their own before too long. One harbinger of this anticipated development is an application submitted to the Federal Communications Commission on December 17, 1980 by the Satellite Television Corporation (STC). This corporation, a subsidiary of the Communications Satellite Corporation (COMSAT), asked for FCC authorization to offer the public a multiple-channel, commercial-free, subscription television service beamed directly from Direct Broadcast Satellites to individual homes.

If its petition is approved, STC will initiate service within three or four years. It will loft two high-power (185 watts/transponder) satellites into geosynchronous orbit and will offer subscription television to an area roughly equal to the Eastern Time Zone of the United States. The satellites will have 17-GHz uplinks and 12-GHz downlinks, and, because of the high power used, their transponders will employ traveling-wave tubes as output devices. An artist's conception of an STC Direct Broadcast Satellite is the lead illustration of this article.

One of the satellites will function as an active relay, with the second held in reserve as a backup. The costs of development and launch for the two satellites and of the ground equipment are estimated by STC to be $252 million. Eventually, a total of six STC satellites will be placed into geostationary orbit, spaced 20 degrees apart in an arc from 115° West to 175° West Longitude. Four will relay signals from an earth station near Las Vegas to receiving installations in the Eastern, Central, Mountain, and Pacific Service Areas (Fig. 4). Backup and control facilities will be in Santa Paula, California.

Each of the four relay satellites will

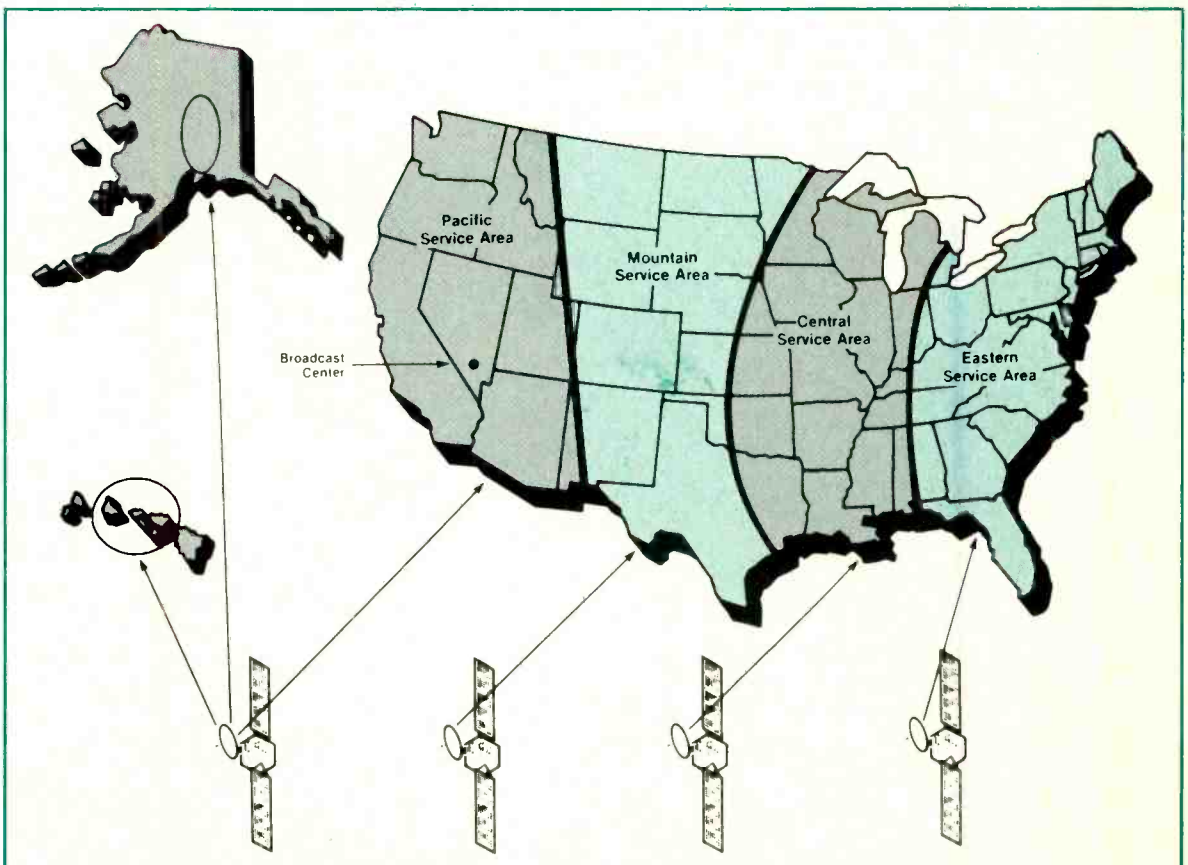

Fig. 4. When the STC direct system is fully operational, four relay satellites will rebroadcast signals from the control center to receiving systems in all 50 states.

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beam signals to a particular service area. The satellite charged with transmitting signals to the Pacific Service Area will provide coverage to the most populated portions of Alaska and Hawaii by means of spot beams. Two satellites will be held in reserve as backups.

A DBS receiving system will employ a small dish antenna approximately 2½ feet in diameter and a compact electronics package, both mounted on the subscriber's rooftop (Fig. 5) or at some other convenient location with an unobstructed line of sight to the appropriate relay satellite. Signals will be fed via coaxial cable from the output of the outdoor electronics package to a small unit placed on top of the subscriber's television receiver. This unit would descramble the signals and shift them to a vacant television channel. Picture quality is expected to be comparable to that of cable-television reception except during periods of torrential rain, when atmospheric attenuation would increase and receiver S/N would be degraded.

The programming to be offered by STC will consist of three commercial-free channels of entertainment, public-affairs, and educational productions. The general programming plans for the three channels appear in the Table. Special programs may be offered on pay-per-program and pay-per-series bases. Optional services would include stereo sound, simultaneous transmission of the program's audio component in a second language, closed captioning for viewers with impaired hearing, and teletext data transmission.

In addition to such general-interest fare as movies and concerts, STC plans to place major emphasis on "narrowcasting," that is, special-interest programming. The corporation will be able to do this because of the DBS service's inherent ability to gather relatively small, scattered groups of viewers with common but special interests into larger audiences. STC plans to take advantage of existing programming sources and, where possible, to simulate the development of new sources or to develop its own programming. These sources might include such institutions as experimental theatres, museums, universities, and scientific and professional organizations. A major feature of the multichannel STC service will be the ability to "counterprogram." That is, different types of programming would appear simultaneously on each of the three channels. This will allow STC to meet the majority of audience interests at the most opportune times.

Subscriber cost would be approximately $25.00 per month for the basic DBS service and the rental of equipment. Installation of the receiving equipment would cost approximately $100, which would include the purchase price of the dish antenna. The remaining equipment could be purchased from STC or from competing sources if the subscriber prefers to own the entire installation. In that case, the basic programming service alone would cost $14 to $18 per month. (All figures are expressed in 1980 dollars.)

GENERAL PROGRAMMING PLANS FOR THE STC DBS CHANNELS

Channel A "Superstar"	Channel B "Spectrum"	Channel C "Viewer's Choice"
Major motion pictures	Children's programs	Sports
Popular concerts	Film classics	Adult education
Theatre specials	Public affairs	Experimental theatre
Family entertainment	Performing arts and cultural attractions	Lecture hall

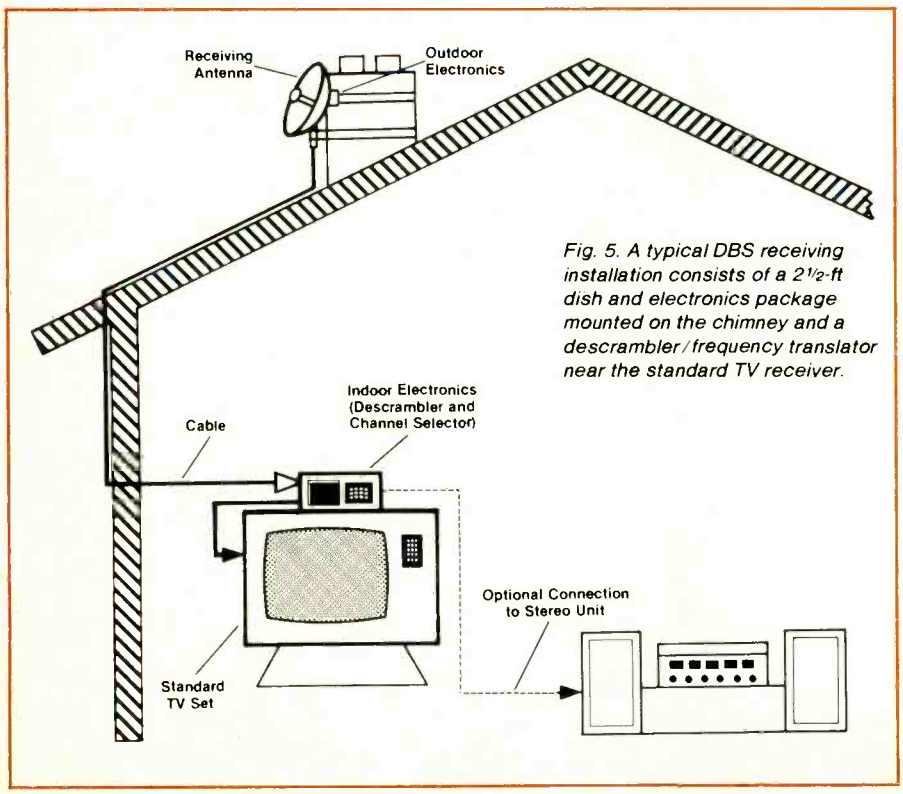

Fig. 5. A typical DBS receiving installation consists of a 2½-ft dish and electronics package mounted on the chimney and a descrambler/frequency translator near the standard TV receiver.

STC's Goals. The obvious goal of the STC program is to satisfy consumer demand for diversified home-video services. Others are to promote competition in the subscription-television market; to stimulate the economy by creating thousands of new jobs in the fields of spacecraft and equipment manufacturing, program production, installation and maintenance of receiving systems, and marketing and promotional activities; to provide minority and dual-language programming; and to bring subscription-television programming to rural and other underserved areas. The STC also hopes its efforts will help to preserve the traditional United States leadership in space-communications technology.

Several other nations are engaged in the planning and development of DBS services for their citizens. Japan's BSE satellite has been providing direct broadcasts to home receivers in Japan and Okinawa for several years. The European Space Agency is also involved in DBS research and development.

It is clear that Direct Broadcast Satellites will play a key role in the coming video revolution. Their influence will soon be felt—odds are that within a few years *you* will be given the opportunity of receiving DBS programming in your home on a subscription basis. ◇

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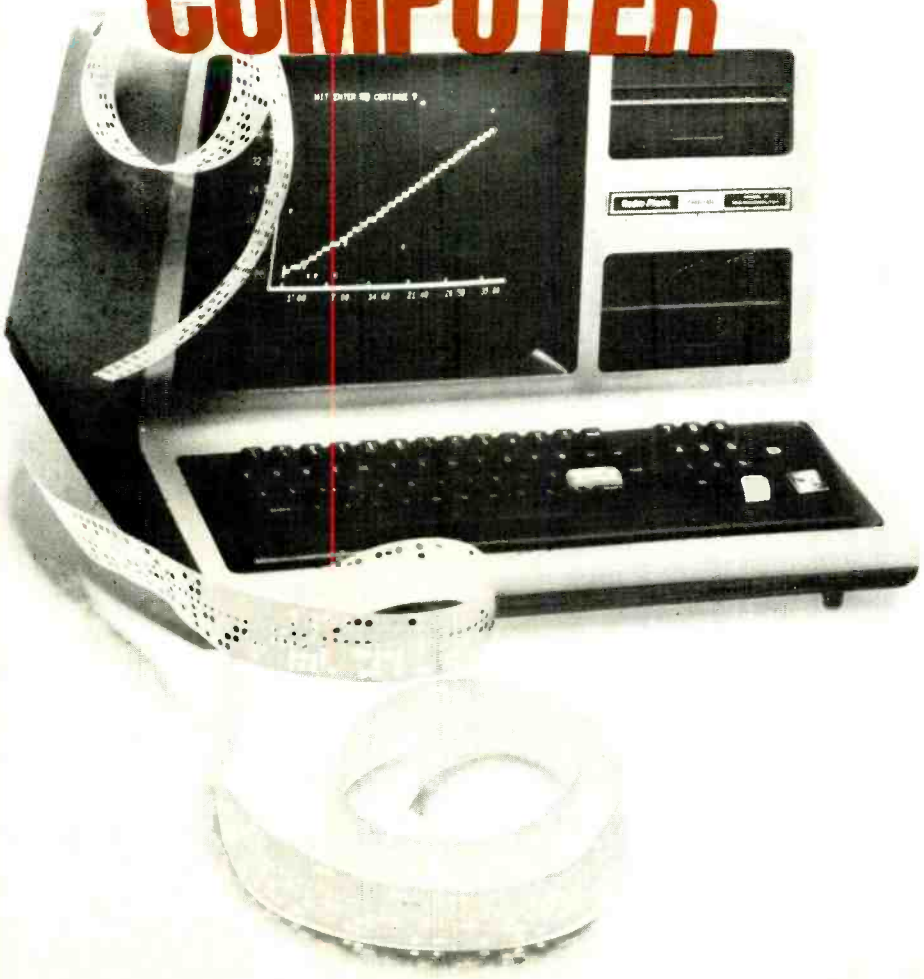
BY KARL THURBER, W8FX/4

Microprocessors, video terminals and other sophisticated gear are bringing radioteletype up-to-date

RTTY MEETS THE COMPUTER



RADIOTELETYPE transmissions, which have a "deedle-deedle" sound to the human ear, constitute one of the more exotic modes of shortwave communication. Traffic sent via RTTY includes news dispatches, weather bulletins, commercial messages, and amateur radio chit-chat. Whereas in the "old days," RTTY was based on temperamental electromechanical equipment, one can now use compact, quiet, and totally electronic gear such as video terminals, keyboard units, and the latest microcomputers.

RTTY. There are two common types of RTTY teleprinter in use, the *page printer* and the *tape printer*. The former is more popular, and prints on a paper roll almost as wide as business letter paper. The latter prints on paper tape (usually gummed) to be cut to letter-size widths and pasted in a series of lines on sheets of paper. Teleprinters usually operate at standard speeds of 60, 67, 75 or 100 words per minute (wpm). RTTY communications at any of these speeds can be found on the amateur bands.

Page printers such as the Models 15, 26, 28 and 32 are favorites for ham use, especially the Model 15 and the Model 28. Usually too expensive to be purchased new, used commercial printers can frequently be obtained for as little as $30 to $35 at hamfests and swap meets or through the classified ads of the ham magazines.

Other common devices are *reperforators* and *typing-reperforators*, such as the Model 14RO that allows recording of received messages or locally typed messages on punched paper tape. Having tape capability allows one to peck out a message slowly but transmit it at regular speed on the air. Most fancy "RTTY pictures" are generated thus.

Tape readers (or TDs for Transmitter Distributors) will also be found in a well-equipped RTTY installation. These electromechanical devices read or scan the punched paper tape made on the reperforator and convert the patterns of holes into electrical impulses. The Model 14TD is a popular tape reader for ham use.

In addition to these devices, *composite machines* that can perform page-printer, tape-reader and reperforator functions are also used. These include such surplus units as the Model 19, 28ASR, and 32ASR.

Codes. To transmit information expeditiously over wire and radio links, special codes have been developed. The familiar Morse, a binary (on/off) code

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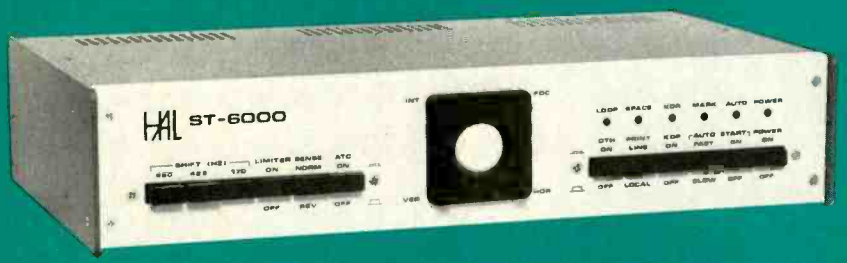
originally developed in the early 1830s, is the basis for manual telegraphy and radiotelegraphy or "CW" transmission. Teleprinter is similar, but uses "marks" and "spaces," (two different signals) rather than the "dots" and "dashes" (merely different signal durations) used in Morse. The teleprinter code, known as *Baudot*, is such that each code character contains the *same number* of information elements (bits) and each element is of *fixed length*.

Baudot is a binary, 5-level code with 32 characters available. Adding a "lower case" register to the keyboard results in additional combinations, just as on a typewriter. Each set of five elements is sent in serial fashion, and each element has two possible conditions—mark or space. On punched tape, holes represent the marks and unpunched areas the spaces. Normally, a start pulse is sent ahead of the five information elements and a stop pulse is added at the tail end, for a *total* of 7 pulses. These start and stop signals make possible the synchronization of the transmitting and receiving teleprinters. The standard Baudot code is shown in the Table.

The relatively simple 5-level Baudot code, with its 32 available characters, is somewhat limited. Stock tickers and teletypesetter machines use 6-level codes, and an 8-level code is common in computer applications. The American Standard Code for Information Interchange, or ASCII, is a more flexible code and is making many inroads into Teletype® and related work. Like Baudot, the ASCII code employs start and stop pulses, but it has eight rather than five information pulses. This allows a much larger variety of characters.

Transmission Methods. For radio communications, the dc pulses generated by the teleprinter ("on" corresponding to "mark" and "off" to "space") must be applied in some way to the transmitter. It's possible to transmit RTTY signals by CW-like on/off or make-and-break (MAB) keying. The common practice, however, is to employ two discrete signals, slightly separated in frequency, in a system known as *frequency-shift keying* (FSK). This method of transmitting teleprinter information has real advantages in that there is little sensitivity to interference from signals on nearby frequencies. There is a high degree of discrimination against noise pulses and signal fading, too.

In FSK, the transmitter is generating an r-f output from the start of the transmit interval to its conclusion, whether or not encoded information is being sent. When no information is being transmitted, the carrier frequency remains constant. When encoded text is sent, the carrier rapidly switches back and forth between the mark and space frequencies. Many different "standard" and "nonstandard" shifts have been used over the years. On the amateur bands, 850-Hz shift (the difference between the mark and space frequencies) was once popular. However, as narrower-bandwidth receivers, with their in-



The HAL ST-6000 demodulator features three shift ranges, an audio tone keyer, keyboard-operated switch, and oscilloscope tuning indicator.

Microcraft's RTTY Reader uses a microprocessor to handle Baudot at four speeds or ASCII and display it on an eight-moving-character readout.

This automatic send-receive terminal (HAL OS-3100) has full buffering for Baudot or ASCII teleprinter codes or Continental Morse.

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creased signal-to-noise ratios and enhanced selectivity characteristics, came into vogue, 170-Hz shift took the lead on the crowded ham bands.

Radioteletype Today. There are essentially two main types of new RTTY systems. One is the *dedicated* RTTY system, which usually consists of an electronic keyboard and a video display monitor. This system has its own special-purpose microprocessor built-in and is intended strictly for RTTY encode and decode functions. HAL Communications, Microlog, Info-Tech and Xitex have introduced highly sophisticated systems that directly replace mechanical teleprinters.

The second type teams up a computer interface unit with the character-generating, display and computational capabilities of a home computer system. For such computers as the Radio Shack TRS-80, Apple, Sorcerer, and Pet, interface units are available that make it possible to use them as automated RTTY systems. Macrotronics, Inc., of Keyes, California, offers interfaces, software and accessories. Some of the more useful features provided by such interface units include narrow or wide shift selection, keyboard-selectable speeds, programmable message memories, automatic shift, line feed and unshift-on-space, and automatic CW ID.

For those who want to explore RTTY cheaply, at least one company has marketed a low-cost RTTY decoding unit. Microcraft Corp. produces the RTTY Reader, a device that accepts the audio output of the receiver and automatically decodes and displays RTTY characters on a large LED display. The RTTY Reader can handle Baudot at 60, 67, 75, and 100 wpm, as well as 110-baud ASCII, at shifts of 170, 425, or 850 Hz. It is easily read when characters are sent "hunt-and-peck" from a keyboard and the effective speed is as little as 20 to 25 wpm, but is not as useful with commercial stations transmitting at steady speeds of 60 or more wpm. At $250, the device will be of interest to DXers, ragchewers, and SWLs who want to "get their feet wet" in RTTY without a deep, expensive plunge.

Equipment. To do RTTY work, you'll need a transmitter and receiver or transceiver and an antenna. The transmitter must be stable in frequency and rugged enough to be capable of extended "key-down" operation. This is an especially severe requirement for many contemporary hf rigs, which were designed primarily for use in SSB applications and use low-duty-cycle, TV-sweep tubes as final amplifiers. Running them with a 100% duty cycle during the transmitting interval stresses their power supplies and r-f output stages. A good hf transmitter or transceiver with transmitting-type tubes in the final amplifier stage should work well on RTTY, but additional forced-air cooling might be necessary. Similarly, the transmitting antenna must withstand continuous application of power.

The receiver should be stable in frequency (especially for narrow shift work), and high in selectivity. The typical 2.4-to-2.7-kHz, −6-dB selectivity of most receivers in the SSB mode is acceptable in many cases, but better selectivity will reduce QRM. If your receiver needs more selectivity, you can add an accessory i-f filter or an external active audio filter, or use an RTTY demodulator that has adequate audio filtering.

The demodulator—sometimes called the converter, terminal unit, or "TU"—converts the receiver's audio output into dc keying pulses. Demodulators vary in complexity and price, depending mainly on the systems used to achieve selectivity, tuning, noise discrimination, and suppression of fading and multipath. Most include a high-voltage dc "loop" output that can be used to drive a mechanical teleprinter. Some recent models have digital I/O interfaces for use with electronic terminals.

A terminal—sometimes known as an ASR, or "automatic send-receive" unit—will have two main elements: a keyboard assembly and a printer or display unit. As in the case of the demodulator, the more flexible, newer gear has both a dc loop and an I/O interface so that it can be used with either classic mechanical systems or the newer solid-state equipment. Desirable terminal features include ability to process ASCII and Morse codes in addition to Baudot; programmable messages; text editing; keyboard-operated transmit ("KOX"); transmit and receive buffer memories; split-screen operation (for the simultaneous display of received and transmitted information); a real-time clock; and other RTTY amenities.

For FSK transmission, a modulator is required. (One is often incorporated in the terminal.) Its function is either to produce the desired frequency shift or generate audio tones that can be used to modulate the transmitter. "Direct" keying of a transmitter's vfo circuit, the classic way to generate FSK, requires modification of the transmitter and some potentially tricky adjustments.

Very popular today, especially for use

BAUDOT-CODE CHARACTER SET AND BIT SEQUENCES

Lower Case	Upper Case	Start Bit*	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Stop Bit
A	-	0	1	1	0	0	0	1
B	?	0	1	0	0	1	1	1
C	:	0	0	1	1	1	0	1
D	$	0	1	0	0	1	0	1
E	3	0	1	0	0	0	0	1
F	1	0	1	0	1	1	0	1
G	&	0	0	1	0	1	1	1
H	#	0	0	0	1	0	1	1
I	8	0	0	1	1	0	0	1
J	1	0	1	1	0	1	0	1
K	(	0	1	1	1	1	0	1
L	)	0	0	1	0	0	1	1
M	.	0	0	0	1	1	1	1
N	,	0	0	0	1	1	0	1
O	9	0	0	0	0	1	1	1
P	0	0	0	1	1	0	1	1
Q	1	0	1	1	1	0	1	1
R	4	0	0	1	0	1	0	1
S	Bell	0	1	0	1	0	0	1
T	5	0	0	0	0	0	1	1
U	7	0	1	1	1	0	0	1
V	;	0	0	1	1	1	1	1
W	2	0	1	1	0	0	1	1
X	/	0	1	0	1	1	1	1
Y	6	0	1	0	1	0	1	1
Z	"	0	1	0	0	0	1	1
Blank	N-P**	0	0	0	0	0	0	1
Carr ret.	N-P	0	0	0	0	1	0	1
Line feed	N-P	0	0	1	0	0	0	1
Space	N-P	0	0	0	1	0	0	1
Letters	N-P	0	1	1	1	1	1	1
Figures	N-P	0	1	1	0	1	1	1

*1 = mark; 0 = space
**N-P means "nonprinting"

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with hf SSB transmitters, is *indirect* FSK or audio-frequency shift keying (AFSK). In this system, application of audio tones to the transmitter's microphone input results in an equivalent FSK output signal. For example, if a SSB transmitter is placed in its lower-sideband mode and driven with a 2125-Hz audio tone, the transmitter's r-f output will be 2125 Hz *below* the suppressed-carrier frequency. If the input tone is then changed to 2295 Hz (corresponding to a 170-Hz shift), the r-f output frequency will be 2295 Hz below the suppressed-carrier frequency. If carrier and unwanted-sideband suppression are good, the transmitter output will be indistinguishable from a signal generated by direct keying of the vfo.

At one time, RTTY tones were 2125 Hz (mark) and 2975 Hz (space) for an 850-Hz shift. As transmitter stability and receiver selectivity and stability improved, 170-Hz shift became practicable. The space frequency was accordingly changed to 2295 Hz (the mark remained at 2125 Hz). These three tones are still considered standard in the US. However, filter-type SSB equipment (with its −6-dB bandwidth as narrow as 2.1 or 2.4 kHz) will not pass the 850-Hz shift, 2975-Hz space tone with sufficient amplitude. Either the SSB equipment has to be modified, or the tones must be lowered to fit the filter bandpass. Both approaches have been used. There is a low-tone standard, popular in Europe, that places the mark at 1275 Hz and space at 1475 Hz (170-Hz shift). The space is at 2125 Hz for an 850-Hz shift.

The two sets of tones can work interchangeably in hf SSB work because the receiver's bfo detection scheme makes it possible to place the tones at any appropriate pair of frequencies. However, in vhf AFSK applications, the two sets are not compatible because the *actual* audio tones are transmitted as AM or FM and cannot be frequency-translated by simply retuning the receiver. In the United States, the standard high tones are used on vhf so that the same demodulator and modulator can be used in both vhf and hf. However, on vhf, the mark tone is customarily changed or inverted from 2125 to 2295 Hz. A shift of 170 Hz is used almost exclusively, as on hf.

Unique Aspects of RTTY. There are many unique communications modes that can be used on RTTY. These include the *Answer-Back* (W-R-U, or "Who are you"); *Autostart* or "all-call"; and *Selcal* or "selective calling." Answer-Back is triggered by a specific access code. In response, a preprogrammed message will be sent by the teleprinter so configured. Autostart turns on the teleprinter circuits whenever an RTTY signal is received and requires no specific access code. Selective calling allows a teleprinter so equipped to be interrogated and controlled remotely by means of a special access code. It's also possible to design, receive and transmit RTTY pictures and "artwork." Even music can be sent using the bells of mechanical printers.

Being in the audio range, demodulated RTTY signals can be recorded on magnetic tape. A cassette recorder is usually employed, and it's considerably cheaper, quieter and more convenient than a mechanical paper tape unit. However, recordings become very sensitive to wow and flutter at the low (170-Hz) shift usually used in ham work, so a recorder with less than 0.25% weighted rms wow and flutter should be used. Also, cassette recordings might not be exactly compatible *between* machines due to the small differences in drive-motor speed between them. Of course, when using home computers with RTTY interfaces, the cassette recorder that is part of the computer system can be used not only to store the enable RTTY program, but also to record QSOs (contacts), "brag tapes," and other material.

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Where the Action Is. RTTY operation is very popular on the 80- and 20-meter CW bands, with spotty activity on the other bands. Eighty-meter stations congregate between 3600 and 3650 kHz, and 20-meter stations are active between 14.075 and 14.100 MHz. Other nominal frequencies popular among RTTY enthusiasts are 7090 kHz, 21090 kHz and 28090 kHz. As we noted, 170-Hz shift is used almost universally. Sixty wpm (45 baud) is the most popular speed, but 100 wpm (74 baud) is also used. On vhf, operation is concentrated on the 2-meter band around 146.700 MHz. There are many RTTY FM repeaters in use which typically use the standard 146.10-MHz input/146.70-MHz output channelization.

Bear in mind that a RTTY QSO is different from a SSB QSO if for no other reason than it all has to be typed out. Results depend on the typing skills and characteristics of the two operators. However, the same general conversations take place and include such staples as name, QTH (location), equipment used, weather, and technical talk. It takes a bit longer to type things out, so attention must be paid to transmission length to avoid exceeding the FCC's 10-minute identification rule and to keep the rig's PA from overheating.

For "just listening," weather, point-to-point, ship-to-shore, and news service transmissions are of interest. However, unusual speeds and shifts other than the standard 170 or 850 Hz will make it impossible to copy much of what you hear. Remember—it is unlawful to divulge the contents of any nonbroadcast traffic that you monitor.

Much useful information can be found in the daily RTTY bulletins broadcast by the ARRL headquarters station, W1AW, in Newington, CT. This includes propagation forecasts, OSCAR satellite technical data, as well as regulatory and general-interest newsworthy information. The ARRL's monthly magazine, *QST*, regularly contains W1AW's operating schedule.

Hopefully, the wealth of fascinating RTTY activity will whet your appetite to explore this mode further. An old means of communications has successfully merged with the newest computer technology to produce an exciting challenge for the operator who's willing to give it a try. ◇

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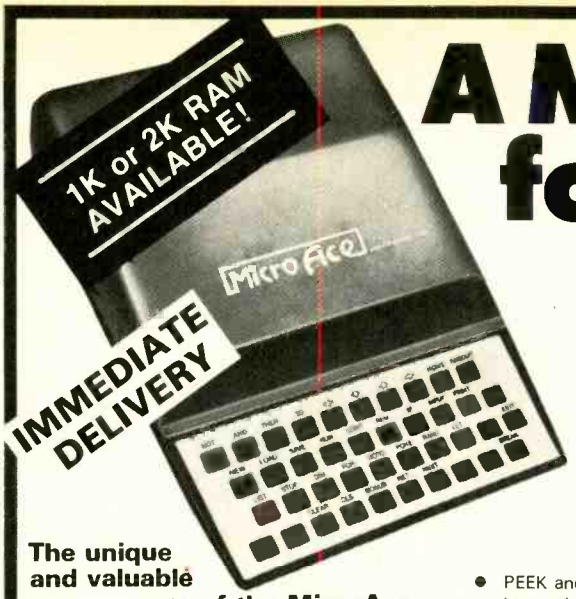

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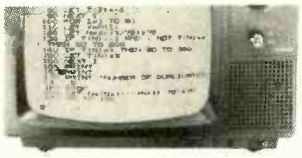

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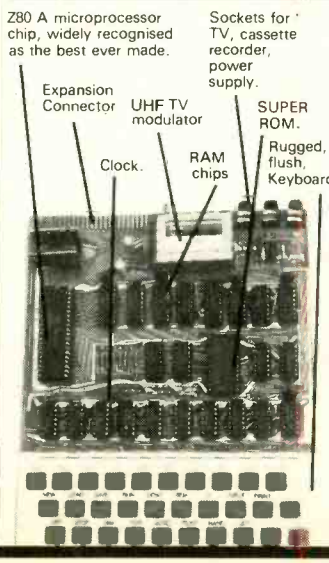

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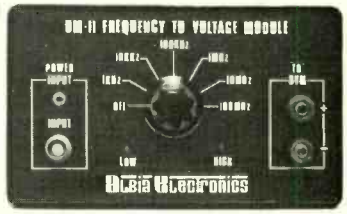

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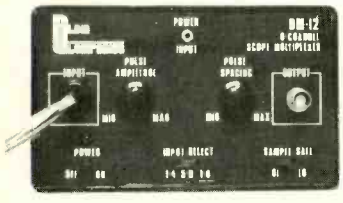

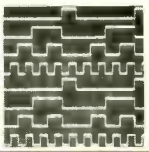

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A "SMART" GREENHOUSE LIGHT CONTROLLER

Grow temperamental plants with artificial light when the sunlight goes away

BY MARK L. McWILLIAMS

WITH their controllable growing conditions, greenhouses and hot frames can make possible the cultivation of plants too delicate to survive the rigors of the natural environment in many parts of the north Temperate Zone. Well-established technologies for the control of temperature and humidity exist, but photoperiod (the time for which the plant is exposed to light) and the intensity of light in its duration are also important, if not critical, to plant growth. Lamps whose spectral output is consistent with plant needs exist; the problem is how to control them.

To allow the lamps to run for a fixed period of time regardless of whether the sun is hidden or not is unacceptable. For one thing, some plants would be subject to excessive illumination, and, for another, heat build-up could stress the temperature-control system. Turning the lamps on when the sun is hidden and off when it reappears would be an improvement, but this too is subject to difficulties. One is that temporary occultations of the sun, as by passing clouds, birds, or aircraft, would cause an excessive number of on-off cycles and adversely affect lamp life.

An acceptable controller would give positive control of the duration of the photoperiod, turn on the lamps if the sun were to disappear for any significant length of time, and ignore short-term solar "dropouts." The system described in this article has these attributes.

Overall operation of the controller is shown in Fig. 1. The photoresistor monitors the sun's light and produces a voltage drop across its associated series resistor that is compared against a value set by the sensitivity control. If the light intensity, hence the voltage applied to the comparator noninverting input, is too low, the comparator will trigger timer 1. This timer will delay for a preset interval (up to 10 minutes or so) to determine if the light intensity remains low. Thus, momentary blockages of the sun won't cause the lamps to turn on. If allowed to time out, timer 1 will trigger timer 2, which will turn on the lamps for some minimum time (for example, 30 minutes), but will also keep the lights on as long as the sun remains hidden.

If it has finished timing-out, when the sunlight returns, timer 2 will trigger timer 3. This timer will keep the lamps on for some period (15-20 minutes) to make sure that the sun is back to stay. If it is, the lamps will turn off when timer 3 times out. If not, the comparator will trigger timer 1, and the whole cycle starts again. (If timer 1's delay is sufficiently less than that of timer 3, the lamps will stay on after the timer 3 period times out if the sun is hidden again.)

Circuit Operation. The complete circuit is shown in Fig. 2. Photoresistor *PC1's* resistance can range from a few hundred to 100,000 ohms or more depending on how much light falls on it. However, only 20 to 50 ohms difference was found when a bright sunny day was compared to an overcast day. To detect such a very small difference, comparator *IC1* is used. With *S3* in its normal position, the voltage drop across *R3* is compared against that set by sensitivity control *R1*. When the light is relatively dim, the *IC1* output at pin 2 goes low, thus triggering timer 1 (*IC4A*) via *C1*. The *IC1* output is inverted by *IC2A* and applied to one input of AND gate *IC3*. Resistor *R2* acts as feedback to improve the *IC1* switching action.

Timer 1 (*IC4A*) is one-half of a 556 operating in its one-shot mode. When it times out, its output at pin 5 is inverted by *IC2B* and fed to the other input of AND gate *IC3*. When both inputs to *IC3* are high, the gate triggers timer 2 (*IC5A*), via inverter *IC2D*. Thus, two conditions are necessary to trigger timer 2—low ambient light and the timing-out of timer 1.

Timer 2 (*IC5A*) will turn on for a

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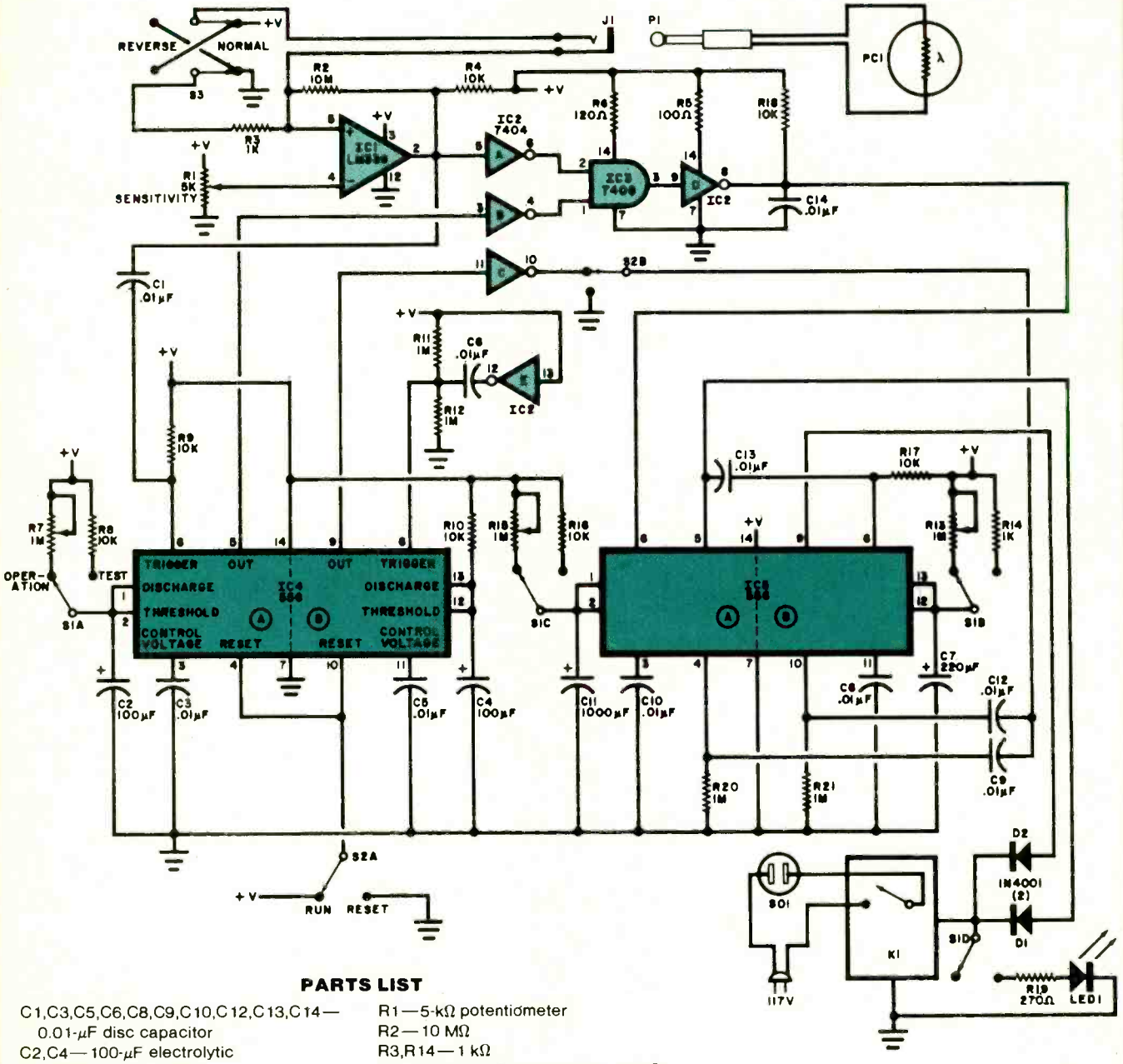
minimum period determined by *R15-C11*. However, this timer will stay on indefinitely as long as the light impinging on *PC1* is low, since the *IC1* output will remain low, and as long as it is low, timer 1 (*IC4A*) will not be released from its timing cycle. Capacitor *C14* will keep timer 2 on even after it has timed out for as long as timer 2 is in its "on" state, it will energize relay *K1* via *D1* which, in turn, supplies ac power to lamp socket *S01*.

After timer 2 turns off, it triggers *IC5B* timer 3 via *C13*. This timer remains on for a period determined by



PARTS LIST

C1,C3,C5,C6,C8,C9,C10,C12,C13,C14—0.01-μF disc capacitor
C2,C4—100-μF electrolytic
C7—220-μF electrolytic
C11—1000-μF electrolytic
D1,D2—1N4001 diode
IC1—LM339 quad comparator
IC2—7404 hex inverter
IC3—7408 AND gate
IC4,IC5—556 dual timer
J1—2-conductor jack
K1—Solid-state relay (Radio Shack 275-236)
LED1—20-mA light-emitting diode
PC1—CdS photoresistor (Radio Shack 276-116)
Following are ½-W, 10% resistors unless otherwise specified
R1—5-kΩ potentiometer
R2—10 MΩ
R3,R14—1 kΩ
R4,R8,R9,R10,R16,R17,R18—10 kΩ
R5—100 Ω
R6—120 Ω
R7,R13,R15—1-MΩ mini-potentiometer (Radio Shack 271-229)
R11,R12,R20,R21—1 MΩ
R19—270 Ω
S1—4-pole, 2-position rotary switch (Radio Shack 275-1384)
S2,S3—Dpdt miniature toggle switch (Radio Shack 275-620)
Misc.—Sockets for ac, IC mounting sockets, case (Radio Shack 270-627), pc board, wire, solder, 6-volt battery eliminator, etc.

Fig. 2. Schematic diagram of the complete timer circuit. Points marked +V can be connected to a 6-volt battery eliminator or a separate 6-volt supply can be built and mounted in the enclosure.

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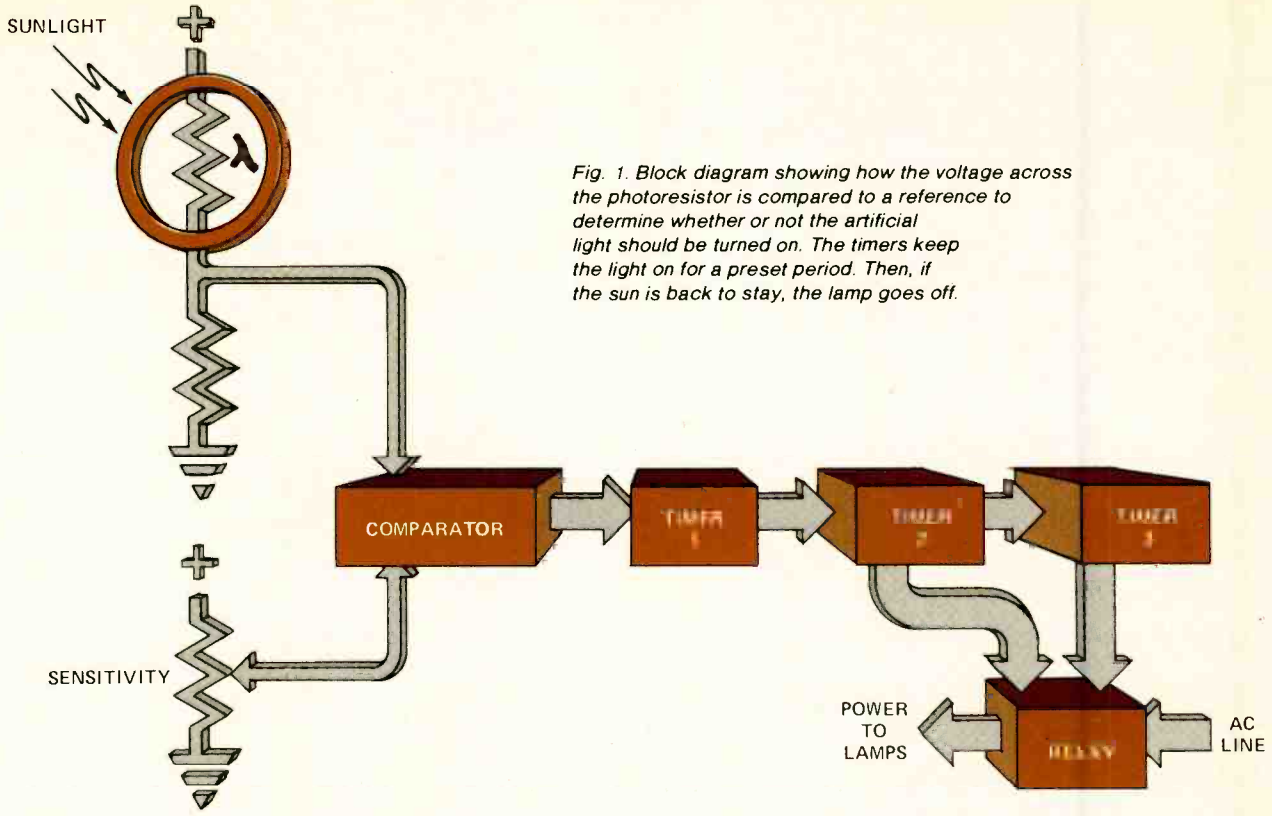

Fig. 1. Block diagram showing how the voltage across the photoresistor is compared to a reference to determine whether or not the artificial light should be turned on. The timers keep the light on for a preset period. Then, if the sun is back to stay, the lamp goes off.

R13-C7. Timer 3 also energizes the relay via *D2*.

When timer 3 times out, relay *K1* is de-energized if the *IC1* output went high since timer 3 started. However, if the low light condition returned and *IC1* went low again, timer 1 will turn on again, and the cycle starts over. If timer 1's delay is sufficiently less than timer 3's, timer 2 will turn on before timer 3 can time out and the relay will remain energized.

IC4B is used as a switch debouncer, and prevents timers 2 and 3 from being triggered when the power is first applied. This timer is used to momentarily reset both halves of *IC5* (via *C9* and *C12*) during the one second or so period just after the power is applied to the circuit.

A conventional 6-volt battery eliminator can be used to supply the 45 or 70 mA needed by the circuit. A 24-hour clock timer can then be used to power the battery eliminator so that the light controller operates only during daylight hours.

Switch *S1* places the controller into either TEST or OPERATION status. The only difference between these two conditions is that the timer delays are only a few seconds in the TEST mode. This latter mode is used mainly to adjust sensitivity control *R1*. *LED1* will glow in TEST so the lamps do not have to be connected to *S01*. When the unit is not in the test mode, the LED will not operate.

Switch *S3* permits the unit to be used for much more than just a light controller. For initial testing as a light controller, *S3* should be positioned as shown with *R3* grounded.

Construction. The controller can be built on perf board, or a pc board can be fabricated. Sockets can be used for the ICs if desired. Once built, the circuit can be mounted within a selected enclosure with only the three switches, *R1*, *J1*, *LED1*, and lamp power socket *S01*, mounted on an outside surface. A 6-volt power supply can also be mounted within the enclosure. The ac power line can exit via a grometted hole at the rear.

Adjustment. Plug the photoresistor into *J1*, and place it so that its light-sensitive surface is receiving direct sunlight. Place *S1* in the TEST position, then *S2* to RESET, then RUN. Adjust *R1* in small steps until a small amount of shade caused by your hand (12 or more inches away from *PC1*) causes *LED1* to turn on. Allow sufficient time between each *R1* adjustment for timer 1 to time out. If it does not time out, place *S2* in RESET, back *R1* off, and try again.

When you have adjusted *R1* to your satisfaction, place *S1* in the OPERATION position and connect the lamps to *S01*. Control *R1* may have to be readjusted under actual overcast conditions. Note that a little hysteresis is present in *IC1* and if *R1* is adjusted "too tight", the controller will not turn the lamps off even when full sunlight appears.

While it was designed primarily as a light controller, the unit can be used to control other ac loads depending on the type of sensor plugged into *J1*. For example, replacing *PC1* with a temperature sensor, the controller could be used to turn on heating elements after ignoring momentary *high* temperatures. Using the same probe but placing *S3* in the REVERSE position, which switches the relative positions of *R3* and the external probe in their voltage divider configuration—the controller can be used to turn on exhaust fans while ignoring sudden *low* temperatures.

It is possible that some user modification of potentiometer *R1* and *R3* might be necessary if probes having different resistance characteristics from those of *PC1* are used. Also, if even the small amount of hysteresis present in *IC1* cannot be tolerated, experiment with different valued resistors for feedback resistor *R2*. ◇

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A LOW-COST **ELECTRONIC RINGER** FOR TELEPHONE LINES

Solid-state circuit can replace the electromechanical ringer in a telephone

BY BRADLEY ALBING

RECENT FCC rules changes allow users to connect electronic devices of non-Bell manufacture to telephone-company lines. One such device is the low-cost Electronic Ringer. Like a standard electromechanical ringer, it generates bursts of sound when triggered by ring pulses. However, it is not physically bulky and doesn't load down the telephone line. The sound it generates can be modified in several respects to suit the user's taste and to help him differentiate activity on one telephone line from that on another. The Electronic Ringer can also be used to actuate external devices in response to an incoming call. Several optional circuits for this application will be described.

About the Circuit. The schematic diagram of the Electronic Ringer appears in Fig. 1. At the onset of an incoming telephone call, an ac signal is applied between the green (*tip* or *T*) and red (*ring* or *R*) wires of the telephone line. This signal, which has an amplitude of approximately 90 volts root mean square and a frequency of between 20 and 40 Hz, is capacitively coupled to optoisolator *IC1*. The input network comprising *R1*, *R2*, *C1*, *D1*, *D2* and *IC1* minimizes the line loading and imbalance that simpler ring-detection circuits can cause. Diodes *D1* and *D2* are included to suppress "dial tapping"—the tendency of rotary-dial pulses to actuate the ringer circuit.

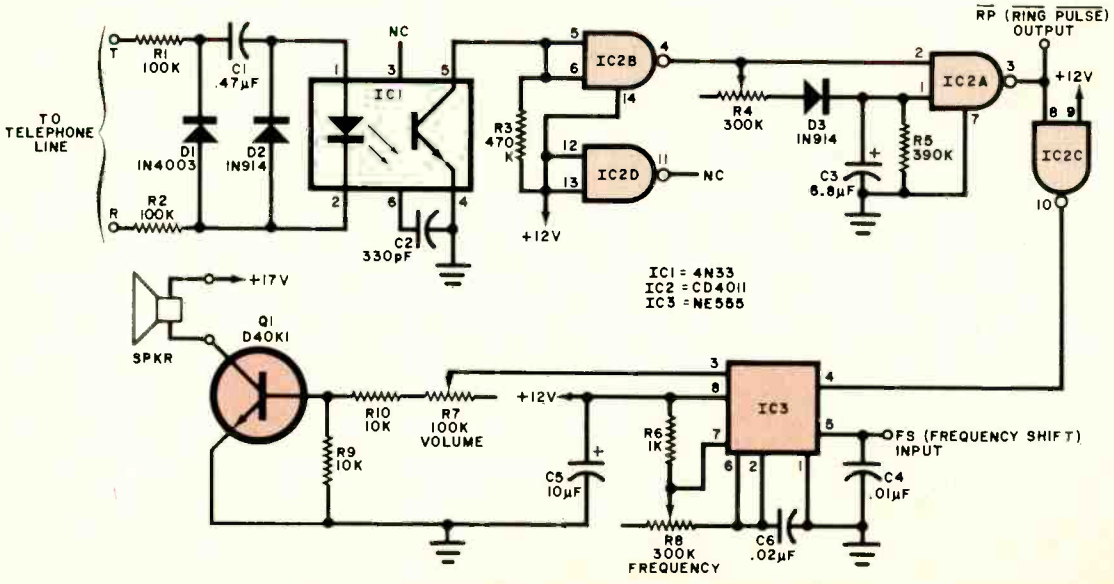

Fig. 1. Schematic diagram of the Electronic Ringer. Optoisolator IC1 couples ring pulses from the telephone line to the detector circuit.

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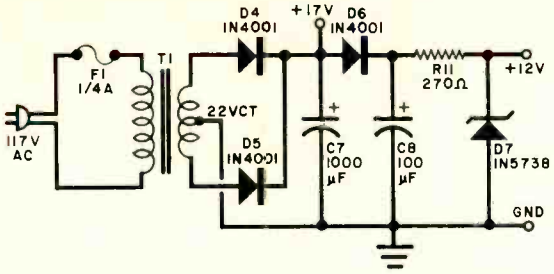

Fig. 2. Schematic diagram of the project's power supply which provides required operating voltages.

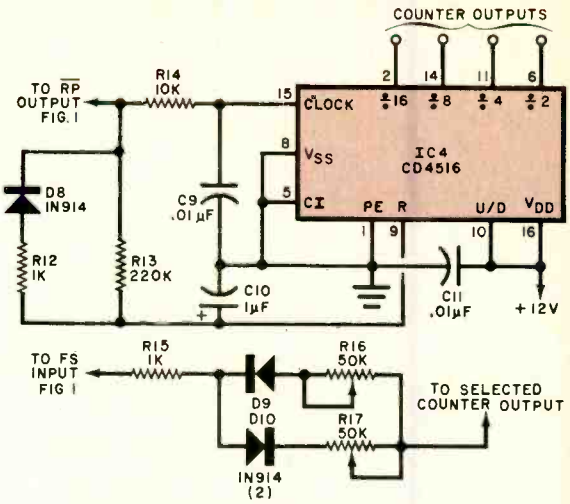

Fig. 3. An optional circuit that can convert the project into a two-tone ringer.

Output pulses from *IC1* are applied to *IC2B*, which squares and passes them to one input of NAND gate *IC2A* and to the delay network consisting of *R4*, *D3*, *C3* and *R5*. This network furnishes additional protection against dial tapping. Capacitor *C3* is initially discharged, so pulses of sufficient quantity or energy or both must be integrated by *C3* to cause the output of *IC2A* to change state. The pulses generated by a rotary-dial telephone are neither sufficiently numerous nor energetic. Potentiometer *R4* determines the charging time constant (delay time), and resistor *R5* discharges *C3* shortly after the end of the input pulse train.

The output of *IC2A*, designated the $\overline{\text{RP}}$ (RING PULSE) OUTPUT, is inverted by *IC2C* and applied to the RESET input of 555 timer *IC3* (pin 4). The timer is connected as a gated astable multivibrator. Its RESET input is normally at logic 0, which prevents the timer from oscillating. When ring

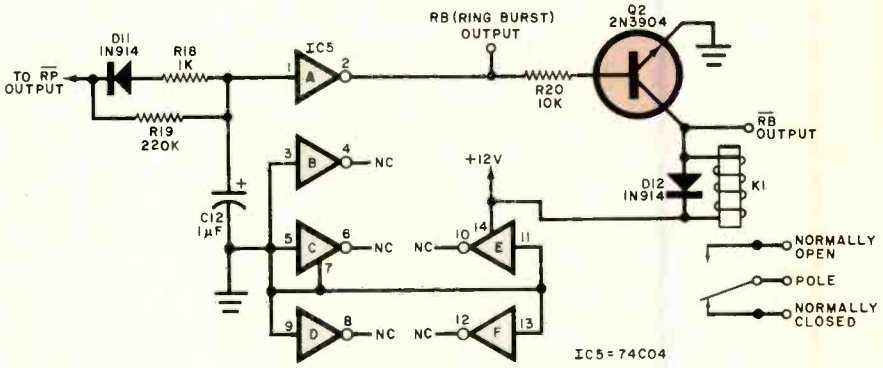

Fig. 4. Schematic diagram of an optional circuit that can actuate external electronic equipment by means of relay K1.

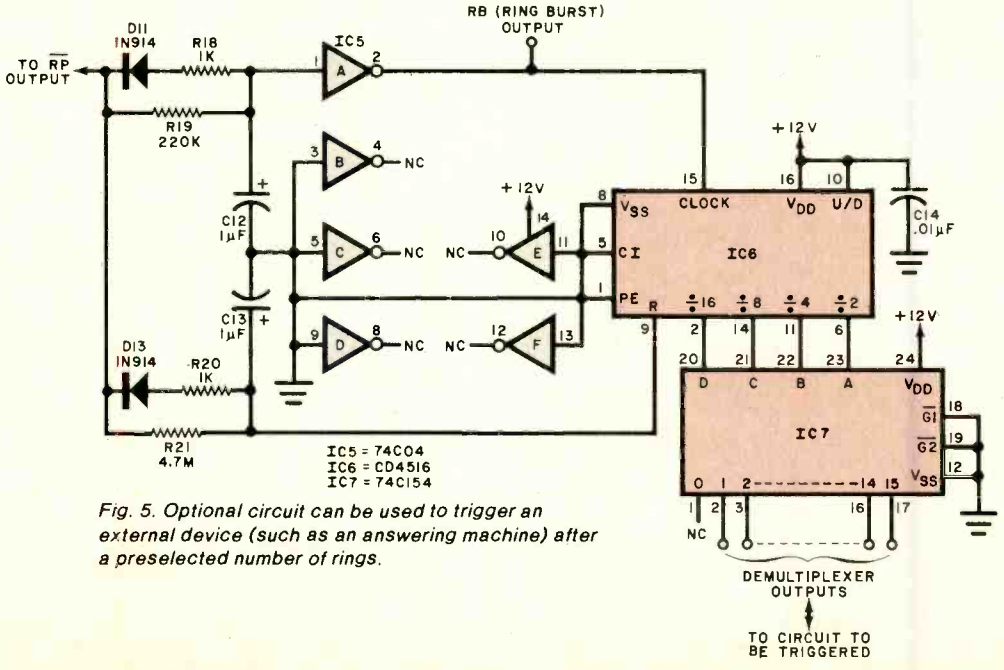

Fig. 5. Optional circuit can be used to trigger an external device (such as an answering machine) after a preselected number of rings.

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Components denoted by an asterisk comprise the optional circuits shown in Figs. 3, 4 and 5.
C1—0.47-μF, 200-V Mylar capacitor
C2—330-pF, 25-V disc ceramic capacitor
C4, C9*, C11*, C14*—0.01-μF, 25-V disc ceramic capacitor
C3—6.8-μF, 16-V tantalum capacitor
C5—10-μF, 16-V tantalum capacitor
C6—0.02-μF, 25-V disc ceramic capacitor
C7—1000-μF, 35-V aluminum electrolytic
C8—100-μF, 35-V aluminum electrolytic
C10*,C12*,C13*—1-μF, 16-V tantalum
D1—1N4003 rectifier
D2,D3,D8*,D9*,D10*,D11*,D12*, D13*—1N914 silicon switching diode
D4, D5, D6—1N4001 rectifier
D7—1N5738 12-V, ½-W zener diode
F1—¼-A, fast-blow, type 3AG fuse
IC1—4N33 optoisolator
IC2—CD4011 quad two-input NAND gate
IC3—NE555 timer
IC4*, IC6*—CD4516 four-stage, up/down programmable binary counter

PARTS LIST

IC5*—74C04 hex inverting buffer
IC7*—74C154 4-line-to-16-line decoder/demultiplexer
K1*—12-V dc spdt relay
Q1—D40K1 or equivalent npn silicon power transistor
Q2—2N3904 or equivalent npn silicon switching transistor
The following, unless otherwise specified, are ¼-watt, 10% tolerance, carbon-composition fixed resistors.
R1, R2—100 kΩ
R3—470 kΩ
R4, R8—300-kΩ, linear-taper, pc-mount trimmer potentiometer
R5—390 kΩ
R6, R12*, R15*, R18*, R20*, R22*—1 kΩ
R7—100-kΩ, linear-taper, pc-mount trimmer potentiometer
R9, R10, R14*—10 kΩ
R11—270 Ω
R13*, R19*—220 kΩ
R16*, R17*—50-kΩ, linear-taper, pc-mount trimmer potentiometer
R21—4.7 MΩ
SPKR—8-Ω dynamic speaker
T1—22-V, 500-mA, center-tapped step-down transformer
Misc.—Printed circuit or perforated board, IC sockets or Molex Soldercons, fuseholder, line cord, strain relief, suitable enclosure, standoffs, terminal strips, suitable connectors, two-conductor cable, hookup wire, solder, etc.

Note—The following is available from BFA Electronics, Box 212, Northfield, OH 44067: Kit of parts for the basic Electronic Ringer project (Figs. 1 and 2) excluding the dynamic speaker, No. ER-Kit, priced at $25.00 plus $2.00 postage and handling for U.S.A. Also available separately is an etched and drilled printed-circuit board (Fig. 6), for $6.00 plus $1.00 postage and handling for U.S.A. orders. Ohio residents, add state sales tax.

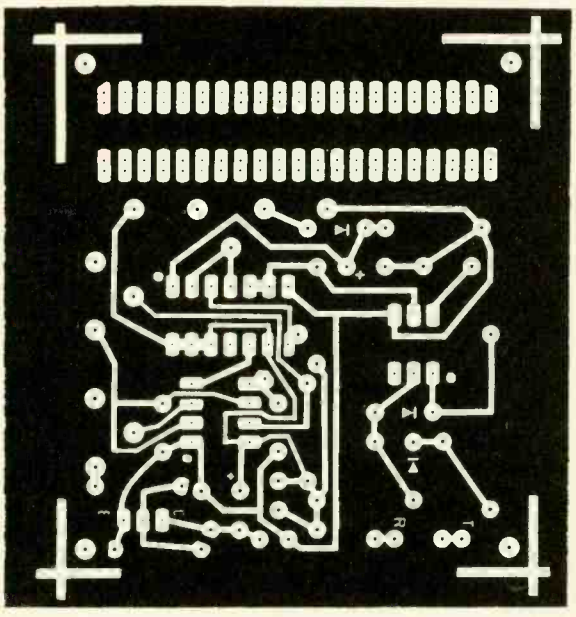

Fig. 6. Etching and drilling guide for pc board.

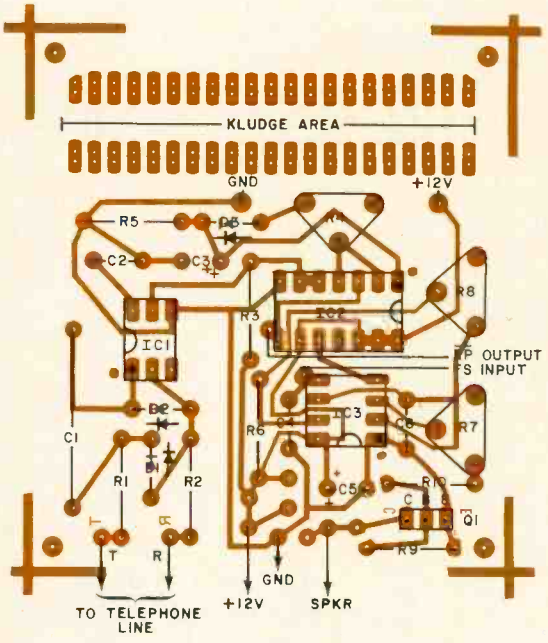

Fig. 7. Component-placement guide for pc board.

pulses are received, the RESET input is switched between logic 0 and logic 1 by *IC2C*, and the multivibrator produces bursts of oscillation at a rate determined by the frequency of the pulse train. The output of the timer is a square wave whose frequency (nominally 500 Hz to 2 kHz) is determined by potentiometer *R8*. The square wave appears at pin 3 and is coupled to driver transistor *Q1* via VOLUME control *R7* and resistor *R10*. The transistor alternately saturates and cuts off at an audio rate and causes a square-wave current to flow through the voice coil of the dynamic speaker.

Power for the Electronic Ringer is provided by the supply shown in Fig. 2. Line-voltage ac is stepped down by *T1* and full-wave rectified by *D4* and *D5*. Capacitor *C7* filters the output of the rectifier into an unregulated +17 volts dc. This voltage is applied to one side of the voice coil of *SPKR* and to the voltage-regulating network *D6*, *C8*, *R11* and *D7*. This network provides +12 volts dc, regulated, to the rest of the circuit. Note that the supply lacks a switch; in use, the project should be powered continuously.

Circuit Options. The pitch of the Electronic Ringer's tone signal can be varied by means of potentiometer *R8*, and its volume by means of *R7*. Further modification of the tone is possible by use of the circuit shown in Fig. 3. The $\overline{\text{RP}}$ OUTPUT from *IC2A* clocks four-bit binary counter *IC4*, which generates output pulse trains at one-half, one-fourth, one-eighth and one-sixteenth of the input signal frequency. One of these outputs can be fed back to the FS INPUT of timer *IC3* by means of the network *R16*, *R17*, *D9*, *D10* and *R15* to shift the frequency of the timer's square-wave output. The high- and low-frequency tones can be adjusted independently by means of *R16* and *R17*. At the end of each burst of ring pulses, counter *IC4* is reset by the network *D8*, *R12*, *R13* and *C10*.

The $\overline{\text{RP}}$ OUTPUT can be used to drive

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telephone ringer

other circuits, such as those shown in Figs. 4 and 5. External devices can be actuated by means of the circuit shown in Fig. 4. The network *D11*, *R18*, *R19* and *C12* integrates the $\overline{RP}$ OUTPUT into a dc level that is inverted by *IC5A*. This inverting buffer provides base drive to *Q2* when its output is at logic 1. When the transistor receives base drive, it conducts and sinks current for the coil of relay *K1*. The contacts of this relay can control an external electronic circuit or electromechanical device.

In the more complex circuit of Fig. 5, the $\overline{RP}$ OUTPUT is processed by an input network similar to that of Fig. 4. The output of inverting buffer *IC5A*, however, drives four-bit binary counter *IC6*, whose four output lines are connected to the address inputs of demultiplexer *IC7*. Fifteen of the demultiplexer's output lines are employed in this project. Each in turn changes states when the appropriate number of pulses clocks counter *IC6*. A selected demultiplexer output can be connected to a driver/relay circuit or similar interface. If this is done, an external circuit or device will be actuated after the appropriate number of rings.

Construction. The Electronic Ringer can be assembled on either a printed-circuit or perforated board. Full-size etching-and drilling, and component-placement guides for a suitable pc board appear in Figs. 6 and 7, respectively. The board contains a kludge area at one end within which circuit options can be installed. If the existing ringer of a standard 500-series desk telephone is removed, this pc board can be installed inside the telephone enclosure. Alternatively, a custom enclosure can be used.

The project's power supply should be isolated from the telephone to prevent stray pickup of 60-Hz ac radiated by the power line and the step-down transformer. A two-conductor cable can be used to connect the *T* and *R* input terminals of the project to the green and red wires, respectively, of the telephone line. If desired, telephone-type connectors can be used to facilitate interconnection of the project and the line.

If the project won't respond to incoming calls or if dial tapping occurs, reverse the *T* and *R* connections. Also, reverse the polarity of the connections between power transformer *T1* and the ac line cord. ◇

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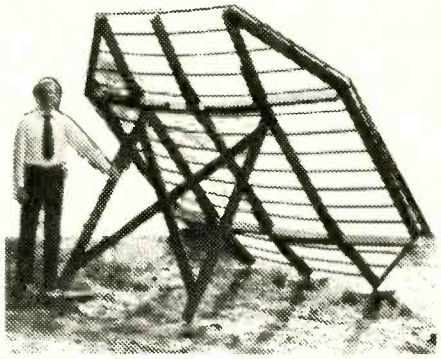

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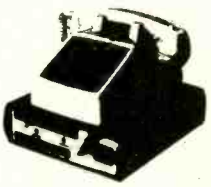

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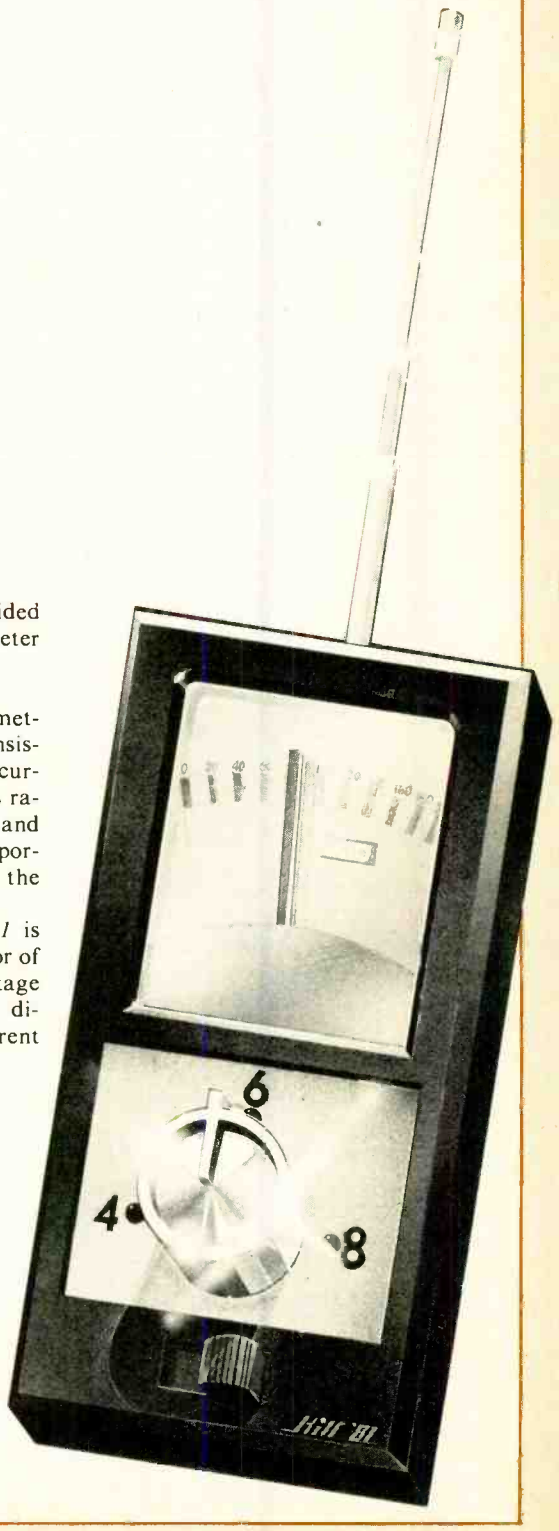
A WIRELESS IDLE TACHOMETER FOR AUTO TUNE-UPS

Eliminate risk of damage to electronic ignition systems

BY JOHN E. DAVIS



PERFORMING your own automobile tune-ups can be a source of personal satisfaction as well as a way to save money, but if you own a late-model car with electronic ignition, you'll find that the process is not what it used to be. Many modern ignition systems are magnetically triggered and have no points to adjust, thus relegating dwell meters to museums. However, the anti-pollution devices on modern engines have made idle speed considerably more critical than it once was, so an idle tachometer is still required. Since some of these systems can be severely damaged by momentarily grounding the tachometer tie-in point, the problem is where and how to connect the tach without damaging the ignition module.

The best way would be to avoid electrical interconnection with the ignition system entirely, and you can achieve this by building the Wireless Idle Tachometer described here. The tachometer is designed to operate with any four-, six- or eight-cylinder, four-cycle engine having spark ignition. It can be used with two-cycle engines, but the meter indications will be twice the actual engine speed.

Idle tachometers generally indicate from 0 to 1000 rpm. However, partly for ease of calibration it was decided to extend the range of the tachometer described here to 2000 rpm.

Circuit Operation. The tachometer circuit (Fig. 1) uses a two-transistor monostable as a frequency-to-current converter. The input signal is radiated from the ignition system and picked up on a small telescoping (portable radio-type) antenna nearby; the output is displayed on a meter.

Under quiescent conditions, *Q1* is off and *Q2* is on. Since the collector of *Q2* is low, there is not enough voltage to forward-bias series-connected diodes *D3* and *D4* and produce a current flow through *R10*, *R11*, and *M1*.

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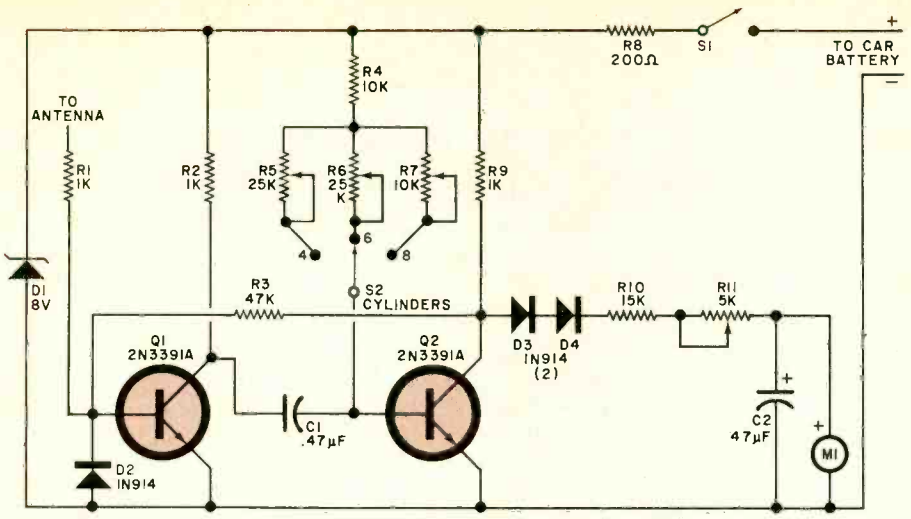

Fig. 1. The tachometer uses a two-transistor monostable circuit as a frequency-to-current converter.

PARTS LIST

C1—0.47-μF capacitor
C2—47-μF electrolytic
D1—8-V, 1-W zener diode
D2,D3,D4—Silicon diode (1N914 or similar)
M1—200-μA meter
Q1,Q2—2N3391A transistor
R1,R2,R9—1-kΩ, ½-W resistor
R3—47-kΩ, ½-W resistor
R4—10-kΩ, ½-W resistor
R5,R6—25-kΩ, mini-pc potentiometer (Radio Shack #271-336 or similar)
R7—10-kΩ mini-pc potentiometer (Radio Shack #271-335 or similar)
R8—200-Ω, 2-W resistor
R10—15-kΩ, ½-W resistor
R11—5-kΩ linear-taper potentiometer
S1—Spst toggle switch
S2—Three-position rotary switch
Misc.—Telescoping portable radio antenna, suitable plastic enclosure, two-conductor power cable, battery connector, etc.

When the antenna picks up a positive-going ignition signal, *Q1* turns on and forces *Q2* to turn off for an interval determined by the time-constant of *C1* and the resistance selected by switch *S2*. The choice of time constant sets the tach for 4-, 6-, or 8-cylinder engines.

When turned off, the collector of *Q2* rises to deliver a constant-voltage, constant-duration pulse to the meter network. Meter *M1* will indicate the current flow. When each positive-going ignition pulse finishes, *Q1* returns to its cutoff state, and *Q2* reverts to its conducting state. This stops generation of the meter pulses. As the ignition system rapidly cycles on and off, the two-transistor circuit will follow, and the meter needle will flutter. This is prevented by *C2* which smooths the current pulses.

Potentiometer *R11* provides means to compensate for errors due to ambient temperature variations. For example, if the ambient temperature is 20°F different from the temperature at which the tachometer was calibrated, an error of about 25 rpm will be found. If you are not overly concerned about temperature variations, use a fixed 2,200 ohms for *R11*.

Resistor *R8*, in conjunction with zener diode *D1*, maintains a constant 8 volts for the circuit. Switch *S1* is the on/off switch. Diode *D2* protects *Q1* from negative spikes, while *R3* provides the necessary feedback.

Construction and Calibration. Circuit layout is not critical and the builder may use point-to-point wiring on perf board or the printed circuit board shown in Fig. 2.

Meter *M1*, switches *S1* and *S2*, and control *R11* are mounted on the top panel of the case. Capacitor *C2* is mounted directly on the meter terminals. The two-conductor power cable exits the case where convenient.

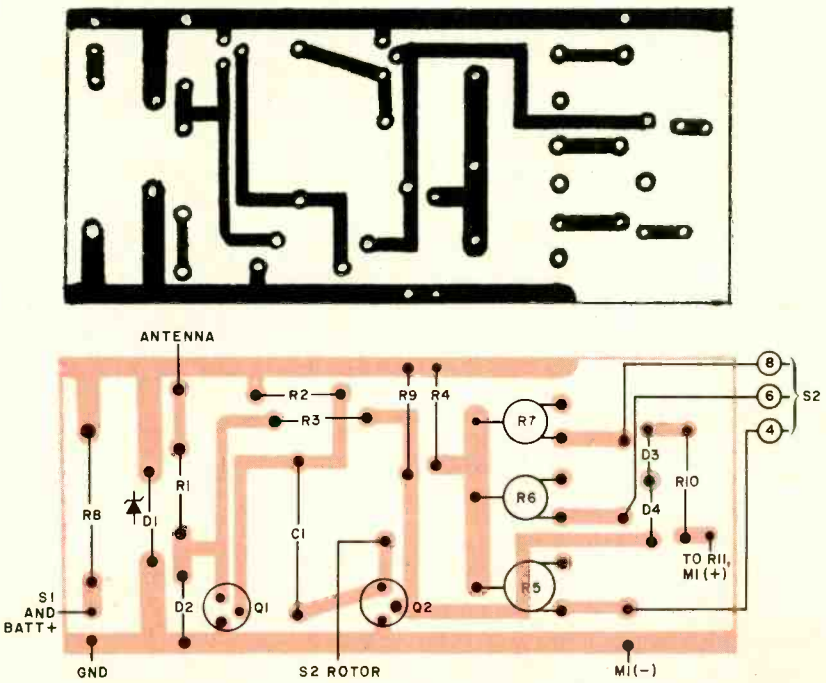

Fig. 2. Etching and drilling guide (top) and component layout diagram for a printed-circuit board for the tachometer.

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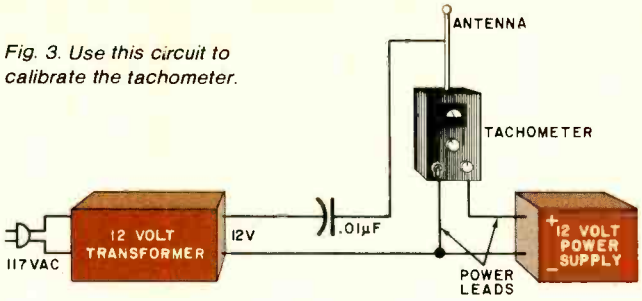

Fig. 3. Use this circuit to calibrate the tachometer.

The antenna can be mounted in any part of the case where space allows, with a hole drilled so that the antenna can be extended. If you use a plastic case, it isn't necessary to insulate the antenna. If a metal case is used, insulation will be required whenever the antenna connects to, or passes through, the cabinet.

Calibration requires a 12-volt dc power supply (or a car battery), a 12-volt transformer, and a capacitor (approximately 0.01 μF). These components are arranged as illustrated in Fig. 3.

Turn the tachometer on and allow a few minutes for temperature stabilization. Position *R11* to the center of its rotation. This point should be marked on the case for future reference. Set cylinder-select switch *S2* to "4" and adjust *R5* for a meter indication of 180 (1800 rpm). Place the switch to "6" and adjust *R6* for an *M1* indication of 120 (1200 rpm), then set the switch to "8" and adjust *R7* for 90 (900 rpm).

If *R11* is left in the circuit and the user wishes to recalibrate the unit for accurate readings at an elevated or reduced ambient temperature, the procedure is as follows. At that ambient temperature chosen, hook up the circuit shown in Fig. 3, and adjust *R11* for the correct reading on any of the three settings of *S2*. The other two scales will also be correct, since *R11* adjusts all three scales simultaneously. Potentiometers *R5*, *R6*, and *R7* *should not be readjusted* for temperature compensation.

Use. With the vehicle engine running, hook the tachometer power leads to the car battery, turn it on, wait approximately one minute, then extend the telescoping antenna. Set cylinder-selector switch *S2* to the proper setting and hold the antenna about one or two feet over the engine. You should get a stable indication of engine rpm. If the display is erratic and the needle jumps around, there is insufficient coupling between the ignition system and the antenna. This is most likely to occur when the car's ignition wires are concealed by the air cleaner or some other metallic element. If this is the case, move the antenna closer to the ignition coil or distributor. If you get no meter display, the power leads of the tachometer may be reversed. This will keep the unit from operating, but won't damage it. Once you get stable readings, you can tune your car accurately and be confident that you won't "blow" costly ignition parts. ◇

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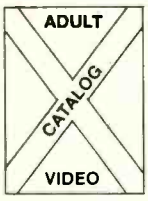

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VOCAL ZAPPER MAKES YOU A "SUPERSTAR"

Cancels the "phantomed" center channel of a stereo record and lets you substitute your own voice

BY CRAIG ANDERTON AND DAVID KARR

WHETHER to practice singing, have fun at parties, or just feel like a rock star, the Vocal Zapper may be just what you want. This inexpensive device lets you remove a lead singer's voice during playback of most stereo records and substitute your own voice. The Zapper is effective only with stereo records and most effective with those in which the lead vocalist (and bass instruments, if used) occupy center-stage, with vocal and nonbass-instrumental accompaniment mixed more toward the left or right of the stereo spread. (This type of mix is common in popular music.)

To create the center-channel effect, the sound engineer generally mixes equal amounts of in-phase lead-vocal (and bass) signal with the directional left- and right-channel signals. When a stereo record mastered in this manner is played back, the mix psychoacoustically places the lead vocalist stage-center, with accompanying voices and instruments to the left and right of the stereo spread.

In the ZAP mode, the Zapper subtracts the left and right stereo signals fed to its inputs in a differential amplifier. The result is that all common-mode (equal-amplitude, in-phase) signals in both channels—in this case, the lead vocalist—are cancelled out. What emerges from the amplifier and is fed back into the stereo system is a single mono signal with all the original left- and right-of-center information, including any reverb that may have been added to the lead vocal, but no lead vocal. The residual reverb will generally be of a low enough level to be unobjectionable if you replace the lead vocal with your own voice. In fact, you may even find it desirable, since it adds depth to the sound.

To prevent complete cancellation of common-mode bass information, one channel has been modified to permit only those frequencies above about 160 Hz to be cancelled by the Zapper. Since unequal amounts of common-mode bass signal appear in the differential amplifier, little of it is eliminated from the mono signal at the output. Mono signals fed to the Zapper will be cancelled almost entirely.

About the Circuit. The heart of the Vocal Zapper, shown schematically in Fig. 1, is differential amplifier *IC1*. This IC and microphone preamplifier *IC2* can be an LM301, LM748, or any equivalent uncompensated operational-amplifier integrated circuit.

With *S1* set to NORM, both the left input at *J1* and the right input at *J2* are mixed together and fed to the negative, inverting input of *IC1*. Since in this mode only one input of *IC1* has a signal applied to it, no differential amplification occurs. In this event, *IC1* simply passes on *all* the signal information, including common-mode vocal in mono form, to both *J3* and *J4*, the left and right outputs, respectively. If a microphone is plugged into *J5* in the NORM mode, its signal would be amplified by microphone preamplifier *IC2* and mixed with the left and right input signals to provide a "duet" signal capability. (Microphone gain is set as desired with potentiometer *R11*.)

Setting *S1* to ZAP (common-mode cancel) causes the left-channel input signal to feed the positive, noninverting input of *IC1*, while the right-channel signal continues to feed the negative input. Once the two signals enter *IC1*, one of them is inverted (phase shifted by 180°) so that common-mode information cancels. The music at this point would be lower in volume than in the NORMAL mode.

The value of *C3* has been selected to prevent complete cancellation of bass information in the common-mode signals. Frequencies below about 160 Hz pass through the differential amplifier from *J1* with considerably lower amplitude than those

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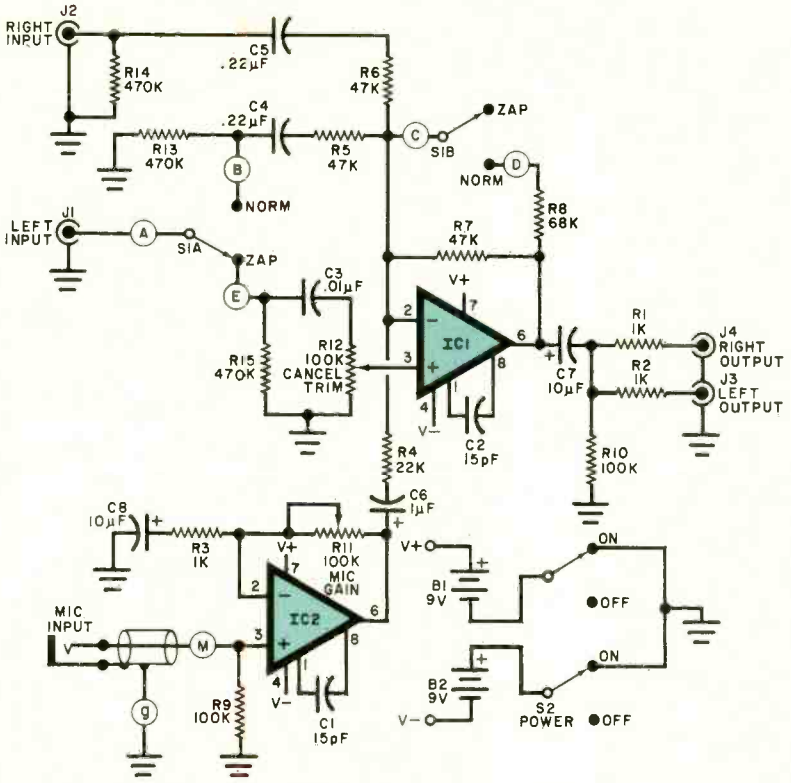


PARTS LIST

B1,B2—9-volt transistor battery
C1,C2—15-pF disc capacitor
C3—0.01-µF, 15-V disc or Mylar capacitor
C4,C5—0.22-µF, 15-V disc or Mylar capacitor
C6—1-µF, 15-volt electrolytic or tantalum
C7,C8—10-µF, 15-volt electrolytic or tantalum
IC1,IC2—LM301, LM748 or equivalent op amp (see text)
J1 through J4—Phono jack (see text)
J5—Microphone jack (see text)
Unless otherwise specified the following are ¼-watt, 10% tolerance fixed resistors
R1,R2,R3—1 kΩ
R4—22 kΩ
R5,R6,R7—47 kΩ
R8—68 kΩ
R9,R10—100 kΩ
R11,R12—100-kΩ upright pc-type trimmer potentiometer
R13,R14,R15—470 kΩ
S1,S2—Dpdt switch
Misc.—Printed-circuit or perforated board; IC sockets (optional); sheet aluminum for front and rear panels; L brackets; No. 6 machine hardware; dry-transfer lettering kit; hookup wire; solder; etc.

Fig. 1. Schematic diagram of the Zapper. IC1 and IC2 can be any uncompensated op amp ICs similar to the LM301.

from *J2*. Although these two bass signals are common-mode, they are of unequal amplitudes and, therefore, don't cancel completely. During zapping, you can add your own voice in place of the vocal being cancelled simply by singing into a microphone plugged into MIC input *J5*.

Power for the circuit is supplied by a pair of 9-volt transistor batteries, *B1* and *B2*. Since the circuit requires a bipolar source, *B1* and *B2* are ar-

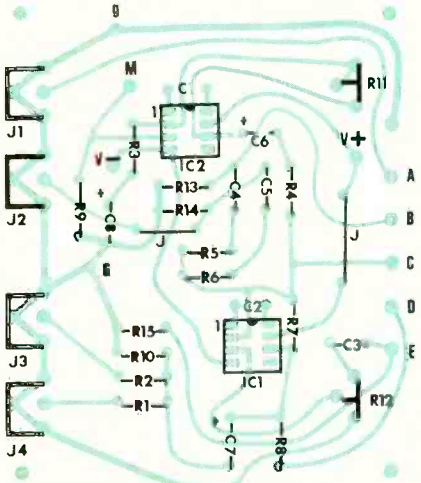
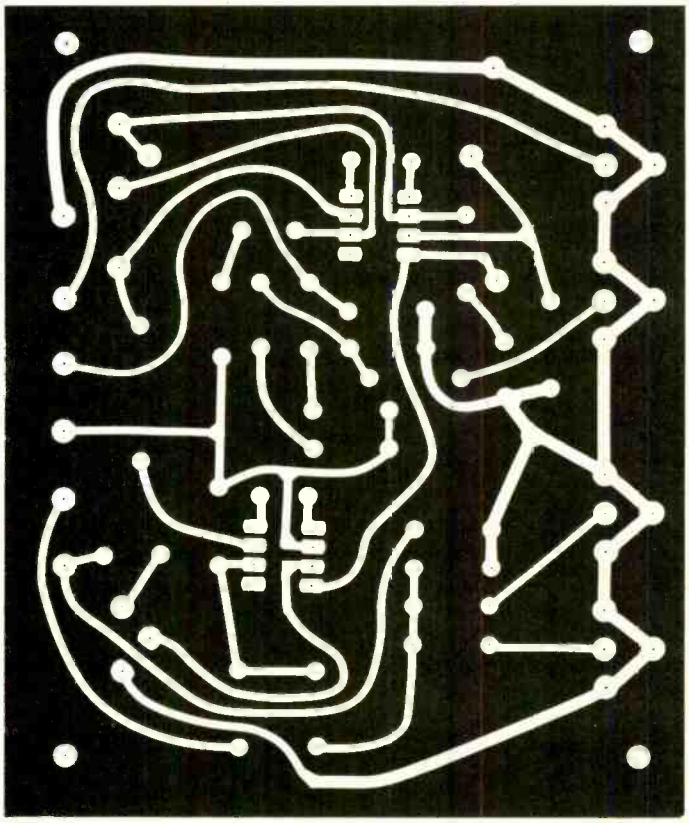


Fig. 2. Actual-size foil pattern for a pc board is at right; component layout above.



KIT ORDERING INFORMATION

The following is available from PAIA Electronics, Inc., P.O. Box 14359., Oklahoma City, OK 73116: complete kit of parts No. 673OK, including front panel for $24.95 plus $3 postage. Also available separately: pc board No. 6730pc for $9.95. Add $5 handling charge for foreign orders.

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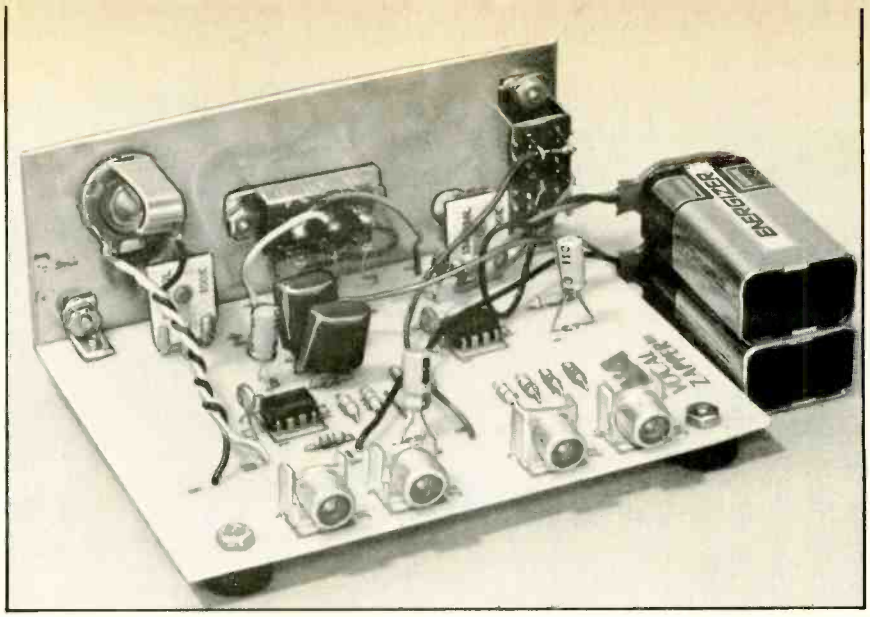

Fig. 3. Photo of the interior of the author's prototype. Right-angle pc-mount jacks were used for J1 through J4.

ranged to supply ±9 volts, referenced to signal ground.

Construction. The Zapper is best assembled on a printed-circuit board (see Fig. 2) or perforated board with solder clips. In either case, sockets are optional, but recommended, for *IC1* and *IC2*.

Mount the resistors, capacitors, trimmer potentiometers, and ICs (or their sockets) as shown in the component-placement guide. Don't forget to install the two jumpers at the locations labelled *J*. You have the option with *J1* through *J4* of using either right-angle pc-mount jacks (see Fig. 3) or standard panel-mount jacks.

Referring to the lead photo, prepare a front panel to accommodate POWER and NORM/ZAP switches *S1* and *S2* and MIC jack *J5* and to provide access to CANCEL TRIM and MIC GAIN controls *R12* and *R11*. (Note: Select a

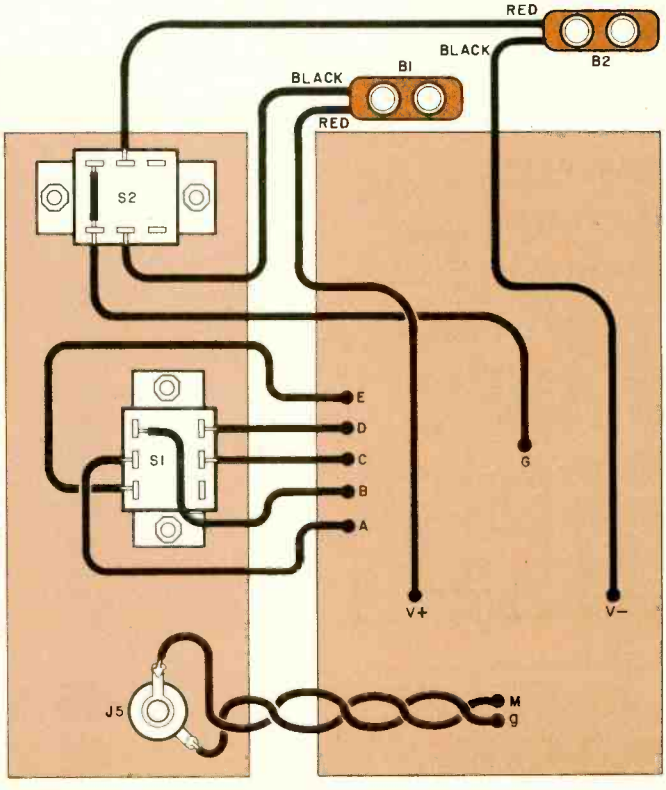

Fig. 4. Follow this wiring diagram to connect the front panel to the components on the pc board.

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jack that mates with the connector on the microphone you plan to use with the Zapper and drill a hole just large enough to accommodate it.) Then mount the panel to the pc assembly edge with the letters A through E on it with a pair of small L brackets.

Loosely twist together two lengths of different colored insulation hookup wire or substitute a length of shielded cable and solder one end to the lugs on the MIC jack. Being careful to maintain proper polarization, connect and solder the other end of the twisted pair or shielded cable to points M (hot) and g (signal ground) on the pc board. This step and the remainder of off-board wiring are shown in Fig. 4.

Installation and Use. Snap a pair of batteries into their connectors, but leave the POWER switch off. Then connect the Zapper into your stereo system's TAPE OUT/TAPE MONITOR loop. From now on, when you wish to use the Zapper, all you do is activate the receiver or amplifier tape-monitoring function.

After installation, turn on power first to the Zapper and then to the stereo sytem. Set your stereo system's input selector to PHONO but leave the TAPE MONITOR switch in the out position. When you play a stereo record, you should now hear normal stereo sound. Set the Zapper to NORM and switch in the stereo system's tape-monitor function. The stereo spread should now disappear and be replaced by mono sound. You might also note a slight drop in overall volume.

Now switch to the ZAP mode and listen to the sound. The lead vocal should be absent, but the stereo spread should remain. If you can hear the lead vocal (don't confuse this with any reverb that may have been added), adjust the CANCEL TRIM control for maximum cancellation, which should occur somewhere near the center of the pot. The CANCEL TRIM control need not be touched again.

Once the Zapper is operating properly, plug headphones into the amplifier and then a microphone into the Zapper. (Don't attempt to listen through speakers with a live microphone. If you do, acoustic feedback can damage your system.) As you sing into the microphone, adjust the MIC GAIN control for the proper blend between microphone and program material. At first, you might tend to set mike gain too high, which could result in distortion. With a little practice, you'll soon be using the MIC GAIN control with the proper "touch." ◇

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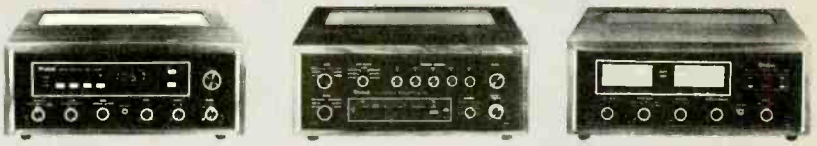

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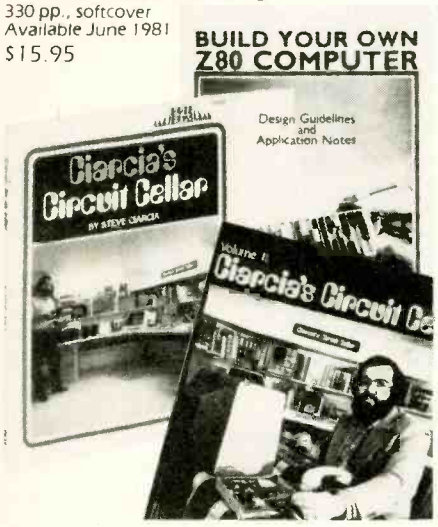

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PROGRAM MERG

Machine-language utility permits combining two programs

BY JAMES L. FRIDDLE

UNLESS you have an expansion interface and disk system, adding a subroutine to one or more BASIC programs in a TRS-80 means typing. And if the subroutine is long or often used, it means lots of typing, which can generate errors in your work as well as fatigue.

The machine-language program in Listing 1 allows you to load a BASIC program from cassette tape into memory and combine it with a BASIC program already in memory, using the Level-3 MERGE command. (This assumes that the second program has line numbers higher than the program already in memory.) If you are unfamiliar with machine-language programming, Listing 2 comprises a BASIC program that will POKE the MERGE routine into protected memory, and then erase itself. Since the MERGE routine contains only relative addressing, it can be located at any block of memory the user desires. If the addresses given in the listing are retained, the KBFIX routine can be used as well. When using the MERGE routine, enter 32594 for MEMORY SIZE? when the TRS-80 is turned on. Address 418CH must be loaded with MERGE program address, in this case 7F53H. Once this has been accomplished, then activating the MERGE command, starts the program.

To use the MERGE command, enter your main program after making sure that its highest line number does not encroach on the lowest line number of the subroutine. Place the cassette containing the previously recorded subroutine in the recorder, press the play button, and enter the command MERGE. The recorder will start; and when the program is found, the usual asterisks will appear. When the cassette stops, enter LIST and verify that there is a single program containing the original main program with the appended subroutine. ◇

LISTING 1

Add.	Code	Line#	Mnemonics	Remarks
7F53		010	ORG 7F53H	
		020		;L2MERGE VERSION 2.0
7F53	DD 2A F9 40	030	LD IX, (40F9H)	;GET LINE # POINTER
7F57	DD 2B	040	DEC IX	
7F59	DD 2B	050	DEC IX	;LINE POINTER ADDR
7F5B	DD 2B	060	DEC IX	
7F5D	DD 2B	070	DEC IX	
7F5F	AF	080	XOR A	
7F60	CD 12 02	090	CALL 0212H	;DEFINE DRIVE
7F63	CD 96 02	100	CALL 0296H	;FIND SYNC BYTE
7F66	06 04	110	LD B,4	;READ FIRST 4 BYTES
7F68	CD 35 02	120 LP1	CALL 0235H	;READ BYTE
7F6B	10 FB	130	DJNZ LP1	;DONE?
7F6D	CD 35 02	140 LP2	CALL 0235H	;LOAD BASIC TAPE
7F70	DD 77 02	150	LD (IX+2),A	;PUT BYTE IN MEM
7F73	B7	160	OR A	
7F74	20 08	170	JR NZ, SKP	
7F76	3A 3F 3C	180	LD A, (3C3FH)	;CHANGE *
7F79	EE OA	190	XOR OAH	
7F7B	32 3F 3C	200	LD(3C3FH),A	;* CHANGED
7F7E	AF	210 SKP	XOR A	;O A & RESET FLAGS

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ING ON A TRS-80

```
7F7F  DD B6 00    220          OR (IX)          ;TEST FOR TAPE END
7F82  DD B6 01    230          OR (IX+1)
7F85  DD B6 02    240          OR (IX+2)
7F88  DD 23       250          INC IX
7F8A  20 E1       260          JR NZ,LP2        ;IF NOT END DO AGAIN
7F8C  CD F8 01    270          CALL 01F8H       ;TURN OFF CASSETTE
7F8F  2A F9 40    280          LD HL,(40F9H)    ;GET LINE # POINTER
7F92  E5          290          PUSH HL
7F93  DD E1       300          POP IX
7F95  11 EB 42    310          LD DE,42EBH
7F98  ED 52       320          SBC HL,DE        ;HL IS DISPLACEMENT
7F9A  E5          330          PUSH HL
7F9B  D1          340          POP DE
7F9C  DD 2B       350          DEC IX
7F9E  DD 2B       360          DEC IX
7FA0  DD 6E 00    370CHANGE    LD L,(IX)        ;CHANGE ADDR LOOP
7FA3  DD 66 01    380          LD H,(IX+1)
7FA6  AF          390          XOR A
7FA7  7C          400          LD A,H
7FA8  B5          410          OR L
7FA9  28 0D       420          JR Z,EXIT        ;IF FINISHED EXIT
7FAB  AF          430          XOR A
7FAC  19          440          ADD HL,DE
7FAD  E5          450          PUSH HL
7FAE  DD 75 00    460          LD (IX),L
7FB1  DD 74 01    470          LD (IX+1),H
7FB4  DD E1       480          POP IX           ;IX NOW NEW ADDRESS
7FB6  18 E8       490          JR CHANGE        ;REPEAT TILL DONE
7FB8  DD E5       500 EXIT     PUSH IX
7FBA  E1          510          POP HL
7FBB  23          520          INC HL
7FBC  23          530          INC HL
7FBD  22 F9 40    540          LD (40F9H),HL    ;UPDATE LINE# POINTERS
7FC0  22 FB 40    550          LD (40FBH),HL
7FC3  22 FD 40    560          LD (40FDH),HL
7FC6  C3 19 1A    570          JP 1A19H         ;RETURN TO "READY"
7F53              580          END
```

LISTING 2

```
 1    REM MERGE 2.0 BASIC LOAD JLF 6/29/80
 2    REM ENTER 32594 FOR MEMORY SIZE ON POWERUP
10    FOR X=32595 TO 32712
20    READ Y:POKE X,Y
30    NEXT
40    DATA 221,42,249,64,221,43,221,43,221,43,221,43,175,205,
      18,2,205,150,2,6,4,205,53,2,16,251,205,53,2,221,119,2,183,32
50    DATA 8,58,63,60,238,10,50,63,60,175,221,182,0,221,182,
      1,221,182,2,221,35,32,225,205,248,1,42,249,64,229,221,225,
      17,235,66
60    DATA 237,82,229,209,221,43,221,43,221,110,0,221,102,1,
      175,124,181,40,13,175,25,229,221,117,0,221,116,1,221,225,
      24,232,221
70    DATA 229,225,35,35,34,249,64,34,251,64,34,253,64,195,25,
      26
80    POKE 16780,83:POKE 16781,127
90    NEW
```


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

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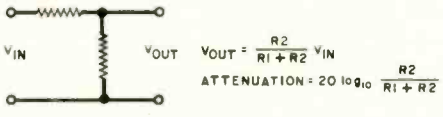
HOBBY SCENE

By John McVeigh, Technical Editor

Add-On Audio Muting

***Q.** I have a stereo receiver that offers excellent performance but lacks audio muting—that is, a network activated by a pushbutton switch that introduces a specific amount of attenuation to reduce the audio level during telephone interruptions, etc. Could you describe an external circuit that can be used for this purpose?—S. Jordan, Chattanooga, TN*

A. The circuit shown in the figure can attenuate an audio signal by a fixed

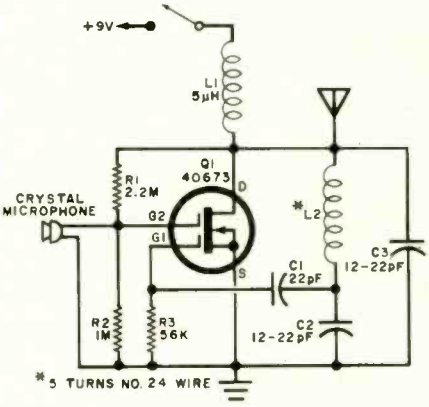


amount. Resistor values should be selected to provide the desired attenuation according to the formula given. The value of *R2* should be at least ten times less than the input impedance of the stage which it drives. This will prevent that stage from loading the voltage divider and changing the amount of actual signal attenuation. The circuit can be installed at a line-level point in the audio chain. A spare tape-monitor loop controlled by a pushbutton switch is an ideal candidate. If one is not available, the attenuator can be mounted in a small, external enclosure. It can be inserted into and removed from the signal chain (say, at the preamplifier output/power-amplifier input) by means of a double-throw switch at the attenuator input to bypass the voltage divider. Note that one resistive network is required for each audio channel.

Another Wireless Microphone

***Q.** In the Hobby Scene for July 1980, you showed a three-transistor vhf wireless microphone. May I suggest a simple, single-transistor vhf wireless microphone?—R. Perrigo, Merseyside, Liverpool, U.K.*

A. Thank you very much for your suggestion, which is shown schematically in the accompanying figure. I'm sure many readers will want to experiment with the circuit. Although you have not stated so explicitly, seemingly a short length of solid copper wire should be used for the antenna and the values of *C2* and *C3*



chosen for the desired transmitting frequency. Some adjustment of the operating frequency is possible by increasing or decreasing the pitch of the winding comprising *L2*. The circuit can be powered by a 9-volt transistor battery.

Motor Speed Control

Q.** I have a few questions about the "Drill Speed Control" presented in the Tips and Techniques column of the November 1980 issue. What is an RC network? What is an SCR? Is the modular bridge rectifier RECT1* **one unit, or is it made up of four separate diodes?—James L. Keyser, Toledo, OH*

A. An *RC* network is a group of electrically interconnected resistors (*R*) and capacitors (*C*). In the circuit under discussion, it comprises the two 100-ohm resistors and 50-μF electrolytic capacitors. An SCR is a silicon controlled rectifier. It is a three-terminal, four-layer (pnpn) semiconductor that functions as a switch. When a small amount of current is injected into its gate, it can allow a much larger current to flow from its anode to its cathode. Such devices are often used as power switches that can be controlled by low-level gate signals. The modular bridge rectifier as specified is one unit that contains four silicon diodes. However, you can use four individual diodes, each having its own case. Using four separate diodes in place of one modular bridge rectifier will have no effect on the electrical operation of the Drill Speed Control or, for that matter, any other circuit.

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SOLID-STATE DEVELOPMENTS

By Forrest M. Mims

Optoisolators—The Photon Connection

THE *optoisolator* is a solid-state component that permits one circuit to influence or control a second circuit even though virtually total electrical isolation exists between the two. As its name implies, the relation is achieved by optoelectronic means.

There are many kinds of optoisolators, and they are described by various names, the most common being the *optocoupler*. Nearly all combine a semiconductor light emitter and a detector in a single package. The light source and detector are electrically isolated from one another within the package, which is usually made of opaque plastic. Optical coupling between the two is provided by an air space or a transparent glass or plastic channel.

In a typical LED/phototransistor optoisolator (Fig. 1), the LED chip is almost always either GaAs or GaAs:Si. A transparent glass window called a *dielectric channel* insulates and isolates the LED chip from the phototransistor.

The phototransistor in six-pin mini-DIP optoisolators is generally mounted directly on the package's lead frame. This provides electrical contact to the collector. Flying bonding wires connect the base and emitter to their respective pins. Electrical access to the LED chip is also by means of flying bonding wires.

The electrical isolation between the two semiconductor devices is enhanced by bringing their respective bonding leads to opposite sides of the package. An isolation of 2500 volts or more is readily achieved. Many other package configurations are also available, some of which provide exceptionally high isolation voltages as shown in the photos.

Various source/detector combinations can be used to make optoisolators. Here are some of the most common:

Source	Detector
Incandescent lamp	CdS Photoresistor
Neon glow lamp	CdS Photoresistor
GaAsP red LED	CdS Photoresistor
GaAs IR LED	Phototransistor
GaAs IR LED	Photodarlington
GaAs IR LED	Photodiode
GaAs IR LED	LASCR
GaAs IR LED	LATriac
GaAs IR LED	PhotoFET

The devices which use cadmium-sulfide photoresistors are much slower than those using silicon detectors (phototransistors, photodiodes, etc.). They are, however, very simple to manufacture, often consisting of a plastic tube with a light source inserted into one end and the detector into the other.

Silicon detectors can be assembled in this way also. Indeed, you can quickly make a working optoisolator by inserting a phototransistor and infrared LED into opposite ends of a short length of heat-shrinkable tubing. This arrange-

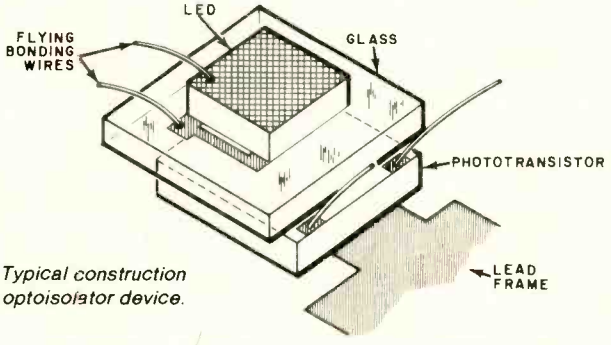


Fig. 1. Typical construction of an optoisolator device.

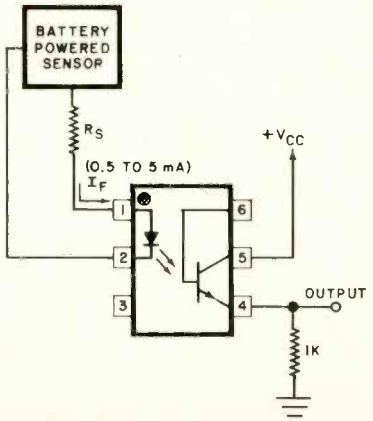
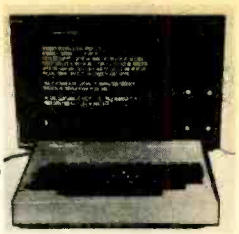


Fig. 2. Patient-monitoring circuit with 2500-V isolation.

By Netronics

ASCII/BAUDOT, STAND ALONE



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The keyboard follows the standard typewriter configuration and generates the entire 128 character ASCII upper/lower case set with 96 printable characters. Features include onboard regulators, selectable parity, shift lock key, alpha lock jumper, a drive capability of one TTY load, and the ability to mate directly with almost any computer, including the new Explorer/85 and ELF products by Netronics.

The Computer Terminal requires no I/O mapping and includes 1k of memory, character generator, 2 key rollover, processor controlled cursor control, parallel ASCII/BAUDOT to serial conversion and serial to video processing—fully crystal controlled for superb accuracy. PC boards are the highest quality glass epoxy for the ultimate in reliability and long life.

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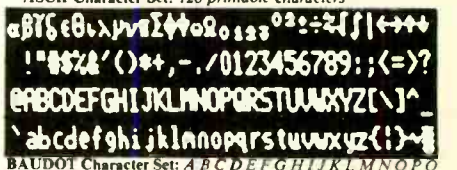
When connected to a computer, the computer must echo the character received. This data is received by the VID which processes the information, converting to data to video suitable to be displayed on a TV set (using an RF modulator) or on a video monitor. The VID generates the cursor, horizontal and vertical sync pulses and performs the housekeeping relative to which character and where it is to be displayed on the screen.

Video Output: *1.5 P/P into 75 ohm (EIA RS-170)* • **Baud Rate:** *110 and 300 ASCII* • **Outputs:** *RS232-C or 20 ma. current loop* • **ASCII Character Set:** *128 printable characters—*



BAUDOT Character Set: *A B C D E F G H I J K L M N O P Q R S T U V W X Y Z - ? : • 3 $ # ( ) . , 9 0 1 4 ' 5 7 ; 2 / 6 8* • **Cursor Modes:** *Home, Backspace, Horizontal Tab, Line Feed, Vertical Tab, Carriage Return. Two special cursor sequences are provided for absolute and relative X-Y cursor addressing* • **Cursor Control:** *Erase, End of Line, Erase of Screen, Form Feed, Delete* • **Monitor Operation:** *50 or 60Hz (jumper selectable.*

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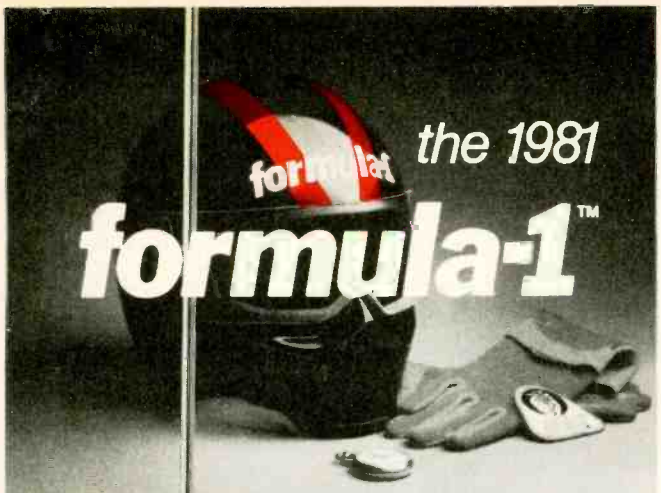

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ment can provide excellent high-voltage isolation, but the physical distance between the elements is such that the LED will require more current for the same degree of coupling as that of an optoisolator in which the LED and phototransistor are separated only by a thin glass window.

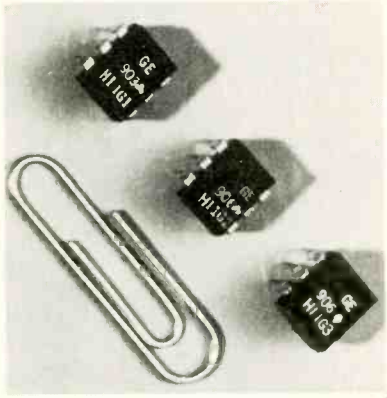
This brings us to the optoisolator parameter know as the *current transfer ratio* (CTR). Simply stated, CTR is the ratio of the input current applied to the isolator's light emitter to the output current generated by the isolator's photodetector. Commercial optoisolators have CTRs ranging from less than 20 percent to more than 500 percent.

Higher isolation voltages are achieved by moving the LED away from the phototransistor, so the CTR is usually inversely proportional to electrical isolation. Note the values given for the illustrated units.

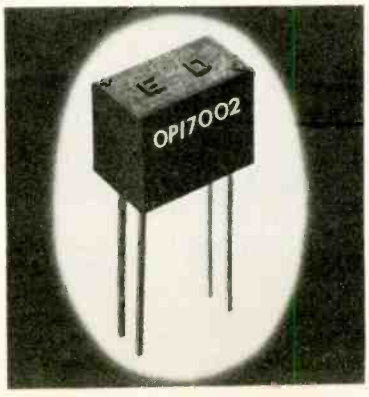
Incidentally, a CTR greater than 100 percent doesn't violate conservation of energy. High CTR results from the inherent gain of a phototransistor or photodarlington detector. Optoisolators using these types of detectors can be considered optoelectronic amplifiers or gain blocks with applications beyond electrical isolation and signal coupling.

Applications. One of the most important applications for optoisolators is high-voltage electrical isolation. There have been instances of accidental electrocution of hospital patients by the very electronic monitoring equipment intended to help them. Fig. 2 shows how a low-cost photodarlington optoisolator can provide electrical isolation between a battery-powered metabolic sensor and a bedside, line-powered monitoring system. This not only reduces shock hazards, but also protects the low-voltage circuits.

Fig. 3 shows how an optoisolator can monitor a high-voltage ac signal and emit a dc output when the high ac voltage is present. This idea can be adapted to monitor a telephone line to detect the ac ring signal.



Three types of optocouplers Made by General Electric in 6-pin mini-DIPs.



Three TRW Optron isolators: above right, 15-kV rating with CTR of 20%; above left, 50-kV, 10% CTR; at right, 6-kV, 400% CTR.

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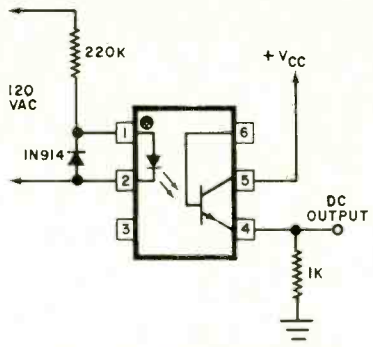

Fig. 3. Use of an optoisolator as a line-voltage monitor.

Fig. 4 shows a telephone-ring detector that was published in Hewlett-Packard Application Note No. 951-1. The circuit provides 2500 volts of isolation between the telephone line and an external circuit. Although it extracts power from ring voltage to forward-bias the LED in the optoisolator, loading of the telephone is minimal. The circuit consumes only about 100 microamperes from a ring signal.

It's important to realize that the voltage-isolating capability of the optoisolator in these and other applications is no greater than the isolation provided by the circuit board upon which the unit is mounted. Solder bridges, bits of wire, nearby metal objects or wire leads can greatly reduce effective isolation. The isolation can also be reduced by surrounding contaminants such as solder flux and moisture.

Special-Purpose Optoisolators. Thanks to optical fibers, it's possible to make optoisolators that can provide complete isolation of potential differences of many millions of volts! These are handy for monitoring high-voltage transmission lines and controlling high-voltage switching circuits.

Another use for optical-fiber isolation is coupling signals between avionic equipment that may be subjected to massive electromagnetic pulses (EMP). The Air Force exposes various of its aircraft to such pulses at several special test facilities near Albuquerque. The pulses simulate the EMP that accompanies a nuclear blast. Conventional shielded cables are not sufficient to prevent the induction of noise spikes by the EMP. Optical fibers, on the other hand, intercept absolutely none of the EMP.

Optical Integrated Circuits. Laboratories in the United States and abroad are doing research and development work on what can be termed "optical integrated circuits." In such circuits, photons play the role that electrons do in conventional circuits, thus making possible faster switching speeds and direct interfacing with optical fibers.

The news releases issued by some of these laboratories would have us believe that the optical IC is a radically new development. Actually, ordinary optoisolators can be considered types of hybridized optical ICs. They have been available for more than 15 years. Nevertheless, optical integrated circuits represent a fascinating new technology, and future installments of this column will keep you posted on new developments.

Reader Mail. Alvin O. Kriegel, Jr. of Beaumont, TX has written to express interest in solid-state gas detectors, particularly those capable of detecting methane. Alvin is a drilling "mud logger" on the Texas gulf coast and is interested in finding natural gas.

In 1968, Figaro Engineering, Inc. introduced a semiconductor gas detector made from sintered tin dioxide (SnO_2). The electrical resistance of SnO_2 decreases when combustible or reducing gases are absorbed by the material. The detector can detect concentrations of a few hundred parts per million of many gases, including methane, ammonia, carbon monoxide and dozens of others.

Figaro manufactures several SnO_2 sensors, all of which require relatively simple drive and sensing electronics. The company's address is 3-7-3, Higashitoyonaka, Toyonaka City, Osaka 560 Japan. I've seen these sensors (they're designated with a TGS prefix) advertised in various technical magazines published in this country, but I cannot find them in electronics buyers' guides.

Alvin and other interested readers might also want to contact Economy Gauge and Instrument Supply (4560 West 34th Street, Houston, TX 77092), which sells many different types of gas detectors. ◇

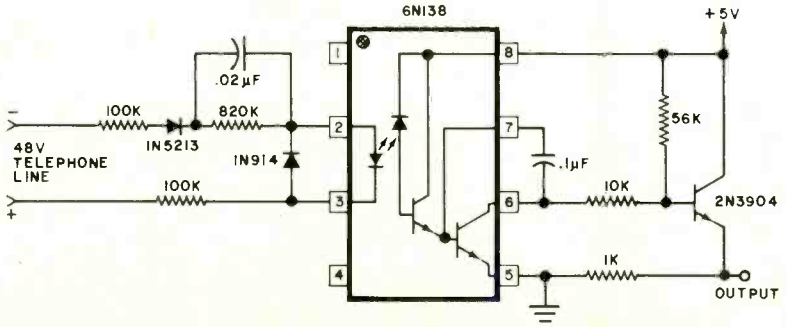

Fig. 4. This telephone-ring detector from Hewlett-Packard provides 2.5 kV of isolation.

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EXPERIMENTER'S CORNER

By Forrest M. Mims

The Polapulse® Wafer Battery

SOME of my relatives own Polaroid SX-70 Land cameras. One reason I look forward to family gatherings is the frequent use these cameras receive on such occasions. It's always nice to see the excellent photos the cameras provide, but perhaps my primary interest lies in the empty film packs, each of which contains a used Polapulse® 6-volt wafer battery. The battery powers the camera's electronics and drive motor.

The Polapulse battery has been deliberately overdesigned by Ray-O-Vac and Polaroid engineers to ensure that it will reliably power the SX-70 camera even under the most demanding circumstances. Probably the worst possible scenario is when all the available emulsions in the SX-70 film pack are exposed in rapid sequence under low-temperature conditions. Overdesigning the Polapulse battery provides plenty of reserve power for rapid-fire photo sessions. This also means that the battery still has plenty of life left in it even after its film-pack carrier has been tossed in the trash.

Recently, Polaroid began selling Polapulse batteries as products in their own right. For $15, one can buy five Polapulse P100 batteries and a plastic holder that has connection wires.

This month, we will take a detailed look at the new Polapulse P100 battery. We will examine the battery's specifications as given in Polaroid's literature, and then look at the characteristics of Polapulse batteries that have been salvaged from discarded SX-70 film packs.

Polapulse Construction. The Polapulse battery utilizes the traditional LeClanche carbon-zinc chemistry in a physical configuration which differs radically from the cylindrical LeClanche cells with which we are all familiar.

The basic building block of the Polapulse has about the same physical dimensions as a playing card and is called a *duplex sheet*. As its name implies, the duplex sheet is a thin conductive card coated on one side with manganese dioxide and on the other with zinc. A single duplex sheet forms one-half of each of two adjacent 1.5-volt cells.

In the Polapulse, four duplex sheets are interspersed with separator layers made from synthetic fibers which have been impregnated with a gelled electrolyte. The conductive layer of the duplex sheet interconnects adjacent cells without the need for solder tabs, welded connections or wires. This provides a very simple, highly reliable, multicell battery.

The top side of the sandwich of cells is covered with an aluminum foil sheet coated on its lower side with zinc. This functions as the battery's negative terminal. The bottom side of the battery is covered with a second aluminum foil sheet coated on its upper surface with manganese dioxide. This becomes the positive terminal.

A paper insulating sheet, which has a square hole for electrical access, is bonded to the positive electrode. A protruding portion of the upper negative electrode is folded over the paper backing so that both electrodes are on the same side of the battery. The multilayer battery is then laminated into a sturdy package by adhesive borders around the perimeter of each separator sheet. A vent prevents excessive gas buildup.

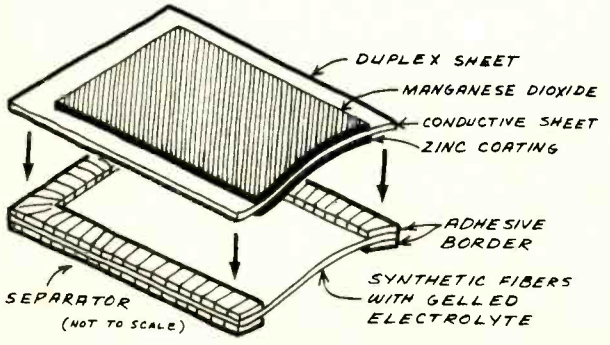

Fig. 1. Two layers in a Polapulse battery.

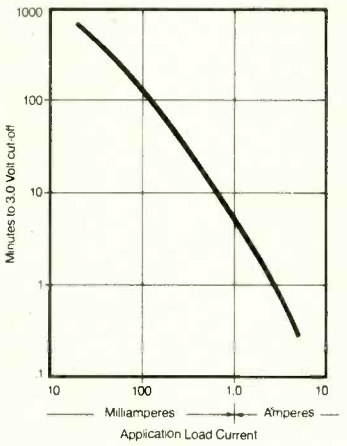

Fig. 2. Capacity (in minutes of time in use) of a Polapulse vs. load current.

Figure 1 shows the construction of the duplex sheet and its orientation with respect to one adjacent separator. The overall dimensions of the Polapulse at this point are 3.73" x 3.04". The battery is a wafer-thin 0.18", and it weighs just under an ounce.

Polapulse batteries intended for use in SX-70 film packs are mounted on a card measuring 3.45" x 4.2" and are secured in place with laminated plastic film. Electrical access to the electrodes is provided by two circular apertures punched in the card.

The paper, plastic and foil construction of the Polapulse probably sounds very flimsy if you have not held one of these batteries in your hand. Actually, however, the battery is surprisingly sturdy. The adhesive bond around its perimeter provides a very rigid frame around the relatively fragile layers which form the battery.

More than 300,000,000 Polapulse batteries have been manufactured for SX-70 film packs. Thanks to the battery's adhesive bond and its protective outer layers, no instances of damage caused by leakage have been reported.

Electrical Specifications. The Polapulse delivers up to 6.8 volts, open circuit. Its useful temperature range is 20° F to 130° F (−7° C to 54° C). The most important feature of the battery is its surprisingly high capacity. For example, a fresh Polapulse can deliver a hefty 26 amperes on an instantaneous basis. After 30 seconds, the current decreases to a still-

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impressive 5 amperes. The current decreases to 2.5 amperes after 60 seconds.

Polaroid has published the following continuous discharge ratings for the Polapulse (3-volt cutoff).

Discharge Current (A)	Discharge Interval (Minutes)	mAH
0.02	690.0	230
0.05	234.0	195
0.10	102.0	170
0.50	14.7	123
1.00	5.7	95
5.00	0.4	33

These data are summarized in the graph of capacity versus load current in Fig. 2. A Polaroid brochure on the Polapulse P100 battery includes the family of constant-current drain curves in Fig. 3. How do these data compare with the performance of other types of batteries? Figure 4 shows plots of

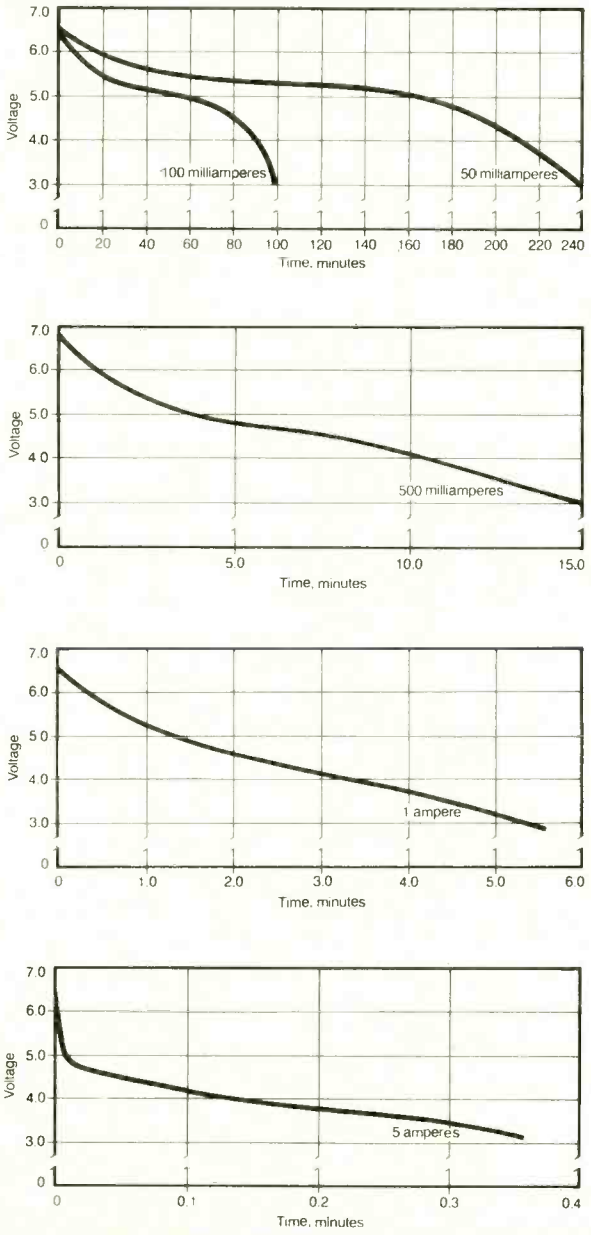

Fig. 3. Constant-current discharge curves for the Polapulse battery showing how the voltage drops off with time for various current drains. Top to bottom, currents are: 50 mA, 100 mA, 500 mA, 1A, and 5 A.

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load current versus voltage for the Polapulse and several conventional batteries. The Polapulse provides superior performance under the conditions specified.

Experimenting with Polapulse. In preparing this column, I evaluated several Polapulse batteries salvaged from discarded film packs about a year ago. The results were fairly impressive, considering the batteries' age and prior use.

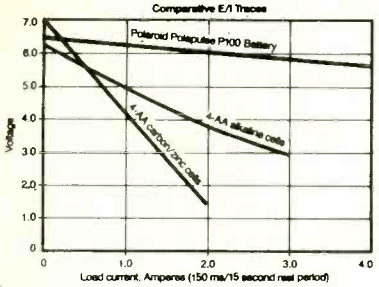

Fig. 4. Comparing the output of the Polapulse with other batteries.

Figure 5, for example, is a graph of one battery's discharge voltage over a period of 30 minutes. The data from which the plot was derived were obtained by connecting a 100-ohm precision resistor across the terminals of the Polapulse. The voltage across the battery was then measured with a DVM at 30-second intervals for the first five minutes, and at 5-minute intervals for the remaining 25 minutes.

The discharge current during this test, discounting that which flowed during the initial 10-second surge, ranged from 47 mA when the battery developed 4.72 volts to 39 mA when battery voltage decreased to 3.9 volts. These discharge currents and output voltages mean that the Polapulse is more than adequate for powering many CMOS circuits. Intermittent operation will result in longer battery life and permit higher discharge rates.

I am particularly interested in emergency lighting. So I was curious to know if a used Polapulse battery would power a

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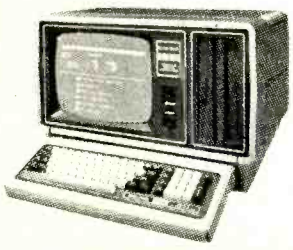

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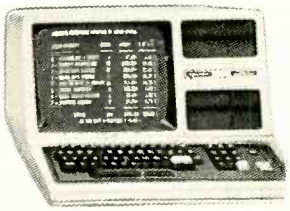

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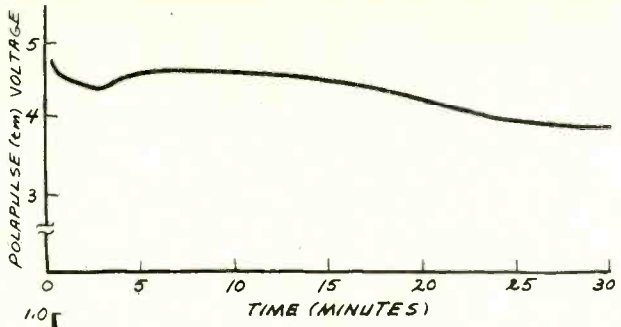

Fig. 5. Discharge curve of a salvaged Polapulse over 30 min.

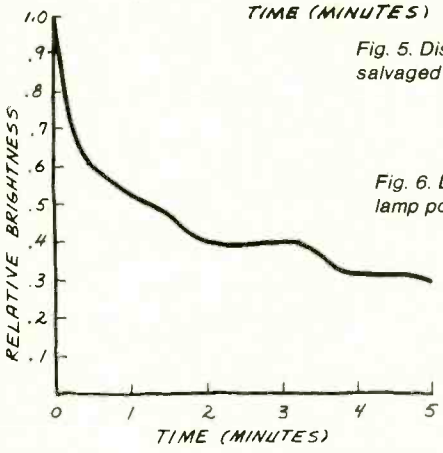

Fig. 6. Light output of a PR-13 lamp powered by a Polapulse.

PR-13 incandescent lamp. This lamp is often used in hand-held lights powered by 6-volt batteries. At 5.5 volts, they drain about 470 mA from the battery.

A quick check with clip leads showed that the Polapulse can easily power a PR-13 lamp at a high level of brightness. To monitor the lamp's output over a period of time, I placed the lamp adjacent to a solar cell whose output was monitored with a milliammeter. Figure 6 shows the results. When the light from the lamp became too dim for practical use, the meter gave a reading of 0.3 mA.

The salvaged Polapulse provided excellent light levels for approximately two minutes and usable light for the next two minutes. Four minutes isn't very long, but intermittent operation would result in even greater overall duration. Considering the compact size of the Polapulse, it makes an ideal power source for a miniature, short-term emergency light for camping trips and bike tours.

Making Connections to the Polapulse. The easiest way to solve the connection problem is to buy a Polapulse holder from a Polaroid dealer. This holder, however, will not accept Polapulse batteries salvaged from film packs. For these, you can use alligator clips to make temporary connections. Make sure the clips don't touch one another and don't penetrate the battery's protective covering. For best results, wrap a layer of vinyl electrical tape around one-half of each clip. The exposed half of each clip should be placed over the aluminum contact terminals of the battery.

Incidentally, you can reduce the size of salvaged Polapulse batteries by removing the outer protective envelope. Place the battery on a work surface with its printed side down. Then use a hobby knife to slit the clear plastic covering along the edge of the battery. This procedure will not harm the battery, but it will reduce its size.

For More Information. You can obtain more information about the Polapulse P100 wafer battery from the Polaroid Corporation's Commercial Battery Division (784 Memorial Dr., Cambridge, MA 02139). Ask for a specification sheet. ◇

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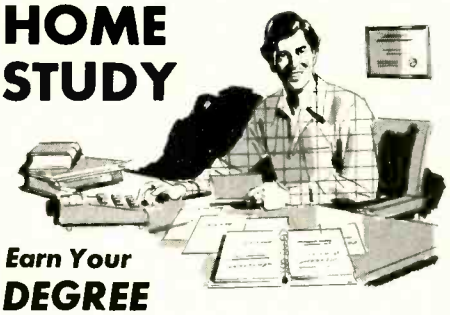

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DX LISTENING

By Glenn Hauser

Revolution by Radio Revisited

SCARCELY a sesquiyear after *Radio Sandino* played such an important role in the Nicaraguan revolution, El Salvador gained a shortwave clandestine station of its own. Previously reported on mediumwave only, then occasionally on 7500 and 7900 kHz, *Radio Liberación*, "the official voice of the Farabundo Martí National Liberation Front" (FMLN), began regular broadcasts on 8243.1 kHz, January 10. This coincided with the rebels' "final offensive," which was a bit too optimistic.

Radio Liberación could be heard clearly in North America, as early as 2245 GMT, and as late as 1400. The announced schedule changed from day to day, but the most reliable times to hear the station were around 1200 and 0100 GMT. On at least one occasion, *Radio Liberación* stayed on the air all night. Coinciding with setbacks the rebels suffered at the hands of government forces ten days later, the station disappeared for a week. There were also frequent breaks in transmission.

As is customary with clandestine outlets, it claimed to broadcast from "somewhere in El Salvador", though it seems far more likely to have operated from secure territory across the Gulf of Fonseca in Nicaragua, which openly supported the FMLN movement. In any event, the sound of *Radio Liberación* was very reminiscent of *Radio Sandino* when it was clandestine—fever-pitch exhortations to rise up and overthrow the government, Cuban revolutionary music, speeches by *comandantes*, explicit "revolutionary orientation" on how to make Molotov cocktails and contact bombs, calls for general strikes, and bursts of machine-gun fire. During its first few days on the air, *Radio Liberación* suffered only incidental interference from maritime traffic, which is authorized to use the 8-MHz band; but then there appeared deliberate interference including CW transmissions and a continuous carrier 1 kHz away. The only frequency announced was "8.2 MHz between the 31 and 41 meter bands," leaving the station wide latitude for variation. Should the fate of El Salvador still be undecided as you read this, you might still hear *Radio Liberación* somewhere in this range. However, in late January, another pro-FMLN station, *Radio Venceremos* was being heard with one-hour broadcasts around 1200 and 2300 GMT on weaker frequencies varying widely between 7025 and 7075 kHz; and by Feb. 8, Radio Liberación was no longer on 8243.

The government station, *YSS*, had been irregularly active on shortwave as well, but after two weeks of silence decided it had better get back on the air Jan. 12 to counter the "final offensive." Unfortunately, the only frequency of *YSS*, 9553½ kHz, has always been subject to heavy interference from other "legal" stations within a crowded band. During this period, all Salvadorian stations (AM and FM) not under rebel control were required to relay *YSS*, which identified only as the "Gran Cadena Nacional de Radiodifusión". In contrast to the revolutionary uproar on *Radio Liberación, YSS* tried to keep the populace calm with elevator music and much calmer patriotic exhortations to repel all foreign invaders. On Jan. 14, we learned from *YSS* that the country had gone on "summer time" (though it's a tropical country, it's still officially winter in the Northern Hemisphere) of EST instead of CST. This also brought about some changes in the transmission schedule of *Radio Liberación*. YSS could be heard best around 0100-0230 GMT, when *HCJB* opened on 9555 until a late closing at 0700, and from 1100 GMT. Also penetrating well into North America is the split-frequency mediumwave outlet of *YSS*, on 655 kHz (halfway between *WSM* and *WNBC* or Mexico City).

It's also possible to *see* El Salvador television, best along the U.S. Gulf Coast and 300 km inland, if you have a clear channel 2, 4 or 6, during a sporadic-E opening from that direction. Look for test patterns or call slides of YSR-TV, YSU-TV and YSLA-TV, respectively, on those channels.

Several other shortwave stations carried lots of news about the fighting in El Salvador—*Radio Habana Cuba*, the Costa Ricans *Radio Reloj* on 6006 kHz,

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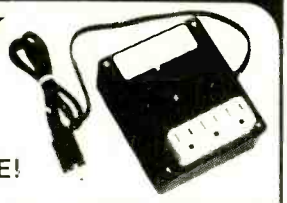

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dx listening

and *Radio Noticias del Continente* on 9615 (the latter suffering severe jamming at times); and *La Voz de Nicaragua* on 5950. Its mediumwave counterpart, *Radio Sandino*, can often be heard by those in a position to null out *WSB* on the same frequency, 750 kHz. Those limited to English language news could tune *Radio Free Grenada* at 2300 on 15045; or *Radio Habana Cuba at* 0100 and 0230 on 11930, 0330 and 0500 on 11760; 0630 on 9525.

Meanwhile, conflict in neighboring Guatemala had an impact on shortwave broadcasting and shortwave listening. The Toronto *Globe & Mail* reported that a station operated by a 400-year-old church from the shores of beautiful Lake Atitlán, was destroyed by the Guatemalan army Nov. 3, shortly after the director of *La Voz de Atitlán*, Gáspar Culán Yataz, had been kidnapped and badly wounded. The station had served the predominantly Indian audience of the area, advocating human rights. It was often heard in North America on 2390 kHz, and many DX listeners have verifications signed by Sr. Culán. (This is not to be confused with a Mexican on the same frequency, *Radio Huayacocotla*, which benefits from this tragedy by a reduction in interference.) Our thanks to Syd Osterman for this report.

Country by Country. *Austria*. One of the better DX programs is "Austrian Shortwave Panorama," Sundays from *ORF*, at 0900 GMT on 9770, 1235 on 21655, 1805 on 15560. Reception is best in eastern North America. Included are frequent contributions from yours truly, such as unhurried DX news, and background features (for example, tapes of *Radio Liberación*.)

Cook Islands may be among the first countries to appear on the new 22-meter shortwave broadcast band (13.6-13.8 MHz) agreed to at the 1979 World Administrative Radio Conference. Richard Wood reports that Radio Cook Islands is planning to register a frequency on this band to boost daytime coverage.

Gabon. Africa Number One returned to the air Feb. 4, but to everyone's surprise, on the 60-meter band where it had never operated before. Its 500-kW transmitter put powerful signals into North America until sign-off at 2305 GMT and from sign-on at 0500—all in French but with slick European production. *ANO* tried various frequencies between 4808 and 4812 kHz.

Iran & Afghanistan (*to* rather than *from*). While anyone's first guess as to the location of clandestine stations opposing the Khomeini regime in Iran would be Iraq, this has been confirmed by the careful monitoring of Ernest Behr in Kenora, Ont., and the not-so-

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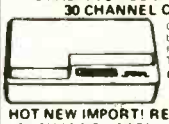

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dx listening

careful operation of the transmitters involved. Ernie found that Farsi programs of *Free Voice of Iran*, another clandestine called *Radio Iran*, and of *Radio Baghdad*'s Persian service all used the same frequency (with pauses in between). This wouldn't necessarily be positive proof, except the frequency varied from day to day between 9560 and 9580 kHz; and there were no detectable breaks in transmission. Two other clandestines, *Radio Vatan* (Homeland), for Iran, and *Radio Mujahidin*, for Afghanistan, use different frequencies but their schedules are coordinated in such a way that it seems likely they share another site, more distant (since higher frequencies are used), and for political reasons, Egypt is the most likely source.

Korea, North. Listening to *Radio P'yongyang* may be rather tedious, but just reading through their program schedule can be rather entertaining. Thanks to Bill Bergadano for forwarding it to us. Monday, "20 Year Long Anti-Japanese Revolt Under Red Sunrays" (repeated Thursday); Tuesday, "Travelogues on a Beautiful Place" (repeated Sunday); Wednesday, "Bio: Kim Il Sung" and "Korea in the Eyes of Foreigners"; Thursday, "The Juche Idea is the Beacon of Revolution"; Friday, "Cholema Korea Accelerates the Juche" and "Modernization & Scientification of the National Economy"; Saturday, "A Great Man" and "Mailbag"; Sunday, Music. So far, I have not determined just when the shows occur within 110-minute-long transmissions, and may never do so. It should be noted, however, that since the last schedule we received, there has been a marked decline in the number of program titles involving Our Great Leader Kim Il Sung (known familiarly among aficionados as "OGLKIS").

USSR. Radio Moscow isn't the only station emanating from the Soviet capital. Entirely distinct to the Soviet mind is *Radio Station Peace & Progress*, "the voice of Soviet public opinion", which has some half-hour English broadcasts not directed to North America, but which you might encounter by tuning around the bands at 1300, 1330, 1430, 1530 and 1630 GMT. It generally takes a line even harder than *Radio Moscow*, but has been known to include some readings from great Russian literature for general interest.

But there is still another Moscow shortwave station, which does not appear in such references as the *World Radio-TV Handbook*. It may be debatable whether it's a broadcast station, but other stations doing the same thing are listed. To the CIA it is, since it appeared in *Broadcasting Stations of the World* (last published in 1974). It is the Soviet

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News Agency TASS, which broadcasts "news" in Russian at dictation speed (presumably for remote areas of the USSR or embassies abroad still not tied in by more sophisticated methods) on an unknown schedule. DX listener Paul Kowalski in Milwaukee ran across this last winter on 9850 kHz around 0630-0800 GMT. During the lengthy pauses there would be the sound of a clock ticking, once per second. This and four other channels are listed by the CIA—7420, 9160, 9490 and 9880 kHz, each with the relatively low power of 15 or 50 kW.

Updating items in our January and March columns: The Cuban clandestine serving Africa may be in Angola instead of Ethiopia. *Radio Patagonia Chilena* has been reported on 6105 instead of 6080. "Malta Calling" should have been mentioned in the item on Malta—it's Saturday 0700-0800 on 9670. *Rádio Renascença* has been operating on 11745 at 1830-2030. The *VOA* relay on Antigua is to be mediumwave only; *Radio Free Grenada* refers to it as "Free Caribbean."

English-Language Listings: The following changes and additions should be made to the listings that appeared in the April issue. To make the corrections as concise as possible, only the GMT, station name, and frequency correction are given.

1200-1230, R. Japan, 9505, ex-1000-1030, now 1000-1015
1200-1230, R. Tashkent, 6025, 9540 (until late April)
1200-1255, R. Peking, 9820 (until late April)
1230-1415, TWR, Bonaire, 11815, not 15255
1400-1500, V. of Indonesia, 11790, ex-11715; 15150, ex-15200
1400-1500, R. Malaysia Sarawak, 4950
1535-1545, V. of Greece, 21455 not 21555
1600-1630, R. Portugal, 21475, ex-21530 (exc. Sun.)
1600-1800, AFRTS, add 17765
1800-1900, V. of Vietnam, 15010
1800-2200, AFRTS, add 17765, 21570
1900-1930, R. Japan, 15270 (ex-1400-1530, now 1400-1415)
2000-2030, Kol Israel, 17645, 15582, 12025, 11637; not 15105, 9815, 9425
2100-2130, R. Algiers, 15365, ex-15307
2100-2155, R. RSA, 17780, ex-17775
2130-2200, R. Sophia, 11860, 11920
2200-2215, R. Japan, 11955, ex-11790 (via Portugal)
2200-2300, CBC Radio, 11925, not 11780
2230-2300, R. Nacional, Angola, 11955 (Mon.-Fri.)
2230-2300, Kol Israel, add 12025
2300-2330, R. Vilnius, 17870, 15240, 15100, 11790, 11770
2300-2400, AFRTS, 11790, not 15430
2300-2400, WYFR, 9535
2345-2445, R. Japan, 15430, ex-15270
0000-0100, R. Sofia, 15330, 11830
0000-0500, FEBC, Philippines, delete 17810
0035-0230, HCJB, Ecuador, 15360, ex-15355
0100-0200 AFRTS, 15345, 15330, not 6030
0200-0255, R. RSA, 5980
0200-0430, AFRTS, add 9755
0300-0330, R. Portugal, 6025. ex-6185
0300-0730, VOA, 15240 not 15245; 15330 from 0600 only
0430-0500, R. Sofia, 11860
0430-0600, AFRTS, add 17765, 15330, 9755
0500-0515, Kol Israel, 17710, 15582, not 11960, 9009
0500-0515, R. Japan, 15430, ex-15270
0500-0600, TWR, Bonaire, 9755, 800
0500-0800, R. Nigeria, Kaduna, 4770 (not all English)
0530-0545, R. Niamey, Niger, 5020
0600-0615, R. Japan, 15430, ex-15270
0600-0700, AFRTS, add 9755
0600-0730, HCJB, Ecuador, 15225, ex-9760, ex-0700-0830
0700-0715. R. Japan, 15430 ex-15270; 11770 ex-15130 via Portugal
0700-0720, R. Netherlands, 25650, 21480, 11720
0945-1215, R. New Zealand, delete 6105. ◇

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CIRCLE NO. 46 ON FREE INFORMATION CARD

PROJECT OF THE MONTH

By Forrest M. Mims

Model-Railroad Crossing Light

MODEL railroad enthusiasts can add a touch of realism to their layout with this flashing signal light. It includes two red LEDs which begin flashing alternately when a train approaches and continue flashing until the train has passed. The signal does so no matter which direction the train is moving.

Circuit Description. Figure 1 is the schematic diagram of the crossing light. Phototransistors *Q1* and *Q2* are installed on either side of the protected crossing as shown in Fig. 2. Both transistors are illuminated by a dc-powered light source. A single incandescent lamp can illuminate both *Q1* and *Q2*, or individual lamps or infrared LEDs can be used. Fig. 3 shows how to connect a pair of infrared emitters so that a forward current of 30 mA will flow.

When both *Q1* and *Q2* are illuminated, the inverting inputs of both op amps are slightly above ground. The outputs of *IC1* and *IC2* are at +9 volts. These outputs are applied to NAND *IC3A* whose output is at logic 0 under these conditions. This disables the dual LED flasher comprising gates *IC3B* and *IC3C*. Gate *IC3D* turns off *LED2* when the flasher is disabled. If *LED2* were connected directly to the output of *IC3C*, it would glow continuously when the flasher was disabled.

Should the light path between the light source(s) and either *Q1* or *Q2* be blocked by an arriving train, the output of gate *IC3A* goes high. This allows the dual flasher to oscillate, and LEDs 1 and 2 begin flashing alternately. The flasher continues to oscillate as long as either *Q1* and *Q2* or both are blocked. When the train has passed and light again strikes both *Q1* and *Q2*, the flasher circuit is again disabled.

Using the Circuit. Operation of the circuit is fairly straightforward. If the flasher fails to operate properly, substitute a 0.1-μF disc capacitor for *C1*. If the LEDs then flicker rapidly when the flasher is enabled, the electrolytic capacitor you previously used as *C1* is the culprit. Reconnect it to the circuit, making sure to observe its polarity. If the LEDs still fail to flash, use another electrolytic capacitor.

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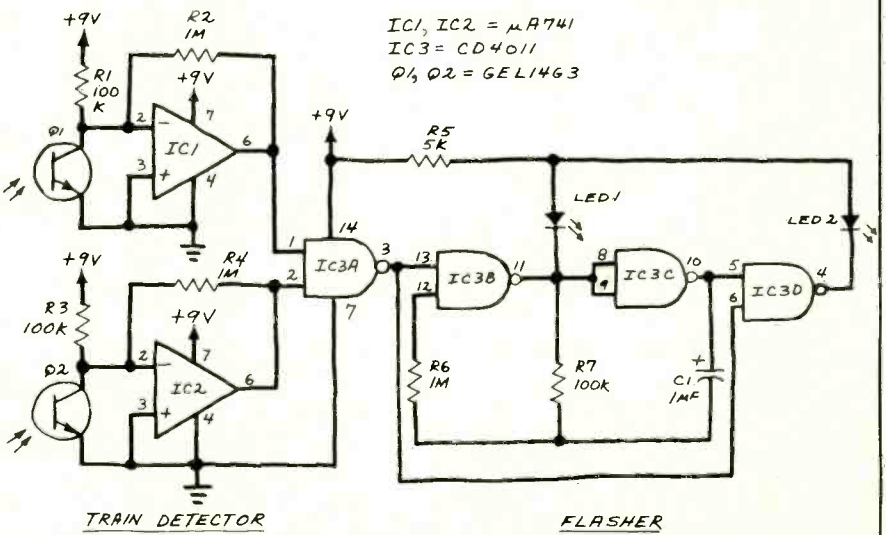

Fig. 1. Schematic diagram of a circuit for a model railroad crossing signal light.

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3242	10.00	4015	1.15	4072	.35	74C02	.39	74LS14	1.25	74LS151	.79	74LS273	1.75
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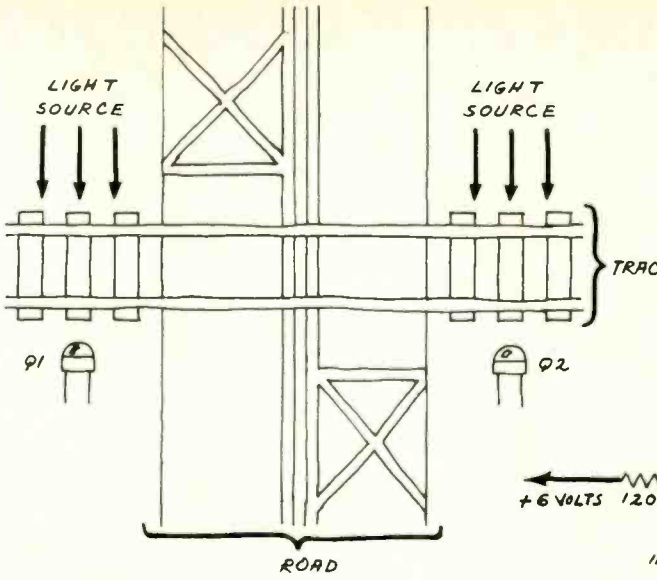

Fig. 2. Suggested positioning for phototransistors for railroad crossing lights.

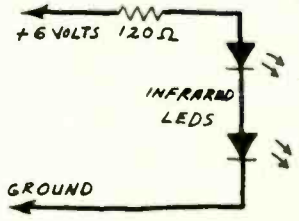

Fig. 3. A possible infrared illuminator circuit.

lighted, you may need to place light shields or infrared bandpass filters over the apertures of the phototransistors. One-inch lengths of quarter-inch black heat-shrinkable tubing work well. Unexposed, processed pieces of Kodachrome or Agfachrome color slide film make excellent, inexpensive infrared bandbass optical filters. They can be secured with glue.

Be sure the distance between the two phototransistors is either greater or less than the length of one of your pieces of rolling stock. Otherwise, the warning signal might be deactivated if both phototransistors are simultaneously illuminated by light passing between adjacent cars. Also, install the phototransistors at heights low enough so that the light paths will be blocked by low-lying rolling stock such as flatcars.

Going Further. For best results, you should install the two LEDs in a miniature replica of a signal-crossing light. Avoid the temptation of increasing the brightness of the LEDs by reducing resistance of *R5*. If you want the LEDs to flash more brightly, parallel two of the gates in a second 4011 to drive each LED. You can then use series resistors of, say, 270 ohms to limit the forward current through each LED to approximately 25 mA. This will result in plenty of brightness.

Referring again to Fig. 1, note that the outputs of *Q1* and *Q2* are compared and then the result put through a NAND gate. Separate op amps are used to reduce the chance of stray noise pick-up. You can combine the two op amps into a single chip to reduce the parts count by using a dual op amp. A more efficient modification, however, is to eliminate one op amp entirely by wire-ANDing the outputs of the phototransistors.

Fig. 4 shows how this is done. Phototransistors *Q1* and *Q2* are connected in series. NAND gate *IC3A* of Fig. 1 is converted to an inverter to achieve the NAND operation required for proper control of the flasher circuit.

Flip-flops and timer chips can also be used to make railroad crossing lights. Perhaps you can use them to design custom circuits on your own. ◇

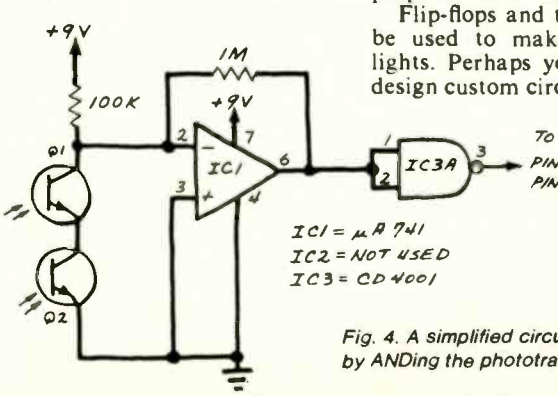

Fig. 4. A simplified circuit made by ANDing the phototransistor outputs.

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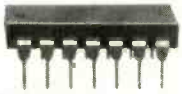

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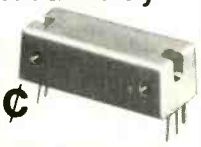

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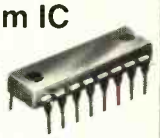

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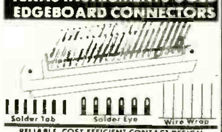

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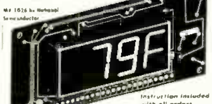

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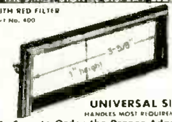

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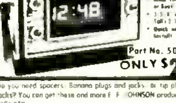

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X006	4.000	.200	HC-6/U	2.95
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74LS22	.34	74LS175	1.09	74LS22	.34	74LS175	1.09
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74LS28	.39	74LS191	1.31	74LS28	.39	74LS191	1.31
74LS30	.35	74LS192	.88	74LS30	.35	74LS192	.88
74LS32	.39	74LS193	.98	74LS32	.39	74LS193	.98
74LS33	.54	74LS194	1.80	74LS33	.54	74LS194	1.80
74LS37	.78	74LS195	1.39	74LS37	.78	74LS195	1.39
74LS38	.39	74LS196	.82	74LS38	.39	74LS196	.82
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74LS51	.35	74LS242	1.89	74LS51	.35	74LS242	1.89
74LS54	.35	74LS243	1.89	74LS54	.35	74LS243	1.89
74LS55	.32	74LS244	1.79	74LS55	.32	74LS244	1.79
74LS73	.44	74LS245	2.89	74LS73	.44	74LS245	2.89
74LS74	.48	74LS251	1.32	74LS74	.48	74LS251	1.32
74LS75	.58	74LS253	.89	74LS75	.58	74LS253	.89
74LS76	.50	74LS257	.89	74LS76	.50	74LS257	.89
74LS78	.59	74LS258	.89	74LS78	.59	74LS258	.89
74LS83	.90	74LS259	2.89	74LS83	.90	74LS259	2.89
74LS85	1.23	74LS260	.68	74LS85	1.23	74LS260	.68
74LS86	.45	74LS266	.68	74LS86	.45	74LS266	.68
74LS90	.70	74LS273	1.69	74LS90	.70	74LS273	1.69
74LS92	.82	74LS275	3.39	74LS92	.82	74LS275	3.39
74LS93	.71	74LS279	.59	74LS93	.71	74LS279	.59
74LS95	1.11	74LS283	1.03	74LS95	1.11	74LS283	1.03
74LS96	.86	74LS290	1.25	74LS96	.86	74LS290	1.25
74LS107	.43	74LS293	1.89	74LS107	.43	74LS293	1.89
74LS109	.49	74LS295	1.09	74LS109	.49	74LS295	1.09
74LS112	.48	74LS298	1.24	74LS112	.48	74LS298	1.24
74LS113	.48	74LS352	1.59	74LS113	.48	74LS352	1.59
74LS114	.55	74LS353	1.59	74LS114	.55	74LS353	1.59
74LS122	.55	74LS363	1.39	74LS122	.55	74LS363	1.39
74LS123	.99	74LS365	.99	74LS123	.99	74LS365	.99
74LS134	2.99	74LS366	.99	74LS134	2.99	74LS366	.99
74LS125	.99	74LS367	.99	74LS125	.99	74LS367	.99
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74LS132	.69	74LS373	1.85	74LS132	.69	74LS373	1.85
74LS136	.58	74LS374	1.81	74LS136	.58	74LS374	1.81
74LS138	.79	74LS377	1.48	74LS138	.79	74LS377	1.48
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7432	.29	7491	.69	74173	1.39
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SN7403N	.25	SN7474N	.35	SN74161N	.89
SN7404N	.25	SN7475N	.49	SN74162N	.89
SN7405N	.29	SN7476N	.35	SN74163N	.89
SN7406N	.35	SN7479N	5.00	SN74164N	.89
SN7407N	.35	SN7480N	.50	SN74165N	.89
SN7408N	.29	SN7482N	.99	SN74166N	1.25
SN7409N	.29	SN7483N	.69	SN74167N	2.79
SN7410N	.25	SN7485N	.89	SN74170N	1.95
SN7411N	.29	SN7486N	.35	SN74172N	4.95
SN7412N	.35	SN7489N	1.75	SN74173N	1.39
SN7413N	.40	SN7490N	.49	SN74174N	.99
SN7414N	.69	SN7491N	.59	SN74175N	.89
SN7416N	.29	SN7492N	.45	SN74176N	.79
SN7417N	.29	SN7493N	.45	SN74177N	.79
SN7420N	.25	SN7494N	.69	SN74179N	1.49
SN7421N	.29	SN7495N	.69	SN74180N	.79
SN7422N	.45	SN7496N	.69	SN74181N	2.25
SN7423N	.29	SN7497N	3.00	SN74182N	.79
SN7425N	.29	SN74100N	1.49	SN74184N	2.49
SN7426N	.29	SN74107N	.35	SN74185N	2.49
SN7427N	.25	SN74109N	.39	SN74190N	1.25
SN7428N	.49	SN74116N	1.95	SN74191N	1.25
SN7430N	.25	SN74121N	.39	SN74192N	.89
SN7432N	.29	SN74122N	.55	SN74193N	.89
SN7437N	.25	SN74123N	.59	SN74194N	.89
SN7438N	.40	SN74125N	.49	SN74195N	.69
SN7439N	.25	SN74126N	.49	SN74196N	.89
SN7440N	.20	SN74132N	.75	SN74197N	.89
SN7441N	.89	SN74136N	.75	SN74198N	1.49
SN7442N	.59	SN74141N	.99	SN74199N	1.49
SN7443N	1.10	SN74142N	3.25	SN74221N	1.25
SN7444N	1.10	SN74143N	3.49	SN74251N	.99
SN7445N	.89	SN74144N	3.49	SN74276N	1.95
SN7446N	.79	SN74145N	.79	SN74279N	.79
SN7447N	.69	SN74147N	1.95	SN74283N	1.49
SN7448N	.79	SN74148N	1.29	SN74284N	3.95
SN7450N	.20	SN74150N	1.25	SN74285N	3.95
SN7451N	.20	SN74151N	.69	SN74365N	.69
SN7453N	.20	SN74152N	.69	SN74366N	.69
SN7454N	.20	SN74153N	.79	SN74367N	.69
SN7459A	.25	SN74154N	1.25	SN74368N	.69
SN7460N	.20	SN74155N	.79	SN74390N	1.49
SN7470N	.29			SN74393N	1.49

74LS

Part	Price	Part	Price	Part	Price
74LS00	.29			74LS192	1.15
74LS01	.29			74LS193	1.15
74LS02	.29	74LS92	.75	74LS194	1.15
74LS03	.29	74LS93	.75	74LS195	1.15
74LS04	.35	74LS95	.99	74LS197	1.19
74LS05	.35	74LS96	1.15	74LS221	1.19
74LS08	.29	74LS107	.45	74LS240	1.95
74LS09	.35	74LS109	.45	74LS241	1.95
74LS10	.29	74LS112	.45	74LS242	1.95
74LS11	.75	74LS113	.49	74LS243	1.95
74LS12	.35	74LS114	.49	74LS244	1.95
74LS13	.59	74LS122	.89	74LS245	2.95
74LS14	.99	74LS123	1.25	74LS247	1.19
74LS15	.35	74LS125	.89	74LS248	1.19
74LS20	.29	74LS126	.55	74LS249	1.19
74LS21	.35	74LS132	.99	74LS251	1.49
74LS22	.35	74LS133	.89	74LS253	.99
74LS26	.35	74LS136	.49	74LS257	.89
74LS27	.35	74LS138	.89	74LS258	.99
74LS28	.35	74LS139	.89	74LS260	.69
74LS30	.29	74LS151	.89	74LS266	.69
74LS32	.35	74LS153	.89	74LS273	1.95
74LS33	.59	74LS154	1.75	74LS279	.75
74LS37	.45	74LS155	1.19	74LS283	1.09
74LS38	.49	74LS156	1.19	74LS290	.99
74LS40	.35	74LS157	.89	74LS293	.99
74LS42	.89	74LS158	.99	74LS298	1.25
74LS47	.89	74LS160	1.15	74LS352	1.29
74LS48	1.15	74LS161	1.15	74LS353	1.29
74LS49	1.15	74LS162	1.15	74LS365	.75
74LS51	.29	74LS163	1.15	74LS366	.75
74LS54	.29	74LS164	1.25	74LS367	.75
74LS55	.29	74LS165	1.25	74LS368	.75
74LS73	.45	74LS168	1.19	74LS373	1.95
74LS74	.45	74LS169	1.19	74LS374	1.95
74LS75	.59	74LS170	2.49	74LS375	.89
74LS76	.45	74LS173	1.39	74LS386	.69
74LS78	.49	74LS174	.99	74LS393	2.49
74LS83	.89	74LS175	.99	74LS399	2.49
74LS85	1.25	74LS181	2.95	74LS670	2.49
74LS86	.45	74LS190	1.25	81LS95	1.95
74LS90	.59	74LS191	1.25	81LS97	1.95

74S

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

* LIMITED AVAILABILITY ON THESE PROMS

CA—LINEAR

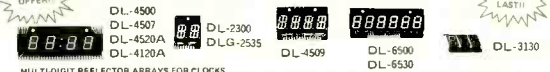
Part	Price	Part	Price	Part	Price
CA3013H	2.15			CA3089N	3.75
CA3023H	3.25			CA3096N	3.95
CA3039H	1.35			CA3130H	1.39
CA3046N	1.30	CA3081N	2.00	CA3140H	1.25
CA3059N	3.25	CA3082N	2.00	CA3160H	1.25
CA3060N	3.25	CA3083N	1.60	CA3401N	.59
CA3080H	1.25	CA3086N	.85	CA3600N	3.50

CD—CMOS

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

LITRONIX DISPLAY SALE

LIMITED OFFER!! — WHILE THEY LAST!!



MULTI-DIGIT REFLECTOR ARRAYS FOR CLOCKS

PART NUMBER	CHAR. HT (IN.)	POLARITY	DESCRIPTION	LIGHT OUTPUT (MCD) TYP	MIN	@mA	FORWARD VOLTAGE SEGMENT (V) I_F = 20mA TYP	MAX	CONTINUOUS FORWARD CURRENT PER SEGMENT (mA) MAX	PRICE
DL 4500 (Red)		C.C. MPX		8	5					2.49
DL 4507 (Red)				—	1.0					2.49
DLO-4507 (orng)	50	C.C. non MPX	4 Digit 7 Segment With Colon And Auxiliary Indicators	8	5	10	1.7	2.0	30	4.95
DLG 4507 (grn)										4.95
DL-4520A (red)										2.49
DL 4120A (red)	1.0	C.C. non MPX		15	8		3.4	4.0		4.95

MULTI-DIGIT REFLECTOR ARRAYS

PART NUMBER	CHAR. HT (IN.)	POLARITY	DESCRIPTION	TYP	MIN	@mA	TYP	MAX	MAX	PRICE
DL 2300 (Red)	30	C.C. MPX	7 Seg. 2 Digit D.P. Right	2.6	1.1	20	1.7	2.0	30	.99
DLG-2535 (green)	50	C.A. MPX	8 Seg. 2 Digit		2.5	20		3.5	25	1.49
DL-4509 (Red)	50	C.C. MPX	8 Seg. 4 Digit D.P. Right	8	5	10	1.7	2.0	30	2.49
DL-6500 (Red)	50	C.C. MPX	7 Seg. 6 Digit D.P. Right	8	5	10	1.7	2.0	30	2.95
DL-6530 (Red)	50	C.A. MPX	7 Seg. 6 Digit D.P. Right	.8	5	10	1.7	2.0	30	2.95
DL-3130 (Red)	1.0	C.A. MPX	7 Seg. 3 Digit D.P. Right	1.6	1.0	10	3.4	4.0	30	3.95

DISCRETE LEDS

XC556R	.200"	red	5/$1	MV50	.085"	red	6/$1	XC111R	.190"	red	5/$1
XC556G	.200"	green	4/$1	XC209R	.125"	red	5/$1	XC111G	.190"	green	4/$1
XC556Y	.200"	yellow	4/$1	XC209G	.125"	green	4/$1	XC111Y	.190"	yellow	4/$1
XC556C	.200"	clear	4/$1	XC209Y	.125"	yellow	4/$1	XC111C	.190"	clear	4/$1
XC22R	.200"	red	5/$1	XC526R	.185"	red	5/$1				
XC22G	.200"	green	4/$1	XC526G	.185"	green	4/$1				
XC22Y	.200"	yellow	4/$1	XC526Y	.185"	yellow	4/$1				
MV10B	.170"	red	4/$1	XC526C	.185"	clear	4/$1				

XC556 RED LED, METAL MTG. HDW. 2-4" LEADS.

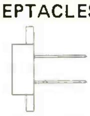
RL-2 . . $.39 ea. or 3/$1.00

DISPLAY LEDS

C.A. — Common Anode   C.C. — Common Cathode

Type	Polarity	Ht	Price	Type	Polarity	Ht	Price
MAN 1	C.A.—red	.270	2.95	DLG507	C.A.—green	.500	1.25
MAN 2	5x7 D.M.—red	.300	4.95	DL704	C.C.—red	.300	1.25
MAN 3	C.C.—red	.125	.25	DL707	C.A.—red	.300	1.25
MAN 52	C.A.—green	.300	1.25	DL728	C.C.—red	.500	1.49
MAN 54	C.C.—green	.300	1.25	DL741	C.A.—red	.600	1.25
MAN 71	C.A.—red	.300	.75	DL746	C.A.—red ± 1	.630	1.49
MAN 72	C.A.—red	.300	.75	DL747	C.A.—red	.600	1.49
MAN 74	C.C.—red	.300	1.25	DL750	C.C.—red	.600	1.49
MAN 82	C.A.—yellow	.300	.49	DLO847	C.A.—orange	.800	1.49
MAN 84	C.C.—yellow	.300	.99	DLO850	C.C.—orange	.800	1.49
MAN 3620	C.A.—orange	.300	.49	DL33B	C.C.—red	.110	.35
MAN 3630	C.A.—orange ± 1	.300	.99	FND358	C.C. ± 1	.357	.99
MAN 3640	C.C.—orange	.300	.99	FND359	C.C.	.357	.75
MAN 4610	C.A.—orange	.400	.99	FND503	C.C. (FND500)	.500	.99
MAN 6610	C.A.—orange—DD	.560	.99	FND507	C.A. (FND510)	.500	.99
MAN 6630	C.A.—orange ± 1	.560	.99	HDSP-3401	C.A.—red	.800	1.50
MAN 6640	C.C.—orange—DD	.560	.99	HDSP-3403	C.C.—red	.800	1.50
MAN 6650	C.C.—orange ± 1	.560	.99	5082-7751	C.A., R.H.D.—red	.430	1.25
MAN 6660	C.A.—orange	.560	.99	5082-7760	C.C., R.H.D.—red	.430	1.75
MAN 6710	C.A.—red—DD	.560	.99	5082-7300	4x7 sgl. dig. RHD	.600	22.00
MAN 6750	C.C.—red ± 1	.560	.99	5082-7302	4x7 sgl. dig. LHD	.600	22.00
MAN 6780	C.C.—red	.560	.99	5082-7304	Overnge. char. (±1)	.600	19.95
DLO304	C.C.—orange	.300	1.25	4N28	Photo Xsistor Opto-Isol.		.99
DLO307	C.A.—orange	.300	1.25	LIT-1	Photo Xsistor Opto-Isol.		.69
DLG500	C.C.—green	.500	1.25	MOC3010	Optically Isol. Triac Driver		1.25

SOCKETS — Test TEXTOOL Sockets — RECEPTACLES



ZERO INSERTION FORCE

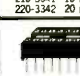
* Nickel Boron Plating
* G.F. PSF Plastic Body
* For testing IC's

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

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

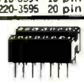
Part No.	Pins	Price	Part No.	Pins	Price
214-3592	14 pin	9.75	222-3596	22 pin	12.95
216-3593	16 pin	9.95	224-3597	24 pin	12.75
218-3594	18 pin	10.95	228-3598	28 pin	13.95
220-3595	20 pin	11.95	240-3599	40 pin	15.95

LOW PROFILE (TIN) SOCKETS



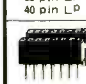
	1-24	25-49	50-100
8 pin LP	.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)



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

SOLDERTAIL (GOLD) STANDARD



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

WIRE WRAP SOCKETS (GOLD) LEVEL #3

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

1/4 WATT RESISTOR ASSORTMENTS – 5%

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

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INTERSIL

Part No.	Function	Price
7045IPI	CMOS Precision Timer	14.95
7045EV/Kit*	Stopwatch Chip, XTL	22.95
7106CPL	3½ Digit A/D (LCD Drive)	16.95
7106EV/Kit*	IC, Circuit Board, Display	34.95
7107CPL	3½ Digit A/D (LED Drive)	15.95
7107EV/Kit*	IC, Circuit Board, Display	28.95
7116CPL	3½ Digit A/D LCD Dis. HLD.	18.95
7117CPL	3½ Digit A/D LED Dis. HLD.	17.95
7201IDR	Low Battery Volt Indicator	2.25
7205IPG	CMOS LED Stopwatch/Timer	12.95
7205EV/Kit*	Stopwatch Chip, XTL	19.95
7206CJPE	Tone Generator	5.15
7206CEV/Kit*	Tone Generator Chip, XTL	9.95
7207AIPD	Oscillator Controller	6.50
7207AEV/Kit*	Freq. Counter Chip, XTL	11.10
7208IPI	Seven Decade Counter	17.95
7209IPA	Clock Generator	3.95
7215IPG	4 Func. CMOS Stopwatch CKT	13.95
7215EV/Kit*	4 Func. Stopwatch Chip, XTL	19.95
7216AIJI	8-Digit Univ. Counter C.A.	32.00
7216CIJI	8-Digit Freq. Counter C.A.	26.95
7216DIPI	8-Digit Freq. Counter C.C.	21.95
7217IJI	4-Digit LED Up/Down Counter	12.95
7218CIJI	8-Digit Univ. LED Drive	10.95
7224IPL	LCD 4½ Digit Up Counter DRI	11.25
7226AIJL	8-Digit Univ. Counter	31.95
7226AEV/Kit*	5 Function Counter Chip, XTL	74.95
7240IJE	CMOS Bin Prog. Timer/Counter	4.95
7242IJA	CMOS Divide-by-256 RC Timer	2.05
7250IJE	CMOS BCD Prog. Timer/Counter	6.00
7260IJE	CMOS BCD Prog. Timer/Counter	5.25
7555IPA	CMOS 555 Timer (8 pin)	1.45
7556IPD	CMOS 556 Timer (14 pin)	2.20
7611BCPA	CMOS Op Amp Comparator 5MV	2.25
7612BCPA	CMOS Op Amp Ext. Cmvr. 5MV	2.95
7621BCPA	CMOS Dual Op Amp Comp. 5MV	3.95
7631CCPE	CMOS Tri Op Amp Comp. 10MV	5.35
7641CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7642CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7660CPA	Voltage Converter	2.95
8069CCQ	50ppm Band—GAP Volt Ref. Diode	2.50
8211CPA	Volt Ref/Indicator	2.50
8212CPA	Volt Ref/Indicator	2.50

* INTERSIL'S EVALUATION KITS

74C

Part	Price	Part	Price	Part	Price
74C00	.39			74C195	1.59
74C02	.39			74C221	1.95
74C04	.39			74C240	2.25
74C08	.39	74C106	.75	74C244	2.25
74C10	.39	74C107	1.89	74C373	2.49
74C14	.75	74C151	2.95	74C374	2.59
74C20	.39	74C154	3.95	74C901	.89
74C30	.39	74C157	2.25	74C903	1.15
74C42	1.39	74C160	1.69	74C911	10.95
74C48	1.95	74C161	1.60	74C912	10.95
74C73	.79	74C162	1.49	74C915	1.69
74C74	.79	74C163	1.69	74C917	10.95
74C85	1.95	74C164	1.59	74C922	5.49
74C86	.99	74C173	1.39	74C923	5.75
74C89	6.95	74C174	1.39	74C925	7.50
74C90	1.29	74C175	1.39	74C926	7.50
74C93	1.29	74C192	1.69	80C95	.79
74C95	1.59	74C193	1.69	80C97	.79

LINEAR

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

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

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

100 VOLT MYLAR FILM CAPACITORS

Value	1-9	10-99	100+	Value	1-9	10-99	100+
.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022mf	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (Solid) CAPACITORS

Value	1-9	10-99	100+	Value	1-9	10-99	100+
.1/35V	.39	.34	.29	1.5/35V	.41	.37	.29
.15/35V	.39	.34	.29	2.2/35V	.51	.45	.34
.22/35V	.39	.34	.29	3.3/25V	.53	.47	.37
.33/35V	.39	.34	.29	4.7/25V	.63	.56	.45
.47/35V	.39	.34	.29	6.8/25V	.79	.69	.55
.68/35V	.39	.34	.29	15/25V	1.39	1.25	.95
1.0/35V	.39	.34	.29	22/6V	.79	.69	.55

MINI. ALUMINUM ELECTROLYTIC CAPACITORS

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

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4093-S	Quad 2 in NAND Schmitt trig	4/$2
4507-S	Quad EX-OR	4/$2
4510-S	BCD up/down counter	2/$2
4511-S	BCD to 7 seg decode/drvr	3/$2
4512-S	8 channel data selector	4/$2
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(package type H = TO99, M = minidip, D = dip, TK = TO66)

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308H-S	Micropower op amp	6/$2
703H-S	RF/IF amp	6/$2
723D-S	Voltage regulator	6/$2
741M-S	Compensated op amp	15/$2
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1000 uF 35V axial capacitor	10/$2.00
10,000 uF 10V axial capacitor	5/$2.00
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Resistor asst. (cut & bent leads)	1000/$5
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General purpose silicon signal diodes	50/$2
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NPN transistor similar 2N3904	100/$7.95
PNP transistor similar 2N3906	100/$8.95
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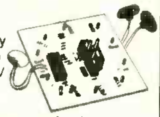
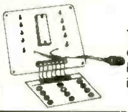
These are the complete functional circuit boards from popular hand held games — no case or batteries supplied.

Computer Perfect



Has 10 LEDS and tone signals. You try to guess correct button sequence to light LEDS in order. Requires two 9V batteries. With instructions. C24404 **$4.50**

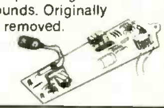
Computer Mind



You guess the secret number stored in computer chip memory. Has 10 LEDS and keyboard. Requires one 9V battery. With instructions.
C24405 **$3.75**

Starsound Board

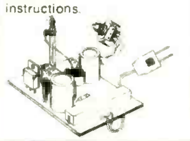
Unique board uses IC circuitry and gravity switch to produce space engine sounds. Point the board downwards and it produces "idle" sounds. Point upwards and the sound increases in pulsating frequency to produce "Blastoff" sounds. Originally had LED circuitry but this has been removed. Sound portion is 100% perfect. Requires 9V battery and speaker. C24406 **$2.50**



2" Speaker for above. C24311 **99¢**

120 VAC Xenon Strobe Kit

Complete variable rate strobe light kit. Contains all parts, PC board, line cord and instructions. C23071 **$7.50**



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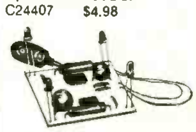

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74LS04N	.35
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74LS08N	.35
74LS10N	.35
74LS13N	.55
74LS14N	1.00
74LS20N	.35
74LS22N	.35
74LS28N	.35
74LS30N	.35
74LS33N	.60
74LS38N	.50
74LS74N	.45
74LS75N	.65
74LS90N	.60
74LS93N	.75
74LS95N	1.00
74LS107N	.45
74LS112N	.45
74LS113N	.45
74LS132N	.89
74LS136N	.50
74LS151N	.75
74LS155N	.79
74LS157N	1.10
74LS162N	1.10
74LS163N	1.10
74LS174N	1.15
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MOS MEMORY RAM	
2101-1	3.85
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2111-1	3.75
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2114L 300ns	4.25
2114L 450ns	4.00
4116 200ns	4.50
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MM57100	4.50
GIAY38500-1	9.95
MCM66751A	9.95
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4100	10.00
416	16.00

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2716T1	18.00
2716 5 Volt	10.50
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2732	29.50
2758	19.50
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8755A	55.00
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N82S126	4.75
N82S129	4.75
N82S131	6.50
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8T28	2.75
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6522	9.95
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6850	5.95
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8255	5.75
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CDP1802D	35.00
CDP1861P	7.95

RESISTORS ¼ watt 5%
10 per type .03
25 per type .025
100 per type .015
1000 per type .012
350 piece pack 5 per type 6.75
½ watt 5% per type .05

IC SOCKETS

Solder Tin PIN	1 UP	Low Profile PIN	1UP
8	15	22	30
14	14	24	35
16	16	28	42
18	27	36	58
20	29	40	57

2 level 14 pin ww .20

WIRE WRAP LEVEL 3

PIN		PIN	
14	.55	24	.86
16	.57	28	1.00
18	.67	40	1.23

CRYSTALS	
1 MHz	4.50
2 MHz	4.50
4 MHz	4.25
5 MHz	4.25
10 MHz	4.25
18 MHz	3.90
20 MHz	3.90
32 MHz	3.90
32768 Hz	4.00
1.8432 MHz	4.50
3.5795 MHz	1.20
2.0100 MHz	1.95
2.097152 MHz	4.50
2.4576 MHz	4.50
3.2768 MHz	4.50
5.0688 MHz	4.50
5.185 MHz	4.50
5.7143 MHz	4.50
6.5536 MHz	4.50
14.31818 MHz	4.25
18.432 MHz	4.50
22.1184 MHz	4.50

DISPLAY LEDS			
MAN1	CA	270	2.90
MAN3	CC	125	.39
MAN72 74	CA CA	300	1.00
DL704	CC	300	1.25
DL707 DL707R	CA	300	1.00
DL727 728	CA CC	500	1.90
DL747 750	CA CC	600	1.95
FND359	CC	357	.70
FND500 507	CC CA	500	1.35
FND503 510	CC CA	500	.90
FND800 807	CC CA	800	2.20
3 digit Bubble			.60
10 digit display			1.25
7520 Clairex photocells			.39
TIL311 Hex			9.50
MAN3640	CC	30	1.10
MAN4610	CA	40	1.20
MAN4640	CC	40	1.20
MAN4710	CA	40	.95
MAN4740	CC	40	1.20
MAN6640	CC	56	2.95
MAN6710	CA	60	1.35
MAN6740	CC	60	1.35

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Fully assembled	77.50
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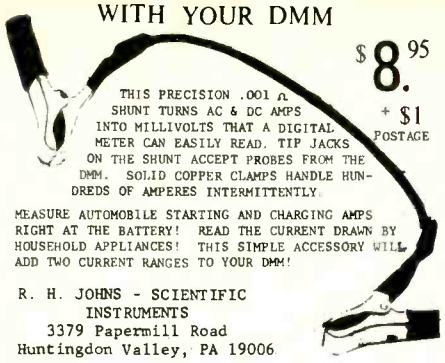

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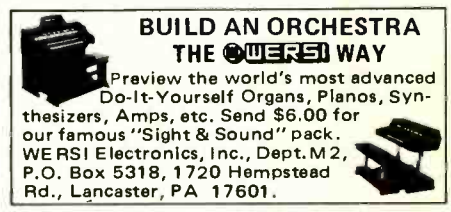

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ANNUAL 15% GROWTH FOR US COMPUTERS is forecast by Venture Development Corp. (Wellesley, MA) with a total sales in computers, peripherals, and data storage systems by 1982 of $49.2 billion. Computer industry growth is expected to be 50% greater than that of the consumer electronics industry during the same period. In special areas, the largest growth rate will be 39.1% in small business computers. Floppy disk drives will be the fastest growing product in the data-storage area.

SPEED LISTENING FOR VCR, combined with speed viewing, will be possible without the common "Donald Duck" distortion, with the use of a new IC developed by Variable Speech Control Co. (San Francisco, CA). The new linear, bipolar LSI chip has been used with a Matsushita bucket brigade device to provide continuously variable-speed viewing in a number of videocassette recorders. The touch of a button on a remote control unit is claimed to provide as much as double-speed playback with intelligible audio.

DEMAND FOR CIRCUIT DESIGN ENGINEERS IS HOT according to a survey conducted by National Personnel Associates (Grand Rapids, MI) a network of 237 agencies. Electronic designers ranked third behind programmers and systems analysts in scarcity in the job market. Design of circuits for computers and new military contracts are areas in which the demand is particularly high and which have created the shortage.

SMOKEY BEAR'S RADAR GUN may have to measure up. Standards for speed-measuring radar devices have been drafted by the National Bureau of Standards and proposed by the Department of Transportation's National Highway Traffic Safety Administration. The proposed performance requirements and test methods for evaluating radar devices were requested by NHTSA in 1977 after the national 55 mph speed limit was set. If the standard is adopted, only those devices that meet it will be eligible for purchase by state and local governments with federal highway funds.

GENERAL ACCESS TO AN ASTRONOMICAL SATELLITE is the purpose of a project sponsored by the Independent Space Research Group in coordination with 20 students and faculty members of Rensselaer Polytechnic Institute (Troy, NY). The satellite being built by the group will weigh 175 lb, measure six feet in length and feature an 18-inch diameter space telescope. It will probably be launched as a piggyback payload on an Ariane rocket. Initial plans are for the satellite to photograph planets and measure the brightness of stars. Its transmissions back to earth could be picked up by amateur radio equipment with photographic printers or slow-scan TV sets.

STAR OF AN OTHELLO TOURNAMENT in Santa Cruz, CA, was Instant Software's Pro-Thello III microcomputer program. It defeated all comers on mini and microcomputers and was in the process of downing Digital Equipment's macrocomputer program when a 400,000-to-1 bug in the program surfaced and caused it to default. As of now, Pro-Thello III should be available in both cassette and disk for the TRS-80 from Instant Software (Peterborough, NH).

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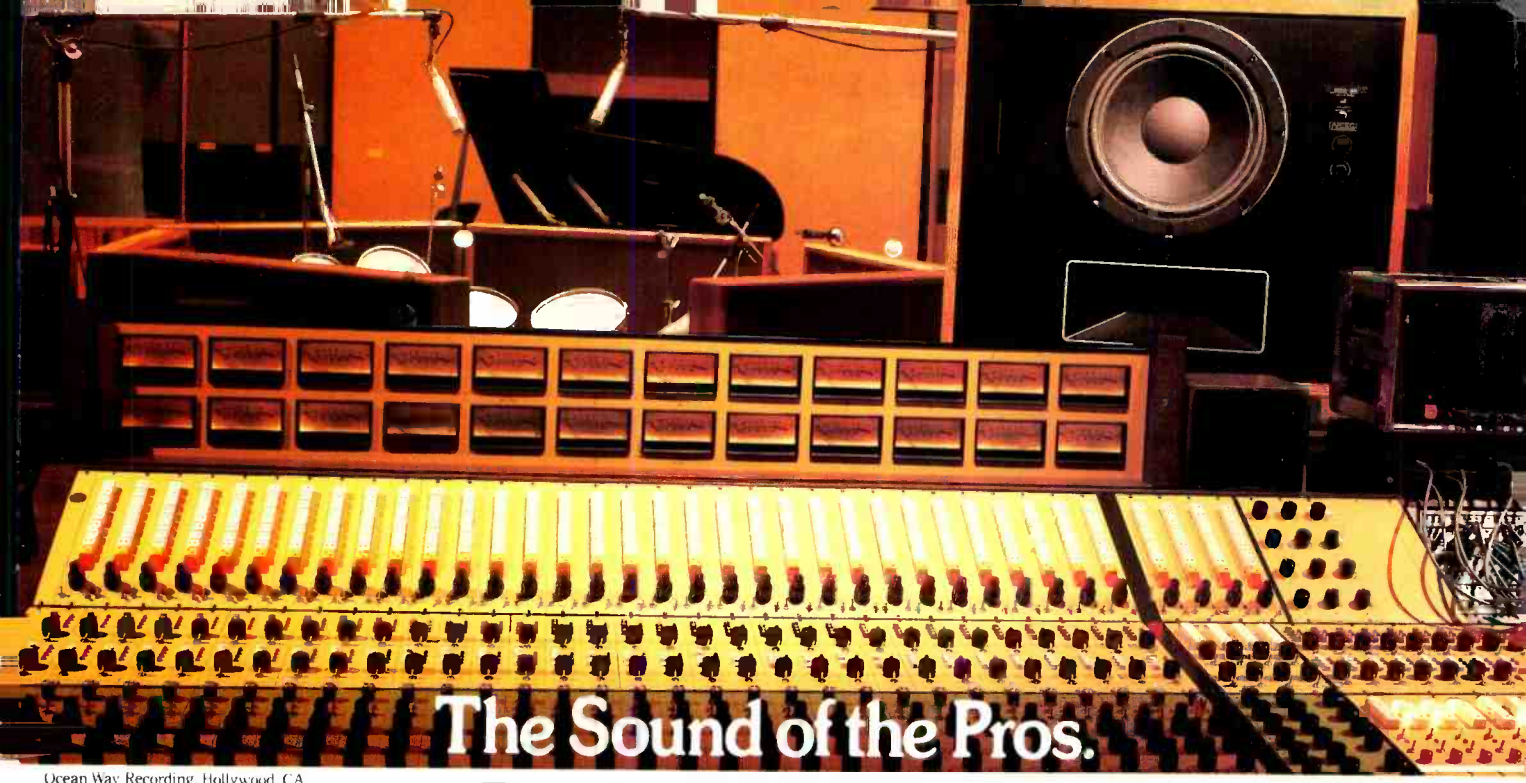

Ocean Way Recording, Hollywood, CA

For the Pro at Home.

We've been perfecting professional sound reproduction for almost half a century. From the famous Voice-of-the-Theater™ to our studio monitors and large floor-standing models, Altec Lansing is continuing a tradition of creating significant advancements in speaker technology. And now we've taken the most recent professional sound innovations and put them into our new speakers for the house, our models 4, 6 and 8. As a result, you can hear what has made Altec Lansing a long time favorite in studios, theaters and on sound stages from coast to coast: Crisp, clear sound realism.

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Here are some of the acoustic innovations featured by our new speakers: The Altec Tangerine,® a revolutionary radial phase plug that brings out all the high frequencies blocked by standard circumferential phase plugs. It works with our new LZT (Lead Zirconate Titanate) ultra high-frequency compression driver that replaces magnets and voice coils with a state-of-the-art semiconductor for super clean sound.

Another important professional feature is our Mantaray® constant directivity horn that expands your listening "sweet spot" well off to the sides of the speakers.

We've also developed a different approach to a cross-over network design that minimizes distortion and improves high-frequency response. In addition, each of our new models is equipped with an Automatic Power Control to protect the speaker from power overloads without shutting off the sound.

There's also a new look to our new home speaker line. We use rare Endriana wood from the South Pacific for our speaker cabinetry which highlights an unusually rich woodgrain and exhibits extraordinary acoustic properties.

Of course, there's a lot more to our speaker designs than these new enhancements. The sum total of many years spent in speaker research and development is incorporated in our home models.

Sound experience in a Free brochure.

If you'd like to learn more about all the professional features we've built into our new line, write for our free brochure "A New Generation of Speaker Systems for the Home." Better yet, visit your nearest Altec Lansing listening room and find out how we adapted our professional sound quality to the environment of your home. For the name of your local dealer, call toll-free (800) 528-6050, Ext. 730; in Arizona (800) 352-0458. Or write: Altec Lansing International, 1515 S. Manchester Ave., Anaheim, CA 92803.

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INTRODUCING THE TWO-IN-ONE VIDEO RECORDER FROM RCA:

CONVERTIBLE SELECTAVISION

RECORD THE BEST TELEVISION SHOWS.

This is the videotape recorder you've been waiting for. Convertible SelectaVision VCR. New from RCA.

Our new model VFP-170 lets you *record up to six full hours* of your favorite television shows on a single videotape cassette. It lets you record one show while you watch another. And it gives you the option of playing back those programs at your convenience.

You can even record while you're away from home. Convertible SelectaVision has a *14-day programmable memory* that automatically turns itself on and off—and even changes channels—when you've got places to go and people to see.

And that's just for starters. Because Convertible SelectaVision doesn't just make it *easy to record* your favorite shows on videotape. It makes it *fun to watch* them, too.

There's a twelve-function remote control unit that lets you play back your tapes with special effects like *slow motion, frame-by-frame advance* and *stop action.*

Want to locate your favorite scenes? Press the picture search button, and you can review cassettes in high-speed forward or reverse motion without having the screen go dark. And you can edit out unwanted programming with the *remote pause* while you're recording—all from the convenience of your chair.

Now, this might seem like a lot for any video recorder to do. But Convertible SelectaVision is really two video recorders in one. And this is only half the story.

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Chances are, some of the best shows you watch on Convertible SelectaVision will be family entertainment programs—*starring your own family.*

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Birthdays, weddings, bar mitzvahs, reunions. The best family times all become Prime Time material when you've got Convertible SelectaVision.

It's lightweight, compact and has a *built-in, rechargeable battery.* So you can carry it most anywhere. And videotape your family and friends for *over an hour on a single charge.*

There are practical uses, too. Convertible SelectaVision can videotape your backhand, your sales presentations and record your possessions for insurance purposes.

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Convertible SelectaVision. It's the *two-in-one* video recorder you've been waiting for. And it's waiting for *you* at your RCA Dealer's now.

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Let RCA turn your television into

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