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THE MAGAZINE FOR ELECTRONICS & COMPUTER ENTHUSIASTS

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- **PHONE-RINGER SUBSTITUTE PLAYS UP TO 200 TUNES**

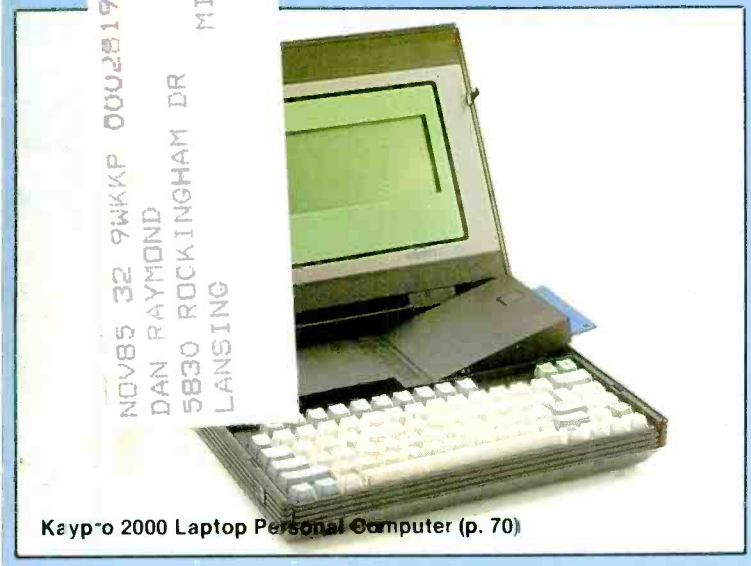
Automobile Radar Detectors (p. 22)

Projects & Applications

- **Computer System Power Controller with Surge-Spike Protection**
- **Bridge for easurements**
- **or Brighten Lights nd Automatically**

First Impressions

- **GEM's Macintosh-Like Graphics for MSDOS Computers**
- **Kapro's 16-Bit Laptop Machine**
- **Health & Fitness Software**



Kaypro 2000 Laptop Personal Computer (p. 70)

"Mello-Phone" Super Musical Telephone Ringer (p. 36)

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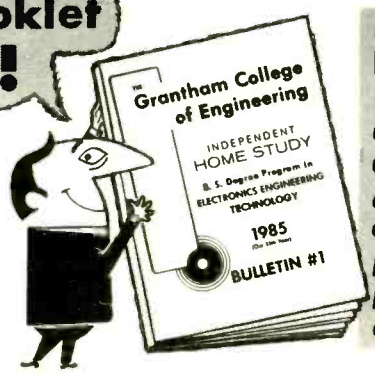

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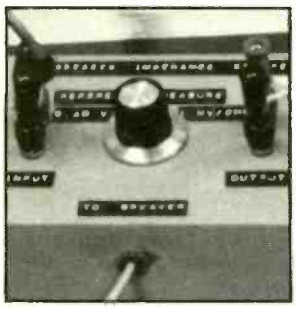
MODERN ELECTRONICS
THE MAGAZINE FOR ELECTRONICS & COMPUTER ENTHUSIASTS

NOVEMBER 1985 VOLUME 2, NUMBER 5



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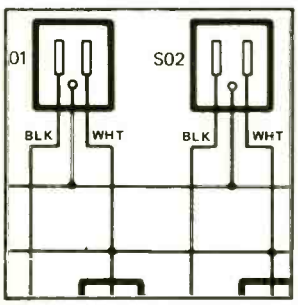

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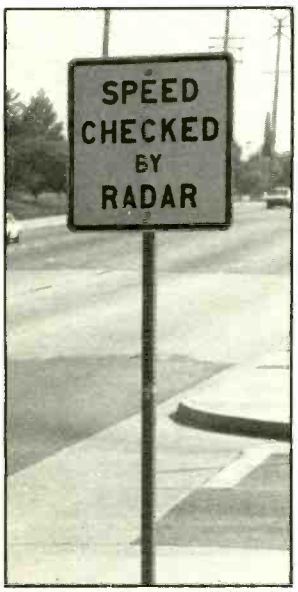

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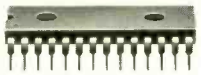
(1) 
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Text-to-Speech IC

(3) 
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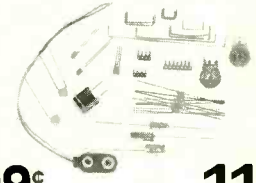

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Timer IC Mini-Notebook. Learn how to use the versatile 555 and 556 timer ICs by building your own circuits. Written in simple language by Forrest Mims III. Large schematic diagrams. 32 pages. #276-5010 ..... 99¢

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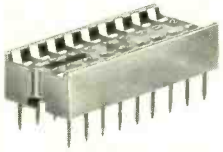

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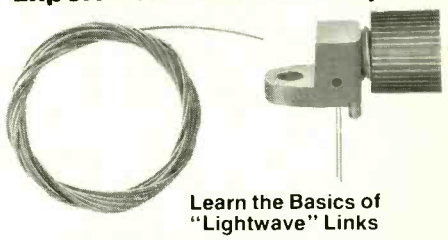

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LETTERS

•I'm writing to correct an error in "Portable Computers '85," in the August issue. His statement that the TRS-80 Model 200 doesn't support PEEK, POKE, or CALL statements in BASIC is wrong. The Model 200 supports all the BASIC commands available to the Model 100, with a few additions and improvements as well. Other than that error, I thought his article was well-written, and fairly presented the computers mentioned.

A recent addition to the laptop group is the Spectravideo Bondwell, a 64K CP/M computer with 80 × 24 line LCD display, built-in 360K 3.5″ disk drive, 8-hour rechargeable battery supply and bundled software (Wordstar, Calstar, Datastar, Reportstar, Xmodem, Scheduling program, and several public-domain utilities). It is the only laptop that has a flip-top screen designed for field use: it has a 180-degree angle of freedom instead of stopping at a preset vertical angle (you can open the display to a horizontal position). Its best feature is its price: $999.95 (Bondwell International, 3300 Seldon Court, Fremont, CA 94539).

While I'm writing, thanks for resurecting the original concept behind the now-defunct *Popular Electronics*. I used to subscribe to it way back when.

Terry Kepner
Peterborough, NH

Not For Export

•The David Wolf article on Akihabara—An Electronics Shopper's Paradise—was well-done, and certainly intriguing at this side of the pond. It certainly appeared that the electronics buyer can find some remarkable products at very low prices to bring back to the USA.

However, when it comes to amateur radio equipment, U.S. amateur-radio companies like Kenwood and Yaesu are dead set against their imported equipment coming back to the States by hams trying to save a buck. Some of their equipment is listed on a Customs blacklist that disallows its entry into the States. A student of mine recently had to send his new Kenwood 940 transceiver back on the same charter flight he brought it in on because Customs would not permit its import.

There are also many subtle frequency and power differences between Japanese and United States-destined equipment. One student save $100 on his handie

(Continued on page 91)

EDITORIAL

Buying By Mail

Many billions of dollars are spent each year in mail-order purchases. In the electronics and computer fields, this mode of doing business has grown enormously for a variety of reasons. Firstly, no single store could ever stock the vast variety of parts and equipment on the market today. Furthermore, selling prices by mail-order companies are generally well below those of local stores for the same product.

There are tradeoffs, of course. For example, many electronic mail-order companies have minimum orders of, say, $10, whereas local stores don't. Also, you pay modest shipping and handling charges when you order by mail. Nonetheless, low prices and parts/equipment availability usually make up for these shortcomings if you want more than just one or two resistors. The slight delay in getting products bought is a small cross to bear for most people.

But what do you do if there is an unreasonable delay in receiving your order, for which you've paid up front? And what do you do should there be a rotten apple in the barrel? Unlike a local store, you can't confront someone who might be a thousand miles away. Moreover, a state's laws can't protect you when dealing with someone in another state.

Should you ever be faced with such problems, you should know that you do indeed have special protection in mail-order transactions. The Federal Trade Commission has a Trade Regulation Rule relating to mail-order merchandise, as an example. The civil penalty for violating the Rule is up to $10,000 per violation (each day of failure to comply with the Rule may be treated as a separate violation). In addition, the FTC can also sue for consumer redress.

Let's examine the Rule now, which was set up to protect consumers who buy by mail and to build up trust and confidence in mail-order transactions.

*Shipment of a properly completed order must be made within 30 days after its receipt unless shipment time is clearly and conspicuously noted in a solicitation (e.g., "Allow 5 weeks for delivery."). Many companies ship within a day or two.

*If a shipment is delayed, the seller must send you a notice within 30 days after receiving the order, or before the shipping time noted in the solicitation, that gives you a revised shipping date or notice that a shipping date cannot be determined—plus an *option* to cancel your order.

The notice should also provide you with a satisfactory way to respond, such as a prepaid post card or an "800" toll-free telephone number that can be readily and consistently used. You should also be advised that non-response is considered consent to a delay of 30 days or less.

If the revised shipping date is more than 30 days after the original date or it's stated that a shipping date cannot be determined, your order should be automatically cancelled if merchandise isn't shipped within 30 days of the original date, or you can cancel beforehand, unless you respond that you consent to the new shipping delay date. If you inform the seller that you agree to an indefinite shipping delay, you still have the right to cancel at any time prior to shipping.

*Refunds must be sent to you by first class mail within seven days after the order is cancelled, except that credit card charges may be refunded within one billing cycle. (The reasoning here is fair since you haven't laid out any money yet.)

A few other FTC rulings you should know about are: Credit vouchers or script are no substitutes for a refund; the Rule does not cover you for using a credit card by telephone only, without going through the mail; merchandise cannot be substituted that's different from what you ordered without your authorization; the seller's receipt of a properly completed order can be construed to mean the time at which he gets notice that a check or money order for the proper amount has been honored. The Rule doesn't cover *all* mail-order activities. There are a few exceptions, which include magazine subscriptions and similar serial deliveries, excepting the first shipment; sales of seeds and growing plants; C.O.D. orders; transactions covered by the FTC's "Negative Option Rule," such as book and record clubs; and mail-order photo-finishing (considered to be a service, not merchandise).

Should you have a serious problem with any mail-order house, you can send your complaint to the Federal Trade Commission, Enforcement Division, Washington, D.C. 20580.

Fraud is another story, of course. Here you have recourse to the U.S. Attorney's

(Continued on page 82)

NEW! uniden® Bearcat® Regency®

Scanners

Communications Electronics,™ the world's largest distributor of radio scanners, introduces new scanners and scanner accessories from J.I.L., Regency and also Uniden/Bearcat. Chances are the police, fire and weather emergencies you'll read about in tomorrow's paper are coming through on a scanner today.

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Frequency range: 25-550 MHz. continuous coverage and 800 MHz. to 1.2 GHz. continuous coverage
In addition to normal scanner listening, the MX7000 offers CB, VHF, and UHF TV audio, FM Broadcast, all aircraft bands (civil and military), 800 MHz communications, cellular telephone, and when connected to a printer or CRT, satellite weather pictures.

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Frequency range: 25-550 MHz. continuous coverage.
Never before have so many features come in such a small package. The *Regency* MX5000 mobile or home scanner has continuous coverage from 25 to 550 MHz. That means you can hear CB, Television audio, FM broadcast stations, all aircraft bands including military and the normal scanner bands, all on your choice of 20 programmable channels.

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Cover your choice of over 15,000 frequencies on 60 channels at the touch of your finger.

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Frequency range: 26-520 MHz continuous coverage. With optionally equipped RF converters 150KHz-3.7 GHz.
The *JIL* SX-400 synthesized scanner is designed for commercial and professional monitor users that demand features not found in ordinary scanners. The SX-400 will cover from 150 KHz to 3.7 GHz. with RF converters. Order the following RF converters for your SX-400 scanner. **RF-1030-K** at $259.00 each for frequency range 150 KHz. - 30 MHz. USB, LSB, CW and AM. (CW filter required for CW signal reception); **RF-5080-K** at $199.00 each for 500-800 MHz.; **RF-8014-K** at $199.00 each for 800 MHz.-1.4 GHz. Be sure to also order **ACB-300-K** at $99.00 each which is an antenna control box for connection of the RF converters. The **RC-4000-K** data interface at $259.00 each gives you control of the SX-400 scanner and RF converters through a computer. Add $3.00 shipping for each RF converter, data interface or antenna control box. If you need further information on the JIL scanners, contact JIL directly at 213-926-6727 or write JIL at 17120 Edwards Road, Cerritos, California 90701 U.S.A.

SPECIAL! JIL SX-200-K

List price $499.95/CE special price $159.00
Multi-Band - 16 Channel • No-Crystal Scanner
Frequency range 26-88, 108-180, 380-514 MHz.
The *JIL* SX-200 scanner tunes military, F.B.I., Space Satellites, Police and Fire, Drug Enforcement Agencies, Defense Department, Aeronautical AM band, Aero Navigation Band, Fish & Game, Immigration, Paramedics, Amateur Radio, Justice Department, State Department, plus other thousands of radio frequencies most other scanners can't pick up. The SX-200 has selectable AM/FM receiver circuits, tri-switch squelch settings - signal, audio and signal & audio, outboard AC power supply - DC at 12 volts built-in, quartz clock - bright vacuum fluorescent blue readouts and dimmer, dual level search speeds, tri-level scan delay switches, 16 memory channels in two channels banks, receive fine tune (RIT) ± 2KHz., dual level RF gain settings – 20 db pad, AGC test points for optional signal strength meters.

Regency® HX1000-K

List price $329.95/CE price $209.00
6-Band, 30 Channel • No Crystal scanner Search • Lockout • Priority • Scan delay Sidelit liquid crystal display • Digital Clock
Frequency range: 30-50, 144-174, 440-512 MHz.
The new handheld *Regency* HX1000 scanner is fully keyboard programmable for the ultimate in versatility. You can scan up to 30 channels at the same time. When you activate the priority control, you automatically override all other calls to listen to your favorite frequency. The LCD display is even sidelit for night use. Order **MA-256-K** rapid charge drop-in battery charger for $79.00 plus $3.00 shipping/handling. Includes wall charger, carrying case, belt clip, flexible antenna and nicad battery. Order now.

NEW! Bearcat® 100XL-K

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Frequency range: 30-50, 118-174, 406-512 MHz.
The world's first no-crystal handheld scanner now has a LCD channel display with backlight for low light use and aircraft band coverage at the same low price. Size is 1⅜" x 7½" x 2⅞". The *Bearcat* 100XL has wide frequency coverage that includes all public service bands (Low, High, UHF and "T" bands), the AM aircraft band, the 2-meter and 70 cm. amateur bands, *plus* military and federal government frequencies. Wow...what a scanner!
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The World's First 800 MHz. Handheld Scanner
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C403-K *Regency* 4 channel scanner	$69.00
R106-K *Regency* 10 channel scanner	$99.00
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EC10-K Programming tool for *Regency* RPH410	$20.00
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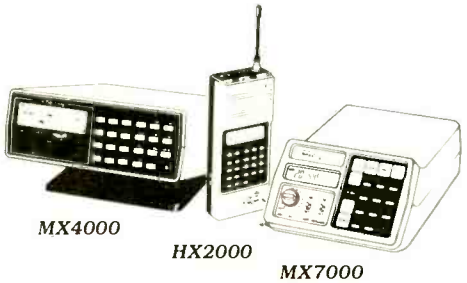

CIRCLE 26 ON FREE INFORMATION CARD

M68000 DESIGN KIT. A design kit with MC68000 and MC8008 microprocessors and six supporting devices, as well as application notes and documentation, is being offered by Motorola's Micro Products Div. through its distributors for $68.

THE PICOCASSETTE. Dictaphone Corp. introduced the smallest magnetic tape medium, moving from a microcassette to a picocassette. Measuring only 1.42" x 0.98" x 0.18" and weighing 1 oz., it has a recording capacity of a full 60 minutes of dictation and other voice applications. It's being used in the company's newest protable recorder, Model 4250 Exec.

CHRYSLER USES BAR CODES. Chrysler Corp. changes electronics component suppliers' business ways by now requiring them to label automotive parts containers with bar-coded information. Other auto makers will follow, all using CODE 39, the bar code chosen by the Automotive Industry Action Group as a standard in the industry.

JUSTICE DEPT. SLAMS RF INTERFERENCE VIOLATORS. The U.S. Dept. of Justice recently announced actions against people who unlawfully operated radio-broadcast equipment. It's suing one person for $900 in accumulated fines for refusing to allow his Citizens Band Radio equipment to be inspected as a result of many complaints from neighbors about TV interference. Inspectors claim that the user was exceeding the maximum power level. In a similar case, where 40 complaints were registered, an FCC engineer determined that the culprit was putting out 47 watts, which is 43 past the maximum allowed. Suit was filed for $750. A third case charged a company with interfering with TV reception for 18 months due to computer-generated signals. Accumulated fines for failing to shield the computer to eliminate interference were $3,000.

CONSUMER ELECTRONIC PRODUCT PRICES DROP. Notwithstanding typical inflationary increases in just about everything, prices of consumer electronic equipment prices continue to decrease. Compact Disc players, for example, dipped from an average dollar value of $429 in 1983 to about $280 in 1985; tabletop VCRs from $470 in 1983 to $375 in 1985; color TV receivers from $386 in 1980 to $330 in 1985; programmable video games from $116 in 1982 to $43 in 1985; home computers from $650 in 1982 to $500 in 1985; telephones (corded) from $54 in 1982 to $31 in 1985.

UNIVERSITY COMPUTERS. Hewlett-Packard has developed programs on artificial intelligence (AI) at U.S. universities to foster basic research in this important computer area. It expects to grant about 600 workstations to 12 to 15 universities, with each receiving a license for prototype AI software developed by HP Labs. It has already announced grant awards to Massachusetts Institute of Technology and the University of Utah. . . Northeastern University's Bay Area Regional Tech Center reports that the Assosciation for Continuing Education Instructional TV Network will televise four of the institution's state-of-the-art engineering courses to member-company employees starting September 23 with System Reliabiltiy Engineering. Other courses announced are Intro to AI, Intro to Data Communications, and Principles of Telecommunications.

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NEW PRODUCTS

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Laptop Computer

The Heath Company is offering an assembled MS-DOS-compatible diskless laptop computer. The Model ZP-150 computer is built around a low-power 80C88 microprocessor, 32K of RAM (expandable to 416K), 224K of ROM containing a raft of applications software, and an 80-column by 16-line LCD screen. Built-in interfaces include a parallel printer port, an RS-232 serial port, audio cassette player port, and a telephone jack that is used with the internal 300-baud modem. These interfaces, the RESET switch, and the ac adapter jack are located on the rear of the computer, behind a drop-down protective panel.

Programmed into the ZP-150's on-board ROM are six business-oriented applications programs developed by Microsoft. Known as the "Works" integrated software package, it consists of Plan, a subset of MultiPlan; Word, a subset of Microsoft's Word processor; File, a new Data Base Management System (DBMS); Calendar appointment secretary; Telcom telecommunications package complete with autodialing capability; and BASIC, a large subset of GW-BASIC. The ZP-150 is the first laptop computer to incorporate this ROM-based software package.

The computer measures 13"W × 11⅛"D × 1¾"H and weighs 7.7 lbs. $1995.

CIRCLE NO. 145 ON FREE INFORMATION CARD

Video Title Generator

A new keyboard-type title generator from RCA can be used with just about any make video camera. It lets you create on tape up to 60 characters at a time on a scene in any of four character sizes. Characters can be stored in the Model CGA010 generator's battery-powered memory for

several months, and up to 40 frequently used words can be stored in the word register.

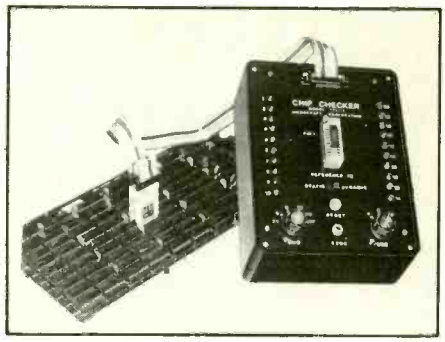
This titler can also store and recall up to 20 groups of characters in either page-at-a-time or scroll forward/backward format. Other features of the titler include: "curtain" and "window" special effects, stopwatch display calendar and time-lapse capability.

The Model CGA010 title generator measures 8" × 3¼" × 1" and comes with a belt clip. $249.95.

CIRCLE NO. 146 ON FREE INFORMATION CARD

In-Circuit IC Tester

Chip Checker from Microcraft Corp. is a full-mode TTL in-circuit tester that can automatically detect



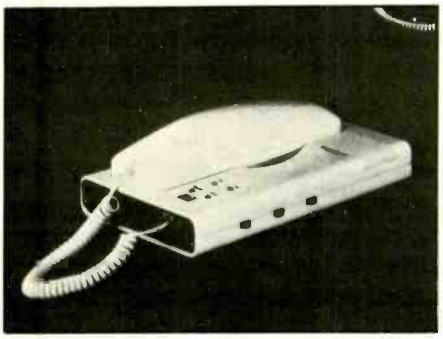
and display IC errors under actual operating conditions. A front-panel zero-insertion-loss socket is used to plug in a known "good" reference IC. The Model TTL-1 Chip Checker tests virtually all 14-, 16-, 18- and 20-pin DIP TTL ICs, including low-power Schottky TTL. Though some specialized ICs and those devices that depend on external resistors or capacitors, such as the 74121 monostable, cannot be tested, tri-state, bidirectional and open-collector devices can in most cases be checked.

Two front-panel switches are provided for selecting the V_{CC} and GND pins for the IC under test. LEDs indicate differences and errors between the IC under test and the reference IC. Chip Checker automatically determines inputs, outputs and logic levels of the reference IC and compares outputs to those of the IC under test. Differences between outputs of the two ICs cause one or more LEDs to light. Stuck logic states and improper operation can be detected and, using a dynamic latching mode, can pinpoint intermittent errors that occur over minutes or even hours. $349.95.

CIRCLE NO. 147 ON FREE INFORMATION CARD

Modem/Phone Combo

Theall Engineering's new Model JC-1200A Smart Modemphone is fully Hayes compatible and features autodial, auto-answer, auto-baud-rate select and has a built-in telephone for voice communications. The 1200-baud modem has a unique tone-sens-



ing circuit that detects voice and data carrier and automatically passes the signal to the computer or telephone. A built-in 2″ speaker lets you monitor the call, while a built-in clock/calendar feature lets you keep track of call length on your computer's video monitor screen.

In addition to the auto-dial and auto-answer features, the JC-1200A is provided with an auto-redial on busy feature and self-test function. Battery backup is provided to maintain clock time and to keep phone numbers stored in memory during power-out conditions. The modem is Bell 103 and 212A compatible and interfaces to the standard RS232C port. $289.95.

CIRCLE NO. 148 ON FREE INFORMATION CARD

Portable Oscilloscope

OK Industries has introduced a new dc-to-10-MHz bandwidth oscilloscope small enough to fit in most briefcases and tool caddies. It measures only 10″W × 7″D × 2½″H and adds only 2 lbs. to the carrying weight. The compact Model 1010 provides 12 sensitivity ranges and 21 timebase ranges. Vertical sensitivity is selectable from 10 mV/division to 50 volts/division, and timebase is variable from 0.1 μs/division to 0.5 s/division.

The mini-scope includes internal and external triggering with sensitivity of < 1 volt/division internal and 1 volt/division external. Coupling modes include: ac, dc, TV frame and TV line. A + / − slope selector is also included. Waveforms are displayed in a 1″ × 1.5″ area on the face of the blue-white CRT in a five horizontal by four vertical graticule division format. A built-in calibration circuit is included. $355.

CIRCLE NO. 149 ON FREE INFORMATION CARD

Sophisticated Scanner

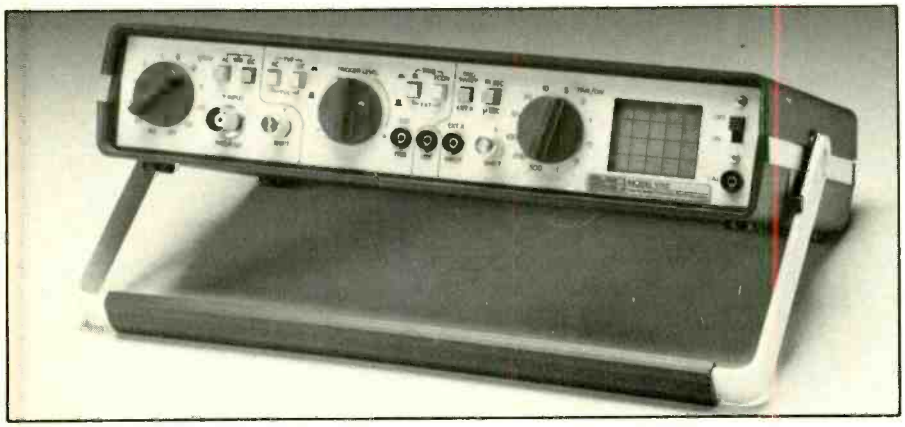
Regency's Model MX7000 is one of the few programmable fixed/mobile scanners that can cover frequencies as high as 1.3 GHZ. It provides continuous coverage between 800 and 1.3 GHz, as well as the usual 25 to 550 MHz. In addition, the scanner can also monitor vhf and uhf TV audio, FM broadcasts between 88 and 108 MHz and all civil and military aircraft bands.

Programming the scanner is simple. Entering frequencies is accomplished by keying in their numbers via a calculator-style keypad. A beep tone is heard when you have made contact. Once frequencies are programmed into the scanner, the keyboard can be locked to prevent anyone from accidentally changing them.

In addition to scanning as many as 20 channels, the scanner can search through an entire band for an active frequency. When a call is received, the frequency of the broadcast appears in the numeric display. You then have the option of continuing to search or storing the new frequency in one of the 20 channels. Search increments of 5, 12.5 and 25 kHz are available.

The multifunction lighted LCD display shows channel numbers during scanning, channel and frequency when a call is received, loss of power, delay function status, channel lockout and search mode selection. $699.95.

CIRCLE NO. 150 ON FREE INFORMATION CARD



Telecommunicatons Tester

Simpson Electric's new 3½-digit DMM is specifically designed for telecommunications servicing. The Model 467-2T has direct-reading dB ranges and is switchable for 600- and 900-ohm references to accommodate both new and old telecommunications systems. It also has a built-in

(Continued on page 62)

Audio

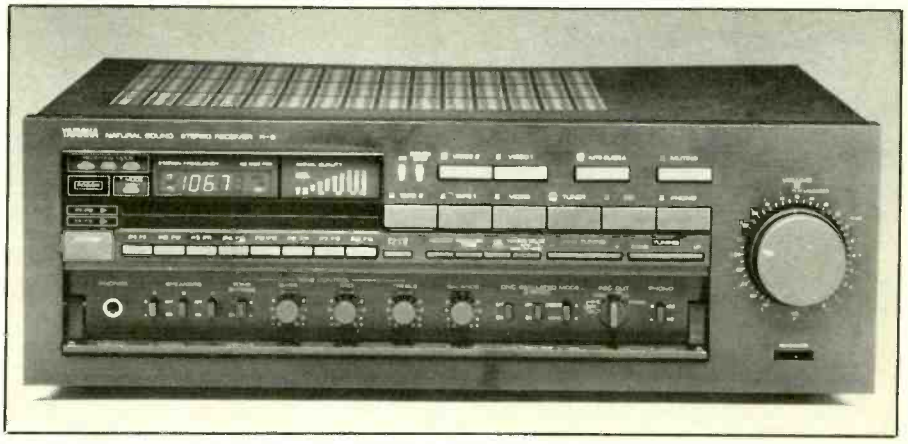
The Yamaha R-9: A Do-It-All Audio Video Receiver

Most well-know manufacturers of stereo components have begun to acknowledge the much talked about integration of audio and video. Nearly all of them have come up with a "new" type of component: the audio/video receiver. This component might be anything from an ordinary stereo AM/FM receiver that has an extra pair of high-level inputs labeled "Video" or "VCR," to a multi-functional unit that includes a TV tuner and video signal switching and section facilities.

Yamaha's elegantly designed R-9 receiver is closer to the latter description, though it does not go so far as to incorporate a TV-band tuner. The Model R-9 is able to handle and switch signals from any one of two video program sources. Both video and audio signals (mono or stereo) from such video components can be handled and the video signals can then be directed to a video monitor, which can also be connected to this central Yamaha component.

As an audio receiver, the Yamaha R-9 is as sophisticated as any audio-only receiver we've tested. Many of the unique and thoroughly valid features introduced by Yamaha in some of its earlier designs have been carried over into this A/V unit, such as continuously variable loudness control (separate and apart from the regular volume control), and a separate "Record Out" selector that permits you to listen to one program while recording another. Rated at 125 watts per channel over the entire audio range, with less than 0.015% THD when connected to 8-ohm loudspeaker loads, the receiver employs digital frequency synthesized tuning for AM and FM listening and a 16-station "preset" capability. It is also one of only a few currently available receivers that includes a wireless remote control.

In terms of circuit innovations, the Yamaha R-9 designers haven't skimped, either. Catering to those purists who maintain that "Class A" amplifier operation still yields "purer" sound that even the best "Class AB" amplifiers can deliver, the R-9 has a switch which, when depressed, converts the output stages of its



amplifier section to Class A operation. For signals requiring less than 20 watts per channel (and that's most music most of the time), the amplifier remains in Class A. For those occasional brief peaks that require more instantaneous power, the amplifier automatically reverts to Class AB.

As for tuner design innovations, the Yamaha R-9 incorporates a circuit called "Computer Servo Lock" tuning. This provision samples incoming signals and "decides" which of two tuning methods will provide best reception. "Local" or "DX" setting can be manually selected as well, and tuning, though digital, can be done in increments of as little as 0.01 MHz for FM and 1 kHz for AM.

The receiver measures 17⅛"W × 16⅝"D × 5 1⅜6"H and suggested price is $799.

Front-Panel Layout

Many of the less-frequently-used controls and switches of this elaborate receiver are hidden behind a hinged door flap so that the panel retains an uncluttered look. Controls that are always visible include the Power on/off pushbutton, eight preset buttons that, in combination with a "shift" button and a "Memory" button, are used to select up to 16 AM or FM stations (in any combination), six major function selector buttons (with additional sub-selectors for choosing AM or FM and Video 1 or Video 2 inputs), manual selectors for choosing receiving mode (for choosing "Local," "DX" or "Automatic" reception of the preferred mode), tuning mode (automatic scanning or manual tuning), audio Muting, a pushbutton for selecting the Automatic Class A/Class AB mode and the dual concentric Volume and Loudness rotary controls. The continuously variable loudness control—a Yamaha feature introduced more than six years ago—has a range of a full 40 dB as opposed to the 20-dB range on earlier versions.

In addition to the usual AM or FM frequency digital displays and a ten-segment signal "quality" display, there are specific readouts for selected tuning mode, currently selected receiving mode, status of the preset keys (whether the "unshifted" 1 through 8 numbers or the "shifted" 9 through 16 numbers are applicable), status of the Dynamic Noise Cancelling circuit, and of the Simulated Stereo Circuit. Small indicator lights are illiminated above whichever program selector button is activated.

Behind the hinged flap along the lower section of the R-9 front panel are a headphone jack, three speaker-selector pushbuttons. a tone bypass switch, bass, treble and midrange rotary tone controls with detented center positions, a balance control, a DNC switch (Dynamic Noise Control, which acts very much like dynamic filtering of the more familiar single-ended DNR circuit), a Simulated

Stereo on/off switch, a Stereo/Mono switch, the Record Out selector switch and a switch for selecting MC (moving-coil) or MM (moving-magnet) cartridge preamplification when the main Phono selector pushbutton is depressed.

The hand-held wireless remote control, while not able to perform all of the control functions found on the front panel itself, is able to handle program selection, power on/off, selection of any one of the 16 preset AM or FM stations, audio muting and volume adjustment.

If you wanted to use this receiver as an audio/video home entertainment control center, you might connect all of the following components to it: a pair of video cassette recorders (VCRs), one of which could just as easily be a videodisc player, a TV monitor (it must be equipped with a video input jack; connection via the antenna input will not do), a compact disc player, a turntable equipped with either a moving-magnet or a moving-coil cartridge, a compact disc player, two audio tape decks and *three* sets of loudspeakers.

As many as three sets of speakers can be connected and activated simultaneously by the front panel speaker selector switches, but if that is done only the speakers connected to the "Speakers A" terminals will have their voice coils directly across the output stages of the amplifier. Those speakers connected to "Speakers B" and "Speakers C" terminals will be operated in series, so as to maintain a reasonably high net impedance across the output terminals or the power amplifiers. With only the "Speakers A" and "Speakers B" switches depressed, normal operation (both sets of speakers in parallel across the output terminals) is maintained.

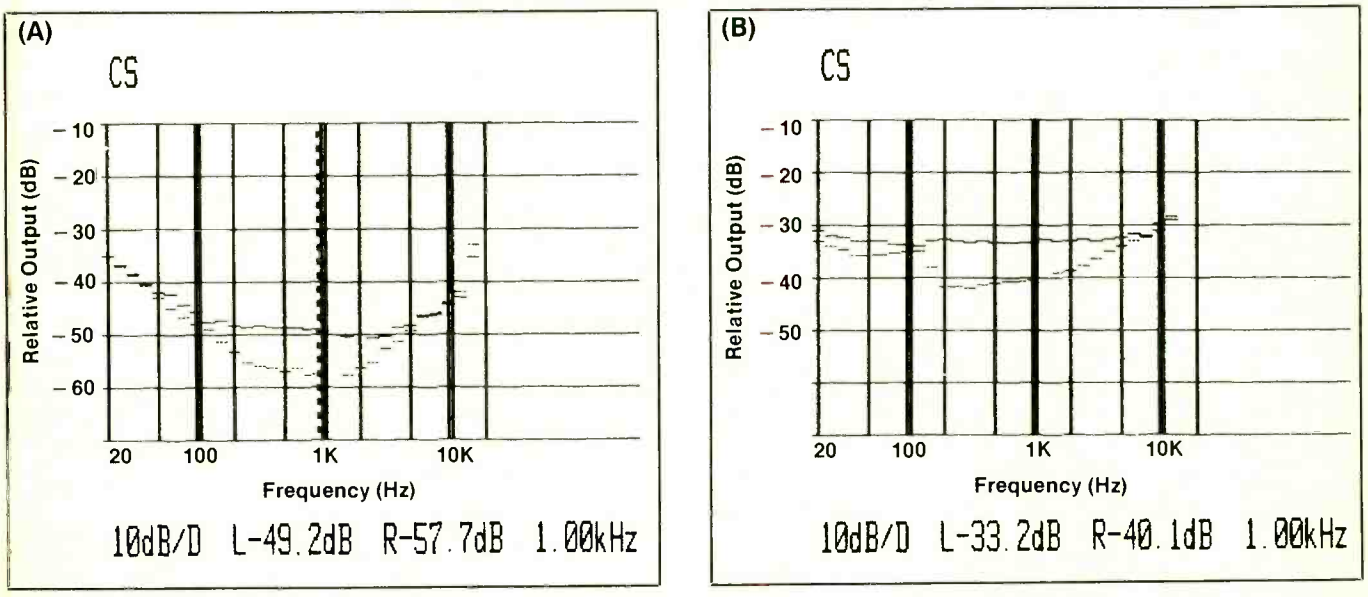
Tuner Measurements

In testing the FM tuner section of the R-9 receiver we quickly established that the major difference between the "Local" and "DX" tuning modes was not so much a difference in sensitivity as a difference in selectivity. In other words, during FM reception the "Local" setting on this receiver corresponds primarily to the "Wide i-f Bandwidth" setting often found on other tuners and receivers, whereas the "DX" setting provides a higher alternate-channel selectivity figure for zeroing in on weaker stations that might otherwise be interfered with by close-by strong stations. Using the "Local" setting, best S/N in mono was 78 dB, while in stereo it was 74 dB. These are better-than-average figures for receiver tuners. Harmonic distortion at strong signal levels was a remarkably low 0.06% for mono and a nearly as low figure of 0.075% in stereo. Usable sensitivity measured 12 dBf, improving somewhat to 10.8 dBf when we switched to the "DX" position.

Fifty dB quieting sensitivity measured exactly 14.5 dBf in mono, which is superb, and 37.0 dBf in stereo, which is about average. Both are close enough to Yamaha's published figures. When the receiver was switched to the "DX" or narrow i-f mode in mono, we measured 0.42% THD at all signal levels above about 40 dBf, while stereo THD rose to around 1.0%.

Mode of tuning ("DX" vs "Local") had a great effect upon FM stereo separation, as you can see by looking at Figs. 1A and 1B. Both of these frequency sweeps were made for strong-signal conditions and covered the range from 20 Hz to 20 kHz in a logarithmic sweep. The two curves in each case represent undesired output from the unmodulated left or

Fig. 1. Separation characteristics for the Model R-9's stereo FM tuner section shown in the local mode in curve (A) and DX mode in curve (B).



right channel, (when the opposite channel is fully modulated). In the "Local" mode (Fig. 1A) separation at mid-frequencies ranged from 49.2 to 57.7 dB, which is more than adequate, while in the narrow-band or "DX" mode (Fig. 1B) it was still adequate, ranging between 33.2 dB and 40.1 dB, depending upon which channel was measured.

Deviation from flat response for the fully modulated channel was never greater than 0.3 dB in the "Local" mode and was down 1.5 dB at 15 kHz in "DX".

We measured an excellent capture ratio of 1.1 dB in the "Local" mode, while in the DX mode, capture ratio increased to 2.5 dB (as claimed by Yamaha). Both i-f and spurious response rejection measured 90 dB, while AM rejection was 57 dB and alternate-channel selectivity measured in the DX mode was 87 dB, the latter a bit higher even than the 85 dB claimed by the manufacturer.

AM frequency response is plotted in Fig. 2 and extended from around 50 Hz to just over 3.0 kHz; not very impressive for the −6-dB points. Best signal-to-noise in AM measured precisely 50 dB as claimed, while harmonic distortion, at 30% modulation, measured 0.35% for a 1 kHz modulating signal.

Amplifier Measurements

In the "Auto-Class A" mode, the power amplifier section of the R-9 remained in Class A until output power into 8-ohm loads exceeded 20 watts, at which point it smoothly switched to the more efficient Class AB operation. Maximum output for rated THD was 144 watts per channel into 8-ohm loads for most of the audio spectrum, decreasing to 136 watts per channel at 20 Hz and 139 watts per channel at 20 kHz. In fact, at rated output of 125 watts per channel, THD at mid-frequencies was only 0.0028%, while at 20 Hz and 20 kHz the THD measured only 0.009% and 0.007%, respectively. The 125-watt per channel rating of this receiver is, therefore, a very conservative one.

Damping factor of the power amplifier was 80, referred to 8 ohms, using a standard 50-Hz test signal. Dynamic headroom, or the ability of the amplifier to produce short-term power peaks in excess of its continuous power rating, was very high, measuring 2.3 dB above the rated continuous power level of 125 watts per channel. This means that for short bursts of signal such as might be produced by actual music programming, the R-9 can deliver in excess of 200 watts per channel without significant clipping!

Phono input sensitivity for a 1-watt output was 0.23 millivolts for the MM (moving-magnet) phono input option and 15 μV for the MC (moving-coil) option. 15 millivolts of input signal applied to any of the high-level inputs produced 1 watt of output. Phono overload measured 145 mV for the MM cartridge option, or 14 millivolts for the MC prepreamplifier input. Frequency response for the high-level inputs was flat within 1 dB from 20 Hz to 50 kHz. Yamaha has incorporated a non-switchable subsonic filter with a nominal cutoff point of 10 Hz, which accounts for the dropoff at the extreme low end. At the bass extreme, the −3 dB point was reached at 12 Hz. High-frequency cutoff (the −3-dB point) occurred at 100 kHz. The range of the three sets of tone controls is shown in the multiple-sweep plots of Figs. 3A and 3B (for the bass and treble action) and Fig. 4 (for the midrange tone control action).

Fig. 2. Frequency response of AM tuner section of R-9 receiver.

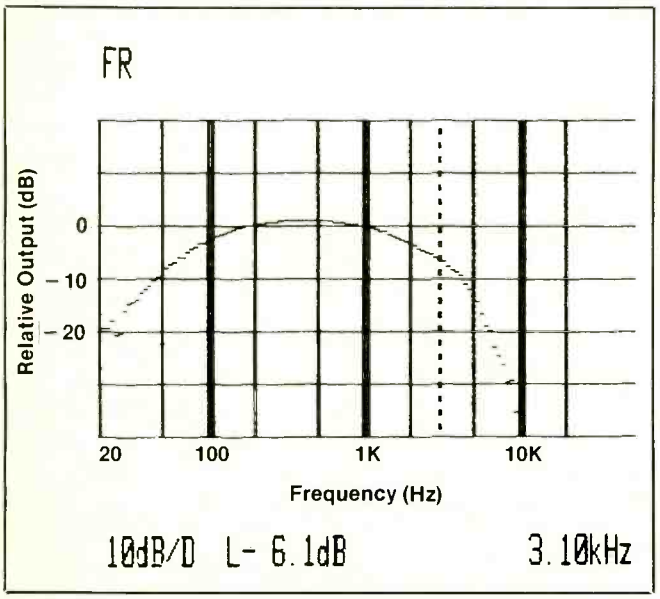
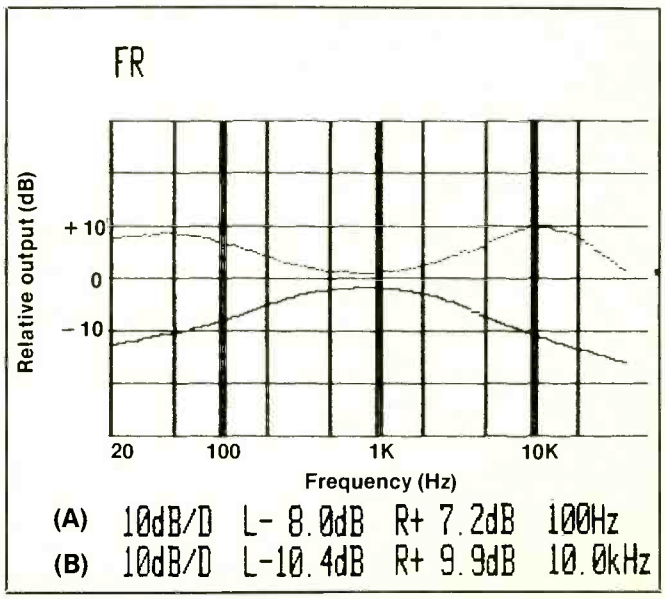


Fig. 3. Boost/cut range of bass (A) and treble (B) controls.



Signal-to-noise ratio for the MM phono inputs was 82 dB, A-weighted, referred to a 5-mV input signal and a 1-watt output level. Any reading above 80 dB would be considered a very good S/N ratio even if this were a separate high-priced preamplifier. The MC phono input did almost as well, with a measured S/N of 76 dB referred to a 0.5-mV input and 1-watt of output. This figure, too, is excellent and compares favorably with the figures obtained for the high-quality separate preamplifiers having MC head ends. Signal-to-noise for all of the high-level inputs measured 83 dB referred to 1-watt output and 0.5-volt input.

In terms of rated output, these figures are such that if a 2.0-volt maximum signal were fed to the high-level inputs (typical of CD player outputs) and the volume control setting were increased to produce 125 watts, the effective S/N would be 116 dB. Since that amount of dynamic range is well above that provided by compact discs or other digital program sources, it is apparent that this receiver is not going to impose any limitations on the dynamic range or signal-to-noise ratio achieved by even these new program sources.

RIAA equalization was accurate to within – 0.4 dB from 30 Hz to 20 kHz. At 20 Hz, response was off by 1.0 dB, but that can be attributed to the presence of the subsonic filter which is in-circuit at all times. Figure 5 shows the action of the separate continuously variable loudness control at its maximum, flat position (upper curve) and at its minimum setting which attenuates mid-frequency levels by around 40 dB, regardless of where the "reference" level has been set by the separate master volume control.

This dual control arrangement allows you to set up the volume control for listening levels such as might be heard at a live performance. Then, the Loudness control is used to lower loudness levels to loudness levels suitable for a home listening room. Adjusting loudness contours in this way results in more accurate loudness compensation than could be accomplished with the typical "Loudness Switch" used with the volume controls on most other receivers and amplifiers.

Summary

The tuner section of this receiver is at least equal in performance to that of separate tuners costing nearly as much as this entire receiver. What's more, the Local/DX automatic feature worked flawlessly, always providing optimum FM reception for a given set of incoming signal conditions. We logged more than 63 usable signals in our test location, using a good outdoor, rotatable, directional antenna. The tuner section rarely switched into the "DX" mode in our listening location, so we were able to take advantage of the extremely low distortion and the excellent stereo separation afforded by this tuner's wideband "Local" mode.

We hooked up a good video monitor to the appropriate terminals on the back of the R-9 along with a video camcorder and a VCR. Dubbing from the camcorder to the VCR was simple, and all the while we were able to monitor what was happening on the connected monitor.

The R-9 served as an excellent "switchboard" or control center for every imaginable type of audio or video program source. When we played my most dynamic CDs through the R-9, its amplifier section never ran out of power—even while driving my low-efficiency reference speaker systems.

(Continued on page 20)

Fig. 4. Curves show range of receiver's midrange tone control.

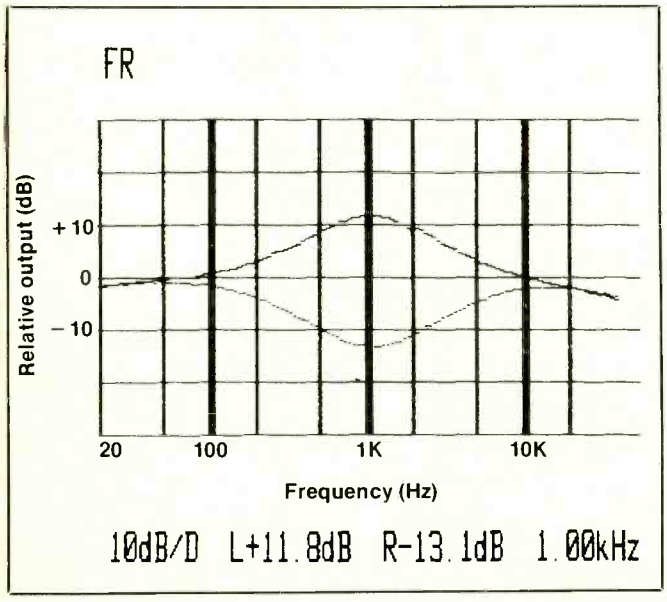
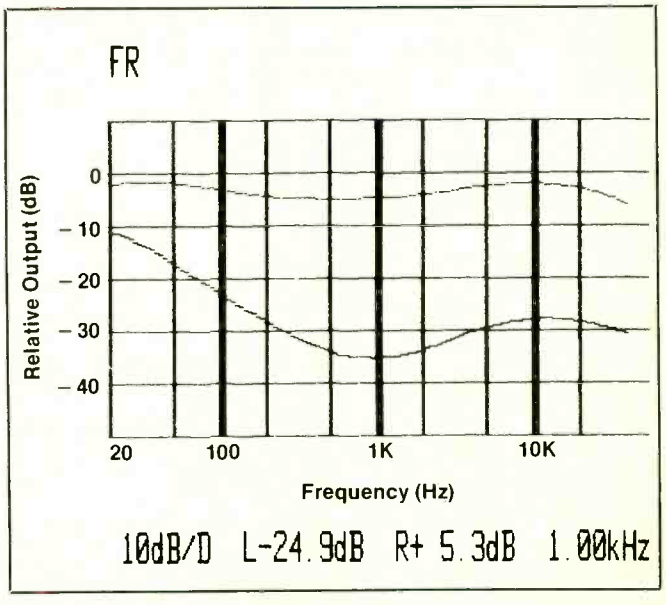


Fig. 5. Curves show action of the variable loudness control.



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PRODUCT EVALUATIONS...

Yamaha R-9 continued . . . *(from page 15)*

The stereo synthesizer circuit, like many others of its type, utilizes a comb-filter circuit to convert a monophonic signal into a simulated stereo signal. Of course, the resulting effect is not "true stereo," but the spread of sound is pleasing nevertheless.

The DNC or Dynamic Noise Canceler circuit worked in a manner very similar to that of the DNR (Dynamic Noise Reduction) circuit, which is sold in the form of an IC and used by many car stereo manufacturers, as well as by tape deck and videodisc player manufacturers, among others. DNC is a sliding low-pass filter that follows the upper frequency limit of program content and removes noise above the frequency.

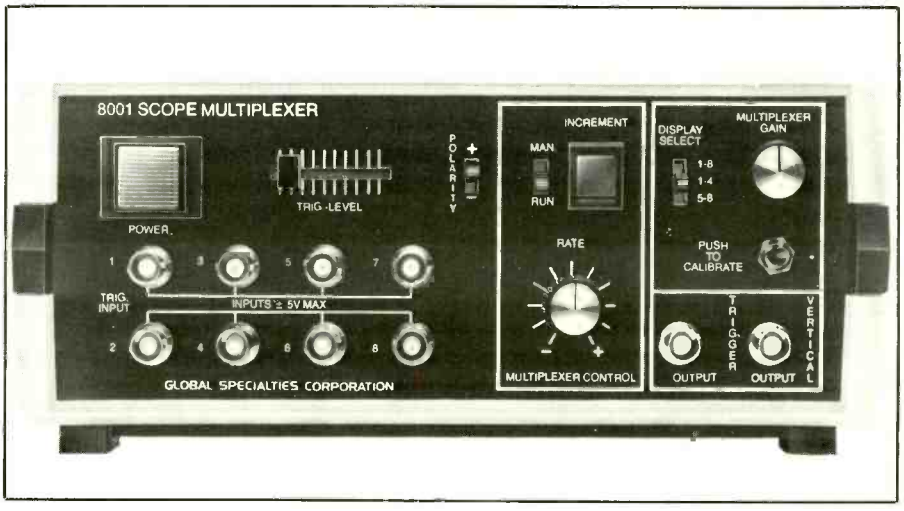
The three tone controls provided just about all of the tonal compensation facilities anyone would ever need. For those who feel that a narrower-band multi-control equalizer is needed, the Yamaha R-9 even has an accessory output loop to which an equalizer or other signal processor can be connected, effectively putting the new accessory in series with the signals passing through the receiver.

The R-9 is, without a doubt, one of the most flexible and well thought out multi-function audio components we have encountered. Foresighted audio and video enthusiasts may find that they may not use all of the extensive facilities of the R-9 at first. As they become more involved in audio and video in the future, it is very likely that more and more of those rear panel jacks will be filled up with audio and video connectors.—*Len Feldman.*

CIRCLE 52 ON FREE INFORMATION CARD

Test Equipment

Global Specialities Scope Multiplexer: 8 inputs for 2-channel scopes



Working on much of the current array of electronic products and systems can tax the capabilities of most general-purpose 2-channel oscilliscopes. Products such as computers in the digital area and video and audio equipment in the analog area require simultaneous display of multiple waveforms. Using a scope with just two input channels can be a serious handicap when servicing them. On the other hand, a scope with four or eight input channels may be well beyond some budgets. However, if you already have a 2-channel scope with at least a 20-MHz bandwidth, Global Specialties' Model 8001 Scope Multiplexer is a relatively low-cost solution to the dilemma.

A sophisticated takeoff on the traditional multichannel switcher used in bygone days, the Model 8001 takes the basic concept a bit beyond what has been available in the marketplace. It has eight inputs and the usual controls and outputs provided by other "multiplexers." To these it adds some fancy circuitry that lets you select the number of channels you wish to be displayed. For example it can be set up to display a single waveform or, with the flip of a switch, four or eight waveforms simultaneously. Furthermore, an incrementing circuit whose function is activated with the touch of a switch lets you step through all input channels individually for examination of a single waveform at a time.

Multichannel signal processing, phase-locked loop (PLL) operation, TV tuning and sync displays, and slower A/D and D/A converters can all the analyzed within the Model 8001's 10-MHz trigger, 20-MHz bandwidth, and 1-MHz sampling limitations. With the instrument's 20-MHz bandwidth limitation, though, it is restricted to use on relatively low-fre-

(Continued on page 78)

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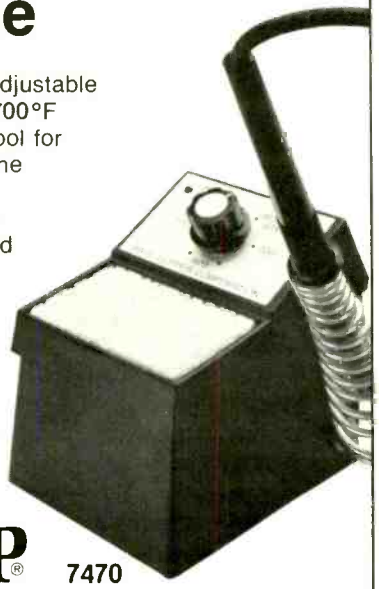

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Radar Detectors

A guide to automobile radar detection equipment and methods

By Ron Cogan

You're moving along at a moderate pace in your car one evening, barely nudging the posted speed limit of 40 mph while traversing from Florida's east coast toward Tampa and the Gulf of Mexico.

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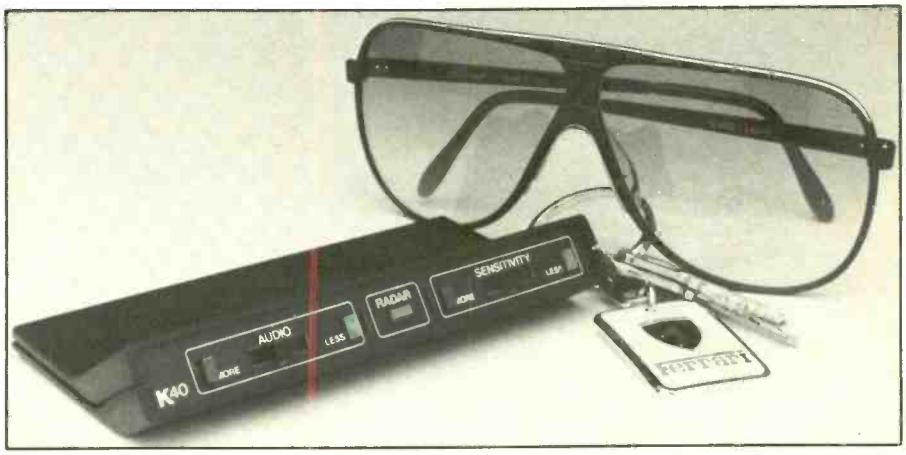
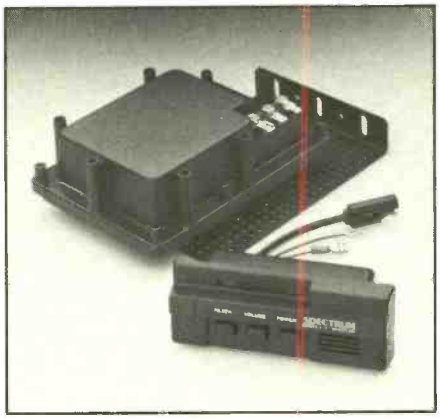
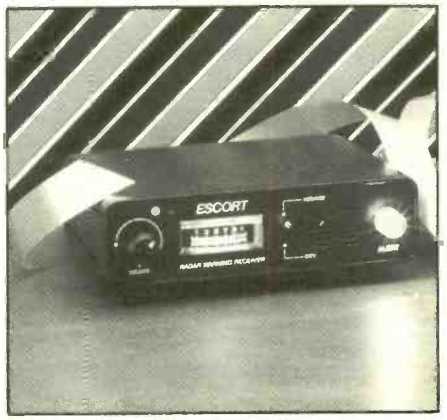


The slim K40 Remote radar detector comes with a guarantee against cost of radar speeding tickets for the first 18 months.



The Spectrum Whistler remote detector with a weatherproof front end that's mounted behind a car's grille.



Cincinnati Microwave's popular Escort, which uses surface mounted device (SMD) construction.

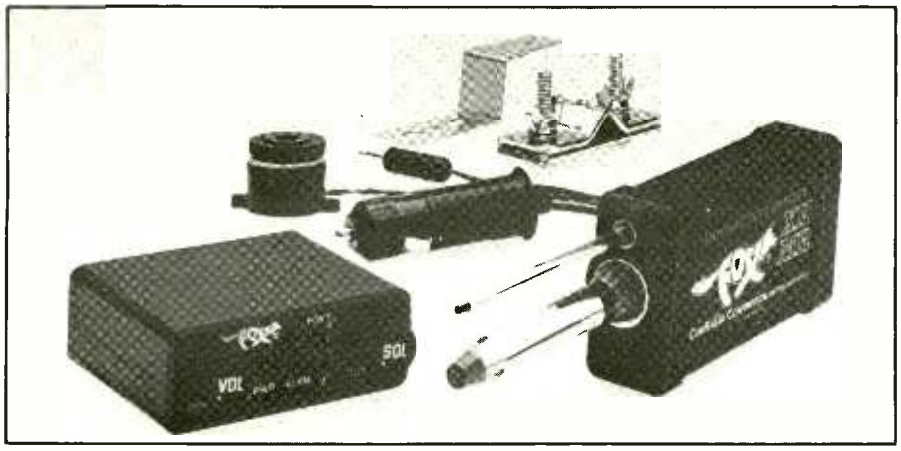
you were caught in the innocent act of one of the greatest revenue-generating devices ever devised for city and state governments—police radar! Many small towns purposefully set up this way to enhance their operating budget. Unknowing drivers suffer for it . . . unless they have a radar detector to defind against entrapment.

What Is Police Radar?

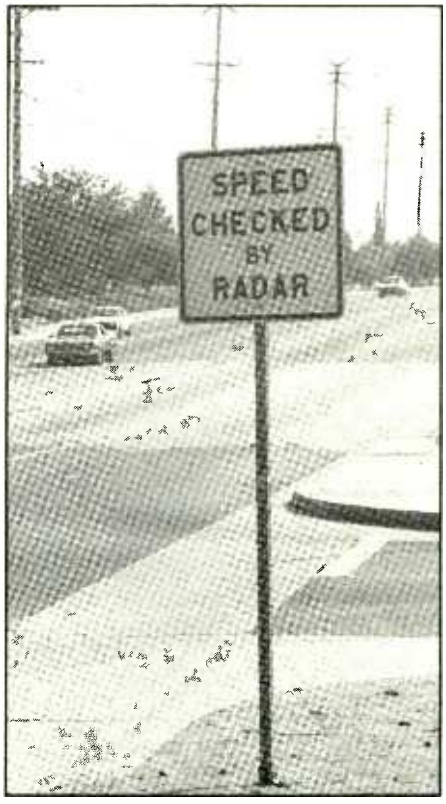
The word "radar" is a simple acronym for "RAdio Detecting And Ranging." We're all aware that this system is used to aid and track the navigation of aircraft everywhere.

Some years ago, an innovative soul came up with an interesting application of radar to combat speeding motorists on the highway. A single radar unit in a strategic location began to be used to pinpoint speeding vehicles. The F.C.C. initially allocated what is known as the "X Band" at a frequency of 10.525 GHz to be used for police radar enforcement. The long wavelength of this band made it perfect for monitoring highways and interstates. After a time, the F.C.C. allocated a second frequency, the "K Band" at 21.150 GHz, to augment the existing radar program. This narrower frequency was better suited for shorter-range applications.

The evolution of police radar units over the years has been an interesting one. Early police radar units were rather simplistic, high-power devices which were capable of pinpointing vehicle speed at about a half-mile range. These were physically mounted to the patrol vehicle and used from a stationary position. This was followed by police radar used in moving as well as stationary vehicles, and these moving patrol cars were cap-



Fox Marketing's XKMR model is designed for use with motorcycles, featuring very small size, weatherproofing, and high shock-resistance.



able of aiming radar to the front and the rear for maximum coverage. Then the police radar arsenal expanded to include low-power, instant-on, pulse, and radar hand-gun units. Radar speed enforcement was here to stay.

While there is certainly some merit to the use of speed radar, it has unfortunately gained a rather soiled reputation because it has been abused. What was initially introduced as an innovative and futuristic method of enforcing traffic speed limits became the high-tech answer to methodically building city coffers.

Countless police agencies foregoed placing their radar-equipped patrol cars in plain view, where their high profile would graphically alert motorists that they should maintain a legal speed. Instead, the police units often "hide" by stationing themselves between parked cars, just over the crest of a hill, and around corners where they could surprise their four-wheeled prey and be guaranteed of writing an iron-clad ticket. Thus, "speed traps" became a popular road game.

But many motorists grew weary of losing and decided to become active players in this game. Concurrently, several innovative companies devised products that they believed would aid the harried motorist in his quest to drive ticket-free without fear of being nailed by major-league electronics. This new and exciting product became known as the "radar detector," of course.

Dynascan's Cobra Trapshooter RD-41000.

An Exciting "Defensive Weapon"

With the introductionof the radar detector came a new way to battle the invisible and effective microwaves of police radar. It could sense the high-power, continuous emissions of X-Band radar well in advance of its effective range, even over hills and around corners. Thus, a driver could be afforded plenty of warning that he had best be traveling the posted speed limit for the coming miles until the radar trap was passed.

As is the case with any new technological wonder, the first generation of radar detectors did their job in a most basic way. They usually did detect the presence of police radar when it was being used, and in fact did save countless motorists from speeding tickets (and some likely accidents) because they were forewarned. But they would have to improve, because the next salvo in the radar war was fired by the other side, and it was substantial enough to make counting on immunity through radar detection a risky endeavor.

This salvo was actually a two-pronged attack. First, a number of states decided that this activity went against the grain of a society intent upon enforcing its laws, so they took the legal approach. In essence, such states banned the use of radar detectors, making such use a ticketable offense. In the case of a few states that took an even more hard-line approach, a motorist caught with a radar detector could be arrested, hauled off to jail, and have his detector confiscated.

Radio Shack's Road Patrol XK.

Uniden's Bandit 55.

Electroalert's Superhet XK.

However, under Title 47 of the Communications Act of 1934, the Federal Communications Commission specifically states that no radio receiver can be licensed, restricted, or banned. Since a radar detector is indeed a radio receiver, this caused the legality of the blanket banning of radar detectors to come into question. After the dust cleared on this legal matter, only two states—Virginia and Connecticut—have chosen to maintain that radar detectors are illegal through rather creative interpretations of the law.

The second part of the two-pronged attack involved police agencies receiving approval for the new K-Band frequency. They began employing these units in conjunction with, and sometimes in lieu of, the first-generation X Band radar devices.

As the radar war heated up and a new generation of radar detectors were unleashed to detect the presence of both X and K band police radar, the offense took further technological steps to make detection more difficult than ever before. Entering the picture at this critical point was the low-power speed radar device to preclude long-range detection, and the pulse radar, which would send intermittant signals in an attempt to thwart easy detection by the present genre of radar detectors on the market.

The counter to this was production of more sensitive detection systems to match the offensive capabilities of the newest police radar devices. They would be infinitely more sensitive to the presence of elusive police microwaves in order to warn of a speed radar trap in time.

Enhanced sensitivity in general does increase the odds of ferreting out the more difficult-to-detect police radar signals, but it does not come without cost. Ultra-sensitive detectors all-too-often experience an unnerving problem that radar detector manufacturers are still trying to engineer out of their units today—false-triggering.

False-triggering is simply your radar detector warning you of the presence of police radar when, actually, none exists. Unfortunately, other devices also operate on the very same frequencies used by police radar. Among these offenders are microwave security systems, phone relay stations, and garage-door openers. Some radar detectors also leak signals that can trigger a radar warning on other detectors.

An answer provided by a number of radar detector manufacturers was to build in simple controls that would enable a driver to reduce X-band detector sensitivity in urban areas, where such signals are more likely to be found.

The city/highway switch found on some radar detectors does the desensitizing job automatically and attempts to find a median where both tasks can be accommodated as best as possible. As a rule of thumb, if a radar detector warning does occur in the city, there is no way you can really determine if it has been triggered by police radar or a spurious signal. The best bet here is to simply slow down to prevent even the possibility of getting a ticket.

Detector Designs

The first radar detectors introduced on the market were typically bulky and designed to reside on a vehicle's dashboard via either a heavy magnet or a solid mount. After a time, technical innovations resulted in lighter, more compact units that could also be installed with clips or Velcro tape.

Smallish units are now available that can be clipped to a sun visor, and

Radar Detector Buying Guide

Deciding which radar detector to buy is probably more challenging than purchasing most other popular electronic equipment. Unfortunately, there are no real standards upon which to weigh one product against another. No specifications for comparison purposes.

The keys to making a buying decision might be broken down into the following: price, one-piece or remote, size, features, company reputation, plus any information you can gather from retail sales people and radar-detector users.

You can pick up a basic radar detector for as little as $60, but don't expect it to have the best sensitivity or selectivity, not to mention anti false-triggering circuits, city/highway switching, and other attractive features. The top detectors are pushing $300 ("list") and some exceed this price, less discount. Remote units are the most costly in any maker's line. Here are some representative suggested retail prices of detectors on the market:

BEL-Tronics' "MicroEye 841" . $190
Cincinnati Microwave's "Escort" $245
Controlonics' "Whistler Spectrum" $300*
Dynascan's "Cobra RD-4100" . . $200
Electrolert's "Fuzzbuster XK" . $160
Fox' "XKMR" (Motorcycle) . . . $200
K-40's "Remote" $340*
Radio Shack's "Road Patrol XK" $180
Regency's "RS Five" $149
Uniden's "Bandit 55" $190

You pay more for really compact units, which use the latest microminiaturization techniques. They offer the benefit of taking up less space in an automobile and can be easily removed and stowed away to avoid the prying eyes of thieves. The control heads of remotes are exquisitely small. For example, Cincinnati Microwave's "Passport" remote ($295) measures only ¾ "H × 4½ "W × 2¾ "D.

Then you should decide how the radar detector should be installed. Would you like to have one with a visor-clip mounting, a permanent under-dash location, a top-of-dash temporary mounting. Do you want to plug the power line into your cigar lighter or have a fixed-power connection? What you wish will determine in part the type of unit you'll buy. Keep in mind, too, that some people are wary of doing their own permanent-installation work, required for remotes and for fixed hookup to the car's battery supply. There'll be an installation charge for a professional to do this, of course.

When you come to features, the latest top-of-line detectors have anti-false-triggering circuits, aural and visual indicators, city/highway switching, volume controls, mute switch, automatic brightness control, system test to verify that the detector is indeed working, and external speaker jack, among other features.

Even among features there are sub categories. For instance, what type of signal-strength indicator is incorporated into the detector to let you know about the strength of the radar transmission being picked up? Is it an audio beeper, flash frequency, LED indicator, meter, or combination of a few? Is there a different sound made to distinguish between an X-band and K-band signal being picked up?

Radar detectors respond to different radar signals in various ways. Whichever model you get, you'll have to familiarize yourself with its warnings. One model might start beeping slowly, increasing as you approach the signal source, beep for several seconds and stop under another condition, emit raspy sounds for a few seconds in yet another condition, etc.

How well does the detector respond on each band under different practical conditions: Over-the-hill, Smokey at your back or front door, around a curve, in a large urban area, and so on. Furthermore, how good is the detector's shielding against local oscillator radiation from other detectors being carried in nearby cars. You'll have to ask a lot of questions to possibly learn the answers.

Keep in mind, too, that radar detectors are not foolproof. For example, an instant-on radar fired at you closeby will catch you even though your detector responds. You won't have time to slow down in this case. Furthermore, VASCAR (visual average speed computer and recorder), among other non-radar devices, will not be detected by a radar detector, naturally. Moreover, this method is dependent on a person starting a timer and is, therefore, inaccurate.

Insofar as company reputation is concerned, this information would have to be ferreted out. Some companies bend over backwards to please purchasers. Others virtually ignore you should you have a problem out of warranty and even in warranty.

one manufacturer has even designed a detector with a contoured housing that allows it to fit between the forward part of a dashboard and the windshield glass so it will be as inconspicuous as possible.

Along with the proliferation of visor-mount detectors we're seeing on the market, the remote-type radar detector has also realized a substantial following. These units typically utilize a weatherproof radar detector that is mounted behind any plastic grille or other non-metallic part at the front of a vehicle, and a tiny hard-wired remote control head that can be mounted inconspicuously inside the car.

Popularity of remote-type radar detectors grows as more people realize that some states and towns do not recognize the legality of using one, and theft of radar detectors has risen sharply, along with car radio-cassette systems.

Packing this sophisticated electronics package into such smallish housings as side mirrors and tiny visor-mount packages (some small enough to fit in a briefcase or pocket) is, of course, due in no small part to the use of integrated circuits and microprocessors. It is also partially due to innovative antenna designs which have grown much more effective, yet smaller, over the years. Among the types of antenna used by the latest radar detectors are the horn antenna, multibeam printed circuit

GUL Industries' Model 83S.

Regency's Super Long Range XK.

An important distinction is that when a suspect signal is received, it processes and analyzes the incoming signals to determine if they are being generated by radar or by a source other than radar. This "electronic fingerprinting" prevents the unit from false-triggering from most other-than-radar sources.

Some of the new radar detectors take a different approach. Instead of discounting all spurious signals, these units presume that a driver should be made aware of a suspect signal even if the detector is not convinced it is being generated by police radar.

As an example, Controlonics, among others, has built a new filter mode into its detectors that can be switched on when driving into an urban area. Instead of reducing the sensitivity of the radar detector (and thereby affecting optimum ability to monitor for police radar), the unit

(Continued on page 83)

antenna, and a hybrid combining a half-horn and microstrip antenna.

Although many radar detectors are designed to be permanently wired into a vehicle's electrical system, others still use the same cigar-lighter plugs (or offer these as options) which were used on most of the early radar detectors. These are particularly handy for drivers who may want to transfer their radar detector from one family vehicle to another, and also for those who want to regularly remove their unit from the car to prevent the possibility of theft when it is parked.

The latest generation of radar detectors incorporate sophisticated superheterodyne circuitry. Unlike their passive first-generation cousins, which simply determine that microwave signals were present in an area and then signaled a warning, these new devices take a more active role in protection againt police radar.

RADAR-DETECTOR MANUFACTURERS

BEL-Tronics Limited
3031 West Pawnee
Wichita, KS
(Brand Name: Micro Eye Selectra)

Cincinnati Microwave
One Microwave Plaza
Cincinnati, OH 45296
(Brand Names: Escort, Passport)

Controlonics Corp.
Five Lyberty Way
Westford, MA 01886
(Brand Name: Whistler)

Electrolert, Inc.
4949 South 25A
Tipp City, OH 45371
(Brand Name: Fuzzbuster)

Dynascan Corp.
6460 West Cortland St.
Chicago, IL 60635
(Brand Name: Cobra Trapshooter)

Fox Marketing
4518 Taylorsville Rd.
Dayton, OH 45424
(Brand Names: Roadstar, Matchbox, SuperFox)

GUL Industries
23978 Craftsman Rd.
Calabasas, CA 91302

K40 Electronics
1500 Executive Dr.
Elgin, IL 60120

Radio Shack
300 One Tandy Center
Fort Worth, TX 76102
(Brand Name: Road Patrol)

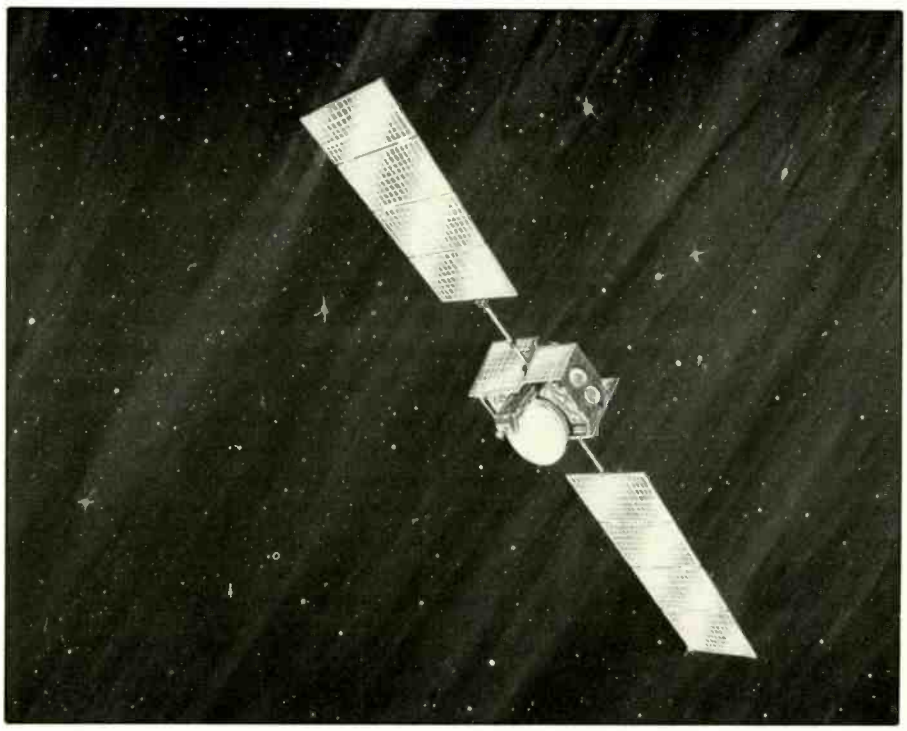
Regency Electronics, Inc.
7707 Records St.
Indianapolis, IN 46226

Uniden Corp. of America
6345 Castleway Ct.
Indianapolis, IN 46250
(Brand Name: Bandit)

RCA Goes Ku-Band

New satellites to serve TV broadcasting, business and home TVRO viewers

By Stan Prentiss



With all systems *go!* RCA is ready to rocket two satellites into Ku-band orbit late this year and expects both to become operational in early 1986. Ground support will consist of excellent ColorTrak 2000 TV receivers with compatible NTSC transmission systems and Linkabit™ scrambling.

In a consolidated effort by RCA Americom, RCA Astro-Electronics, RCA Laboratories and RCA Consumer Products, the massive undertaking will begin with the launch of 12/24-GHz broadcast and syndication satellite K-2 aboard the new Space Shuttle Atlantis this November. Then in December, Space Shuttle Columbia will set into orbit cable and business satellite K-1. Both satellites are scheduled to become operational by February 1986. (A third satellite, K-3 is slated to fly in 1988.)

A preview of the new satellite system was given to selected industry and technical press people at the David Sarnoff Research Center in Princeton, NJ, earlier this year by staff vice-president B.J. Lechner and others. Announcements and demonstrations also included introduction of B-NTSC, an augmented video/audio TV system designed to compete with Britain's B-MAC now being marketed in the U.S. by Scientific Atlanta. B-NTSC is wholly compatible with current TV broadcasting and receivers for standard transmission, and its signals can easily be scrambled and decoded by sets that could have external or internal decoders available in 1986. Later, as additional engineering is further refined and compacted into large-scale integration (LSI) circuits, RCA digital television will join the parade of advanced video/audio developments, bringing even greater flexibility to televised picture and sound processing, along with digital receiver controls and special effects not now available in ordinary analog receivers.

As digital systems are advanced, removal of most, if not all, artifacts (stray video) and cross-color (color interference) should be eliminated with whole frame store instead of today's line of signal additive and subtractive comb filter luma-chroma separation. Furthermore, as techniques are mastered, both line and frame averaging will result in considerably better definition and resolu-

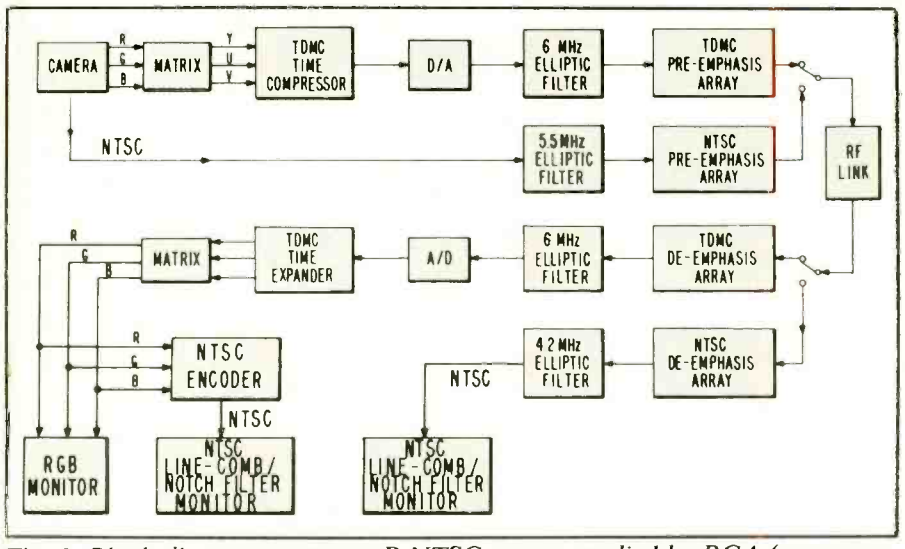


Fig. 1. Block diagram compares B-NTSC system readied by RCA (upper portion) with Britain's B-MAC system (lower portion) currently in operation.

tion at reasonable bandwidths. Even now, up to 30 megasamples can be digitized experimentally, accomodating an analog beamwidth of 15 MHz. So when all luminance has been removed from the chroma channel and vice-versa, you see clean chroma-luminance frequency interleaving without contamination of either color or picture.

B-NTSC Processing

By processing a total NTSC bandwidth of 4.2 MHz and stripping sync in both line and field, space remains for two audio channels as well as digital commands for both sync restoration and scrambling. Digitized, the two encrypted audio channels, control data signals, and 3.58-MHz chroma sync reference occupy the horizontal blanking period, in addition to an auxiliary data channel. During the 1.3-millisecond vertical blanking period, digital sync information is transmitted and video becomes inverted.

When the signal is received, sync is recovered from the vertical interval, audio is removed from horizontal blanking and converted back to analog, video is reinverted, and regenerated sync locks a steady raster. Linkabit scrambling, we are told, will handle up to 250 channels of information and a 56-bit program authorization word for customer access.

A block diagram that compares Time Division Multiplex Component (TDMC) B-MAC to B-NTSC is shown in Fig. 1. The switch at the far

RCA's K-Series Ku-Band Satellites

Identified by RCA as the 4000 Series spacecraft, each of the new K-Series Ku-band satellites can cover part of or the entire U.S. Additionally, there will be one spot beam for Hawaii. Orbital assignments are at 67°, 77° and 87° west longitude (WL). A fourth assignment is being held as a reserve ground spare. Shuttle Mission 61-B, flown by Atlantis, will loft K-2 into orbit on November 27. Then on December 20, Mission 61-C, flown by Columbia, will place K-1 into orbit.

These two new birds will join five other lower-frequency 4/6-GHz C-band RCA satellites that are already providing government and commercial communications throughout the U.S. Services of the K (4000) Series will include broadcast and syndication, master-antenna systems, direct-to-home broadcasting, and "private" voice, voice data, and teleconferencing for business and government.

Certainly the most powerful satellites now in domestic service, 16 45-watt transponders on each satellite will be offered to participants in RCA Americom's syndication system in a no-cost (free) antenna/receiver package. The only charge will be $1000 to defray installation, as long as the 3.7-meter Ku-band antenna is pointed at a K-Series satellite. Signal-to-noise ratios for a single video transponder using this equipment is specified at 55.5 dB, and 50 dB for two over most of the country under clear-sky conditions.

Ground station installations have been under construction since summer, with initial programming scheduled for K-2 in February 1986. More than 400 standard-power commercial TV stations (out of a total of 900) have already accepted the service. Hubbard Broadcasting's U.S. Satellite Broadcasting, Inc. has now leased four of the K-2 transponders for more than $85-million to distribute its news service and other programming to affiliates.

RCA Americom says that RCA's strong Ku-band entry occurred because 50-state C band CONUS (continental U.S.) is "nearing orbital capacity," that power and siting restrictions are less exacting at Ku frequencies, and that there is little terrestrial microwave interference with which to contend and almost unlimited placement of receiving antennas on the ground. Densely populated metropolitan sites are also included, as long as there is line-of-sight access to the particular satellite.

The K Series will have dual horizontal/vertical polarization, a design life of 10 years, and transponder switching from east to west to CONUS on ground command. They will contain six backup transponders for the two polarities and will measure 63.5 feet overall. At time of launch, each will weight 4144 pounds, which will drop to 2170 pounds in orbit.

right serves to illustrate general transmit and receive techniques of each system. While there is video compression and expansion in the TDMC arrangement shown in the lower portion of Fig. 2, NTSC simply passes the composite signal through a 5.5-MHz elliptic filter, adds the usual video preemphasis, reverses the process during receive, and feeds the results into a line comb/ notch filter monitor or receiver. The TDMC system must convert all its compressed information back to analog via an A/D converter, expand and matrix the color difference for RGB, then either supply an RGB monitor directly or go through an NTSC decode process and then feed a standard NTSC receiver.

Although RCA concedes MAC allows slightly more overdeviation and a bit more impulse noise, engineers believe that MAC has poorer luminance S/N. NTSC uses standard CCIR video preemphasis, rather than MAC's fixed 3 dB. The two audio systems, Dolby delta modulation and pulse code modulation, are different, but both begin to fail at carrier-to-noise (C/N) ratios of 6 to 7 dB.

In a consumer product, RCA claims that hard video scrambling is impractical and unnecessary, but audio scrambling becomes essential, along with secure encryption control of coded signals and subscriber turn on and turn off keys. Though MAC eliminates both cross-color and cross-luminance from NTSC, it also requires linear RGB inputs into any TV receiver (few receivers have this capability). Later, of course, the NTSC system will eliminate two problems with frame-comb decoders, and progressive scan will remove any occasional flicker or line crawl. Motion-adaptive progressive scan and frame-comb filters will physically supplant the single-line comb filters used to-

(Continued on page 84)

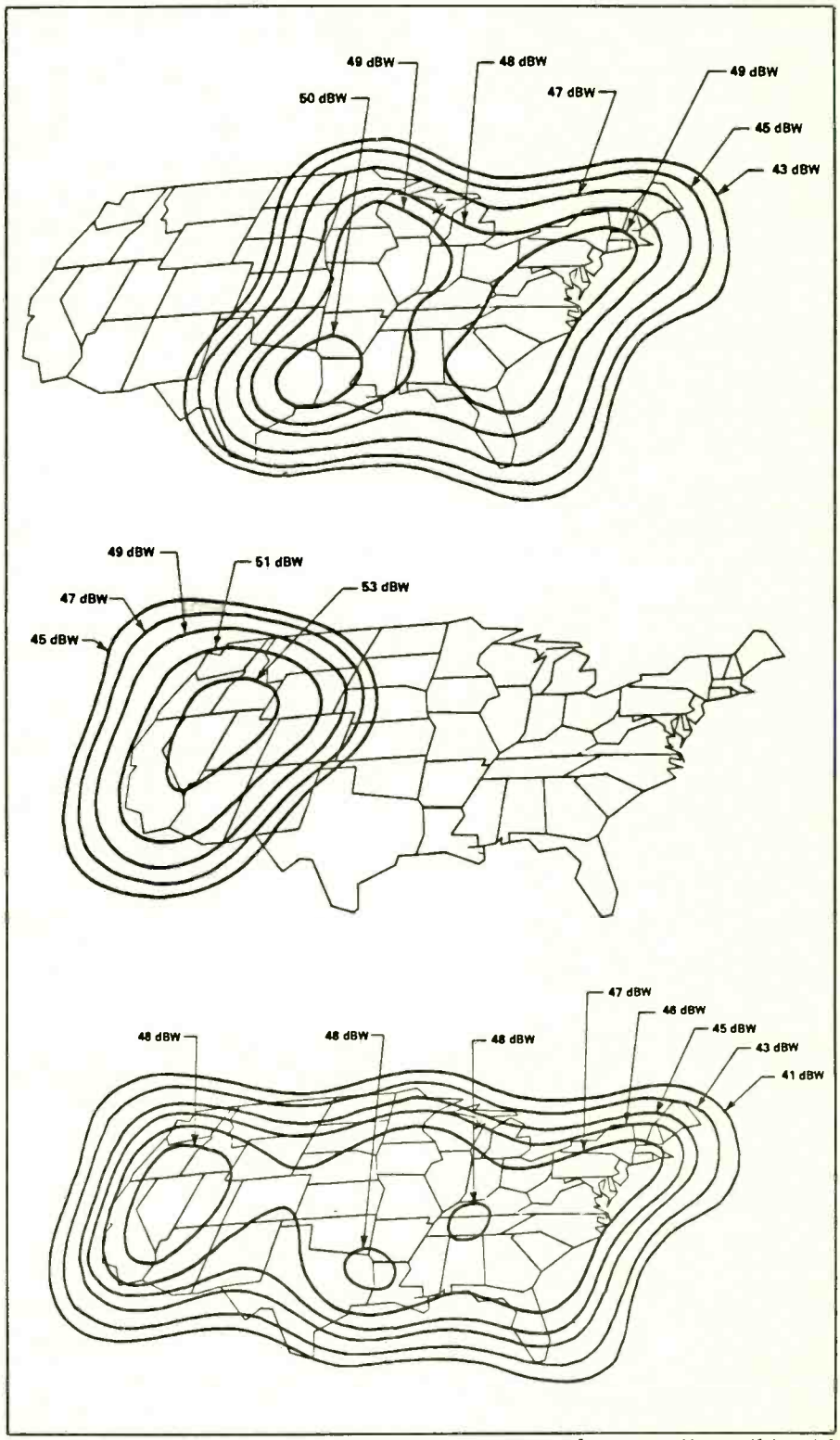


Fig. 2. This series of diagrams illustrates reception "footprints" possible with the new RCA Ku-band K Series satellites. Top diagram shows eastern U.S. coverage, center diagram western U.S. coverage and bottom diagram CONUS coverage. All are with K-2 in orbit at a nominal 77° west longitude assignment.

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The Siliconnection

A new book by Forrest Mims examines the silicon-connected modern age of electronics through his personal involvement in it.

By Art Salsberg

Microelectronic life is largely based on a raw material called silicon, the second most abundant element in the earth's crust. Using special refining methods, this semiconducting material has changed the face of electronics due to its low cost and miniature size.

Starting with the development of a transfer resistor at Bell Laboratories, called a "transistor," and evolving to an integrated circuit in the late 1950s, it has revolutionized our lives through a host of affordable consumer electronics products, from digital watches to computers.

Silicon's impact on society is so strong that an area of the U.S. where many semiconductor developers gathered is called "Silicon Valley," a term applied only 15 years ago to a sleepy, orchard-laden area of northern California, the Santa Clara Valley. Located about 30 miles south of San Francisco, near Stanford University, the seeds were planted by establishment of the first semiconductor company on the West Coast by transistor co-developer William Shockley. The year was 1955, only 30 years ago. High-technology compatriots followed quickly, and the area became a glamour-spot for silicon-based companies.

Forrest Mims, in his new book, "Siliconnections," published by the McGraw-Hill Book Company, is a personalized coming-of-silicon-age story, starting with his first awakening upon seeing a photograph of a transistor in 1954.

H. Edward Roberts reviews a MITS calculator schematic in 1974, a few months prior to designing the Altair computer.
(Photo by Forrest M. Mims III.)

Forrest Mims preparing to launch a radio-controlled rocket near Saigon, 1967.
(U.S. Air Force photo.)

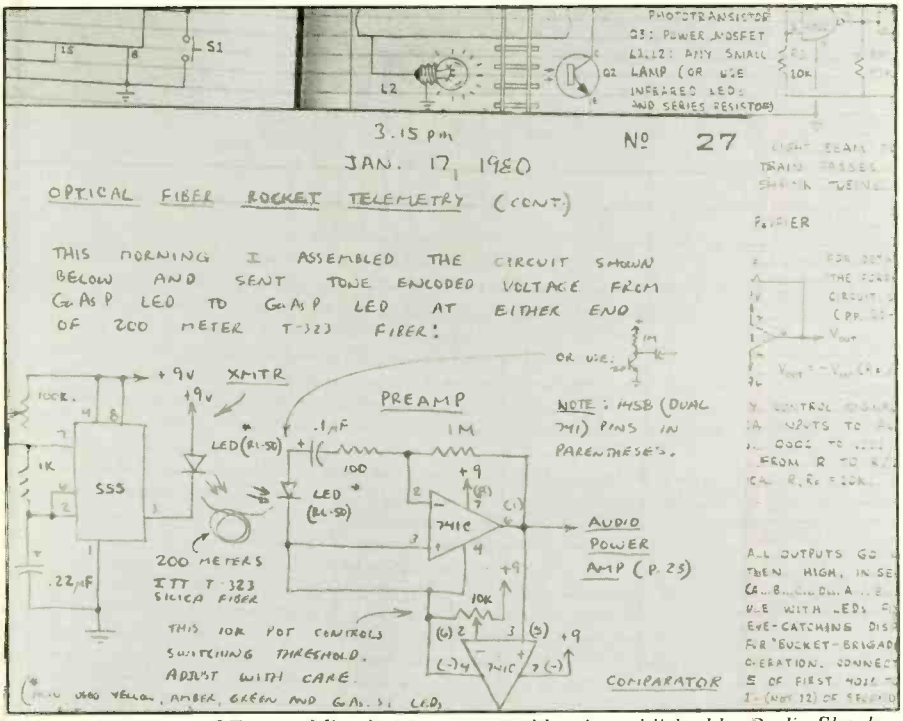
He details his extraordinary experiences related to the silicon technology through three decades of exciting involvement with it. Given his wide-ranging brushes with the world of silicon, he might well have titled his book, "Siliconescapades."

In this book, for example, he relates how he met Ed Roberts and joined business forces with him; the origins of their company, MITS, which later introduced the Altair 8800 computer that spearheaded the personal computer revolution in 1975; and how they split up (amicably with a payout of about $950 in cash and kind. (Six years later the company shares would be worth $15,000!)

His work at the Air Force Weapons Lab is detailed, from the Silicon Zoo to Laser Reflections. His "Confessions of a High-Tech Spy" includes his experiences in building laser "bugging" apparatus, his involvement with the *National Inquirer,* which expressed interest in Forrest using his electronic equipment to fly-by Howard Hughes' abode to capture the man's utterings.

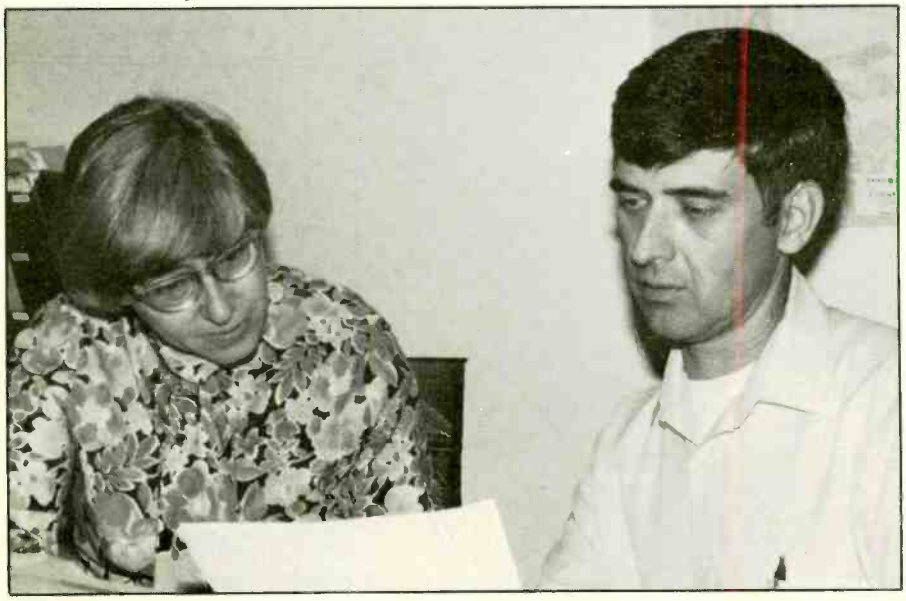
Of special historical interest are his details on William Shockley leaving Bell Labs to return to his hometown, Palo Alto, in California, to establish the Shockley Semiconductor Laboratory in nearby Mountain View, and how key people left to form Fairchild Semiconductor, whose defecting engineers and physicians left, in turn, to turn silicon into gold with such companies as Intel.

Forrest's inside information on



A page from one of Forrest Mims' notebooks that led to his series of hand-lettered books published by Radio Shack.
(Photo by Forrest M. Mims III.)

how the BASIC language was developed for commerical use through the association of Bill Gates with Ed Roberts, the former finally setting up his own company, Microsoft (which later developed the *defacto* standard operating system for 16-bit computers, MS-DOS) is especially intriguing. So was his discussions of the early software pirates.



Dr. Uta Merzbach, a curator at Smithsonian Institution's National Museum of American History and Forrest M. Mims reviewing early MITS papers that Mims will donate to the Smithsonian.
(Photo by Minnie C. Mims.)

His chapters on "Silicon Law" and "Mims Versus Bell Labs" can serve readers well in understanding how tough it is for a little guy to go up against a giant corporation when trying to assert his rights to a development. The inventer of FM radio, Edwin Armstrong, must have suffered extreme anguish during his legal pursuits against RCA, finally committing suicide. Forrest, too, was exasperated, but wrote about his experience instead, which included house searches that stunned him, and other unwelcome actions he reveals. I recall giving a deposition in the Bell Labs case during this period, which concerned fiber-optic communications. Read it and weep!

The author delves deeply into the world of computers, of course, discussing his first-hand experiences with people who were pioneers in the computer industry, including startup of the Radio Shack computers and his secretive introduction to the TRS-80 Model I computer in a Texas warehouse.

In all, Siliconnections is an enthralling inside look at an industry founded on silicon, and how Forrest Mims interacted with it on his journey as an independent electronics/computer journalist, experimenter, and inventor.

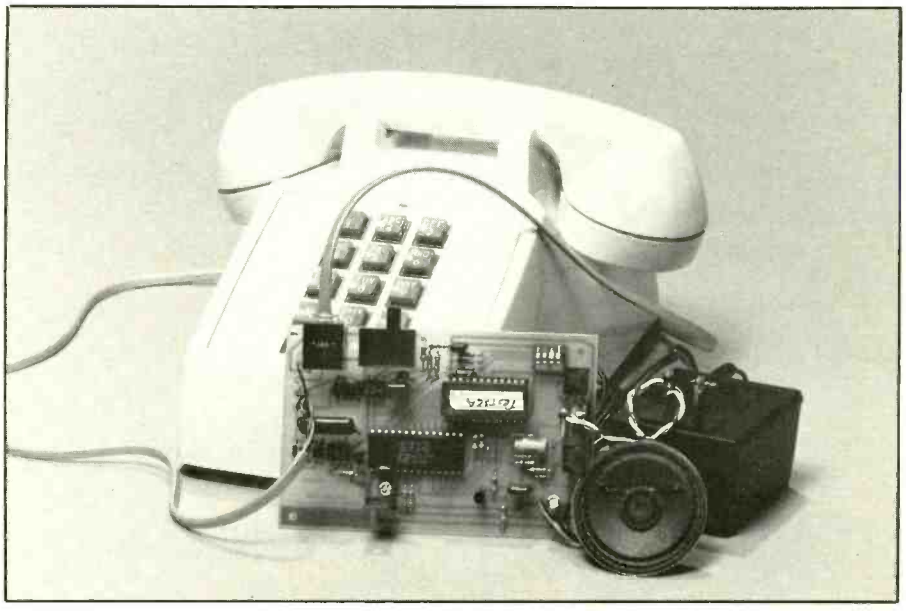
The book is highly recommended to anyone interested in what makes an important part of this amazing high-tech industry tick, as well as providing interesting reading through the author's sprightly writings about his personal involvement with a host of people who contributed to the growth of silicon-based equipment. Eight pages of photographs complement the text. **ME**

Siliconnections by Forrest M. Mims III. Published by McGraw-Hill Book Company, New York, NY. 240 pp., hard cover, $16.95. (Expected publishing date: November 1985.)

Mello-Phone: The Super Musical Telephone Ringer

Build-it-yourself project substitutes up to 200 selectable musical tunes of extended length for a standard telephone ringer

By Steve Lympany



It occurred to me one day, while calming my nerves following a startling blast from my phone's bell ringer, that there must be a pleasant yet effective way of signalling an incoming telephone call. Electronic music being one of my hobbies, I decided what I wanted was a telephone ringer that plays music, and thus was born the "Mello-Phone."

While there are commercial products that substitute an electronic music box for the normal telephone ringer, these are generally limited to just a few notes from a fixed set of tunes chosen by the manufacturer. I wanted to select the tunes to suit my personal tastes and be able to listen to more than seven or eight notes for each tune, as with the Mello-Phone. The Mello-Phone can play up to 200 different selections of varying lengths of up to 252 notes and rests. I use selections such as college fight songs, seasonal tunes, and a few Mozart and Beethoven pieces. The choices, of course, are unlimited.

The Mello-Phone installs between your telephone set and your telephone wall outlet using standard RJ11C telephone connectors. It requires external power from a commonly available 9-volt dc adapter. It won't interfere with normal telephone operation, and it can be used with rotary or Touch-Tone™ dialers. When someone calls, the Mello-Phone automatically disables the bell in your telephone and replaces it with a musical tune that plays repeatedly until you answer the phone or the caller terminates the call. In the latter case, the Mello-Phone will play the current tune through to completion and then stop automatically.

Circuit Description

As shown in Fig. 1, the Mello-Phone uses only four ICs. Here, *U1* and *U2* are opto-isolators, *U3* is the music synthesizer and *U4* is an EPROM for storing the music. The music synthesizer is a General Instruments AY-3-1350 microprocessor.

Operation of the Mello-Phone is as follows. Firstly, P1 plugs into the telephone outlet and your telephone plugs into *J1*. Now, when a 20-Hz ring signal of 40 to 150 volts is present at the tip and ring leads (green and red leads of *P1*), current flows through *R17, C6, D6* through *D9, D1* and opto-isolator *U2*. The current through pins 1 and 2 of *U2* causes pin 5 to go low to signal a start-tune request from the synthesizer via *Q2*.

Diodes *D2* through *D5* form a

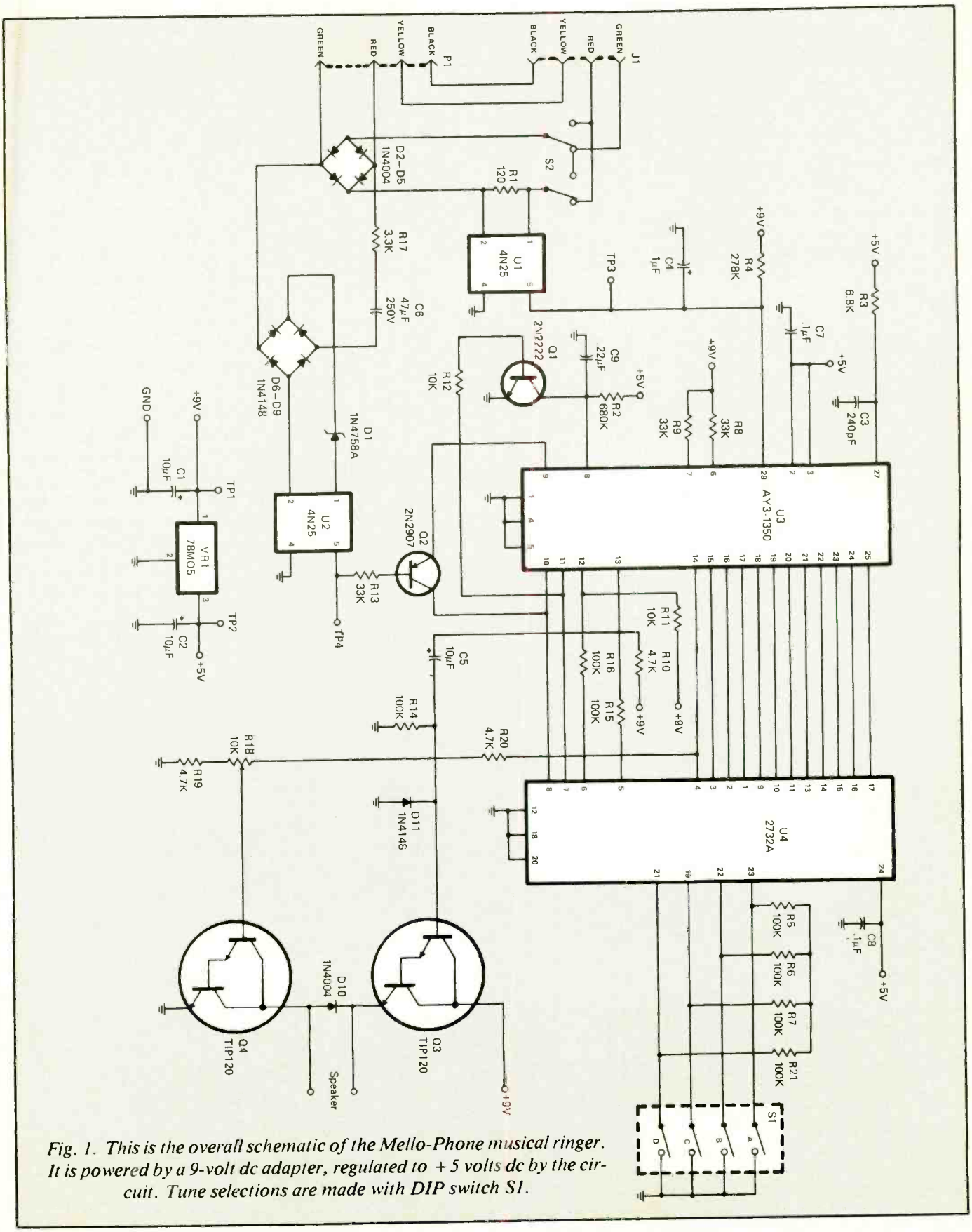


Fig. 1. This is the overall schematic of the Mello-Phone musical ringer. It is powered by a 9-volt dc adapter, regulated to +5 volts dc by the circuit. Tune selections are made with DIP switch S1.

PARTS LIST

Semiconductors
D1—1N4758A zener diode
D2 thru D5,D10—1N4004 rectifier diode
D6 thru D9,D11—1N4148 diode
Q1—2N2222A npn transistor
Q2—2N2907A pnp transistor
Q3,Q4—TIP120 Darlington transistor
U1,U2—4N25 opto-isolator
U3—AY-3-1350 music synthesizer (General Instruments)
U4—2732A EPROM (programmed; see Notes below)

Capacitors
C1,C2,C5—10-μF, 25-volt electrolytic
C3—240-pF disc
C4—1-μF electrolytic
C6—0.47-μF, 250-volt metallized Mylar
C7,C8—0.1-μF disc
C9—0.22-μF disc

Resistors (¼-watt, 10%)
R1—120 ohms
R2—680,000 ohms
R3—6800 ohms
R4—270,000 ohms
R5,R6,R7,R14,R15,R16,R21—100,000 ohms
R8,R9,R13—33,000 ohms
R10,R19,R20—4700 ohms
R11,R12—10,000 ohms
R17—3300 ohms
R18—10,000-ohm upright pc-mount trimmer potentiometer

Miscellaneous
J1—RJ11 (6-position) telephone jack
P1—Telephone line cord
S1—4-position DIP switch
S2—Dpdt slide switch
SPKR—Miniature (2") 8-ohm speaker
Printed-circuit board; 9-volt dc, 150- to 200-mA adapter; IC sockets; suitable enclosure; spacers; hookup wire; solder; etc.

Note: The following are available from Steve Lympany, Clavier Electronics, Inc., P.O. Box 51281, Raleigh, NC 27609: etched and drilled pc board for $6.95; AY-3-1350 for $5.50; preprogrammed 2732A EPROM for $7.50; RJ11 (6-position) telephone jack for $2.25; 4N25 opto-isolator for $1.50 each; complete kit of parts, including speaker, 9-volt adapter and enclosure, for $43.00. Include $1.00 P&H.

bridge circuit that allows only a dc signal to flow through the telephone during incoming ringing. This effectively disables the normal bell or chirp ringer in your telephone, since they require ac to operate. Zener diode *D1* prevents stray current surges, such as those that result from other pulse-dialing telephones on your line, from triggering a tune.

Mello-Phone will play the selected tune until the telephone is answered or until the song is over. While the song is playing, subsequent ringing bursts will not reset the tune. When the tune ends, the next ring burst will restart it, beginning a new cycle.

When the telephone is answered, dc flows through bridge circuit *D2* through *D5, U1,* and out to the telephone via the red and green leads of *J1*. The current through pins 1 and 2 of *U1* pulls pin 5 low, resetting the synthesizer and stopping the tune. Answering the phone resets the processor so that the next time a ring signal comes in, the tune will start at the beginning. Resistor *R1* prevents the ring signal and other minor surges from triggering the off-hook circuit.

In the audio section of the Mello-Phone, envelope control is accomplished with *U3* pin 13. When no tune is playing, pin 13 remains low, keeping *C5* discharged. This allows *R19* to pull the base of *Q3* low, keeping it off. When a note is being played, the note frequency appears at *U3* pin 14. Pin 13 goes to a high-impedance state and allows *R10* to charge *C5* to 9 volts dc. This turns on *Q3* and places 9 volts dc on the emitter of *Q3*. Pin 14 toggles *Q4* to produce the desired pitch at the speaker. At the end of the note duration, pin 14 continues to toggle at the previous note frequency. However, pin 13 goes low, allowing *C5* to discharge through *R19*. This results in a decaying sound upon turn off of each note. If desired, you can replace *R19* with a 100,000-ohm potentiometer to permit adjusting for various decay envelopes.

Other than the address and data lines between the synthesizer and EPROM *U4*, the rest of the Mello-Phone circuitry involves adjustments and song selection switching.

Speaker volume is adjusted by *R21*, which varies the drive level to *Q4*. Tempo resistor *R2* sets the speed at which the synthesizer steps through the notes. If you prefer to be able to vary the tempo, you can replace *R2* with a 1.2-megohm potentiometer. The indicated fixed 680,000-ohm resistor provides a quarter note duration of approximately 250 milliseconds. Absolute pitch of the notes can be adjusted by varying the oscillator frequency at pin 27 by changing the value of *R3*. If you wish, you can replace *R3* with a 10,000-ohm potentiometer. (The fixed 5699-ohm resistor results in a middle C frequency of about 185 Hz, which is low by about six semitones.)

Switches *S1A* through *S1D* are used to select which of the 16 tunes is to be played. These switches set the status of the upper four address bits of the *U4* EPROM. Thus, the switches can select one of 16 "pages" of memory in *U4*, each page containing 256 bytes. (Up to 25 selections can be programmed per page, but more complicated circuitry involving sharing the synthesizer address bus for tune selection is required. There are also 28 tunes programmed into the synthesizer that can be accessed. Interested readers can contact me, per the address in the Parts List, or refer to the General Instruments data sheets for information on these features).

As designed, the Mello-Phone dedicates one page of memory per tune. This simplifies the tune-selection circuitry and permits longer tunes, containing up to 252 notes and rests, to be played. A 2716 EPROM can be substituted as long as *S1D* is set to OFF at all times. Thus, eight tunes can be selected using switches *S1A, S1B* and *S1C*.

Power for the circuit is derived from the ac line via a 9-volt adapter feeding *VR1*, *C1* and *C2*. The incoming 9 volts is regulated down to the 5-volt dc level required by the remainder of the circuitry. A standard 9-volt, 150- to 200-mA adapter is sufficient for powering the Mello-Phone. Maximum power consumption of about 1 watt occurs when the phone is ringing and speaker volume is turned up to maximum.

Programming the Synthesizer

During this discussion, memory locations and data will be referenced in octal, with hexadecimal notation in parentheses. The music to be played by the AY-3-1350 is stored in 2732A EPROM memory in the form of 8-bit data bytes. Each memory byte describes the pitch and the duration of the note being played.

The lower three bits specify note duration, the upper five bits the pitch. This permits 32 different pitches and eight different duration values to be specified. One pitch code is allocated as "silent" to allow musical rests of differing lengths to be implemented. Table 1 gives duration data, while Table 2 gives the pitch data for use in programming.

When programming the EPROM, a few rules must be observed. In each page of memory, EPROM address 000 (00) must contain data 377 (FF). EPROM address 377 (FF) in each page must contain data 125 (55), which is a key to open the external EPROM. Following the tune data, the last two bytes should be 377 (FF) and 376 (FE), indicating the tune end marker and end of listing marker. Fig. 2 is a diagram of EPROM memory allocation per page.

The first part of the "Star Spangled Banner" is shown in Fig. 3 as an example of encoding. Below the notes are shown the octal and hex codes to use.

If you don't have access to an EPROM programmer, you can obtain a preprogrammed EPROM containing 16 tunes ("Camptown Races," Beethoven's Ninth Symphony," "My Darlin' Clementine," "O Come All Ye Faithful," Brahm's Hungarian Dance No. 5, to name just a few) from the source given in the Parts List. Other tunes can easily be programmed from the sheet music; contact the author for details.

Table 1. Note Duration Table

NAME	MUSICAL NOTATION	OCTAL	BINARY
Semiquaver	𝅘𝅥𝅯	0	000
Quaver	♪	1	001
Dotted Quaver	♪.	2	010
Crochet	♩	3	011
Dotted Crochet	♩.	4	100
Minim	𝅗𝅥	5	101
Dotted Minim	𝅗𝅥.	6	110
Semibreve	𝅝	7	111

Table 2. Note Pitch Table

NAME	FREQUENCY (Hz)	OCTAL	BINARY
F	175	00	00000
F#	185	01	00001
G	196	02	00010
G#	208	03	00011
A	220	04	00100
A#	233	05	00101
B	247	06	00110
C (middle C)	262	07	00111
C#	277	10	01000
D	294	11	01001
D#	311	12	01010
E	330	13	01011
F	349	14	01100
F#	370	15	01101
G	392	16	01110
G#	415	17	01111
A (international A)	440	20	10000
A#	466	21	10001
B	494	22	10010
C	523	23	10011
C#	554	24	10100
D	587	25	10101
D#	622	26	10110
E	659	27	10111
F	698	30	11000
F#	740	31	11001
G	784	32	11010
G#	831	33	11011
A	880	34	11100
A#	932	35	11101
B	988	36	11110
Rest	Silent	37	11111

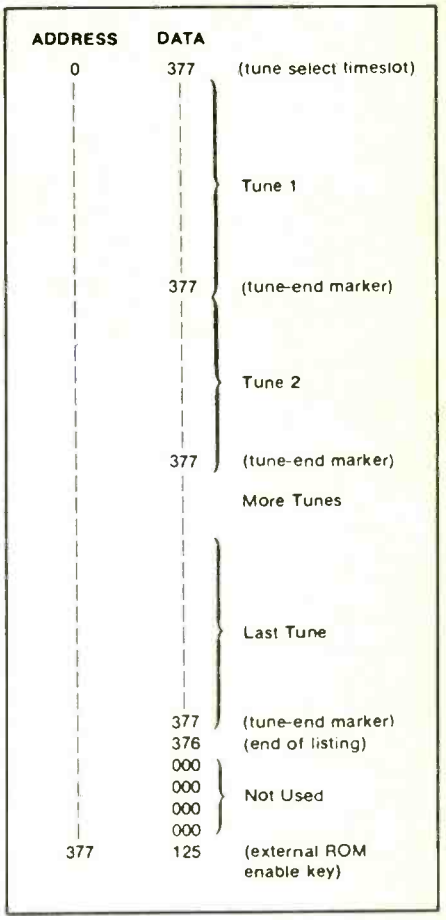


Fig. 2. EPROM allocation map per memory page, data column in octal.

Construction

This is a relatively simple project to build. You can use just about any wiring technique to assemble the circuit. Of course, the printed-circuit-board technique is the simplest, since it offers a neat, logical component arrangement with a minimum of actual hand wiring and minimizes the possibility of making wiring errors.

You can fabricate your own pc board, using the actual-size etching-and-drilling guide shown, or purchase a ready-to-use pc board from the source given in the Parts List. In either case, use the components-placement diagram in Fig. 4 to guide you in component installation. When mounting components on the board, make sure you properly orient the diodes and electrolytic capacitors be-

(Continued on page 88)

A Computer System Power Controller

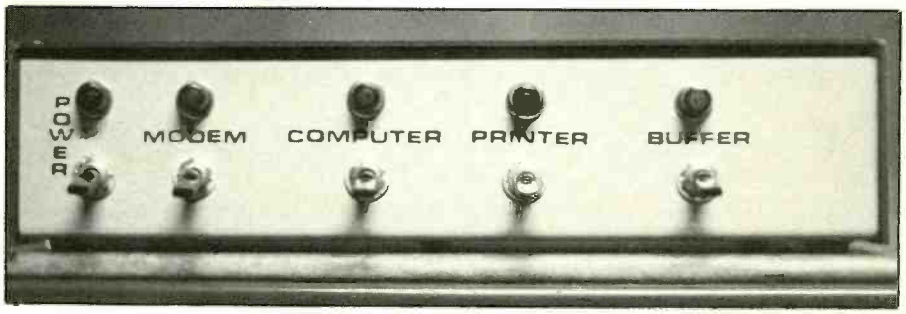
(with Surge-Spike Protection)

Lets you individually turn on/off your computer and peripherals from one central location

By Paul M. Spannbauer

Are you tired of reaching around to the back of your computer, the side of your printer and the back of your modem to turn each on or off? Or wonder if you should add more surge and spike protection devices? You can overcome these irritants by buying a bunch of commercially available devices, of course, but at considerable cost. My solution to this problem was to build my own ac-line power controller with built in surge/spike suppressors. Cost was about $62, including a fancy cabinet for the project.

Everything fits inside a handsome shielded metal box. The ac outlets into which the system equipment plug are located on the rear panel, while all switches and their status indicators mount on the front panel. If you examine the photos, you can see that my Controller was designed to have four outlet/switch/indicator combinations to suit the needs of my computer system, plus a master POWER switch and panel lamp. You can add more outlet/switch/indicator sections as needed to customize your Controller for the needs of your system. You can also use this device for other electronic systems, such as stereo and video setups, of course.



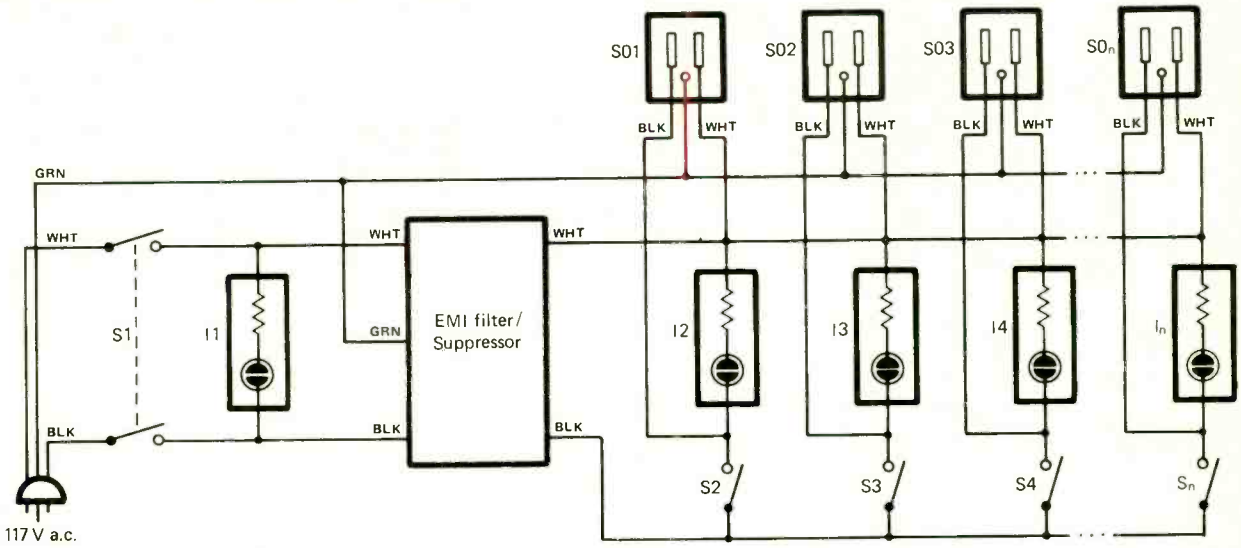
About The Circuit

The complete schematic diagram of the Controller is shown in Fig. 1. The circuit is really quite simple in design. Note that throughout the circuit the standard white/black/green three-conductor wiring scheme is used. It is highly recommended that you maintain this scheme exactly and do not attempt to change it to a two-conductor system. All computer products use this wiring scheme for ac line operation, though most consumer video and audio products don't. Even if you want to control power to only two-conductor wired products, you'll find that they are compatible with this Controller.

Items in your system you want to control plug into ac receptacles *SO1* through SO_n. (The subscript *n* here and below simply indicates that you can have four or more of each components in your Controller.) Power to these receptacles are individually controlled by switches *S2* through S_n, while the neon lamps in *I2* through I_n, respectively, will light whenever the switch in a given circuit is closed and power is being delivered from the ac line. You can add receptacle/switch/lamp combinations as needed by your system, the only limit being the amount of power the EMI filter/suppressor can handle.

Main power switch *S1* determines whether or not ac line power is available for switching to the individual ac receptacles. With *S1* closed this power is available and can be selectively fed to the receptacles. With *S1* open, no power is available, regardless of the status of the other switches in the Controller.

The circuit shown in Fig. 1 is a minimum Controller system. There are, of course a few modifications you can make to it to further custom-



PARTS LIST

I1 thru I_n—Panel-mount neon-lamp assembly
S1—Dpdt miniature toggle switch
S2 thru S_n—Spst miniature toggle switch
SO1 thru SO_n—Chassis-mount, three-conductor ac receptacle
Misc.—EMI filter/suppressor module Corcom Model 8109 or similar); suitble metal enclosure (5⅞"W × 5¼"D × 3"H Radio Shack No. 270-253 accommodates a four-receptacle system; adjust size accordingly for more than this); heavy-duty, three-conductor ac line cord with plug and strain relief; 12- or 14-gauge stranded white, black and green wire; wire nuts (5); spade lugs (optional); rubber feet (4); dry-transfer lettering kit; clear acrylic spray; etc.

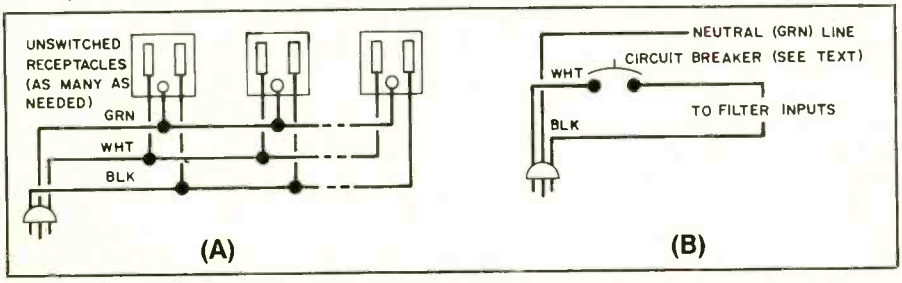
Note: You can substitute illuminated push-on/push-off illuminated switches (Radio Shack No. 275-676) for I2/S2 through I_n/S_n combinations.

Fig. 1. Overall schematic of a minimum controller system.

ize and enhance it. For example, in hi-fi and video systems, there are items you never want unpowered. These include timers, turntables, videocassette recorders and the like. Therefore, you can incorporate into your Controller one or more ac receptacles that are unswitched. Connect these directly across the ac line where the line cord enters the Controller box, ahead of *S1* (see Fig. 2A).

Another modification you might wish to make is the addition of a circuit breaker. You can obtain push-button-reset circuit breakers in a wide variety of load ratings. Determine what the maximum load would normally be for your system and select an appropriately rated breaker. Install the breaker in the line between the point where the ac line cord enters the Controller box and *S1* (Fig. 2B).

Fig. 2. Options that can be added to a basic controller system include series of unswitched receptacles (A) and circuit-breaker protection (B).



Putting it Together

The most difficult step in building this project is making the cutouts in which the receptacles mount on the rear panel. These must be cut square and uniform in size and location. Depending on the tools you have, there are several ways to make these cutouts. The easiest, of course, is with a chassis punch. Second best is to use a nibbling tool. If neither tool is available, you're stuck with drilling holes and working like mad with a file to make the cutouts the proper size and shape. Be careful to make the cutouts just the right size.

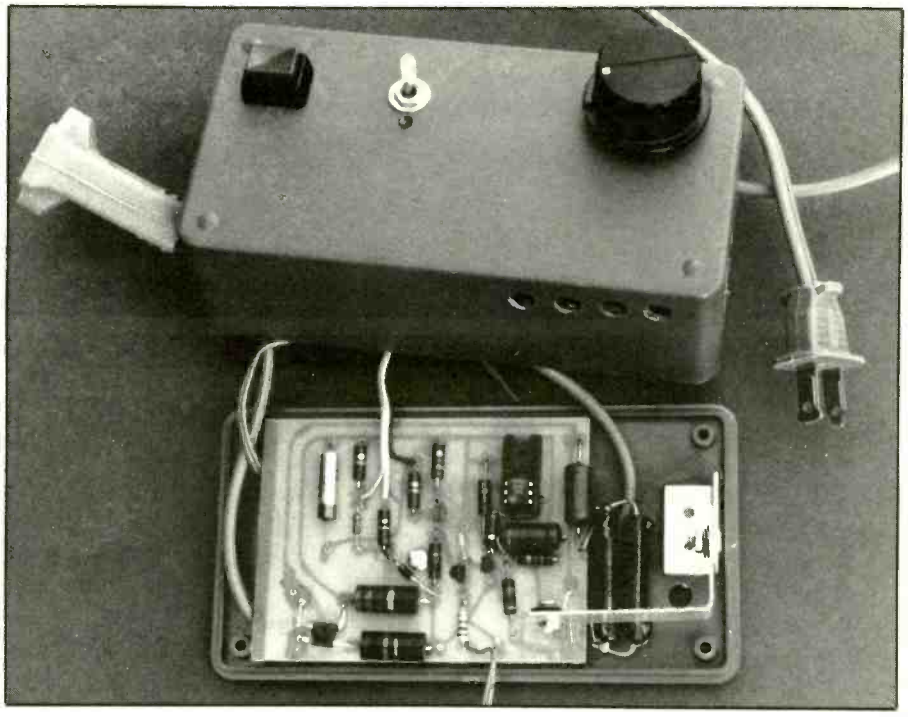
Once you've finished making the receptacles cutouts, drill the entry

(Continued on page 85)

A Solid-State Light Dissolver

Controller smoothly dims or brightens lights automatically with the flip of a switch

By Imre Gorgenyi*



Light controllers are always popular projects not only because they are practical projects, but also because they are fun to use imaginatively. A good light controller, like the Solid-State Light Dissolver described here, will smoothly dim or brighten lights with the flip of a switch. In addition to automatic, flicker-free fade-in or fade-out of lights, the Light Dissolver provides full manual control and an instant-on feature. Also, you can tailor its circuit to suit specific needs simply by changing the value of resistors.

As designed, the Light Dissolver can handle up to 300 watts of lighting (resistive, or incandescent) or a small ac motor, such as a fan. To provide maximum safety and assure long operating life, the project must be housed inside a plastic—not metal—box with adequate ventilation.

Uses

By now, you probably have a good idea of some of the uses to which the Light Dissolver can be put. Here are a representative few:

•You can permanently wire a Light Dissolver for simple fade-in/out of lighting in any room.

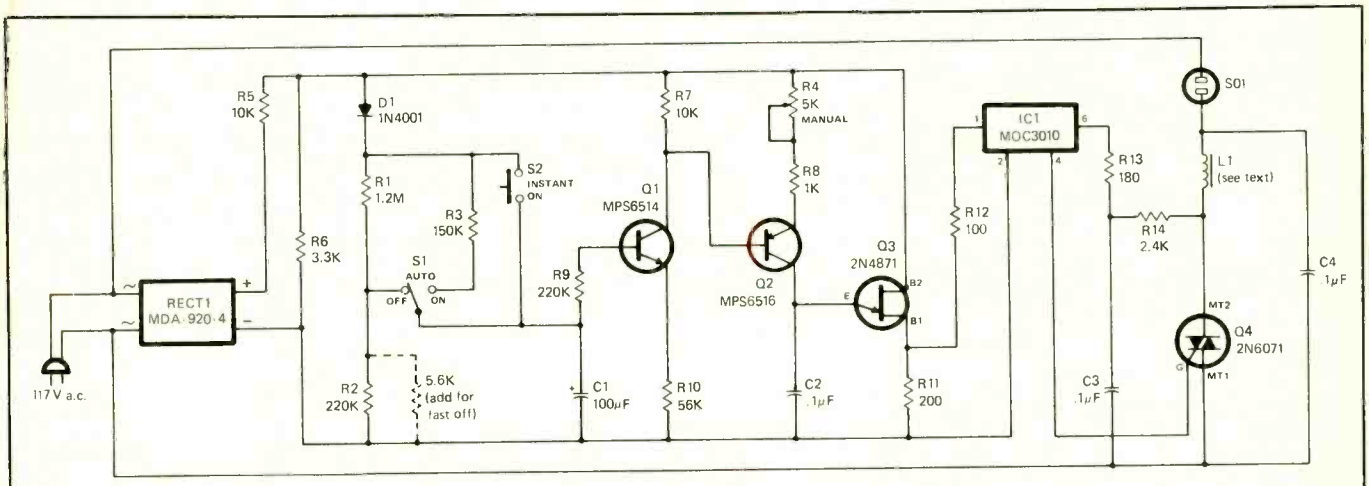
•A very practical application is to use a Light Dissolver to slowly fade out lights when you leave your home, garage, workshop, etc. You will never trip over unseen obstacles in the dark again. For this application, use a 2- to 5-minute fade-out.

•Another application is to have adjustable background lighting for viewing TV, working at a computer video terminal, or setting a "mood." Once the desired level is manually set, flip the switch to on and the light will come up to the preset level.

•You can also use the Light Dissolver as a speed controller for a small dc motor. The motor's speed will come up slowly, instead of abruptly the way it does with HIGH/MEDIUM/LOW fan switches.

•Being more imaginative, you can use two Light Dissolvers with two slide projectors to give really professional presentations. Connect a Light Dissolver to each projector and set one Dissolver for fade-out, the other for fade-in. A 1- or 2-second period for the fade-in and fade-out

*Motorola, Inc. Small Signal and Sensor Products



PARTS LIST

Semiconductors

D1—1N4001 rectifier diode
IC1—MOC3010 triac driver (Motorola)
Q1—MPS3904 or MPS6514 npn transistor (Motorola)
Q2—MPS3906 or MPS6516 pnp transistor (Motorola)
Q3—2N4871 unijunction transistor
Q4—2N6071B (200-volt, 4-ampere) or MAC222-4 (Motorola) triac
RECT1—MDA-920-4 bridge rectifier (Motorola)

Capacitors

C1—100-μF, 25-volt electrolytic
C2—0.1-μF, 50-volt disc
C3,C4—0.1-μF, 200-volt disc

Resistors (½- or ¼-watt, 10%)

R1—2.2 megohms
R2,R9—220,000 ohms
R3—150,000 ohms
R7—10,000 ohms
R8—1000 ohms
R10—56,000 ohms
R11—200 ohms
R12—100 ohms
R13—180 ohms
R14—2400 ohms
R5—10,000 ohms, 2 watts
R6—3300 ohms, 2 watts
R4—5000-ohm potentiometer

Miscellaneous

L1—Coil; two in parallel—see text (Radio Shack No. 273-102 or similar)
S1—Dpst slide or toggle switch
S2—Normally-open, momentary-action pushbutton switch
SO1—Ac receptacle (see text)

Printed-circuit board or perforated board and push-in solder terminals; socket for IC1 (optional); heat sink for Q4 (see text); control knob for R4; suitable enclosure (Radio Shack No. 270-223 or similar); 1"×½" bracket; ¼" spacer; silicone heat-transfer paste; ac line cord or extension cord (see text); machine hardware; hookup wire; solder; etc.

Fig. 1. This is the overall schematic diagram of the Light Dissolver. Note that the common lines for the ac line and control circuits must be kept isolated. This task is accomplished with opto-isolating triac driver IC1.

periods is best. In operation, have the fade-in projector start its action about midway through the fade-out projector's period. This will momentarily superimpose the frame from the two projectors on the screen and eliminate the annoying blackout on the screen between slide changes.

•If you have only one slide projector, you can still spice up your presentations with a Light Dissolver. Just have the Dissolver control a 150-watt lamp directed at the screen to cast a colored light between slides. When you advance the projector, simultaneously push the instant-on button on the Dissolver. (Use the Dissolver's manual control to set the desired light level.)

Many other applications for the Light Dissolver should come to mind. We have presented here just a few ideas to get you started.

About the Circuit

Shown in Fig. 1 is the overall schematic diagram of the Dissolver. Dimming action is controlled by varying the amount of current passed through triac *Q4* and, thus, the lamp plugged into ac receptacle *SO1*. The triac is a solid-state device that can be triggered into conduction in both directions by a low-level, short pulse applied to its gate (G). It can be shut off only by removing the voltage at main terminal 1 or main terminal 2 (MT1 or MT2). Since the ac line voltage passes through zero (effectively removing the voltage) 120 times every second, there is no need for a manual device, such as a switch, to interrupt the voltage. This being the case, we only have to add to our circuit the elements required to turn on the triac.

Since the voltage on the ac line passes through zero every half cycle, the duration of the current going through the load at *SO1* depends on just where in the cycle *Q4* is triggered

into conduction. Early triggering produces bright light, while late triggering allows the lamp to shine less bright. The task of triggering *Q4* into conduction at the desired point in the cycle falls to the circuit made up of bipolar transistors *Q1* and *Q2* and unijunction transistor *Q3*.

Unijunction transistor *Q3* operates as a relaxation oscillator whose output pulse frequency depends on how fast capacitor *C2* recharges after firing. Transistors *Q1* and *Q2* furnish the charging current, with the *R3/C1* and *R1/R2/C1* time-constant networks controlling the turn-on and turn-off times.

You can tailor the circuit to your specific needs in either or both of two ways. If you want the lamp to turn on faster, simply change the value of *R3*, either by using a lower-value resistor or by paralleling the 150,000-ohm resistor with another resistor. Similarly, if you want a faster turn-off, you can do the same with *R2*.

There are two common lines in this circuit. One is connected to the negative (−) side of rectifier assembly *RECT1* and serves the control circuitry. The other is connected to the ac power line and serves as the return path for the load current. It is essential that these lines be kept isolated from each other. While you can use a power or small pulse transformer to provide isolation, an opto-coupled triac driver, shown in Fig. 1 as *IC1*, offers a neater solution.

Inside *IC1* are a light-emitting diode (LED), a detector and a small triac. In the Fig. 1 circuit, the low-level pulses coming from *Q3* make the LED in *IC1* emit short bursts of light that are picked up and converted into electrical current pulses by the internal detector. This small current triggers the internal triac, which then outputs pulses to the gate of power triac *Q4*, triggering it on so that it delivers current to the lamp.

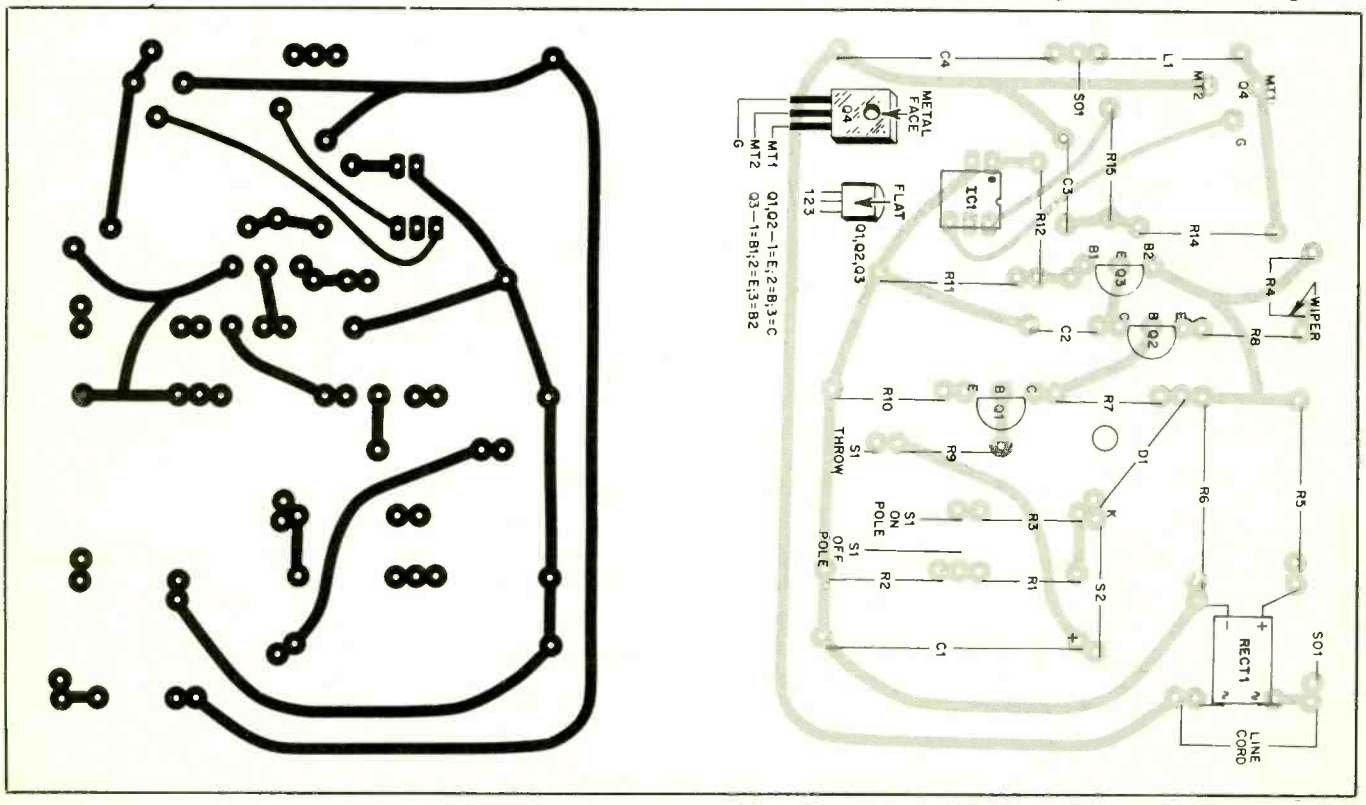
Potentiometer *R4* serves as a master control of the pulse rate and provides both manual control and a limit in the brightness of the lamp plugged into *SO1*. Momentarily pressing *S2* causes the lamp to instantly turn on.

Choke *L1* suppresses any spikes produced by the power triac and limits its interference with AM radio reception. No safeguards against interference need be made for FM and TV reception, since these media are immune to this type of noise.

Construction

This is a relatively simple circuit to build and, thus, lends itself to just about any wiring technique. If you wish, you can fabricate a printed-circuit board for the project, using the

Fig. 2. Use the actual-size etching-and-drilling guide at the left to fabricate a printed-circuit board for the project. Then mount all components (except R4, S1, S2 and SO1) exactly as detailed in the diagram shown at the right.



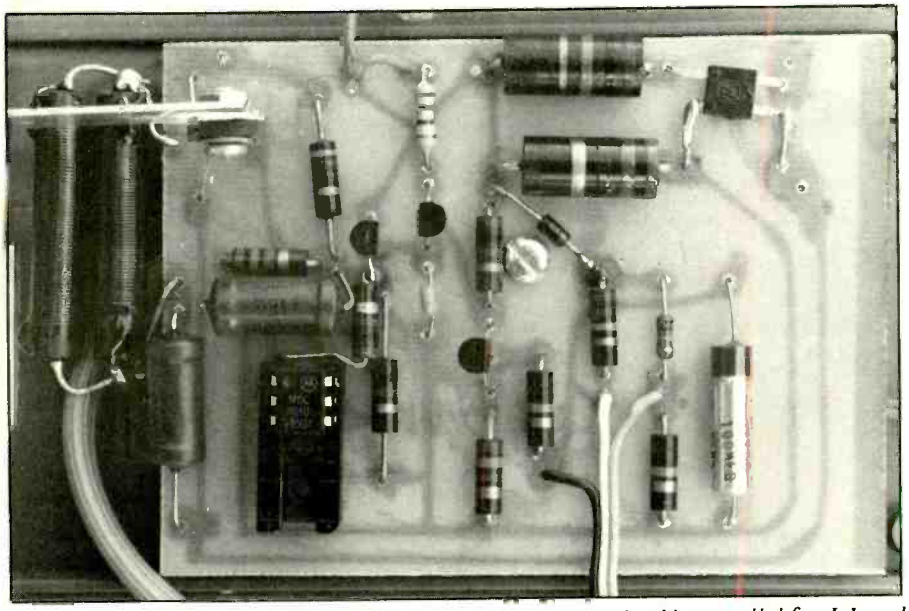


Fig. 3. Note in this close-up view how two chokes are wired in parallel for L1 and the L-bracket heat sink used for Q4 (upper-left), use of a 16-pin socket for IC1 (lower-left), and single screw that mounts the board on the box (center).

actual-size etching and drilling guide shown in Fig. 2. If you do use the pc-board approach and decide to use a socket for *IC1*, be sure to drill a small hole for pin 3 of the socket. (You will not be able to find a six-pin socket in any of the catalogs or electronics parts stores. So you will either have to use a 14- or 16-pin socket carefully trimmed to size or two strips of three Molex Soldercons.) If you forego using a socket, you can simply clip off pin 3 of *IC1* and eliminate the need for an extra hole in the board.

Mount the components on the pc board exactly as shown in the components-placement diagram in Fig. 2, making sure that the leads of the transistors go into the proper holes (see the detail drawings at the lower-left of the components-placement diagram). Note also the orientations of *D1*, *C1* and *RECT1*.

Choke *L1* consists of two 100-μH r-f coils. Place the two chokes side by side and wrap a couple of turns of the leads of one around the leads of the other so that the chokes are in parallel. Solder the connections and clip off the excess lengths from the twisted leads. Then bend the unclipped leads and install the choke pair on the board via the *L1* holes (see Fig. 3 for mounting details).

Mount the transistor about ¼" and the *Q4* triac about ⅜" above the top surface of the board. Make sure the rear (metal) face of *Q4* is oriented away from *L1* and parallels the long edge of the board.

Prepare seven 6" lengths of hookup wire by stripping ¼" of insulation from each end. Plug one end of these wires into the holes labeled *R4, S1* and *S2*. The other ends of these wires will be connected later.

You have two choices with regard to the ac receptacle into which the lamp load plugs. One is to use a chassis-mount receptacle and run lamp cord between it and the appropriate points on the board; the other is to use a cut-off section of extension cord that enters the cabinet through a side wall (see lead photo). The latter is easier and has the advantage of providing you with an essentially no-cost ac line cord.

Disassemble the box in which the project is to be housed and temporarily set aside the top panel. Machine the box as follows. First, drill three or four ¼" holes through the long wall at the lower-right corner and two more holes through the short wall adjacent to where the first set of holes are drilled. These serve as a vent for heat in the area occupied by triac *Q4* when the project is assembled. Drill the hole for the line cord through the long wall opposite that in which the vent holes are drilled. If you use the latter type of receptacle discussed above, drill a second hole in this wall to permit its cord to enter the box and connect to the board.

Off-the-board components *R4, S1* and *S2* mount on what was originally intended as the bottom of the box. Drill the mounting holes for these components, locating them where there will be no interference with the components on the pc board. If you have decided to use a chassis-mount ac receptacle, machine a slot in which it will mount on the blank short wall. Mount the components in their various locations, and place a control knob on *R4*'s shaft.

Turn over the box and place the pc-board assembly alongside it and, referring back to Fig. 1, connect and solder the free ends of the hookup wires to the appropriate lugs on *R4, S1* and *S2*.

If you are using the chassis-mount ac receptacle, clip 6" from the free end of the line cord and separate the two conductors thus obtained. Strip ¼" of insulation from both ends of both conductors. Tightly twist together the fine wires and sparingly tin with solder. Then plug one end of each wire into the holes on the board labeled *SO1* and solder. Connect and solder the free ends of these wires to the lugs of *SO1*. Prepare the free ends of the conductors of the remaining

(Continued on page 83)

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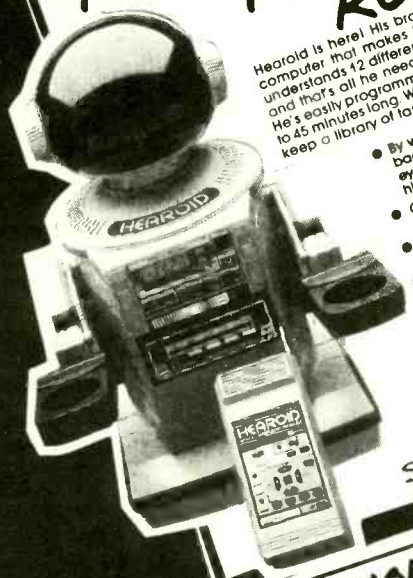

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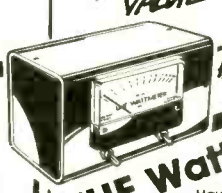

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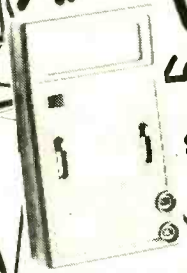

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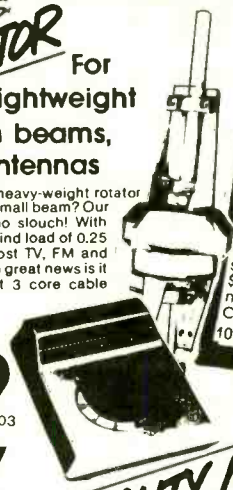

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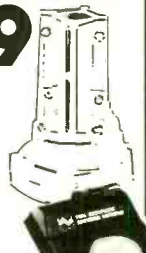

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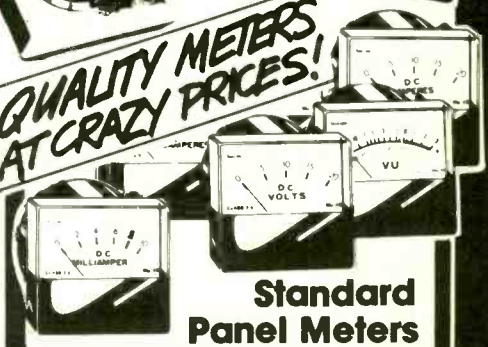

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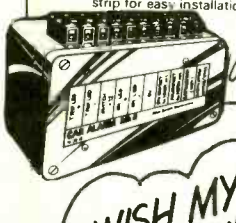

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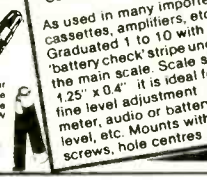

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WHERE THE ELECTRONICS ENTHUSIAST IS #1

A Simple Impedance Bridge

This two-component project lets you measure impedance, determine resonant frequency, calculate input/output impedance ratios, etc.

By William R. Hoffman

Anyone involved in loudspeaker design and construction soon finds the impedance bridge to be an important basic tool in his work. Despite its current unpopularity, the impedance bridge is probably the most versatile piece of test equipment you have to make reactive (inductive and capacitive) measurements.

You have only to consider the range of uses for the impedance bridge to realize its value. With the bridge, you can quickly measure the impedance of an unknown capacitor or inductor at a given frequency and then go on to find the resonant frequency of a loudspeaker. You can also measure the impedances of a transformer's windings and then calculate its input/output impedance

ratio. Analyzing a complex load, such as presented by a distributed line or a multiple-speaker PA system, is a relative snap. Actually, the list of uses can go on and on.

Now that you know the value of the impedance bridge, you can build one of your own. All it takes is a resistor and a switch, plus a signal generator and an ac voltmeter. Though the impedance bridge setup to be described is utterly simple, one exactly like it is regularly used by a well-known hi-fi equipment reviewer for his published test reports.

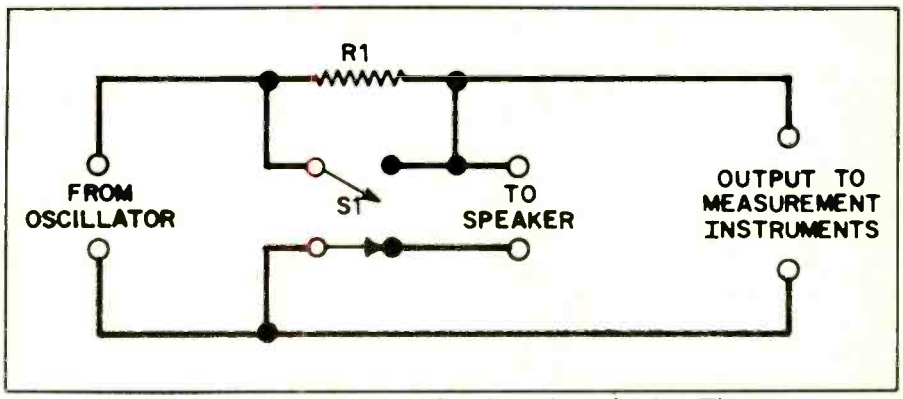
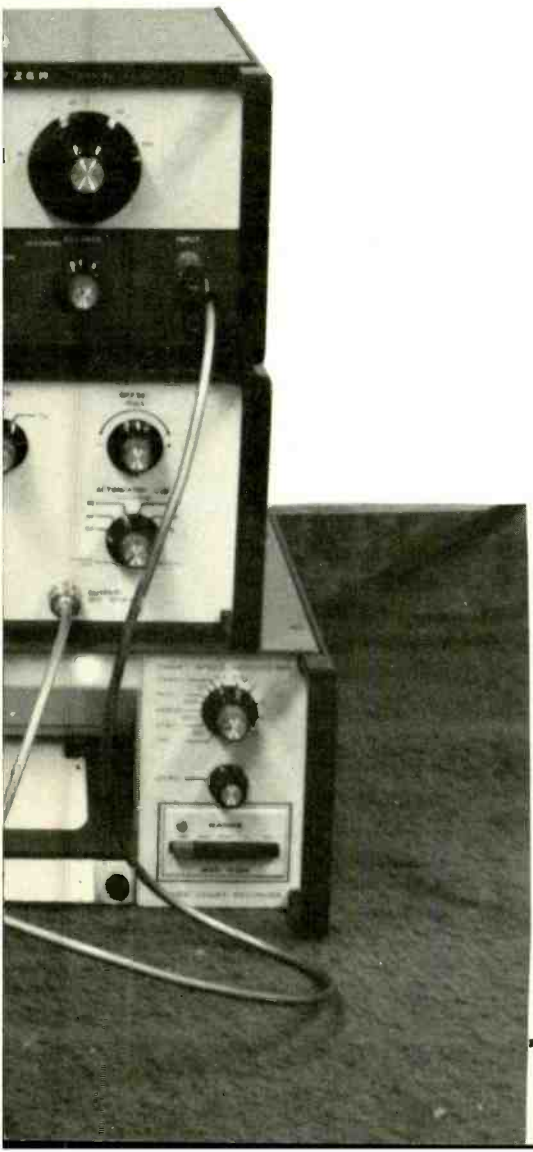


Fig. 1. This is the schematic diagram of the impedance bridge. This two-component circuit must be used with at least an oscillator and an ac voltmeter.

About the Circuit

Shown in Fig. 1 is the schematic diagram of the impedance bridge. Since it contains only a resistor (*R1*) and a double-pole, double-throw switch (*S1*) this circuit is more in the "accessory" rather than "instrument" category. To be useful at all, it must be connected to a signal generator and a voltmeter (or chart recorder or oscilloscope) as detailed in Fig. 2.



In this circuit, *R1* makes the ac voltage from the oscillator appear as a constant current. (The only limiting factor in this arrangement is the oscillator, which can be narrow or broad spectrum, depending on your specific applications.) Therefore, the voltage dropped across the device under test (D.U.T. in Fig. 2) is simply a direct indication of its impedance. When the bridge is calibrated, each ohm of impedance is equal to 1 millivolt at the accessory's output. This greatly simplifies matters, since the measured voltage on the meter (on a millivolt scale) can be directly read as impedance. For example a reading of 2.7 mV becomes 2.7 ohms, while 32 mV becomes 32 ohms.

If your voltmeter lacks adequate sensitivity to accurately respond to signal amplitudes in the millivolt range, you can simply run the oscillator's output through an amplifier to obtain the required signal boost to obtain useable readings. If you do this, note in Fig. 2 that the amplifier connects in *series* with the oscillator and bridge, as indicated by the "X" through the feed line. If you know the amplifier's gain, you can use this figure in any calculations. If the gain is not known, you can place a resistor of known value across the measuring terminals of the bridge and calibrate from that.

Note in Fig. 1 that no value is specified for *R1*. This is because the value used will depend on the output signal amplitude from your signal generator. To determine what value resistor you need, refer to the Table. The first column of the Table lists typical oscillator output levels in peak-to-peak (p-p) voltage. Column two tells you what resistor value is needed at each output level. By the rules, then, if your generator outputs a 1-volt peak-to-peak signal, the value of *R1* should be 1000 ohms; for a 2.4-volt output, *R1* would be 2400 ohms; and so on.

Columns three, four and five of the Table tell you the maximum impedance that can be measured for each oscillator-output/resistor-value combination at 1%, 5% and 10% bridge error, respectively.

Notice that to measure impedances of several hundred or more ohms, an oscillator with greater signal output level and a higher value resistor are needed. If you want to measure higher impedance, then, your oscillator's output will usually have to be boosted with an amplifier capable of reaching the required level and use a higher value of resistance for *R1*. It is not necessary for the amplifier to have an especially low level of distor-

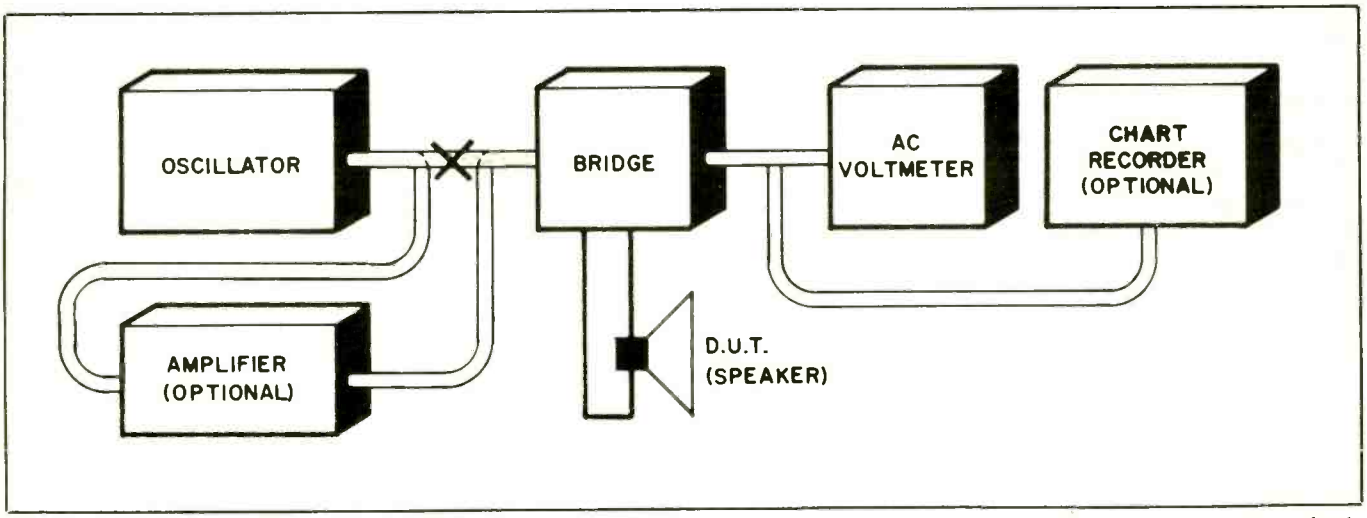


Fig. 2. A typical test setup. Required items are the bridge, oscillator and ac voltmeter. The amplifier and chart recorder are optional. If you wish, you can connect a dual-trace oscilloscope as explained in the text.

tion or a very wide range to obtain adequate measurements from the impedance bridge arrangement.

The impedance bridge is best built into a metal or plastic box. For my prototype, I chose a common sloping top instrument box, with *S1* located in the middle of the sloping panel and the input and output connectors flanking the switch as shown in the lead photo. With this setup, *R1* mounts directly on the appropriate lugs of the switch, and the connections to the D.U.T. were brought out from the appropriate points in the circuit, via a cable, through the front wall of the box. The connectors on the top of the box are all 5-way binding posts, and the D.U.T. cable is terminated in miniature alligator clips. Once the bridge was assembled, I labeled the panel with a tape labeler.

Setup and Use

Figure 2 details the various instruments (including options) that are used with the bridge and the proper connections to be made. Every time you use the bridge, you must set up the system as follows:

(1) Turn on all connected test equipment. If you are using a digital or analog multimeter, set its function selector to ac volts.

(2) Set *S1* to the position that shorts out *R1* and opens the line to the D.U.T. This connects the voltmeter directly to the bridge's output and removes from the measurement any device under test.

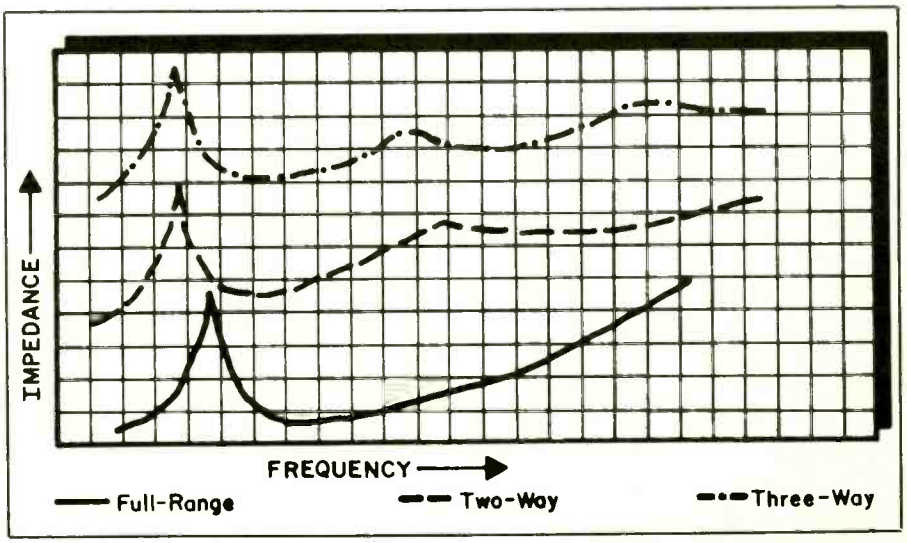
(3) Set the oscillator's level or amplitude control for the correct voltage reading on the voltmeter according to the value selected for *R1*.

(4) Set *S1* to its alternate position

(Continued on page 84)

Oscillator Output (volts)	Value of R1 (ohms, 2% tolerance)	Maximum measurement range (ohms)		
		1% error	5% error	10% error
1	1000	10	50	100
2.4	2400	24	120	240
5	5000	50	250	500
10	10,000	100	500	1000

Fig. 3. Shown here are impedance-versus-frequency plots for typical full-range, two-way and three-way speaker systems. Note resonance peaks on each curve.



Army Wrist Receiver

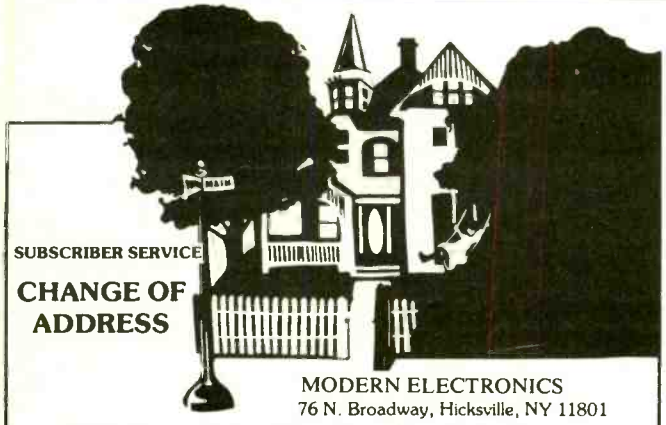
The U.S. Army continually develops new electronic equipment. Among the latest devices, reports the U.S. Army Electronics Research And Development Command, is a wrist-worn receiver for Airborne troops that works in conjunction with a small transmitter that might be carried by a paratrooper leader or packed on top of equipment to be dropped.

Once on the ground, the designated leader simply turns on the transmitter, called a Drop Zone Assembly Aid System (DZAAS), and waits for the rest of the group to find him.

The other paratroopers, who wear the one-lb. receivers on their wrists, tune them to a predetermined frequency, and turn around until the receiver's LED lights up. They then move in that direction until rejoining the group.

Three general officers who participated in a hide-and-seek DZAAS demonstration given at Fort Bragg, NC were enthusiastic about the results. They note that it eliminates confusion at night and greatly speeds up assembly. Student trainees with wrist receivers quickly found a project leader hiding in the woods with an operating transmitter, for example. It was even tested in downtown Salt Lake City, Utah, where it took a bit longer to find the transmitter due to the many buildings, but it worked fine there too.

Now if we can get them to send us the schematic so that we can make 'em and find our wives in a department store . . . .



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Update

"Absolute Reset" for Newest Apple IIs

Information you need to use the Apple IIe Absolute Reset with the new "enhanced" Apple IIe and IIc

The original Absolute Reset article that appeared in the February and March 1985 issues of *Modern Electronics* gave fixes to change the Apple IIe's restrictive ROM monitor to an absolute old reset, thereby unleashing the computer's real power. It was intended to work on only the version of Apple IIe computer made before January of this year. (You have the older version if you cannot enter BASIC commands in lower-case without getting a syntax error.) To have the Absolute Reset code work on a newly enhanced IIe or a IIc, you need "alike but different somehow" patches, as detailed here, customized for each machine version.

Shown in the two boxes is the key information you need for each machine. Note that the new IIe version is pretty much the same as the old. Only the entry point and length of the code change somewhat. But close doesn't count for much.

Note further that the IIc version has two major differences. Firstly, you must use a 27128 EPROM to hold the *entire* monitor. Secondly, the patch goes into the "F" area of the monitor, rather than the "C" area. The patch is in three pieces. There wasn't quite enough room to put it all in one place.

Free construction details of a simple adaptor that will let a 2764 EPROM burner handle a 27128 are available from me on request.(I also have a complete, ready-to-use absolute reset software package that includes all details needed for all three versions.)

One minor bug. Some of the text talks about a 4-second delay on activating the absolute reset. The present value is 2.8 seconds, which is consistent with the present checksums needed to pass all memory diagnostics.

There has been lots of reader interest in an absolute reset for the older

Absolute Reset for the Apple IIc

The Absolute Reset for either Apple IIe will not work on a IIc and should not be used. Instead, a three-piece patch that overwrites part of the "F" ROM area should be used. Note that the *entire* monitor gets written into a single 250-nanosecond 27128 EPROM.

To build an Absolute Reset for the new IIc:

(1.) Use SNATCHMON IIC to grab the IIc monitor image.
(2.) BLOAD IICMON.F, A$8000
(3.) CALL-151
(4.) 8B64: 05
(5.)8CCA: EE F4 03 A0 1C A9 C5 20 A8 FC 2C 61 C0 10 05 88 D0 F3 F0 2A
(6.) 8D03: C8 E5 EC EC EF 4C 59 FF 91
(7.) BSAVE KREBFMON.F IIC, A$8000, L$1000
(8.) Burn the new CDEF EPROM.

If your burner can handle a whole 27128 at one time, combine and move your files downward to a suitable buffer space in memory. For instance, do a BLOAD IICMON.C, A$2000, a BLOAD IICMON.D, A$3000, a BLOAD IICMON.E, A$4000, and, finally, a BLOAD KREBFMON.F IIC, A$5000. This gives you a 16K buffer starting at $2000.

Free plans for a simple 27128 adaptor for older burners are available on request and are included as part of the Reset package.

The new boot prompt is "Hello." Note that the IIc self-test never ends. The C006: 00 black magic is also not needed on the IIc.

To install the chip, unplug IIc power and remove the six outermost screws from the bottom. Press into the front crack directly in front of the "N" key with a 1" dull putty knife to release the front snap. The monitor is the chip directly under the keyboard center at D-18, slightly to the left of the speaker. Make sure the dot and notch go to the left when you replace it.

Absolute Reset for the New Apple IIe

The Absolute Reset for the old Apple IIe will not work on a new IIe or a IIe upgraded to the new ROM set and should not be used. Instead, an "alike but different somehow" patch should be used. This patch goes in a different location, is slightly longer, and has a different checksum.

To build an Absolute Reset for the new IIe:

(1.) Use SNATCHMON to grab the new IIe monitor image.
(2.) BLOAD IIEMON.C, A$8000
(3.) CALL-151
(4.) 82C8: EE F4 03 A0 1C A9 C5 20
A8 FC 2C 61 C0 10 0B 88
D0 F3 4C 59 FF C0 C0 00
00 00
(5.) BSAVE KREBFMON.C NEW IIE, A$8000, L$1000
(6.) Burn the new CD EPROM. Use KREBFMON.C NEW IIE for the low 32K and IIEMON.D for the high 32K.

If your burner can handle a whole 2764 at one time, combine and move your files downward to a suitable buffer space in memory. For instance, do a BLOAD KREBFMON.C NEW IIE, A$2000 and then a BLOAD IIEMON.D, A$3000. This gives you an 8K buffer starting at $2000.

Note that you will plow DOS if you try using an 8K buffer that starts at $8000. Note also that the self-test on the new IIe behaves differently than the old. Expect some page two garbage and an occasional flash, followed by a "System OK" message after a minute or two.

Apple II+. The simplest way to handle this is to dig up an old integer card and use it. (These "old monitor" chips have been advertised from time to time in computer magazines.)

Alternatively, you can do a 2716 EPROM substitution here, provided you add an inverter to handle the reversed sense of the 2316 ROMs initially used. Skip this detail, and certain cards will hang the machine and

(Continued on page 85)

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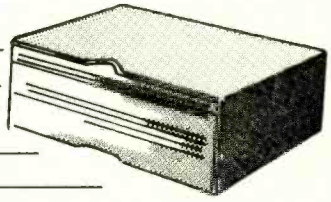


Pressure-Sensitive Resistors

By Forrest M. Mims III

There are many applications for pressure-sensitive resistors. For example, a pressure-sensitive resistor can serve as the transducer for an electronic scale or an accelerometer. When connected to an appropriate circuit, a PSR (from here onward, I will use "PSR" interchangeably with "pressure-sensitive resistor") can provide a warning when an object placed on it is moved. PSRs can also be used in various kinds of keyboards and computer graphic input devices.

I first wrote about pressure-sensitive resistors in the November 1982 issue of *Computers & Electronics* magazine. A few years later, that magazine published a letter from Scott Allner who suggested yet another application for these versatile devices. Mr. Allner wrote that he worked for an institution for severely mentally retarded and physically handicapped people, many of whom spend their days in wheelchairs. To protect these patients from receiving bed sores, Mr. Allner wrote, specially designed cushions are necessary. Therefore, he was working on a special cushion fitted with an array of 260 pressure-sensitive resistors. Mr. Allner's objective is to obtain a visual representation (LED array or computer screen) of the weight distribution of various patients seated on the test cushion.

The sensors about which Mr. Allner wrote were do-it-yourself devices fashioned from the conductive foam used to ship CMOS and other voltage-sensitive semiconductors. Many other kinds of PSRs are also available. In this month's column I'll discuss several kinds, emphasizing an inexpensive commercial device which has recently become available. I'll also present some specific circuit and computer applications.

Do-It-Yourself Pressure-Sensitive Resistors

In 1969, I was attempting to measure the forces exerted on a small, homemade infrared-seeking guided rocket suspended in a wind tunnel. The wind tunnel was fashioned from a length of stove pipe fitted with air compression, straightener, and expansion stages. When suspended from the passenger side of my 1966 Chevy, the wind tunnel achieved an airspeed of 90 miles per hour when the car was driven at 70 mph, the legal speed limit at that time.

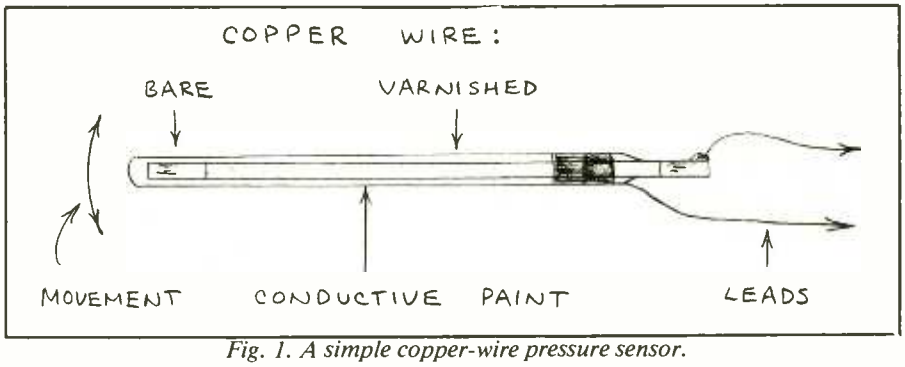


Fig. 1. A simple copper-wire pressure sensor.

One of the force-measuring devices I devised was a short piece of copper wire coated with an insulating film. As shown in Fig. 1, the insulating material was removed from a short length of each end of the wire. The wire was then dipped into a commercially available conductive paint, which was blended with minute particles of copper. After the paint dried, the coating formed a resistor whose resistance could be varied by bending the wire. Separate leads were attached directly to the exposed end of the copper wire and to the conductive paint by means of a strip of tape or small alligator clip.

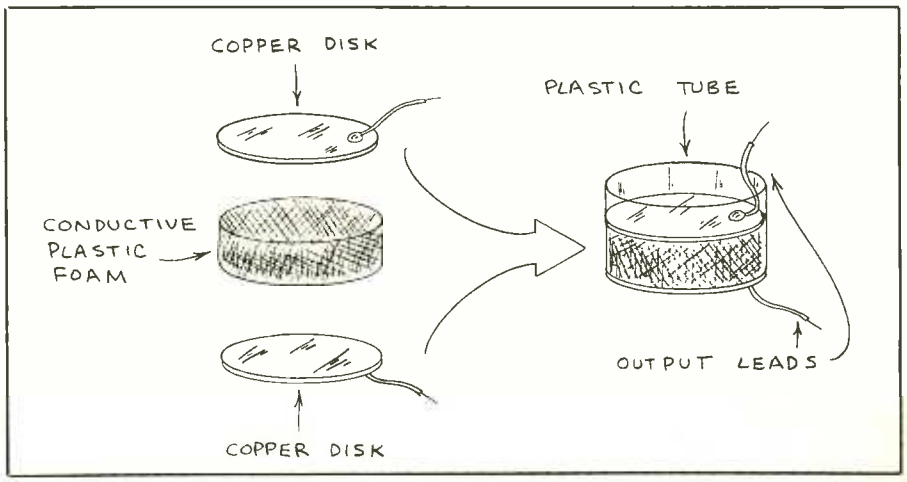
I attempted to use the resistor shown in Fig. 1 to measure variations in the forces on a rocket in my wind tunnel. However, the oscillations of the rocket prevented accurate measurements. Nevertheless, the basic resistor is easy to make and may have other, more practical applications.

Figure 2 shows a do-it-yourself pressure-sensitive resistor made from a small disk of electrically-conductive plastic foam of the kind in which CMOS ICs are sometimes shipped. Conductive foam plastic can also be purchased from Radio Shack and other electronics suppliers.

Contacts for the conductive foam are fashioned from two disks cut from copper foil available from a hobby or craft shop. Unetched, copper-clad circuit board can be used in lieu of copper foil. In either case, the copper surface should be buffed with a pencil eraser until it is shiny to prepare it for soldering. Solder a length of wrapping wire or standard hookup wire to each terminal.

The PSR is assembled by inserting the disks and the conductive foam into a

Fig. 2. A do-it-yourself pressure-sensitive resistor.



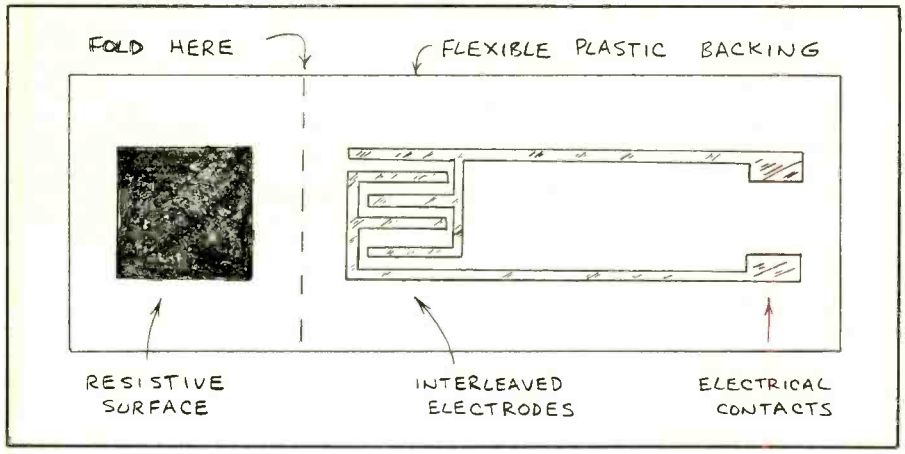


Fig. 3. Details of the Interlink pressure sensitive resistor.

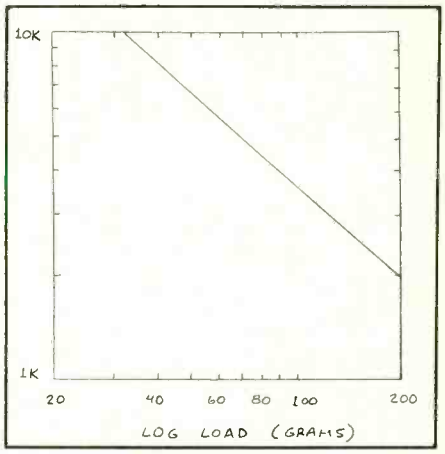


Fig. 4. This is the log-log plot of resistance-versus-force for the Interlink FSR.

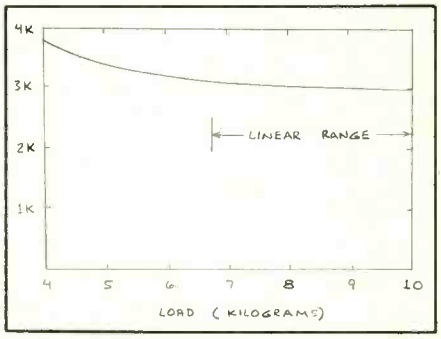


Fig. 5. High-load-value resistance plot for the FSR example in Fig. 4.

small plastic tube as shown. The resistance of the completed device will range from several tens of kilohms with no pressure applied, to a few hundred ohms with pressure applied.

The Fig. 2 assembly is one of many ways to assemble a do-it-yourself PSR. So long as the sandwich configuration of contact-foam-contact is preserved, resistors can be made in many different sizes and shapes. For instance, the contacts and the conductive foam can be formed into a square or rectangular shape. And miniature PSRs can be made by cutting the component materials with a ¼ inch mechanical paper punch and installing them in a small plastic tube like those in which points for lettering pens are sold.

The above are but two of many ways to assemble do-it-yourself PSRs. A third simple PSR can be made by mounting a spring on the control handle of a slide resistor. Though sensitivity might not be as good as that of other methods, results will be repeatable. Back in 1958, one of the first radio transmitters launched in a model rocket used just such a device for an accelerometer. I remember watching that launch from a field near Colorado Springs along with a crowd of high school model rocket enthusiasts and our dads.

Commercial PSRs

Many different kinds of commercial pressure-sensitive resistors are available. For instance, Vernitech (300 Marcus Blvd., Deer Park, NY 11729) makes a potentiometer-type PSR that incorporates an infinite-resolution potentiometer. This device offers a linearity of within 0.3%.

Also available are various kinds of electromagnetic and piezoelectric pressure-sensitive resistors. For information about manufacturers, see one of the electronics trade directories at a good technical library or inquire at companies that represent various electronics manufacturers.

To my knowledge, the least-expensive commercial PSRs are manufactured by Interlink Electronics, Inc. (331 Palm Ave., Santa Barbara, CA 93101). Figure 3 is a drawing of one kind of resistor made by Interlink Electronics. The company labels this device a Force Sensing Resistor or FSR. Three FSRs can be purchased from the company by sending $5 plus $1 for postage and handling to the address given above.

The FSR in Fig. 3 is printed on a thin sheet of clear, flexible plastic which can be easily cut with scissors. Referring to Fig. 3, on the left is a square-shaped deposit of material that has a moderately high resistance. On the right is a pair of interleaved electrodes brought out to two terminals. In operation, the side of the FSR that has the resistive coating is folded over the interleaved electrodes. When the resistive coating is squeezed against the electrodes, a variable resistance appears across the two terminals.

Figure 4 is a logarithmic plot of the resistance of an Interlink Electronics pressure-sensitive resistor versus an applied force. When the load applied to the FSR ranges from about 5 to 12 kilograms per square centimeter, the straight line log-log relationship plotted in Fig. 4 becomes the simple linear relationship shown in Fig. 5. Note how, at least over this range, the change in resistance with respect to the applied load is very small.

Incidentally, both Figs. 4 and 5 are adapted from "Force Sensing Resistors," an application note published by Interlink Electronics. Among the applications for FSRs listed in this note are point-contact graphic tablets for computers, theft detectors, robot grip sensors, musical keyboards, musical drum pads, and theft detectors.

Application Circuits

It's quite easy to demonstrate operation of a pressure-sensitive resistor with the

help of a simple circuit. Both circuits that follow use the symbol, suggested by Interlink Electronics, the pressure-sensitive resistor shown in Fig. 6.

Figure 7 is a simple tone generator using a 555 timer chip configured as an astable oscillator. Oscillation frequency is governed by the values of *R1, R2* and *C2,* calculated as follows: $f_{(approx.)} = 1.44/[(R1 + 2R2)C1]$.

With the values given in Fig. 7 and when *R1* is an Interlink FSR, the tone generated ranges across the entire audio spectrum when the FSR is squeezed between thumb and forefinger. Tone range can be easily altered by changing the value of *C1.* Increase *C1*'s value to reduce the frequency range, and vice-versa.

Figure 8 is a straightforward comparator circuit that permits a pressure-sensitive resistor to switch an LED on or off as the pressure on the resistor is varied. Circuit switching threshold can be altered by changing the setting of *R3.* As shown, the circuit switches the LED on when the pressure on *R1* is increased. If the input connections to the op amp at pins 2 and 3 are reversed, the LED will switch off as the pressure on *R1* is increased.

The circuit in Fig. 8 can easily be modified. For instance, the LED can be replaced by a small relay, such as Radio Shack's No. 275-004, if *R5* is eliminated and the collector of *Q1* is connected directly to the positive supply.

Computer Applications

Computer graphics tablets, such as the KoalaPad™, employ a surface coated with a resistive material. Applying pressure to the surface of the pad gives an output signal that represents the location of the touched region.

Simple pressure-sensitive resistors also have computer applications. For example, any of the homemade pressure-sensitive resistors described above can be connected to the joystick input(s) of computers designed to accept variable-resistance (potentiometer-style) joysticks. In this manner, joystick functions can be achieved simply by pressing on a pressure-sensitive resistor, rather than by moving a joystick handle.

Several joystick circuit configurations are used by various computer manufacturers. In the simplest configuration, each joystick pot functions as a two-terminal variable resistor. This is the approach used in IBM's PC*jr*. A somewhat more complicated approach connects one side of the pots in a joystick to a positive voltage and the other side to ground. This forms a pair of voltage dividers in which the rotor terminals supply a voltage that varies between the positive supply and ground as the stick is moved. This is the approach used in Radio Shack's Color Computer.

Figure 9 shows the internal circuitry of a PC*jr* joystick. The two potentiometers are linear-taper devices with a resistance of 100,000 ohms. Two normally-open pushbutton "fire" switches are included.

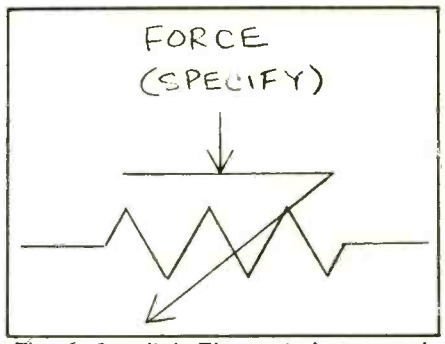


Fig. 6. Interlink Electronics' suggested schematic symbol for the FSR.

Fig. 7. A simple pressure-sensitive tone generator built around a 555 timer.

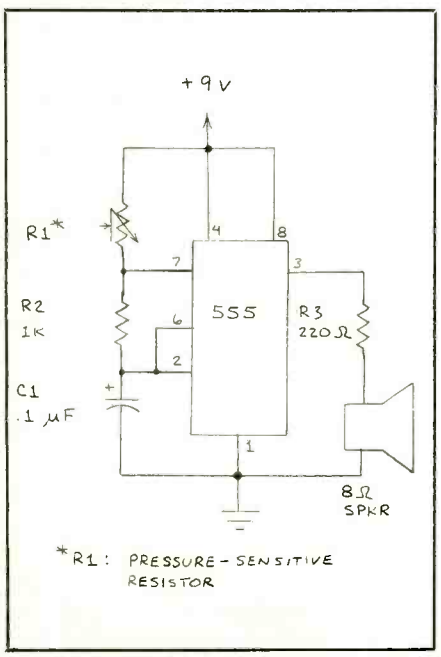
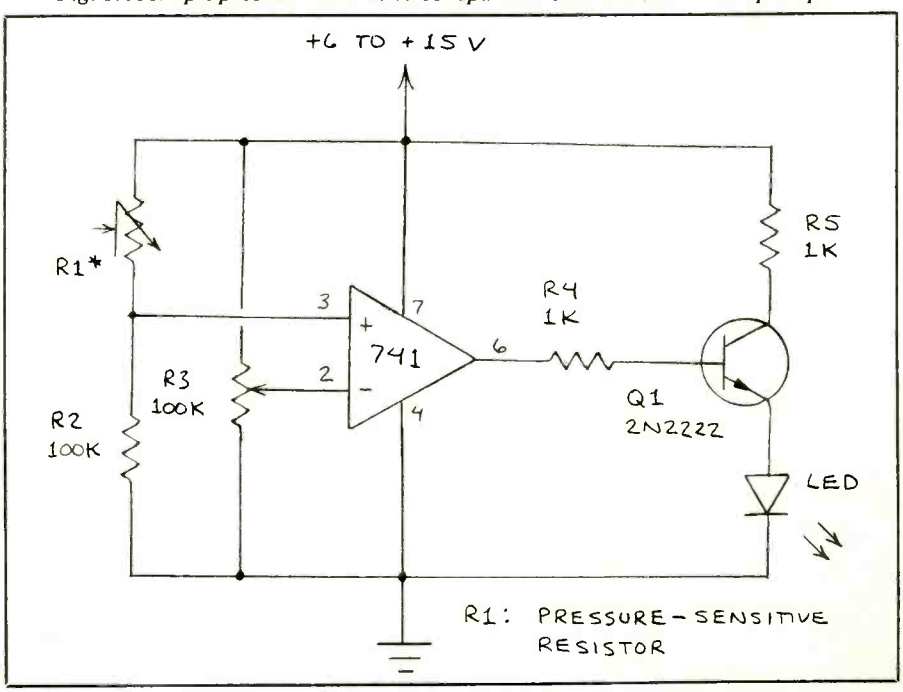


Fig. 8. A simple pressure-controlled comparator built around a 741 op amp.



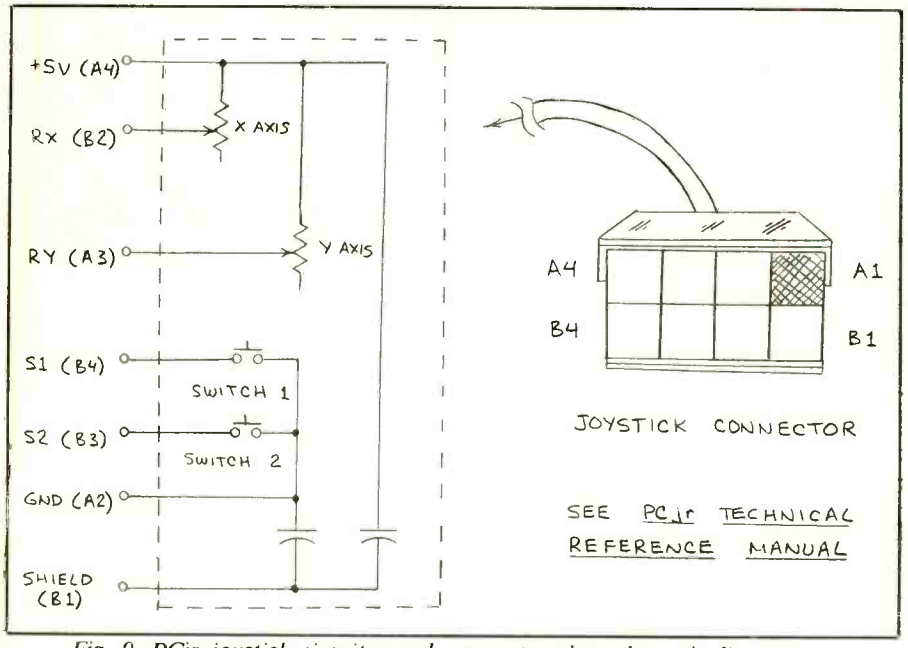


Fig. 9. PCjr joystick circuitry and connector plug schematic diagrams.

Figure 9 also shows the pin connections of one of PC*jr*'s joystick connectors.

Leads from a PSR can be connected directly to the joystick of the PC*jr*, easily done with a Wire Wrap tool. Alternatively, one or two miniature phone jacks can be added to a joystick to permit the resistors to be connected to the joystick itself. I used the latter approach, since the Berg-type connectors used in the PC*jr* are hard to find.

In either case, it's important to know that noise coupled into the joystick ports can cause erratic operation. That's why the joystick cables are shielded. For this reason, keep the leads to the pressure-sensitive resistor short or use two-conductor shielded cable and ground the shield.

This PC*jr* program will display the joystick value of a single pressure-sensitive resistor connected to the x-axis potentiometer:

```
10 CLS
20 X = STICK(0)
30 LOCATE 10,20
40 PRINT X
50 GOTO 20
```

When used with an Interlink Electronics force-sensing resistor, this program emphasizes the low range of joystick values (from about 3 to 15).

The following program permits an FSR to move a dot back and forth across the screen:

```
10 SCREEN (1)
20 CLS
30 X = STICK(0)
40 X = 10*X
50 Y = 20
60 PSET (X,Y)
70 PRESET (X,Y)
80 GOTO 30
```

Since the FSR works best with low joystick numbers, line 40 multiplies the retrieved value by 10. This provides the *x* coordinate for a horizontal line across the computer's display. As the FSR is alternately squeezed and released, a small dot moves back and forth along this line in 10-pixel increments.

If you have a Color Computer, you can connect one or more pressure-sensitive resistors to its joysticks if you first add a single fixed resistor in series with each sensing resistor. Connect the free end of one resistor to +5 volts (available at the joystick port) and the free end of the remaining resistor to ground (also available at the joystick port). The junction of the two resistors then becomes the voltage divider output for the CoCo joystick port.

The value of the fixed resistor depends

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on the resistance range of the pressure-sensitive resistors. Try values of from 1000 to 100,000 ohms. You can also experiment with which resistor is connected to +5 volts. For initial experiments, connect the free end of a fixed 1000-ohm resistor to ground. Connect the PSR's free lead to +5 volts.

Here's a listing that displays CoCo's joystick values:

```
10 CLSO
20 PRINT @ 133, JOYSTK(0);
30 PRINT @ 138, JOYSTK(1);
40 PRINT @ 148, JOYSTK(2);
50 PRINT @ 153, JOYSTK(3);
60 GOTO 20
```

Caution: Exercise care when attaching pressure-sensitive resistors or any other components to the joystick inputs of a computer. You may damage the computer, void its warranty, and disqualify it for repair by the manufacturer. Since digital computers use MOS integrated circuits that are susceptible to permanent damage caused by electrostatic discharge, remove any charge on your body by touching a grounded object. For best results, follow the precautions recommended for handling and working with CMOS ICs. Finally, use caution to avoid exposing yourself to the possibility of electrical shock while working with a line-powered computer.

Going Further

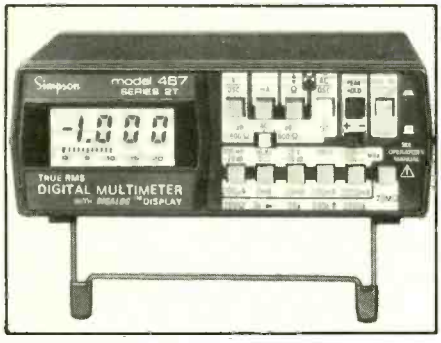
Pressure-sensitive resistors have numerous applications, many of which have yet to be fully developed. Experimenters can play an important role in developing new applications for these devices, since they can be easily assembled from common materials or purchased at low cost.

For more information about pressure-sensitive resistors, see the FSR application note published by Interlink Electronics. Also see "Making Your Own Pressure-Sensitive Resistors" (*Computers & Electronics,* Nov. 1982, p. 124). Thomas Henry of Transonic Laboratories wrote a brief application article on the subject titled "Conductive Foam Forms Reliable Pressure Sensor" (*Electronics,* May 19, 1982, p. 161).

If you wish to find out more about connecting PSRs to the joystick ports of personal computers, several references that cover the general subject of joystick interfacing will prove useful. One of the best is *TRS-80 Models I, III & Color Computer Interfacing Projects* by William Barden, Jr. (Sams, 1983, Chapter 23). Various kinds of joystick interfaces suitable for use with PSR resistors are also given in *Forrest Mim's Computer Projects* (Osborne/McGraw-Hill, 1985). You should also carefully review the documentation provided with the computer you plan to use. Especially important are the technical reference manuals available for machines like the PC*jr* and the Color Computer. ME

NEW PRODUCTS...

(from page 11)



1004-Hz tone generator for line checking and signal tracing.

Among the new DMM's features are Simpson's Digalog™ (digital/analog) LED display with pulse, continuity and low-battery indicators, and a true-rms ac capability. Its 29 ranges are optimized for telecommunications testing and provide full-scale measuring capacities from 200 mV to 1000 volts dc in five ranges; 200 mV to 750 volts ac in five ranges; −60 to +20 dB in three ranges; 200 ohms to 20 megohms in six ranges (three low-power); 200 μA to 2000 mA ac and dc current in five ranges per function. Voltage and resistance ranges have high-voltage transient protection, and all ranges are overload protected, including fusing on the current ranges. Basic dc voltage accuracy is 0.1%, and ac voltage frequency response is to 100 kHz.

Other built-in functions include audible/visual continuity indication, logic level detection up to 35 volts, diode test and differential peak hold. A single 9-volt transistor battery provides up to 100 hours of continuous operation. The DMM measures 5.63″W×4.6″D×2″H and weighs 1.5 lb. $350.

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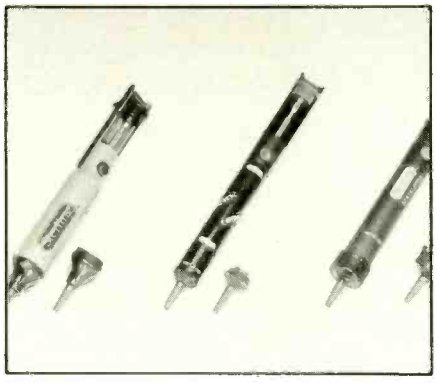

Desoldering Tools

Wahl Clipper Industrial Products has introduced a new series of vacuum-type desoldering tools. The line consists of two static-free models and one antistatic model. All feature durable construction, high vacuum solder sucking action, recoil protection, self-cleaning plungers and replaceable tips. All are also balanced for one-hand operation, with comfortable thumb profiles. $9.95 for each tool; $2.50 for replaceable tip.

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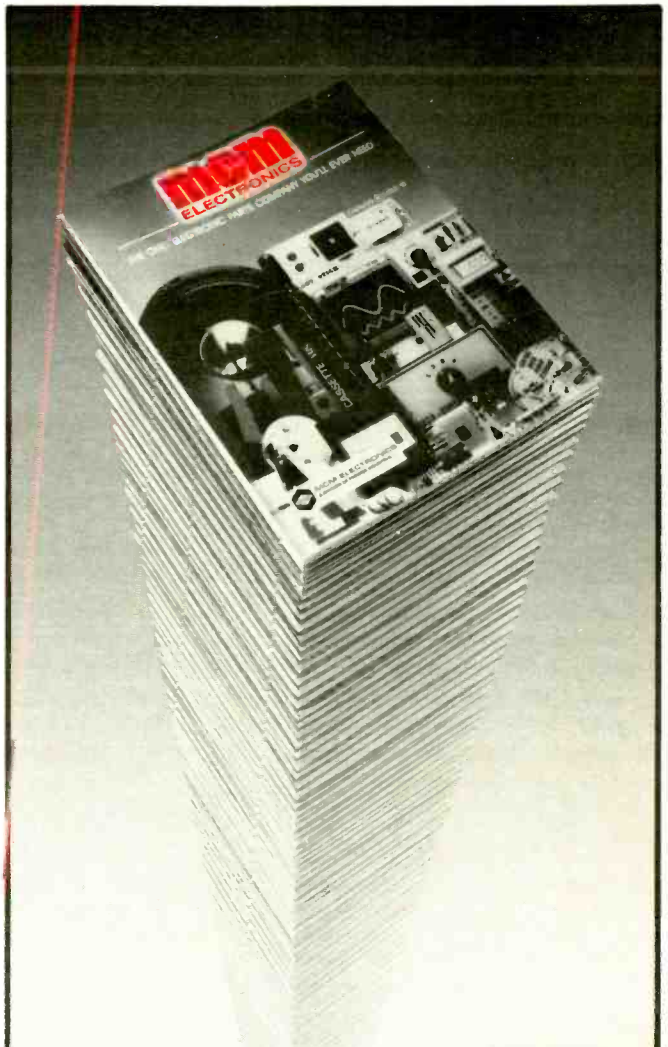

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CIRCLE 85 ON FREE INFORMATION CARD

HARDWARE HACKER

Finding out about bar codes, new fiber-optics goodies, a dual monitor for the Apple IIe, using a word processor to do isometric drawings, new data books

By Don Lancaster

If you happen to be in the neighborhood, why don't you stop in at a *Gila Valley Apple Growers Association* meeting, Thursday nights from 6 to 10 in Eastern Arizona College, Room T8, right here in beautiful downtown Thatcher. If you are very lucky, you might even get to be the first *Modern Electronics* reader to qualify for a free GVAGA tinaja quest. Also, Synergetics now stocks autographed copies of most of my books, in case you have been having trouble picking them up locally.

Lots of offbeat sources for neat stuff this month, so let's get with it.

How can I Find Out About Bar Codes?

Bar codes are those funny product code labels you've no doubt seen at the grocery store. The best running commentary I've run across on the societal impact of bar codes has appeared on the front cover of every issue of *MAD* magazine during the past several years.

Chances are that you would prefer some more technical information than this, though. It turns out there are five major bar-code standards. The one you already know the most about is called the UPC, short for Universal Product Code.

You can get a copy of the UPC standard from, of all places, the *UPC Council.* Actually, they just renamed themselves the *UC* for *Uniform Code.* While this sounds a tad presumptuous, they do seem to be running away with all the marbles.

Other competitive bar-coding schemes include the Code 3 of 9, used by the military and the automotive people; the Interleaved 2 of 5 used for containers and transportation; the Codabar also used for transportation; and the EAN European Article Number standard.

Some further details on these standards appear in the *Hewlett-Packard* bar code components folder, publication number 5954-2152. H-P has lots of fairly expensive solutions to bar-code scanning and reading, including their HBCR1000 series component bar-code readers, HBCS-4300 industrial bar-code wands, and HEDS-1000 reflective sensors. Check out their *Optoelectronics Designer's Catalog* for more details.

One Company that I've found has bar-code components parts at fairly low prices is *Scan-A-Matic.*

For a complete list of all major bar code manufacturers and suppliers, contact the *AIM* Automatic Identification Manufacturers trade group. Their free membership directory lists dozens of major bar-code outfits.

What's new in Fiber Optics?

Let's see. *Motorola* has evaluation samples of its fiber-optic links available. This gives you a 10-MHz infrared emitter, a fast PIN diode detector, and a meter of fiber-optic cable. The fiber cable is removable, and you can easily shorten it to any length with a plain old X-Acto™ or other utility knife.

Advantages of a fiber-optic link include total electrical isolation from input to output; the ability to work in hazardous locations; elimination of noise, coupling and ground loops; and lack of most EMI or RFI interference.

Hewlett-Packard has a well-written *Fiber Optics Handbook,* available from its German division. The handbook has a good fundamental review of the physics and electronics behind fiber-optic communications.

Finally, *Guidelines* is a quarterly *Corning Glass* in-house publication that centers on their fiber-optic activities.

I think all of this stuff is free, provided you make the usual professional-sounding requests, preferably on a business letterhead or by way of a direct phone call.

How can I put Two Different Monitors in an Apple IIe?

By now, it has become painfully obvious that the "enhanced" IIe monitor is pretty much useless when it comes to running older Apple software. And more than a few unfortunate epsilon minuses got sucked into letting an Apple dealer steal their old monitor ROMs when they attempted doing a so-called "upgrade."

Sadly, the "upgrade" is needed for releases of future software even if it utterly demolishes the value of most older software that you already own.

Both the old and new monitor chips are compatible with industry standard 28-pin 2764 EPROM chips by *Intel* and *Hitachi.*

The usual dual monitor solution is to take a mechanically similar, but electrically double sized 27128 EPROM and put two monitors in it, one in the top half and the other in the bottom. A quick and dirty way to switch between the two is to lift pin 2 from the socket and jumper clip it to ground for the "low" monitor and to +5 volts for the "high" monitor.

Figure 1 show us a cleaner and safer way to handle dual monitors at a cost of only a few dollars. You plug two adapter sockets into your Apple where the CD and EF monitor chips are supposed to go. Then you plug 27128 EPROMs into the adapters. A pair of switches is then flipped left for the high monitor and right for the low monitor.

One suitable source for EPROM programming is *E-TECH Services,* who give prompt and low-cost work. Note that you have to send them disk-based images of the code you want burned into both 27128 EPROMs.

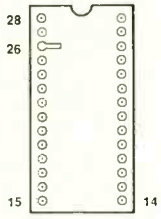
The key to the adapters is to use premium machined contact sockets that may be safely plugged into each other. These sockets are held apart by machined contact DIP strips that give enough separation to make room for the switch. Be sure to use a slide switch and not a toggle switch, and be sure the spdt slide switch is a "break-before-make" type.

There are some obvious modifications or improvements you might like to try. You could replace one switch with a wire that reaches over to the center of the other switch on the other adapter. This way, only a single switch flip will be needed to pick one monitor or the other.

Switch flipping is best done cold. If you try to flip the switches during a program, strange things may happen, depending on whether either monitor is being accessed

1. ( ) Place the 28 pin machined contact DIP socket pins up and identify pin 26. Carefully bend pin 26 towards the center as shown.

( ) Pins are numbered "backwards" from usual when they are viewed from the bottom.

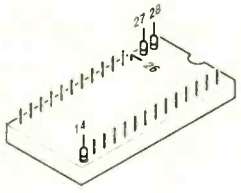


2. ( ) Push a single bare machined contact socket pin onto pins 14, 27, and 28 as shown.

( ) NOTE: In any soldering steps, snap an extra DIP strip onto the cool end of the pins being soldered. This keeps the pins aligned should the plastic soften.

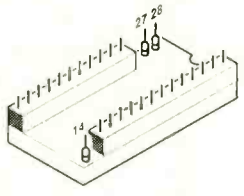
( ) Solder pin to socket at pins 14, 27, and 28.

DON'T GET ANY SOLDER ON THE PIN TIPS!



3. ( ) Push a 13 pin machined contact DIP strip onto pins 1-13 as shown.

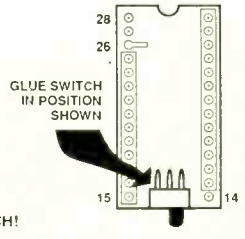
( ) Push an 11 pin machined contact DIP strip onto pins 15-25 as shown.



4. ( ) Carefully roughen one side of the SPDT slide switch and the bottom of the 28 pin DIP socket between pins 14 and 15. Use very fine sandpaper or steel wool.

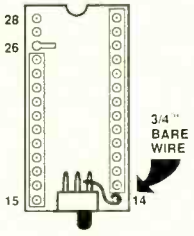
( ) Glue the switch to the 28 pin DIP socket as shown using superglue or epoxy. Let sit overnight and then verify that the switch still works.

DON'T GET ANY GLUE INSIDE THE SWITCH!



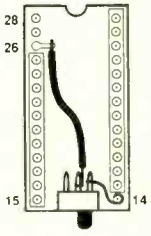
5. ( ) Prepare a 3/4 inch length of bare #24 wire. Connect this wire to pin 14 of the 28 pin socket and then to the nearest pin on the SPDT slide switch.

( ) Solder both connections, using a spare DIP strip as a safety backup heatsink. Cut off any remaining wire. Be very careful not to get any solder on the tip of pin 14.



6. ( ) Take a 1-3/4 inch piece of green #24 solid insulated wire and strip 1/4 inch from each end.

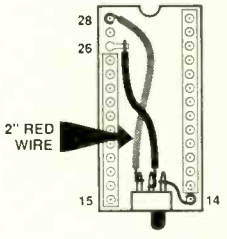
( ) Solder one end of this green wire to pin #26 and the other end to the center pin on the SPDT slide switch.



7. ( ) Take a two inch piece of red #24 solid insulated wire and strip 1/4 inch from each end.

( ) Solder one end of this red wire to the far unused pin on the SPDT slide switch. Solder the other end of this wire to pin #28 after looping it.

( ) Make sure that no solder gets on the tip of pin #28 and that there is no short to adjacent pin #27.



8. ( ) Turn the Apple IIe power off and remove the line cord at both ends. Carefully remove the original CD and EF monitor chips and store them in protective foam.

( ) Plug one adaptor into the CD ROM slot at D8 and the other adaptor into the EF ROM at D10 as shown. Plug your already programmed 27128 EPROMs into these adaptors.

( ) Be sure that the CD EPROM goes in the CD slot, and that the notch and dot on both EPROMs point forwards, towards the keyboard.

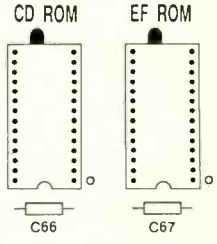


Fig. 1. How to install a dual monitor adapter in the Apple IIe computer. You need two adapters for the modification.

at the time the switch is flipped, and whether the code being used at this instant is different in one monitor than it is in the other.

One really neat trick would be to use a pair of 27512s instead, whose eight 64K banks are selected by an 8-way selector switch. This would let you have an old monitor, new monitor, word processor, spreadsheet, graphics program and three other programs all resident in your machine for instant access. A somewhat different adapter scheme would be needed.

By the way, all artwork (including legends and accompanying text) you see here were completely and totally drawn using Applewriter on a IIe. Not too shabby for a word processor, eh? I sure wish I could find a way to do graphics this good on a Macintosh.

Please keep me posted on your multi-monitor activities.

What's New in the Data Book Department?

Some careless *Modern Electronics* reader must have left two data books sitting too close together on the shelf, for there's now the pitter-patter of happy little data books everywhere. Actually, the terms "stampede" and "avalanche" and "torrent" come to mind. Let's quickly run through what showed up here during the last few weeks.

As usual, most data books have an "optional" price, typically between $5 and $10. You can often get these free if you make a professional enough request. Exceptions are *National Semiconductor, Motorola, Signetics,* and *Texas Instruments.* These outfits have such extensive

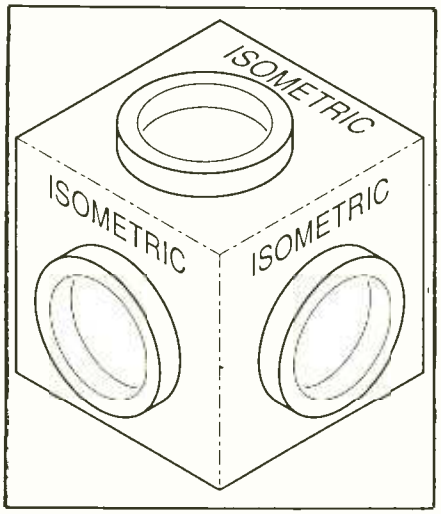


Fig. 2. Isometric drawings are easily done using a Laserwriter printer and Applewriter with the Apple IIe computer.

and detailed data-book libraries that almost everyone has to pay the going rate.

Where to start?

Monolithic Memories has a pair of new data books: the sixth edition of the *LSI Databook* and the second edition of the *Systems Design Handbook*. These are mostly about PALs, or programmable array logic devices, a new EPROM-like replacement for conventional digital logic. There's also a surprising amount of advanced electronic stuff here as well.

Texas Instruments weighs in with four publications: *Power Products Data Book* with lots of goodies on power transistors, power Darlingtons, triacs, SCRs and goodies like that; *MOS Memory Data Book* that covers dynamic and static RAMs, and EPROMs; *Field Programmable Logic Data Book* that covers second-sourcing of the Monolithic Memories PLAs; and *TMS3020 Users Guide* that describes in depth a new type of integrated circuit called a digital signal processor. These are most handy for things like spectrum analyzers, speech synthesis, digital filtering, and radar signal analysis.

Silicon General has a product catalog that includes such goodies as op amps, modulators, regulators, protection circuits, power drivers and a good collection of applications notes. Then *Plessey* has a thick *Integrated Circuit Databook* that covers all sorts of exotic linear ICs. It includes log amplifiers, low-noise amplifiers, radio communication circuits, specialized TV chips, frequency synthesizers, telephone circuits, hundreds of neat products in all.

Hitachi sent along a pair of specialized data books: the *HD65384 CRT Controller Users Manual* and the *HD64180 Microprocessor Data Book*. No less than three data books come from Siemens: the *Power Semiconductors* manual, *SIPMOST Transistor Data Book,* and *SIPMOST Transistor Applications Notes.* The last jewel includes circuits for power electronics, solar power, optoelectronics, audio and television.

Next in the pile is the *EXEL Data Book* that covers both data sheets and ap notes on electrically programmable PROMs, or EEPROMS, followed closely by the *Cypress Semiconductor CMOS Data Book* that covers a very large assortment of static RAMS, PROMS, PALs and general logic circuitry.

Ferranti provided a technical handbook on the *Super E-Line Transistors* that includes a bunch of ap notes on such things as motor speed controls, flashers, microphone amplifiers, infrared transmitters and a fluorescent lamp inverter.

Finally, at the very bottom of the stack was a technical data catalog from *MWS*

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Wire Industries that gives technical information on the various sizes and grades of magnet wire and its insulation.

How can I do an Isometric Drawing?

Why, with Applewriter on a IIe, of course! How else could you possibly do an isometric drawing?

Figure 2 shows us some details. Isometric drawing is one standard way of showing three dimensional objects on a flat sheet of paper. The original *x* axis leans up 30 degrees to the right. The original *y* axis leans up 30 degrees to the left. The original *z* axis still goes straight up and down. You can measure actual scale lengths along all three axes.

I've put together some Postscript routines that easily let you do Laserwriter graphics directly out of Applewriter. The **cl, cr** and **ct** commands handle the circles as ellipses slanted and stomped just the right way for left, right and top faces. **al, ar** and **at** do the same thing for arcs. **lm, lrm, ld** and **lrd** commands handle left moves and left draws, both relative and absolute. Similar commands exist for the other two axes, while the **im, irm id** and **ird** commands do a triple isometric move or draw all in one command. These are needed for positioning or for slanting lines that go in two or three dimensions.

The dashes are done by using the SETDASH operator. Compound curves are handled with the cubic splines we looked at last month.

Neatest of all are the **pr, pl** and **pt** commands that print right, print left and print top, automatically slanting and arranging the letters so they seem to "belong" on any face.

The actual isometric transformations aren't really all that bad. They are:

$$\text{vertical} = z + 0.5\,(x + y)$$

$$\text{horizontal} = 0.866\,(x - y)$$

Here, *x, y* and *z* are the original three dimensions, while vertical and horizontal are the final directions on the final two-dimensional page. Circles are done as ellipses with a magic angle of 35 degrees and 16 minutes, either flat for the top, or rotated ± 60 degrees for the sides.

Trig freaks will note that 0.5 and 0.866 are the respective sine and cosine of 30 degrees, while 35 degrees and 14 minutes is the angle whose tangent is 0.5.

The lettering is nothing but a stock font that gets slanted and rotated. You either lean the letters forward or backwards 30 degrees (utterly trivial with Postscript) and then rotate the message up or down an additional 30 degrees as needed. The other nine lettering orientations not shown in Fig. 2 are also easily done.

Isometric is ideal for "exploded" views that show how things go together, particularly when lots of round parts are involved. One limitation is that boxy subjects seem a tad out of proportion with the far corner looking "too big." You can see if you stare at Fig. 2 long enough. This is caused by your brain being used to seeing things in perspective. (You'll find more isometric examples in Fig. 1.)

Actually, isometric is only one of an infinite number of possible *axonometric* projections. Draftsmen and tech illustrators typically avoid most of the other viewing angles like the plague, since they used to be a royal pain to draw. Oftentimes, some really offbeat axonometric projection will show an object or an assembly drawing in its best light.

But Applewriter and Postscript could not care less. A trig calculation is a trig calculation, no matter how weird the angle or how funny the ellipse. There are a nearly infinite number of ellipse templates sitting inside the Laserwriter, and they are all equally accessible. Thus, you can easily do virtually any 3-D axonometric drawing about as simply as you can do plain old isometric. Perspective, too.

More on axonometric projections appears in just about any book on drafting or tech illustration. Write or call if you need any more info on any of this. **ME**

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First impressions: Digital Research's GEM software for IBM PCs and compatibles and the low-cost Kaypro 2000 laptop computer

By Eric Grevstad

This month's products have the kind of symmetry that writers of introductory paragraphs dream about: some of the newest PC software and some of the oldest. The new item is GEM Desktop, Digital Research's Macintosh-style graphics interface for MS-DOS micros. The other is everyone's favorite old dog, WordStar, taught a few new tricks by a $20 accessory package.

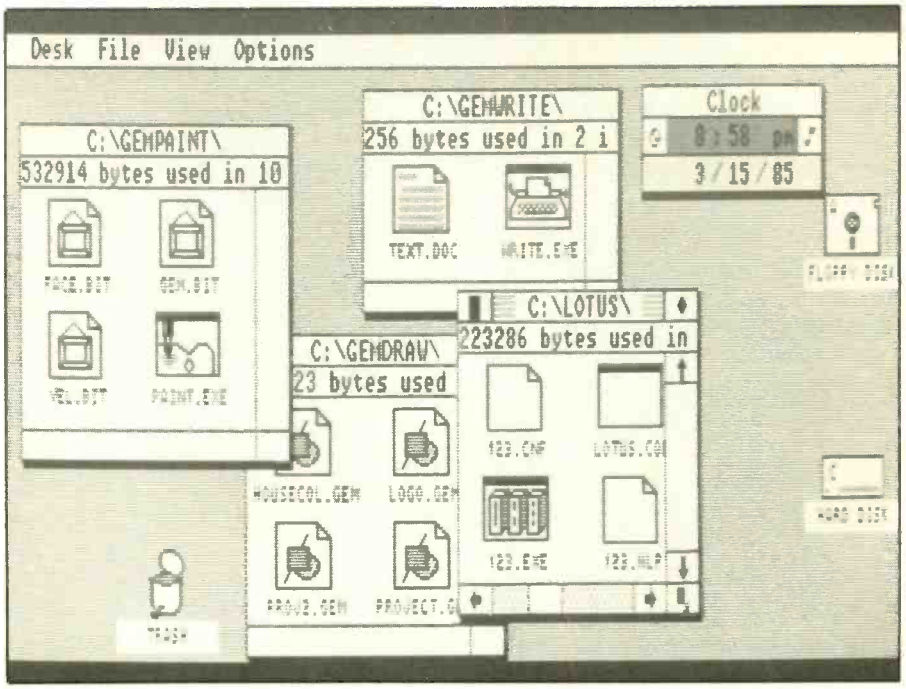
In between, I'll look at the Kaypro 2000—the PC-compatible laptop the Data General/One should have been, or at least one that costs what the DG/One should have cost.

The Blue Apple

No one will call GEM Desktop innovative or original, but anyone who thought the 1981-vintage PC was dead (or that Digital Research Inc., creator of CP/M, was dead) must admit it's a pleasant package. With one exception, DRI has done a remarkable job of emulating Apple's Macintosh user interface, translating it to PCs and compatibles. (Considering the aging 8088 CPU, Desktop reminds me of those sleek fiberglass sports car bodies available for VW Beetle chassis, but more on that in a moment.)

Even on my bare-minimum graphics system (a Tandy 1200 HD with graphics card and monochrome monitor), DRI's Graphics Environment Manager turns the screen into a near clone of the Mac's: floppy and hard-disk icons and a trash can for deletions, disk directories in windows showing folders (subdirectories), papers (files), and cute symbols for word processing, database management, or a dozen other types of programs. At the top of the screen, a bar offers pull-down menus for juggling files, changing defaults, or calling a clock or calculator.

Just as with Macintosh, windows, folders, and files can be opened, closed, or dragged around the desktop by moving a mouse and clicking or double-clicking a button. (It's barely possible to use GEM from the keyboard, awkwardly tapping the cursor arrows and Home key; Mouse Systems' PC Mouse or Microsoft's noisier unit is really essential.)



Digital Research's Graphics Environment Manager (GEM) software turns the screen on IBM PCs and compatibles into a near clone on Apple's Macintosh.

Deleting a file is as simple as dragging it to the trash can; starting work on a file, automatically loading the program that created it, is a point-and-shoot snap. When you're done, the command that normally returns to DOS returns you to Graphics Environment Manager.

An "Enter DOS Commands" option lets you type commands directly. Type EXIT at the DOS prompt and you're in Desktop where you left it—even if you went somewhere else, logging onto a different subdirectory, while using DOS. (Leave Desktop with the Quit command, however, and you land in GEMSYS, one of the program's four directories; you must type CD \ , or add it to the startup batch file, to regain the root directory.)

GEM Desktop has its limitations. While usable with 256K and two floppies, it fairly demands 512K and a hard disk (it takes 129K of RAM, not counting room for DOS or applications). It takes an afternoon to set up. Your applications must be installed for GEM and each program's files given the same extension (fine if your spreadsheet filenames all end .WKS, but a nuisance if you use document names like CHICAGO.LTR and REPORT.NOV). The manual's poor, though its appearance is slick. It details complex setup and printer font choices, but omits some of Desktop's everyday commands (or any of the basic DOS concepts, from directories to disk formatting).

More important, Desktop lacks the Mac's best feature—a clipboard for linking applications, cutting and pasting material between them. And, straining the 8088 to its limits, GEM generally feels slow—sluggish in redrawing windows or displays, plodding when deleting files or installing programs. On a fast Compaq Deskpro 286 or IBM AT with the Enhanced Graphics Adapter or high-resolution Hercules board, GEM would be a pleasure. On a plain PC or compatible, it's a sincere form of MacFlattery.

Still, if you're setting up a system for office novices to run programs, GEM Desktop is a good performer at a bargain price ($49.95, though I'd spend another $100 and buy it with the neat-looking GEM Draw graphics package, first in a series of complementary GEM programs). For real multi-tasking integration, I'm looking forward to DOS 4.0 and Microsoft's long-awaited Windows.

Will many software vendors rewrite their programs to work with DRI's and Microsoft's interfaces? I'm looking forward to finding out.

Flunking the Screen Test

Does it seem eveyone you meet these days is carrying a Data General/One? I haven't noticed it, either. The mini-maker's baby was the first briefcase portable with a 3½" microfloppy drive and 25-line, 80-column LCD, but its dim screen and steep price have kept it in the sales cellar despite high level of IBM compatibility.

Now Kaypro, best known for low-cost CP/M suitcases, has decided to undercut Data General. Compared to its otherwise similar predecessor, the Kaypro 2000 has three advantages: a sexy *Star Wars* design (an 11-pound brushed aluminum wedge with a disk drive that pops up for loading and folds flat for use), a stack of free software (mostly MS-DOS versions of MicroPro CP/M remainders like WordStar and CalcStar), and a $1,000 price cut (to $1,995 with 256K RAM and one 720K microfloppy disk drive).

The low price, a compact but responsive keyboard, and the convenience of ample disk storage and portability (an average four hours' use per charge, though the disk drive is as loud as a gas-engined model airplane) make the 2000 attractive. So does its PC compatibility. I downloaded several programs from an IBM and one from a DG/One disk, and all ran successfully.

Kaypro's options are inexpensive. An upgrade to 768K RAM is $195, and a serial-to-parallel adapter (making up for the lack of a printer port) is $65. Another, a $155 base unit that connects to external 3½" or 5¼" drives ($295 each) or a card that lets you use a desktop's drive ($95), has a slot for a Hercules or similar color card to drive an RGB monitor.

So should you rush out and buy a Kaypro 2000? No, because its 25 × 80 LCD is truly awful—adjustable to only two angles, both too faint and dim to read unless under bright direct light. If only the screen were tolerable, the 2000 would be the best laptop yet. As is, the world's still waiting for a truly viewable LCD display.

(Early impression: The world will still

Kaypro's 2000 laptop computer is a low-cost answer to the Data General One.

be waiting after seeing the Heath-Zenith ZP-150. I've spent five minutes with the machine, thanks to the portable computing specialists at the *Pico* magazine offices, but wasn't thrilled. Microsoft Works looks like a nice 224K ROM package, combining most of Word, Multiplan, GW-BASIC, filer, calendar, and communications software, and I liked the Zenith's keyboard. But a laptop with only 32K RAM, a 16 × 80 screen, albeit with fat LCD characters like Hewlett-Packard's, and no current provision for mass storage except a cassette port, at a list price of $1,995? The Heath catalog's $1,195 introductory offer seems more realistic in this light.)

Refurbished Antique

As I said in my review of Newword (*Modern Electronics,* July 1985, p. 75), the venerable WordStar has many shortcomings. But if you've got the 16-bit version of MicroPro's Cro-Magnon word processor, there are several reasons to spend $19.95 (plus $2 shipping and handling) and get UnderGround WordStar, a collection of tips and patches from Hard/Soft Press of Riverdale, NY.

Half the value of UnderGround's price lies in its helpful, witty manual, which supplies 78 pages of undocumented commands and documented shortcuts even Ctrl-KS-Ctrl-QP veterans may have forgotten (it sent me back to the manual to learn that, yes, Ctrl-KP lets you work on one file while printing another).

There's also a disk of utilities, ranging from MailMerge templates to batch files for those who use Word Star with RAM disks (they safely copy documents to a real disk). One BASICA program serves as a menu-driven alternative to DOS' Debug, helping even novices implement the WS.COM patches described in the UnderGround manual, whether altering Word Star's default tabs or adding a destructive backspace.

Perhaps UnderGround's Mel Murch wrote the beeping musical fanfare that begins the program, but I think it was his coauthor, the pseudonymous War Starr. Work with WordStar long enough and you develop a weird sense of humor. **ME**

Names and Addresses

Digital Research, Inc.
60 Garden Court, Box DRI
Monterey, CA 93942
800-443-4200

Kaypro Corp.
P.O. Box N
Del Mar, CA 92014
619-755-1134

Hard/Soft Press
Box 127
Riverdale, NY 10471
212-543-9313

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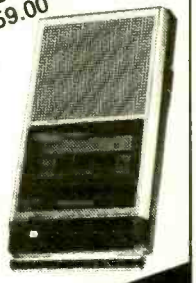

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CIRCLE 94 ON FREE INFORMATION CARD

Health and Fitness Programs

By Charles M. Salsberg

The Original Boston Computer Diet/ Scarborough Systems, Inc./For Apple, Commodore 64, IBM PC, XT, PC*jr.* and compatibles/Two 5.25" disks, 1 drive needed/$79.95.

As in inveterate dieter, who successfully shedded almost half his weight more than a year ago, I approached this popular software package with more than a little interest. I used an IBM version on a Zenith Data System Z-160 portable computer for three weeks, every day, before writing this report. The package comes with a 100-page manual that complements the software as an integral education tool. Disks and manual are packaged in a large plastic case that is converted into an easel with a quick reference guide containing all necessary commands.

One disk is the "Master," while the other is your "Daily" disk. The Master disk contains the installment part of the program. It introduces you to the program and then asks a long list of questions relating to your medical, nutritional and behavioral status. Your answers are recorded and taken into account when the program offers suggestions. The Daily disk keeps track of your weight, food intake and exercise. A monochrome or color video monitor can be used. The latter requires a color graphics board.

The manual that accompanies the program is not documentation that shows you how to use the program. Instead, it contains almost 50 different reading assignments that are coordinated with the diet program. You might think of the disk program as laboratory notes, while the manual contains your homework reading assignments. It's an informative guide to information on helping the user learn about old eating habits and how to correct them, as well as motivational and controversial nutrition and health issues such as facts concerning sodium and artificial sweeteners.

The computer program analyzes your behavioral and nutritional habits based on data you input. It also helps you to plan meals and stick to those choices. It contains a database of over 900 foods (complete with serving size and caloric information) and any other food can be added to the database.

In each "session" you meet with your computer counselor. You can choose from among three "counselors," each of whom exhibits different personalities, as screen responses will illustrate.

Selected keys on the keyboard make controlling the system easier. Menus are complete, with only one press of a key needed for most commands. The function keys help with food reporting.

Keeping track of all food/caloric intake is one of the best ways to shed pounds since most of us are not aware of how much food we actually consume. This program can give printouts of up to a year's intake.

User Comments

The master disk contains the installment part of the program. It introduces you to the program and then asks a long list of questions concerning medical, nutritional and behavioral types of information. Your answers are recorded and taken into account when the "counselor" makes suggestions. The computer will keep you informed about how much you should be eating a day.

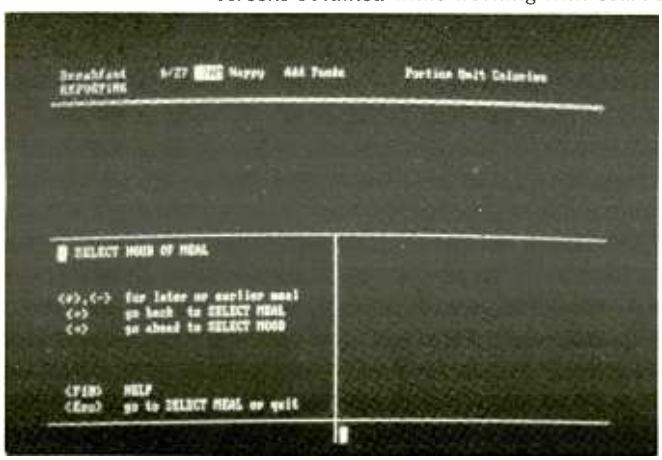
The first week you set your weight-loss goals and caloric targets. Planning meals ahead of time is a concept that's introduced as a weight-loss technique. This way, when you've reported what you actually ate, the computer compares it to what you planned. Developing an exercise plan is next.

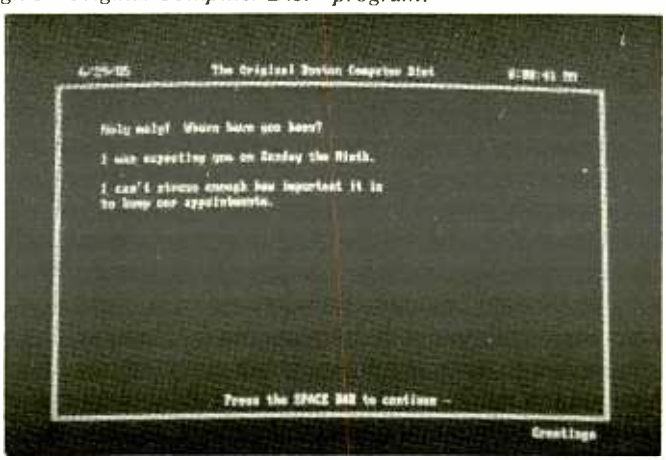
All of these steps need only be done once, unless you decide to modify goals. The whole initial installation, including directions on how to use the program, takes less than 15 minutes to do. During subsequent weeks you will have daily "sessions." This starts off with the counselor's greetings of one sort or another. (The computer "remembers" how long it has been since you last met, and might chide you for missing a session. Then you will be asked to report your food intake since your last appointment.

Afterwards, textual and graphic feedback will be displayed. This is constructive feedback on what you've been doing. Next, a quiz will be given. This quiz is in your most recent reading assignment in the manual. Then the counslor will "discuss" an activity related to the reading.

Planning future meals and assigning new readings is next on the agenda. After this is done, you have a choice of whether or not to obtain printouts of graphs, food reports, and plans. Finally, a new ap-

Screens obtained while working with Scarborough's "Original Computer Diet" program.





pointment is made. The typical session lasts 10 to 15 minutes. If there are any problems, an extensive help section is included and accessed easily.

"The Original Boston Computer Diet" is certainly a well-thoughtout program: easy to use, effective, and inviting. With the use of Artificial Intelligence, the counselor's responses and perfect memory make the recording session fun. This is half the battle won since discipline is vital in any weight-loss program.

Using the program, I was able to lose a few more pounds and maintain the loss easily. Naturally, one has to be motivated to lose much weight, which I had already done previously. Nonetheless, I would say that the program has the capability of helping dieters achieve their weight-loss goals and maintain much of the loss over a long period of time. So if you're a weight-conscious person, you should place this program high on your list of software to buy.

The Running Program by James S. Fixx/ MECA, Westport, CT/Requires IBM PC/XT/AT or compatible computer with 128K or PC*jr* with 256K, monochrome or color monitor, 80-col. printer, PC DOS 1.1 or later, 1 DS disk drive minimum/Two 5.25" DS disks/$79.95.

A neat, free demonstration disk for this program came our way. We tried it, were favorably impressed, and got the real thing. The Running Program is a sort of personalized, computerized version of the late Jim Fixx' running-program idea. Therefore, it's designed for people who either jog or plan to run, whether to enhance physical fitness or for serious marathon running.

The manual that comes with the software package is short and sweet, not to mention very clear. Actually, the disk application program leads the user step by step, setting you up for doing everything except keying in your personal information and ongoing records.

As with MECA's "Managing Your Money" program, Disk 1 of 2 acts as an ignition key and cannot be duplicated. A third disk is provided by the user to keep records on. More than one person can use the system, though everyone is required to use Disk 1.

Part of the program is organized like a

book, with seven chapters, including an Index. Also, an illustrated "stretching" feature is designed for users to warm up and train muscles before running to minimize strains or other possible injuries.

After Chapter 1's introduction, the following chapter examines your present physical condition with a host of questions. Basically, these form the same tests given to me when I joined a health club, including the Harvard Step Test. In essence, this part of the program analyzes your overall health and lifestyle. The next chapter helps you to set goals and reach them, whether it's jogging three continuous miles, losing weight, or training for a competition race.

Remaining chapters show you how to log your running times and maintain records; graphing and charting of your programs; informative suggestions on nutrition, running injuries, and running gear; and an Index that's very comprehensive, letting you whiz through the program out of sequence.

Using It

This program is much more than a brief guidebook to read on screen. That's only a prelude to its real utility. Based on the program's evaluation of your present fitness, it sets up a training program for you (or you can design your own if you wish). It'a all sort of personalized, too. For example, it will decline to create a training schedule for you if you choose to train for running way beyond your capacity, as judged by the computer program on the basis of your determined fitness. In this sense, it's quite realistic.

It maintains in its data bank your schedule, compares your training with your goals, keeps a record of your racing and using a calorie counter for the latter to analyze food intake and to determine how many calories were wasted away by exercise. It will even include records for other physical activities such as swimming or cycling. Moreover, it can predict your probable race times and best competitive distance.

The data disk holds about 15 months of exercise information, according to the software publisher, at which time you'll have to use another data disk. To print graphs you'll need DOS 2.0 or later, which has to be loaded and the "graphics" command entered. If your system is color-ready, the program will fill the screen with appropriate colors.

About the only complaint I've got about the program is the need to switch disks, including the use of the protected "ignition" disk. I appreciate the company's zeal in protecting their program from copying, but it is indeed a pain since disk switching is always required after the startup sequence.

In the program's favor is the high level of motivation it provides. I appreciated the fine tracking of records, the feedback that the computer provides on what you did versus what you hoped to do, the automatic tie-in with calories consumed and burned up, the program customizing you can do, and summary information it produces on screen and hard copy. There's plenty of help screens at your fingertips, too, though this is quickly dispensed with as you familiarize yourself quickly with the program's operation.

You can also have a lot of fun with the program by setting up programs with incorrect personal information just to see how the computer program responds. It does, indeed, take into account the information fed into it. In all, this is a very useful program for anyone intending to maintain fitness by running, with an eye toward nutrition as well. Its effectiveness will,of course, depend on the user's diligence in maintaining the training schedule prescribed or designed. The program itself goes as far as it can,which is commendable. **ME**

International SW Program Updates

By Glenn Hauser

While columns such as this and DX broadcasts can bring you the information you need to make good use of your shortwave radio, there's no substitute for belonging to a DX club. By means of a regular bulletin, hundreds of far-flung members share information about their loggings, station news, equipment experiences, etc. So from time to time we'll profile different DX clubs.

Union of Asian DXers, 32/4a Malwatte Road, Dehiwala, Sri Lanka, is looking for new members in North America—not just anyone, but those with a serious interest in DXing Asia. Third-world DXers face a multitude of difficulties in obtaining equipment and supplies, and UADX deserves great credit for surviving 13 years under the leader of Victor Goonetilleke, well-known for his reports on Radio Netherlands. The mimeographed bulletin of about 8 pages comes out approximately bi-monthly. Samples are 3 International Reply Coupons (IRCs); those who join can later remit directly in dollars to a U.S. representative.

Canadian International DX Club, 6815 12 Ave., Edmonton, Alta., Canada T6K 3J6 is that country's only English-speaking club in which American members may participate fully. Publishes a monthly offset-printed magazine of 44 pages or more, "CIDX Messenger," with a variety of columns covering loggings on MW, SWBC, FM, TV, utilities, hambands; also bandscans, QSL reports, station news and schedules, a forum, very well-done equipment reviews; and the unique "Arctic DX" column with practical information on how to monitor life in the Arctic (and Antarctic) through radio transmissions. Samples are $1; yearly membership is C$19 in Canada, US$18 in the U.S. by check or money order.

Another "club," the American Radio Relay League, has published this year a new edition of the *ARRL Operating Manual,* this time not only restricted to ham radio but also containing an excellent introduction to shortwave listening and DXing. Check your local ham radio store for a copy; or write directly to ARRL, 225 Main St., Newington, CT 06111, for ordering information.

Now we spin the alphabet wheel to help you spin your dials (or, should I say, push the scan button or the keys for direct frequency entry—not quite so romantic, is it?). All times are in UTC, unless otherwise specified.

Argentina. RAE, Buenos Aires, now has this schedule of one-hour English broadcasts; 1800 and 2100 on 15345; 0100 on 11710 and 9690; and a final report at 1200 the next day on 15345, which usually comes in best. On Saturdays and Sundays the 2100 broadcast is also on 9690 and 6060. Last summer (our winter), RAE took Sundays off. Emilio Pedro Povrzenic reports there are plans to start a special broadcast in English to the Falkland Islands (make that Malvinas), possibly using the closest existing mediumwave outlets on 640 or 780 kHz, or on shortwave.

Australia. Radio Australia has a long history of making decisions sure to displease DX listeners. The latest is the elimination of regular DX tips from the Australian Radio DX Club on the "Talkback" program. It's a shame that so many stations not really qualified to broadcast accurate and timely DX tips do so, while a station like RA, which has access to the necessary expertise, chooses to pass it up.

Bolivia. Those who would DX this country naturally think of 6 MHz or lower, often out-of-band, lots of lost sleep and straining through the static. But there's one station active on the 9-MHz band, audible in the middle of the day (at least in Florida last summer when conditions were most favorable)—it's Radio La Plata, Sucre, around 9716 kHz. For instance, on the 4th of July, Bob Wilkner in Lauderdale Lakes found it peaking at near-local levels around 1700 UTC; during a one-hour period the frequency jumped around from 9716.2 to 9717.1 to 9716.3, as reported in *DX South Florida.*

Brazil. Nine 250-kW transmitters have been installed at Radio Nacional, Brasilia —but despite little-publicized relays of the VOA in Spanish and of Radio Suriname International, nowhere near that many are ever used at any one time. Other stations seeking a better signal in North or South America should approach RNB about using those facilities. However, according to September and October registrations with the ITU, certain RNB services achieve 500 kW by using transmitters in parallel: 1745-2200 on 6190, 6195, and 15270; 1700-2200 on 11955. That accounts for eight during this time period, while five more 250-kW frequencies are available from 0800 to 0200 for the Amazonian service—6065, 6175, 6180, 9725, 11780. Obviously, not all these frequencies can be used at once. "Deliberate overlooking" is the rule on registration (via Bob Padula, Australian DX News).

Radio Jornal do Comercio, Recife, has had its license revoked, so we can safely expect not to hear it on 6085, 9565 or 9570, 11825 and 15145. On the other hand, a 10-year license has been granted to Radio Clube/Radio Universal on 11735 in Goiania, accordig to Claudio R. Moraes. His compatriot Antonio Ribeiro da Motta also notes that Radio Cultura, Araraquara sometimes uses 3380 kHz between 0800 and 0300; while 5 kHz up at 3385, Radio Congonhas is on the air at 0900-2200 but sometimes extends to 0125 for sports events.

Costa Rica. On a visit to this beautiful but air-polluted country, we found out that Radio Universidad, 6105 kHz, is building a cubic antenna and plans to raise power again to 5 kW; its manager says the local post office refuses to honor International Reply Coupons, so those sending return postage to Costa Rican stations would be well-advised to use a dollar bill or mint Costa Rican stamps.

The new Radio Costa Rica, set up with U.S. aid in return for relaying the VOA, operates from behind an unmarked door on the third floor of the Cristal Bldg. in downtown San Jose, protected by a guard armed with a machine gun. The main 50-kW transmitter near Ciudad Quesada is heavily fortified. Both it and a 2-kW unit in San Jose itself, operate on 930 kHz. The larger unit is aimed right at Managua, where ironically the Nicaraguans had to do nothing at all to block it, since there was already an off-frequency local station near the VOA channel, causing a heavy heterodyne even in Costa Rica.

Enthusiastic IDs are common on Latin American stations, but Radio Columbia, on 4850 and several mediumwave channels, takes the cake. Their standard ID goes "Columbia, Columbia, Columbia!" but SPEEDX reporter Tom Kephart in Michigan heard them running a phone-in contest to see who could say the most Col-

umbias in row—the winner reached 26 before gasping for breath. If you don't think that's remarkable, try it!

Cuba[non]. In *DX South Florida,* Steve Reinstein notes the lack of cooperation between two minor anti-Castro clandestines—both Radio Antorcha Martiana, 7080, and La Voz de Alpha 66, on 6666 kHz variable, schedule their half-hour broadcasts Tue., Thu., Sat at 0100 UTC. Whether they switch to 0200 when Cuba goes off DST, or when the U.S. does, is not clear at this point.

Denmark. For many years, Radio Denmark has been restricted from broadcasting in any language but Danish. If you'd like to participate in a campaign to encourage resumption of English broadcasts, write to Roger Atkinson, Cillesager 272, 5 tv., DK-2650 Hvidovre, Denmark (per Sweden Calling DXers) The tentative fall schedule for North America is: 1300-1400 and 1500-1600 on 11910; 0000-0100 on 6010 or 9730. There is a quick English ID at opening and closing, saying they broadcast only in Danish.

Dominican Republic. Jeff White of Radio Earth lived here for several months. He developed a deep affection for the Dominican people and concern for their poverty. The result is a moving and eye-opening book, *Santo Domingo Journal,* the royalties from which will go to Dominican humanitarian, educational and developmental projects. The 93-page illustrated softbound book is $7.95 from The Shortwave Store, N4561 Circle Drive, Cambridge, WI 53523.

Ecuador. Due to its strong signal and lengthy hours in English, HCJB is among the first shortwave stations some new SWLs discover. While American-style evangelism is paramount, you still get some feeling for the country. But this is greatly increased if you seek out their domestic broadcasts in Quechua, including nice Andean flute and harp music. Peter Dillon of SPEEDX suggests 9745 and 11900 kHz in the 2230-2430 period.

Egypt. Here are some of Radio Cairo's programs on 9475 and 9675 kHz for the second half of 1985, UTC days: Mon. 0235 Life in Egypt; Tue. 0235 Egyptian Archeology, 0250 Cultural Life In Egypt, 0300 Between Egypt and America; Wed. 0235 Tourism in Egypt; Thu. 0235 Modern Egyptian History; Fri. 0205 Arab Poetry, 0250 Egyptian Scientists; Sun. 0235 Stamp Collectors Club (via John Tow, Alabama).

Haiti. Besides hearing Bolivia in the daytime, DX South Florida members can do the same with the relatively near but rare station Radio Citadelle. David Potter found it on 6154.6 between 1810 and 1930 in Creole. One of the better-heard Haitian stations on mediumwave is Radio Soleil, 1170. Or, *was.* It's been subject to attacks and harassment for daring to oppose Pres.-for-life Duvalier, and in July the Catholic priests who ran it were expelled from the country.

Italy. English from RAI has this fall schedule: 0350-0410 on 11905, 15330, 17795; 0425-0440 on 5990, 7275; 1935-1955 on 7275, 9710, 11800, 2015-2045 on 7235, 9575, 11800; 2200-2225 on 5990, 9710 11800; and to North America 0100-0120 on 6010, 9575. The last is surrounded by Italian, also on 9630, 9710, 11905.

Madagascar. The most distant station on the 120-meter band you're likely to hear is RTM, which unexpectedly reactivated 2495 kHz in August. Kenneth Hill in Massachusetts heard it, from sign-on at 0255 to fadeout at 0330.

Mali. Bamaki has appeared on 3380 kHz until sign-off around 2400, apparently replacing one if its 4-MHz channels; it was first reported by members of Play-DX in Italy.

Mexico. Even Radio Mexico International uses only 10 kW, but now several 100-kW frequencies have been registered, perhaps in anticipation of activating the high-power unit it has had for many years —or could it be some other station? At 1200-2000 and 2300-0300 check 6035, 9575, 11720; 1200-9000 9750; 24 hours on 6110 and 15110. (via ADXN)

Norway. The initial fall schedule for Sunday English to North America from Radio Norway: 1300, 1400, 1700 on 15305; 1600 on 15305, 11850; 1900 on 11850; 0400 Monday on 6015 (via Joe Hanlon, Eric Swedberg).

Pacific. Aviatrix Amelia Earhart mysteriously disappeared new Howland Island in 1937. For those who suspect she somehow survived, this information unearthed by Loren Cox from the April, 1935 issue of *Short Wave Craft,* should be of interest. Her Western Electric shortwave radio "never failed"—night frequency was 3105, day 6210, callsign KHABQ. A "nest" of storage batteries powered the unit, and a close-contact microphone eliminated cockpit noise.

Philippines. The new 100-kW transmitters for the Maharlika Broadcasting System external service from Malolos are registered on the following frequencies on a schedule too lenghty to give here: 6090, 6160, 7190, 7250, 9560, 9565, 9605, 9690, 9740, 11725, 11790, 11800, 11915, 11925, 11965, 15170, 15195, 15225, 15270, 15280, 15360, 15370, 15400, 17705, 17725, 17775. Again, we suspect some overlooking (via ADXN).

Pitcairn Island. One place Earhart definitely did not reach is this isolated piece of rock, with about 62 inhabitants all accounted for as guests or descendants of the *Bounty* mutineers. AT&T claims a coup in outstripping competing U.S. long-distance phone companies in establishing service through New Zealand. However, there's only one phone on the island and the number isn't listed! But, two astute SPEEDXGRAM monitors in Oregon, Bob Bodell and Bruce MacGibbon, have heard communications from Pitcairn on station ZBP around 0400 UTC, switching from 15718 to 12110 to 7859-kHz USB in search of clearest contact with New Zealand. In all probability, phone traffic goes over this SW circuit.

Sa'udi Arabia. An anonymous American businessman visiting this country writes us that he has discovered the Kingdom is now a center of heavy radio jamming, especially on mediumwave but also on shortwave against broadcasts from Iran, Syria, Libya, Israel, and even the BBC in Arabic!—but never the VOA. This "bubble" jamming comes from sites all over the country, but the main one is in the northeast near Dhahran. Until this came to light, Iraq alone was credited with this type of jamming. Among the frequencies affected are 558, 657, 720, 765, 846, 990, 999, 1071, 1125, 1161, 1197, 1224, 1323, 1332, 1350, 1422, 1557, 1566 and 3200 kHz. Any confirmation or refutation of this will be welcome.

Sudan [non]. Not many clandestines can be heard in English, but thanks to a minority speaking that language in southern Sudan, Radio SPLA is one of them. A broadcast believed to be via Ethiopia on

9600 kHz at 1300 past 1330 has been heard by DX South Florida members.

Tahiti. RFO, Papeete, is fairly easy to hear at night on 11825 and 15170 kHz, but the 9-MHz channel, nominally 9750, has been varying widely, noted around 9687-9688 in the period before 0800 by Mitch Sams in Kansas and Ed LaCrosse in California. Strangely enough, Tanzania is also known to use frequencies around 9749 and 9684 at 0400.

Uruguay. Another September-October registration with the ITU which may or may not pan out concerns new frequencies from this country: 10 kW on 9680 at 1100-2100, 18860 at 2100-2400, and 9770 at 2300-0100; 20 kW on 11900 at 1000-0100 (via ADXN).

USA. KCBI, "The National Radio of Texas," began regular programming July 28 with a church service preached by Rev. Criswell, the station owner. Other shows included DJs playing C&W music mixed with devotional messages, call-ins for the same purpose, news at 1800, and briefly at the start an hourly "Radio Connection," inviting DXers to phone in tips. The schedule varied but was approximately 1700-2000 on weekdays, 1600-2100 on Sundays, all on 17790. A week later, contrary to previous rumors about Venezuela and Costa Rica, Radio Earth went on KCBI, Sundays at 1800-2100. When KCBI's second antenna was finished for Latin America, evening broadcasts were expected, perhaps on another frequency since AFRTS uses 11790 then, and Radio Earth was considering switching to Saturday nights.

The shortwave station-to-be in Opelika, Alabama, NDXE, has not reported any progress in actual construction, but continues fund-raising promotions, the latest being an "unbreakable ivory" (white plastic) car or wall tag imprinted NDXE/Worldwide/USA, with a rainbow decal superimposed. The tags are two for $10, the decals alone $1 each, from NDXE, Box 569, Opelika, AL.

Listening to AFRTS can be exasperating, due to its fondness for two or three-minute commercial network features, interrupted once or twice for commercials replaced by military PSAs giving the impression that most servicemen abroad are foolish drug abusers. But fortunately, mostly on weekends, AFRTS schedules some 25- or 30-minute network news interviews or features, including: Sat. 1135 & 1435 Agronsky & Company; 1235 & 1735 AP Portfolio; 1335 & 1835 AP Special Assignment; 2030 & Sun. 0130 Radio Smithsonian; 2135 & Sun. 0235 The Week in Review daily at 2200-2300 (dropping the final third on weekdays) All Things Considered; 2230 & Sun. 0430 UPI Roundtable; Sun. 0035 & 0935 What's the Issue?; 0330 & 0830 Newsmark; 0535 & 1035 Reporters' Roundup; 0630 & 1130 The Source Report; 1235 & 1735 Perspective I; 1330 & 1830 Perspective II; 1435 & 1935 Howard Cosell Speaking of Everything; 1535 & 2035 World News This Week; 1635 & 2135 Listen Closely; Sun. 2330 & Mon. 0330 Monitoradio; Mon. 0135 & 0635 Face the Nation; 0335 & 0835 Meet the Press; 0530 & 1030 This Week with David Brinkley. Of course, one and sometimes both airings of some of these are often preempted by sports. These are winter times; until the end of DST the last Sunday in October, all are one hour earlier by UTC. AFRTS uses four or five frequencies at once, selected from: 21570, 17765, 15430, 15345, 15330, 18805, 11790, 9700, 9590, 9530, 6030.

She's not on AFRTS, but Dr. Ruth Westheimer has attracted quite an audience with her live phone-in "Sexually Speaking" Sunday nights at 10 pm (EDT/EST) via NBC. If she's too tame for you, try the competition—"Sex Talk" at exactly the same time but running longer, on clear-channel WLS, 890 kHz, out of Chicago.

More and more AM stations are going stereo, some with big fanfare, some without. And surprisingly, a lot of them are news/talk stations where stereo is more or less irrelevant. CBS news station KNX, 1070, Los Angeles, turned stereo on April 29. Listeners such as Steve Mittman, reporting to IRCA, knew about it before most people at the station did. Another major AM station, WCCO, 830, Minneapolis, issued a press release four months ahead of its stereo conversion on Oct. 2, its 61st anniversary (although "partial" stereo before then caused stereo indicators to light up).

If you're in California, you don't necessarily have to listen to shortwave in order to hear Radio Venceremos, the clandestine from El Salvador. Mike Hardester found out that the left-leaning Pacifica station in Berkeley, KPFA, 94.1, includes Radio Venceremos in its drive-time magazine "Traffic Jam," Mondays at 5:30 pm (PST/PDT).

Good listening! **ME**

Name _____

Company Name _____

Address _____

City _____ State _____ Zip _____

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(must be completed to process)

MODERN ELECTRONICS

76 N. Broadway, Hicksville, NY 11801

FREE INFORMATION SERVICE

For further information on products, dealers, or literature in this issue, circle the appropriate numbers below. Be sure to include your name and address before mailing.

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32	33	34	35	36
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97	98	99	100	101	102	103	104	105	106	107	108
109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132
133	134	135	136	137	138	139	140	141	142	143	144
145	146	147	148	149	150	151	152	153	154	155	156
157	158	159	160	161	162	163	164	165	166	167	168
169	170	171	172	173	174	175	176	177	178	179	180

BOOKS

The latest technical books and literature in the electronics and computer field.

Standard Radio Communications Manual by R. Harold Kinley. (Prentice-Hall; hard cover; 420 pages; $29.95.)

Written for the electronics communications technician, this book can well serve as a complete one-source test-and-measurement reference. It covers AM, FM and SSB transmitters and receivers, as well as antennas, transmission lines and remote-control lines. It tells you what equipment is needed for a given test, diagrams how the equipment is to be connected, and gives the step-by-step procedures to use to obtain meaningful results. Of course, numerous examples and diagrams show you how to analyze and interpret the test results as well.

The book is replete with procedures for making power and frequency measurements, audio response tests, calibration procedures, to name just a few. Specific procedures described include how and when to use the Bessell Zero method to set the deviation of an FM transmitter, how to use the Autopeak™ modulation monitor to determine and set average modulation of an FM transmitter, SSB transmitter tests and measurements, etc. Throughout the book, the spectrum analyzer is amply used, though there is a close-up look at the latest in communications test and measurements as well.

The text is written concisely in a style that befits a book meant for the professional service technician. It is lavishy illustrated with schematics, block diagrams, line drawings and photos to present as complete a picture as possible. Coverage is quite complete.

Sanyo MBC 550/555 Beginner & Intermediate Guide by Fred Blechman. (CBS Educational & Professional Publishing; solf cover; 361 pages; $17.45.)

This book is a software-oriented adventure that is written around and supports a number of programs and utilities on diskette (available separately). Containing 24 chapters and five appendices, it steps you through the ins and outs of using the Sanyo computer, a low-cost MS-DOS machine that is compatible with some IBM-PC programs. First comes an introduction to the computer, its keyboard and display. Then comes a discussion of how to use Sanyo BASIC, which differs from other BASICs. Under a section titled "Adding the Frills," you learn about color and graphics, translations from other BASICs and the MS-DOS operating system.

A communications primer, hardware reviews and a discussion of users groups brings in the outside world. This is followed by practical applications, including a simple Speed-Letter word-processing program, a telephone toll-charge program and a binary banner program. The last five chapters are devoted to business and professional programs. These include an IRA financial planner, mortgage amortization, investment evaluator, mailing labels, and simple invoice programs. All major programs are on the optional disk, though complete listings are given in the book should you wish to key them in yourself.

The PC-SIG Library. (PC Software Interest Group. Soft cover. 340 pages. $8.95.)

This book is a comprehensive directory of public-domain and user-supported software for the IBM PC, PC*jr* and compatible computers. It contains page after page of listings for a wide variety of useful software, ranging from games to special subroutines to word-processing, spreadsheet and database packages. The listings account for more than 45% of the book's page count and contain comprehensive run-downs on files, along with extensions and one- or two-line comments about each file, for each of the 310 diskettes available at low cost ($6 each) from the publisher.

Disks in the listings are arranged in numerical order, rather than into categories or in alphabetical order. Finding what you want is no problem, though, because separate disk name, file name and topic indexes are provided.

In addition to the main listings, you will find two informative chapters. Getting Started offers important hints to help you get acquainted with DOS commands. Program Descriptions provides capsule summaries of selected disks, including a basic description of what each disk or disk set does, its features and any special hardware/software required to run it.

If you own or use an IBM PC, PC*jr* or compatible computer, you should also own this book.

NEW LITERATURE

Breadboarding, Interconnection & Testing Devices Catalog. A P Products has recently published a comprehensive catalog in which the company's entire line of breadboarding, interconnection and testing devices are listed, illustrated and described. The 30-page catalog is organized by product category to allow the user to quickly zero in on products in his area of interest. Among the products listed are DIP and surface-mount IC test clips; solderless breadboarding blocks and systems, cable testing and connection devices and breadboarding and prototyping accessory items. New items in the listings include the Surface Mount Test Clip, a Low Profile Logical Connection™ and the ACE Board™ 100 series breadboarding system. For a free copy of the A P Product Overview Catalog, write to: A P Products Inc., 9325 Progress Pkwy., P.O. Box 540, Mentor, OH 44060.

Packaging Catalog. Covering everything from Apple II prototyping boards to VME prototyping cards, Vector Electronic's new 66-page catalog describes 705 electronic-packaging, breadboarding and prototyping items. Special sections are devoted to circuit boards, racks and cages with motherboards, connectors, terminals, accessories, tools and breadboarding equipment. An eight-page section covers prototyping boards for VMEbus, S-100, STD, Multi-Bus, IBM PC/AT/Excisor, Apple II, DEC and TI980 systems, as well as general-purpose boards. Also included in this section are motherboards for S-100, STD, RCA Cosmac and Multi-Bus systems. Another section describes 151 card racks and cases in a wide variety of sizes and configurations and contains a cross-index between card size and case model number. The connector section lists Euroconnections for VME systems, IDCs, subminiature D connectors and card edge connectors. Included in this section is information on DIP sockets, Wire Wrap posts and ter-

(Continued on page 82)

Global Specialties Scope continued . . . *(from page 20)*

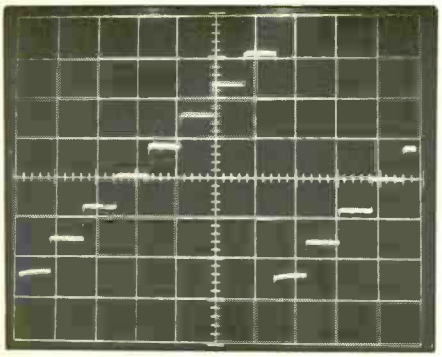


Fig. 1. Multiplexer generated a reasonably linear staircase waveform.

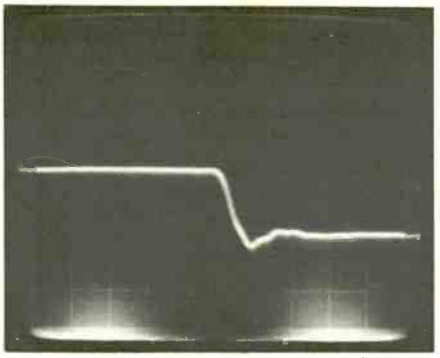


Fig. 2. Trace rise and fall times of 18 ns produce a 20-MHz bandwidth.

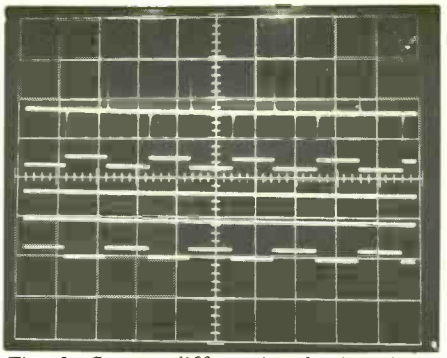


Fig. 3. Strong differentiated triggering produces precise square waves.

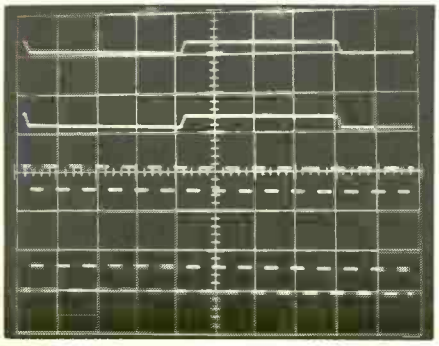


Fig. 4. A 16:1 frequency difference still locks all waveforms in sync.

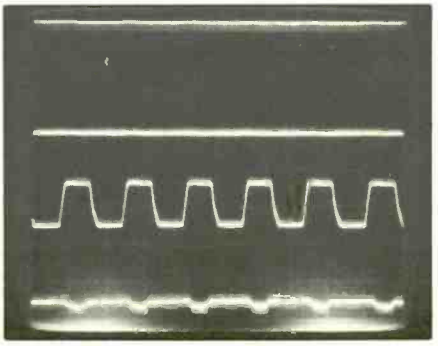


Fig. 5. TV timer clock is obvious, changing channels and audio are not.

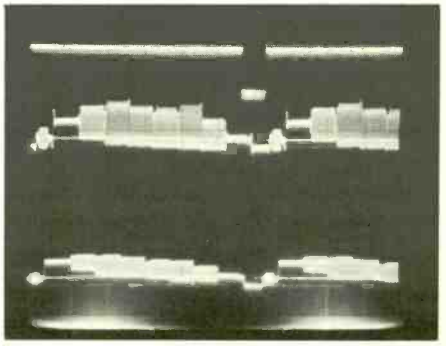


Fig. 6. Screen shows analog and digital signals and microsecond delay.

quency equipment. This should not pose much of a problem with most consumer products, including computers and video.

The Model 8001 carriers a retail price tag of $395.

General Description

Packaged in a sleek 10"W × 7½"D × 4½"H cabinet and weighing only 3 lbs. 12 ozs., the Model 8001 Scope Multiplexer supplies both trigger and vertical output signals and sums all inputs into a staircase waveform between 0 and 400 mV. Contained within the cabinet is a transformer-isolated, fused power supply that delivers four regulated voltages to various points in the instrument's circuitry. The circuitry itself consists of nine integrated circuits and eight FET and bipolar transistors, along with their support components. So much for the innards.

All input and output connectors and controls are located on the front panel, neatly grouped according to function. A large POWER push-push switch illuminates when power is applied to the instrument. Input connectors are all BNC types and are labeled 1 through 8 for easy identification. Between the two four-connector rows appears the legend INPUTS ±5 V MAX., relieving you of the need to have to remember the maximum input voltage limits that can be applied to the inputs.

The TRIGGER LEVEL control is a slide-type potentiometer with graduation marks on the panel, though there is no index mark on the slider knob to serve as a reference. Trigger slope is +/− selectable with a small slide switch.

Boxed off in an area separate from the aforementioned inputs and controls are a MAN./RUN switch, large INCREMENT pushbutton switch, and a rotary-type RATE control with graduated − to + panel markings and a pointer line on its control knob.

In a second boxed-off area are a DISPLAY SELECT slide switch, a rotary-type MULTIPLEXER GAIN control and a PUSH TO CALIBRATE pushbutton switch. The DISPLAY SELECT switch has positions that let you select all eight inputs or inputs 1 through 4 or 5 through 8 for display on the scope's CRT display screen.

Within a final box are contained the OUTPUT connectors, BNC types like the input connectors. These are clearly identified by TRIGGER and VERTICAL labels on the panel.

In use, multiplex sampling frequencies can be varied between 40 kHz and 1 MHz, while the MANUAL/RUN switch allows you to select single or multiple channel display. The PUSH TO CALIBRATE switch conveniently zeroes all traces.

Operation and Use

The users manual supplied with the Model 8001 gives specific instructions for multiplexer checkout, detailed theory of operation and worthwhile recalibration procedures. Only two cables are supplied, both coaxial types terminated at each end in BNC connectors.

For the trigger input, we suggest you use shielded (coax) cable with a secure ground. The other seven cables can be fabricated with 18-gauge stranded wire, preferably the expensive test-lead variety, and suitable connectors.

Selected inputs are sequentially scanned at MULTIPLEXER RATE control settings. They are summed into a D/A converter staircase of equal-amplitude steps (Fig. 1), as determined by the setting of the GAIN control. Buffered signals reach the scope's amplifiers through the latter's channel 1 and 2 inputs, while the Model 8001's TRIGGER OUTPUT connects to the scope's sync input.

Four or eight (or a single) inputs can be displayed on the scope's CRT. Operating the Multiplexer's INCREMENT button causes a 3-bit up/down counter to step through the input channels. The Multiplexer treats any signal on channel 1 as a reference. Hence, all other displayed waveforms (from analog and/or digital sources) must be time-related to this input. Also, the lowest frequency will be that of the signal fed to channel 1.

With trigger and vertical outputs established between Multiplexer and scope, we had no difficulty getting down to work. For the higher frequencies, however, we had to be careful of trigger levels and to maintain frequency relation with the trigger input. We also had to make sure the ±5-volt input range was not substantially exceeded. Because all eight traces fall within a 400-mV full-scale range, we had to set our oscilloscope up to operate between 20 and 50 mV/division to be able to view all traces at one time. To this end, we had to adjust the Model 8001's MULTIPLEXER GAIN as we went along.

From the foregoing, it should be obvious that initial setups can be a bit tricky in order to avoid exceeding normal operating parameters. Furthermore, the scope must be switched to the ac mode, since the Multiplexer outputs a dc component that will move small-amplitude traces off the screen if it is permitted to get into the scope's inputs. Too, it would be nice if your scope's amplifier inverts so that the reference triggers can appear either at the top or the bottom of the screen display. Other than the foregoing cautions, operation of the Model 8001 was relatively simple.

Laboratory Tests

On our testbench, the first thing we did was simulate an A/D converter that we used to check the steps for overshoot, preshoot and nonlinearity components. Using this arrangement, we noted a small amount of turn-up at the beginning of each step (Fig. 1), which is probably more the result of the ac coupling in the scope than to any design deficiency in the Multiplexer. Significantly, we observed no other overshoot components. Linearity, risetime and the absence of trace roundings all tested out satisfactorily.

Our next test was devised to check risetimes and falltimes and, thus, gave us a bandpass result as well. Figure 2 shows the risetime and falltime, along with symmetry. For this test, we used a 60-MHz scope and obtained an 18-nanosecond reading. Plugging this figure into the formula Bandwidth = $350/T_{risetime}$ (350 is a constant), we obtain 350/18 = 19.44

Global Specialties Model 8001 Scope Multiplexer Laboratory Analysis

Bandwidth (confirmed)	19.44 MHz
Trace rise and fall times	18 ns
Input impedances (for ±5 V operations)	1M, 30 pF
(Impedance drops to 10 kilohms, 680 pF above 10 V p-p)	
Maximum voltage	100 V p-p
Operating voltage	±5 V peak
Multiplex frequency rate	40 kHz to 1 MHz
Maximum scope screen signal display	400 mV
Ac operating range (before display change)	100 to 130 V ac
Power drain (100.6 mA at 120 V ac)	12 W rms

Test Equipment: Tektronix 106 square wave generator; Hameg Model HM 605 oscilloscope; Telequipment Model D67A oscilloscope; Data Precision Model 935 multimeter; B&K Precision Model 1260 NTSC color-bar generator, Model 1653 ac power supply; Model 3020 function generator; RCA CTC 92 and CTC 131 television receivers; and Tektronix C-5C camera and Polaroid 107C film.

PRODUCT EVALUATIONS...

Global Specialties Scope continued . . .

MHz, which substantially confirms Global's 20-MHz bandwidth figure.

Continuing with digital responses, we obtained the traces shown in Fig. 3, this time showing the trigger input at the top of the display as differentiated pulses turn on and off square waves. Observe that very sharp risetimes and falltimes continue throughout the display and that everything is precisely in sync.

We did encounter some problems in setting the precise trigger level for the fourth waveform, due largely to the disparity in repetition rates between the smaller and larger rectangular pulses. But as Fig. 4 shows, even a 16 × difference in rates (2 cycles per division as opposed to 1 cycle in eight divisions) is possible—provided, of course, such frequencies are related.

In the television department, both up/down channel selection and remote control commands were examined on an older RCA CTC 92C TV receiver with somewhat mixed results. In Fig. 5, clock frequencies and waveform levels (such as channels, audio, etc.) were plainly evident but not overwhelming. More recent models and their bit streams may prove to be somewhat more photogenic. However, all indications show at least dc shifts—a rather specialized condition.

For our analog test, we used a combined NTSC color-bar generator signal and a TV receiver to see what would happen. Oscilloscope timebase was set for 10 microseconds per division for this test, with top and bottom traces in Fig. 6 taken directly from the generator and the center trace from the receiver's video detector. Note that the 6-microsecond pulse is precisely coincident with the generator's bottom NTSC color-bar sync but is somewhat ahead of the receiver display. As you can see, all color-bar levels are not exactly precise, but burst and horizontal pulses are well-defined and of proportional amplitude. The interesting part, however, is the receiver's waveform of approximately 3 microseconds of delay—a very useful measurement when comparing analog or digital responses under synchronous conditions.

User Comment

Decidedly, the Model 8001 Scope Multiplexer is going to require a short familiarization period for a new user. But it will be worth the effort, since this is certainly a practical digital/analog switch accessory that provides adequate operation from dc to low megahertz frequencies. Of course, it goes without saying that you are going to need a good dual-input scope with one channel to receive the Multiplexer's trace signals and the other to check ac/dc levels in any suspected high-swing voltage equipment to prevent exceeding prescribed parameters. We would like to see somewhat larger trace amplitudes and more linear trace separation for the GAIN control.

We can truthfully recommend this 4/8-channel multiplexer to anyone who wants to upgrade his two-channel scope. It works very well with all those low-voltage digital products just begging to be serviced. **ME**

—Stan Prentiss

CIRCLE 54 ON FREE INFORMATION CARD

EDITORIAL

(from page 4)

office. With mail being involved, the Postal Inspector can be brought into the act. There are five regional offices in the country that handle this. Contact your local Postal Inspector for directions.

Again, violators of the FTC Rule are minuscule in number compared to the thousands of mail-order sellers who operate to the full satisfaction of buyers. I've never had a problem with an order I placed by mail, for example, and have often been pleasantly astonished at the responsiveness of the people in this industry. Nonetheless, I did get some reader phone calls with complaints about a former advertiser, Pinecom International, in California, whose phone was disconnected I was told. Tracking them down, I was advised that either all orders paid were filled or that payments such as checks were not deposited. Should anyone have a problem here, please write to me and we'll follow through on this as best as we can. Thanks.

Art Salsberg

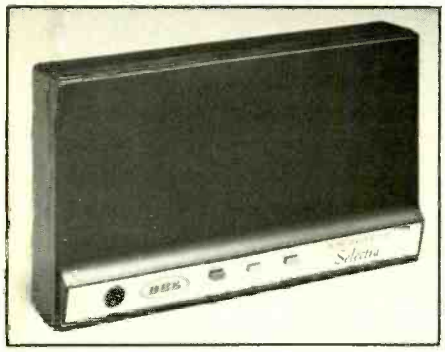
NEW LITERATURE

(from page 77)

minals. All products are indexed by generic name and part numbers, and a complete price list and list of authorized Vector dealers is included. For a free copy of the catalog, write: Vector Electronic Co., 12460 Gladstone Ave., Sylmar, CA 91342.

Used Equipment Catalog. A 36-page illustrated catalog in which are listed thousands of like-new, state-of-the-art electronic instruments for sale has been published by Genstar REI Sales. Products listed are by categories. The nearly 50 categories cover such devices as: amplifiers; analyzers; calibrators; counters; desktop computers; microprocessor development and analysis systems; oscilloscopes; telecommunications equipment; and much more. Listed equipment is from such brand-name manufacturers as Hewlett Packard, Intel, Tektronix, Digital Equipment Corp., Texas Instruments, Fluke, and many others. All items listed are described, including prices, and are offered with full warranties. For a free copy of the catalog, write to: Genstar REI Sales Co., 6307 De Soto Ave., Suite J, Woodland Hills, CA 91367.

Radar Detectors
(from page 27)



BEL-Tronics' ultra-slim Micro Eye Selectra 841.

simply produces a low-frequency sound and flashes an amber light. This continues until the driver leaves the field of energy causing the warning, or until the unit detects true speed radar signals, in which case the louder audio warning will sound and the red warning light flash.

Detecting a Bright Future

It can be confidently assumed that police departments will continue to utilize speed radar because it provides an effective way for traffic patrolmen to write a constant barrage of tickets that are difficult to dispute in court. It is equally clear that state and local governments will continue to support this because substantial revenue is involved.

So, if we can count on speed radar traps as an integral part of life as we know it, we can also count on the continued existence of radar detectors. They are obviously the best insurance one can have against the speed radar ticket, as well as heightening driver awareness of his speed.

The radar-detector industry as a whole grew some 50 percent in 1984, and some 15 to 20 percent growth is expected for the next couple of years. It's now a $200-million per year business, with about 2-million units sold. It should be interesting to note just what the coming years will bring in the form of detection hardware and electronic innovation as the Radar War continues. **ME**

A Solid-State Light Dissolver
(from page 47)

length of line cord. Pass this cord through its entry hole in the box and tie a knot in it about 6″ from the prepared end. Solder the conductors to the LINE CORD pads.

If you have decided to use the extension cord instead of the chassis-mount ac receptacle, cut it apart about 12″ from the socket end and prepare all conductors at the cut ends. Pass the free ends of both pieces through their respective holes in the box and tie a knot about 6″ from the prepared ends of both. Connect and solder the conductors to the appropriate *SO1* and LINE CORD pads on the pc board.

Retrieve the lid of the box and determine where to drill the mounting hole for the pc board. Drill this hole and then mount the board in place using a ¼″ spacer and 6-32 × ½″ machine hardware.

Bend a 4″ × ½″ strip of 1/16″-thick aluminum into an L shape, locating the bend 1½″ from one end of the strip. Drill a ⅛″ hole centered and ⅜″ in from the ends of each leg. Spread some heat-transfer silicone paste over the metal face of *Q4* and mount the L-bracket heatsink to the triac (use the long leg of the bracket) with machine hardware. Loosely mount a 1″ by ½″ L bracket on the other end of the heat sink, facing its free leg in toward the pc board. Mark the mounting hole on the box lid.

Remove the L bracket from the heat sink and carefully drill a hole through the marked location. Mount the L bracket via its short leg to the box lid with machine hardware. Then secure the bracket to the heat sink with machine hardware. This done, mount the lid on the box and affix four rubber feet to it near the securing screws. The project is now ready to be put into service. **ME**

SHORTWAVE PROPAGATION HANDBOOK Second Edition

You have a receiver—you've got an antenna—now let the experts share with you the secrets of long-distance communications. Take advantage of signal propagation techniques. Whether you are tuned in with a scanner, a communications receiver, a Ham or CB rig, this is the vital information you need to have.

The all new revised 2nd edition of *The Shortwave Propagation Handbook* is here. Authors W3ASK and N4XX explore the whys and wherefores of how radio signals between 3 and 300 MHz travel over long distances under the influence of sunspots, the ionosphere, meteor trails, auroral ionization, sporadic-E, scatter phenomena, and other factors. Through fascinating text, amply supplemented by many charts, photos, and illustrations, you find out how to predict and use to your communications advantage the various types of skip openings—whether you're using a scanner to monitor the low or high VHF bands, an HF communications receiver or transceiver to pinpoint that hard-to-hear station, or are a 27 MHz operator or an Amateur operator looking for that rare country—the information in this book will tell you what you need to know so that you can take the fullest advantage of your communications facilities.

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Impedance Bridge *(from page 52)*

(*R1* in the circuit and the line to the D.U.T. closed). At this point, you should have nothing connected to the D.U.T. cable. Set the voltmeter's range selector for making measurements in the low millivolt range.

(5) Connect the component to be tested to the D.U.T. (speaker) cable and read the impedance directly from the meter's display.

The system is very simple to set up and use. You can make impedance measurements at any frequency within the oscillator's or meter's range (whichever is the lowest), without having to recalibrate the system. (Most oscillators nowadays have a constant output voltage that does not vary with frequency.)

Figure 3 shows a typical set of impedance-versus-frequency curves for full-range, two-way and three-way speaker systems. The left-most peak on each curve is the systems' free-air resonances. This peak usually has a value of 25 to 70 ohms. Lowest impedance is usually measured just to the right of the resonance peak and may be as low as 3 to 5 ohms. The exception to the curves illustrated in Fig. 3 is the case of the bass-reflex system, where the single resonance peak will be absent, usually replaced by two smaller peaks.

Checking capacitors and inductors (the latter including transformers) is as easy as observing the impedance trend of the readings on the meter's display as the frequency of the oscillator is varied. Any good capacitor will show an impedance that constantly decreases as the frequency is increased. With a good inductor, on the other hand, impedance will increase as the frequency is increased. You can use your measurements to check the value of a component, too, simply by plugging the known frequency and measured impedance into the appropriate reactance formula and solving for the unknown value.

One more function that the bridge can perform should prove of value to you. That is the ability to indicate phase angle, a parameter associated with the reactance of the component being tested. As you may recall, voltage leads current in an inductor, while voltage lags current in a capacitor. To read phase angle, simply connect the output from the bridge to the channel 2 input of a two-channel oscilloscope and the output from the oscillator to the channel 1 input. You will then observe that the two traces on the scope's screen are offset (not in vertical alignment with each other). This offset is the phase angle.

For a component that is predominantly capacitive, the trace for the output from the bridge will be lagging the trace for the output from the oscillator. This condition will be just the opposite for an inductor.

With all we have said about the impedance bridge, we have not begun to scratch the surface in telling you how useful this "instrument" can be on your testbench. However, we hope that what has been written here will induce you to at least give the impedance bridge a try. Once you do, you are almost certain to find uses for it we have not mentioned. **ME**

RCA Goes Ku-Band *(from page 30)*

day as well as the usual 261.5 lines-per-field of *interlaced* scanning.

Consumer Meaning

What this all means to satellite enthusiasts begins with additional programming, even though it may be scrambled. Follow this with excellent video and dual-channel stereo sound; availability of 16 transponders received on 1-to-1.2-meter dish antennas with Ku-band electronics at an eventually predicted price of some $500/terminal. New television receivers with everything built in and controlled from a single multikeyed remote that will even "menu" your payment fee status and possibly present and future programming is yet another benefit. Top this all off with terminal installation and service by RCA and, of course, the entry of a major TV receiver manufacturer into the TVRO business, backed by excellent technology.

Programming is expected to be first rate. At 45 watts per channel, there should be little or no outage due to heavy rainfall or momentary eclipses. We are told that a 1.2-meter (4-foot) receptor will operate within the system at a C/N of 13 dB and a S/N of 48 dB—a level approaching 54 dB studio quality.

Receiver remote controls, in addition to the usual TV and VCR functions, will also execute descrambling commands, the key password, and programming, while rendering a selection menu on the TV screen. You can also expect polarity and switchable skew, *separate* C- and Ku-band selections, signal-strength indicators, up/down audio and channel tuning, variable audio, and on-board adjustable automatic gain control. This, of course, is *not* a stripped-down satellite receiver and is far removed from any eventual Ku-band $500 system futuristically predicted. But it will certainly reproduce superb noise-free sound and pictures within a reasonable satellite footprint as shown in Fig. 2 (EIRP is in watts, denoting receive signal strength available).

At this point, we have no idea what RCA satellite receiver prices will be at the retail level. Nor do we suspect does RCA. At whatever price is finally decided upon, you can be sure that this system, when it goes into operation, will have a significant impact on satellite TV viewing. **ME**

Computer System Power Controller *(from page 43)*

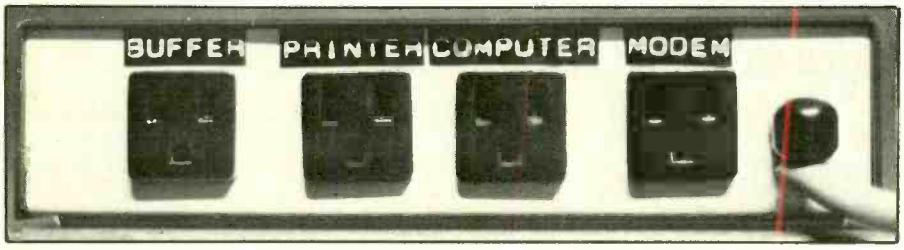

Photo shows details of controller's rear panel. Ac power cord enters through and ac receptacles mount on panel. So, too, does a circuit breaker.

hole for the ac line cord at one end of the rear panel. (If you plan on using a circuit breaker, drill its mounting and reset button holes in the rear panel, too. Then work on the front panel. Here, you need two holes for each lamp/switch combination, unless you opt for the more expensive lighted push/push switches mentioned in the Note at the end of the Parts List, in which case you need only one hole for each *S2/I2* through S_n/I_n combination.

Determine where to mount the EMI filter/suppressor module. Make sure that it is completely isolated from all other components. Then drill its mounting holes. This done, deburr all holes.

Label all switch/lamp pairs on the front panel and all ac receptacles on the rear panel with their appropriate legends, using a dry-transfer lettering kit. Then spray two or more light coats of clear acrylic over all exterior surfaces of the front and rear panels. Allow each coat to dry before spraying on the next.

When the acrylic has completely dried, mount the components in their respective locations. Then, referring back to Fig. 1, wire the circuit exactly as shown. Use only heavy-duty (12- or 14-gauge) stranded wire throughout, and maintain the white (WHT), black (BLK) and green (GRN) color-code scheme throughout. Connections to all filter/suppressor module leads are made with wire nuts; all other connections are soldered.

Double check all your wiring. Then plug the Controller's line cord into an ac outlet. Flip master POWER switch *S1* to on and note that *I1* lights. Leave *S1* set to on and toggle on then off and then on the other switches on the front panel, observing that their respective neon lamps come on then go off and then come on again. Flip the POWER switch to off; *all* neon lamps should extinguish, indicating that all is well.

Disconnect the ac line cord from the wall outlet and finish assembling the enclosure. Your Power Controller is now ready to be put into service. **ME**

"Absolute Reset"
(from page 55)

possibly damage it. Apple clones and Hong Kong knockoffs normally do not need this inverter.

One prompt and low-cost source of EPROM burning services is E-TECH Services (Box 2061, Everett, WA 98203; 206-337-2370). Be aware, however, that no legal EPROM burning service can directly drop ship you a ready-to-use EPROM. Instead, you must furnish them with an exact image of the code you wish to have burned. Only after they receive your code image can they burn and ship the EPROM.

If you experience any difficulties in implementing either of the Absolute Resets detailed in the boxes, please contact me immediately.

You can get further information on any of the IIe and IIc (not the II+) stuff by calling me at (602) 428-4073 or writing me at Synergetics, Box 809, Thatcher, AZ 85552. **ME**

—Don Lancaster

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TRS-16K4	250ns	(Model 1)	$5.49

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TRS-64K-2. . . . . . $11.95

Update!* TRS-80 MODEL IV, 4P *Update!

Easy to Install Kits come complete with: TRS-64K-2 (8 ea. 4164N-20 (200ns) 64K Dynamic RAMs), TRS-64K-2PAL (8 ea. 4164's plus PAL chip) and documentation for conversion.

TRS-64K-2	Expands Model IV from 16K-64K or Model IV & 4P from 64K-128K (w/Mem. Disk).	$11.95
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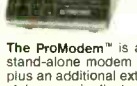
PROMETHEUS MODEMS



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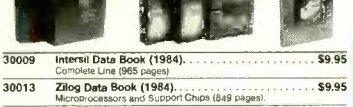
PM-ALP	(Alphanumeric Display).	$79.95
PM-Special	(Incl. Options Processor, 64K Memory and Alphanumeric Display).	$149.95

DATA BOOKS



30009	Intersil Data Book (1984). Complete Line (965 pages)	$9.95
30013	Zilog Data Book (1984). Microprocessors and Support Chips (849 pages).	$9.95
210830	Intel Memory Components Hndbk. (1983/84). Contains all Applications Notes, Article Reprints, Data Sheets & other design information on Intel's RAMs, DRAMs, EPROMs, E²PROMs and Bubble Memories (880 pages).	$14.95
230843	Intel Microsystem Components Hndbk. (1983/84) Contains Data Sheets on all of Intel's Microprocessors & peripherals – 2 volumes (2575 pages)	$19.95
30022	National Logic Data Book Set (1984). Volumes I & II (3485 pages) Contains information on National's TTL product line and CD4000 family. This includes 7400, 74L, S, AS, LS and ALS Series devices, and MM54HC / 74HC / 54HCT / 74HCT High Speed Micro CMOS family, MM54C / 74C family, and CMOS LSI / VLSI.	$24.95

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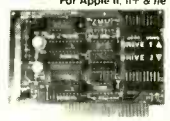
JE860 (ARC-16K/MEM-1). . . . $39.95

Controller Card For Apple II, II+ & IIe*



The JE875 is a Standard Apple* Controller Card capable of handling up to two drives. Easy to install. Recommended drives: ADD-5!4 or ADD-1!2. Complete with instructions. Key: (a,b)

JE875 (ACC-1). . . . $49.95

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JE883 (P/S Buffer). . . . $79.95

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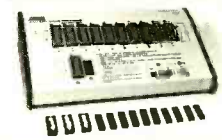
EPROM PROGRAMMERS

JE670 GANG EPROM PROGRAMMER 8K TO 512K (E)EPROMS



NEW!

The JE670 is a stand-alone Programmer that gang-programs most EPROMs and EEPROMs (up to 512K) from your Master IC. Operation is simple, foolproof and fast.

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JM G16A	2716 Intel, TMS2516 TI, NEC, etc	$19.95	JM G64C	MCM68764, MCM68766 Motorola	$19.95
JM G32A	2732A Intel, NEC, TI, etc	$19.95	JM G128A	27128 Intel, TI, NEC, etc	$19.95
JM G32B	2732 Intel, NEC, National, etc	$19.95	JM G256A	27256 Intel, NEC, Hitachi, etc	$19.95
JM G32C	MCM2532 Motorola, TI, National, etc	$19.95	JM G512A	27512 Intel, AMD, etc	$19.95
JM G64A	2764 Intel, NEC, TI, etc.	$19.95	JM G513A	27513 Intel	$19.95
	EEPROMS/MPU			EEPROMS/MPU	
JM GE12A	5213, 52B13, SEEQ	$19.95	JM GE32A	MCM2832 Motorola	$19.95
JM GE16A	2816 (Exel, Intel, Rockwell, Xicor, etc.	$19.95	JM GE64A	X2864A, X28640, X28C64 Xicor	$19.95
JM GE16B	2816 Intel	$19.99	JM GE256A	X28256, X28C256 Xicor	$19.95

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JE664 EPROM JUMPER MODULE NO.	EPROM	Programming Voltage	EPROM MANUFACTURER	PRICE
JM08A	2708	25V	AMD, Motorola, National, Intel, TI	$14.95
JM16A	2716, TMS2516 (TI)	25V	Intel, Motorola, National, NEC, TI, AMD, Hitachi, Mostek	$14.95
JM32A	TMS2532	25V	Motorola, TI, Hitachi, OKI	$14.95
JM32B	2732	25V	AMD, Fujitsu, NEC, Hitachi, Intel, Mitsubishi, National	$14.95
JM32C	2732A	21V	Fujitsu, Intel	$14.95
JM64A	MCM68764, MCM68L764, MCM68766	25V	Motorola	$14.95
JM64B	2764	21V	Intel, Fairchild, OKI	$14.95
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The ProModem 1200B/BS is a 1200/300 baud modem card which plugs into IBM PC and XT. Provides a third serial Comport. Two versions available: 1200B (without software) and 1200BS (with software). The PM1200BS is supplied with powerful MITE communications software from Mycroft labs.

PM1200B	(without Software).	$239.95
PM1200BS	(with MITE Software).	$274.95

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Documentation Included

RFD480	(Remex 5¼" DS full-ht.).	$ 79.95
FD55B	(Teac 5¼" DS half-ht.).	$119.95
SA455	(Shugart 5¼" DS half-ht.).	$109.95
TM100-2	(Tandon 5¼" DS full-ht.).	$129.95

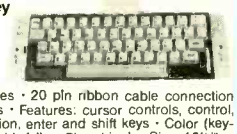
5¼" DISK DRIVE ENCLOSURES

Complete with power supply, switch, power cord, fuse/holder and connectors

DDE-1FH	(Houses 1 full-ht. 5¼" floppy drive)	$ 69.95
DDE-2HH	(Houses 2 half-ht 5¼" floppy drives – vertical).	$ 79.95
HDDE-1FH	(Houses 1 hard drive).	$219.95

General Application Keyboards

Mitsumi 54-Key Unencoded All-Purpose Keyboard



• SPST keyswitches • 20 pin ribbon cable connection • Low profile keys • Features: cursor controls, control, caps (lock), function, enter and shift keys • Color (keycaps): grey • Weight: 1 lb. • Pinout incl. • Size: 13⅛"L x 4¼"W x ¾"H

KB54. . . . . $14.95

74-Key ASCII Cherry Keyboard

• 7-bit parallel ASCII • Full Upper Case, Full Lower Case except l, m, n, o and p. • Cursor keypad • SPST mechanical keyswitches • 26-pin header connector • Color: white • Size: 18"L x 6¼"W x 1¼"H • Spec included

KB8201. . . . . *(1700 available).* $19.95

UV-EPROM ERASER

Erases all EPROMs. Erases up to 8 chips within 21 minutes (1 chip in 15 minutes). Maintains constant exposure distance of one inch. Special conductive foam liner eliminates static build-up. Built-in safety lock to prevent UV exposure. Compact – only 9.00"L x 3.70"W x 2.60"H. Complete with holding tray for 8 chips.

DE-4	UV-EPROM Eraser.	$74.95
UVS-11EL	Replacement Bulb.	$16.95

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7400

Part No.	Pins	Price	Part No.	Pins	Price	Part No.	Pins	Price
SN7400N	14	.29	SN7474N	14	.39	SN74159N	24	1.95
SN7401N	14	.29	SN7475N	16	.45	SN74160N	16	.59
SN7402N	14	.29	SN7476N	16	.39	SN74161N	16	.59
SN7403N	14	.29	SN7479N	14	4.95	SN74162N	16	.59
SN7404N	14	.35	SN7480N	14	.89	SN74163N	16	.59
SN7405N	14	.49	SN7482N	14	1.49	SN74164N	14	.69
SN7406N	14	.59	SN7483N	16	.55	SN74165N	16	.69
SN7407N	14	.59	SN7485N	16	.59	SN74166N	16	.69
SN7408N	14	.29	SN7486N	14	.39	SN74167N	16	2.95
SN7409N	14	.35	SN7489N	16	2.25	SN74170N	16	1.59
SN7410N	14	.29	SN7490N	14	.49	SN74172N	24	4.95
SN7411N	14	.29	SN7491N	14	.79	SN74173N	16	.85
SN7412N	14	.49	SN7492N	14	.45	SN74174N	16	.59
SN7413N	14	.39	SN7493N	14	.45	SN74175N	16	.59
SN7414N	14	.49	SN7494N	14	.89	SN74176N	14	.79
SN7416N	14	.49	SN7495N	14	.49	SN74177N	14	.79
SN7417N	14	.59	SN7496N	16	.49	SN74179N	16	1.49
SN7420N	14	.19	SN7497N	16	3.25	SN74180N	14	.69
SN7421N	14	.59	SN74100N	24	1.95	SN74181N	24	1.95
SN7422N	14	.59	SN74105N	14	1.19	SN74182N	16	1.05
SN7423N	16	.69	SN74107N	14	.29	SN74184N	16	2.29
SN7425N	14	.39	SN74109N	16	.39	SN74185N	16	2.29
SN7426N	14	.39	SN74116N	24	1.49	SN74190N	16	.69
SN7427N	14	.25	SN74121N	14	.45	SN74191N	16	.69
SN7428N	14	.59	SN74122N	14	.69	SN74192N	16	.69
SN7430N	14	.35	SN74123N	16	.55	SN74193N	16	.69
SN7432N	14	.39	SN74125N	14	.49	SN74194N	16	.69
SN7433N	14	.49	SN74126N	14	.49	SN74195N	16	.49
SN7437N	14	.25	SN74128N	14	.79	SN74196N	14	.75
SN7438N	14	.49	SN74132N	14	.59	SN74197N	14	.75
SN7439N	14	.79	SN74136N	14	.69	SN74198N	24	1.19
SN7440N	14	.19	SN74141N	16	.89	SN74199N	24	1.19
SN7441N	16	.89	SN74142N	16	3.95	SN74221N	16	1.19
SN7442N	16	.45	SN74143N	24	3.95	SN74251N	16	.79
SN7443N	16	1.25	SN74144N	24	3.95	SN74273N	20	1.95
SN7444N	16	1.25	SN74145N	16	.65	SN74276N	20	2.49
SN7445N	16	.69	SN74147N	16	1.29	SN74279N	16	.79
SN7446N	16	.75	SN74148N	16	.89	SN74283N	16	1.39
SN7447N	16	.75	SN74150N	24	1.49	SN74284N	16	2.95
SN7448N	16	.75	SN74151N	16	.49	SN74285N	16	2.95
SN7454N	14	.19	SN74152N	14	.49	SN74365N	16	.55
SN7459N	14	.35	SN74153N	16	.99	SN74366N	16	.55
SN7460N	14	.39	SN74154N	24	1.49	SN74367N	16	.55
SN7470N	14	.39	SN74155N	16	.49	SN74368N	16	.55
SN7472N	14	.39	SN74156N	16	.59	SN74390N	16	1.49
SN7473N	14	.39	SN74157N	16	.49	SN74393N	14	1.49

74LS

Part No.	Pins	Price	Part No.	Pins	Price	Part No.	Pins	Price
74LS00	14	.29	74LS132	14	.65	74LS244	20	1.29
74LS01	14	.29	74LS133	16	.59	74LS245	20	1.49
74LS02	14	.35	74LS136	14	.39	74LS251	16	.59
74LS03	14	.29	74LS138	16	.59	74LS253	16	.59
74LS04	14	.39	74LS139	16	.59	74LS257	16	.59
74LS05	14	.35	74LS145	16	1.19	74LS258	16	.59
74LS06	14	.99	74LS147	16	1.95	74LS260	14	.59
74LS07	14	.99	74LS148	16	1.79	74LS266	14	.49
74LS08	14	.35	74LS151	16	.59	74LS273	20	1.49
74LS09	14	.35	74LS153	16	.59	74LS279	16	.49
74LS10	14	.35	74LS154	24	1.49	74LS280	14	1.95
74LS11	14	.35	74LS155	16	.69	74LS299	20	2.95
74LS14	14	.59	74LS156	16	.69	74LS322	20	3.95
74LS20	14	.29	74LS157	16	.69	74LS323	20	3.95
74LS21	14	.35	74LS158	16	.59	74LS347	16	.79
74LS26	14	.29	74LS160	16	.69	74LS353	16	1.09
74LS27	14	.35	74LS161	16	.69	74LS364	20	1.95
74LS28	14	.39	74LS162	16	.69	74LS365	16	.49
74LS30	14	.39	74LS163	16	.69	74LS366	16	.49
74LS32	14	.39	74LS164	14	.89	74LS367	16	.49
74LS37	14	.35	74LS165	16	.89	74LS368	16	.49
74LS38	14	.39	74LS168	16	1.19	74LS373	20	1.49
74LS42	16	.49	74LS169	16	1.49	74LS374	20	1.49
74LS47	16	.89	74LS170	16	1.49	74LS375	16	.69
74LS51	14	.29	74LS173	16	.69	74LS386	14	.39
74LS73	14	.39	74LS174	16	.69	74LS393	14	1.19
74LS74	14	.49	74LS175	16	.69	74LS399	16	1.49
74LS75	16	.45	74LS181	24	2.49	74LS490	16	1.95
74LS76	16	.39	74LS190	16	.79	74LS533	20	1.95
74LS85	16	.89	74LS191	16	.89	74LS534	20	1.95
74LS86	14	.39	74LS192	16	.79	74LS540	20	1.49
74LS90	14	.55	74LS193	16	.89	74LS541	20	1.49
74LS92	14	.55	74LS194	16	.69	74LS640	20	2.19
74LS93	14	.59	74LS195	16	.59	74LS641	20	2.19
74LS96	16	.89	74LS196	14	.89	74LS644	20	2.19
74LS107	14	.39	74LS197	14	.89	74LS645	20	2.19
74LS109	16	.39	74LS221	16	1.09	74LS670	16	1.49
74LS112	16	.45	74LS240	20	1.09	74LS688	20	2.95
74LS122	14	.49	74LS241	20	.99	81LS95	20	1.49
74LS123	16	.79	74LS243	14	1.09	81LS96	20	1.49
74LS125	14	.59				81LS97	20	1.49
74LS126	14	.59				81LS98	20	1.49

74S/PROMS*

Part No.	Pins	Price	Part No.	Pins	Price	Part No.	Pins	Price
74S00	14	.35	74S132	14	1.89	74S241	20	1.95
74S02	14	.35	74S133	16	.45	74S242	14	2.19
74S04	14	.45	74S135	16	.89	74S244	20	2.19
74S05	14	.45	74S136	14	1.39	74S251	16	.99
74S08	14	.45	74S138	16	.89	74S253	16	.99
74S09	14	.39	74S139	16	.89	74S257	16	.99
74S10	14	.35	74S140	14	.69	74S258	16	.99
74S11	14	.35	74S151	16	.99	74S273	20	2.39
74S15	14	.35	74S153	16	.99	74S280	14	1.89
74S20	14	.35	74S157	16	.99	74S287*	16	1.79
74S22	14	.35	74S158	16	.99	74S288*	16	1.79
74S30	14	.35	74S160	16	2.29	74S299	20	5.95
74S32	14	.45	74S169	16	4.29	74S373	20	2.49
74S37	14	.99	74S174	16	1.09	74S374	20	2.49
74S38	14	.89	74S175	16	1.09	74S387*	16	1.95
74S64	14	.39	74S188*	16	1.75	74S471*	20	4.95
74S65	14	.39	74S194	16	1.49	74S472*	20	4.95
74S74	14	.55	74S195	16	1.49	74S473*	20	4.95
74S85	16	1.99	74S196	14	1.49	74S570*	16	2.95
74S86	14	.55	74S240	20	1.95	74S571*	16	2.95
74S112	16	.55				74S572*	18	4.95
74S124	16	2.75				74S573*	18	4.95

74ALS

Part No.	Pins	Price	Part No.	Pins	Price	Part No.	Pins	Price
74ALS00	14	.59	74ALS32	14	.65	74ALS138	16	1.25
74ALS02	14	.59	74ALS74	14	.79	74ALS240	20	2.25
74ALS04	14	.59	74ALS109	16	.79	74ALS244	20	2.25
74ALS08	14	.59	74ALS112	16	.69	74ALS245	20	2.59
74ALS10	14	.59				74ALS373	20	2.59
74ALS30	14	.59				74ALS374	20	2.59

74F

Part No.	Pins	Price	Part No.	Pins	Price	Part No.	Pins	Price
74F00	14	.69	74F86	14	1.15	74F240	20	3.75
74F02	14	.75	74F109	16	.95	74F244	20	3.49
74F04	14	.89	74F138	16	1.69	74F253	16	1.79
74F08	14	.75	74F139	16	1.49	74F257	16	1.79
74F10	14	.75	74F157	16	1.69	74F280	14	1.69
74F20	14	.69	74F158	16	1.69	74F373	20	4.89
74F32	14	.79				74F374	20	4.59
74F74	14	.85				74F379	16	1.99

CD—CMOS

Part No.	Pins	Price	Part No.	Pins	Price	Part No.	Pins	Price
CD4000	14	.29	CD4041	14	.69	CD40103	16	2.49
CD4001	14	.29	CD4042	16	.69	CD4503	16	.69
CD4002	14	.29	CD4043	16	.79	CD4506	16	1.29
CD4006	14	.89	CD4044	16	.79	CD4507	14	1.19
CD4007	14	.29	CD4046	16	.89	CD4508	24	1.95
CD4008	16	.89	CD4047	14	.89	CD4510	16	.85
CD4009	16	.59	CD4048	16	.59	CD4511	16	.85
CD4010	16	.49	CD4049	16	.39	CD4512	16	.85
CD4011	14	.29	CD4050	16	.39	CD4514	24	1.49
CD4012	14	.29	CD4051	16	.79	CD4515	24	1.49
CD4013	14	.39	CD4052	16	.89	CD4516	16	.89
CD4014	16	.89	CD4053	16	.79	CD4518	16	.89
CD4015	16	.39	CD4056	16	2.95	CD4519	16	.59
CD4016	14	.49	CD4059	24	3.95	CD4520	16	.89
CD4017	16	.79	CD4060	16	.89	CD4522	16	1.69
CD4018	16	.79	CD4066	14	.45	CD4526	16	1.19
CD4019	16	.49	CD4068	14	.39	CD4528	16	1.19
CD4020	16	.75	CD4069	14	.35	CD4529	16	1.69
CD4021	16	.75	CD4070	14	.29	CD4531	16	.89
CD4022	16	.75	CD4071	14	.29	CD4538	16	1.49
CD4023	14	.29	CD4072	14	.29	CD4541	14	1.49
CD4024	14	.69	CD4073	14	.29	CD4543	16	1.19
CD4025	14	.29	CD4075	14	.29	CD4553	16	4.95
CD4026	16	1.59	CD4076	16	.89	CD4566	16	2.95
CD4027	16	.45	CD4077	14	.35	CD4583	16	2.49
CD4028	16	.69	CD4078	14	.49	CD4584	14	.59
CD4029	16	.79	CD4081	14	.29	CD4585	16	1.39
CD4030	14	.39	CD4093	14	.49	CD4723	16	1.19
CD4034	24	1.79	CD4094	16	1.95	CD4724	16	1.19
CD4035	16	.79	CD4098	16	1.95	MC14410	16	8.95
CD4040	16	.75	CD4099	16	1.89	MC14411	24	11.95
						MC14412	16	7.95
						MC14433	24	17.95
						MC14490P	16	4.95
						MC14572	16	1.19

RED-HOT RAM & EPROM PRICES

Part No.	Description	Price
21C14	(200ns) CMOS SRAM CMOS USES LESS POWER	.99
27C16	(450ns) CMOS EPROM	9.95
4164N-200	(DRAM)	9/9.95
6116P-4	(200ns) SRAM	3.49
6116LP-4	(200ns) L.P. SRAM	3.69
6264LP-15	(150ns) L.P. SRAM	7.49
MC146818	REAL TIME CLOCK & RAM	7.95
27128-25	(250ns) EPROM	5.95
41256-150	(150ns) DRAM	6.49
68764	(450ns) 25V EPROM	12.95
68766	(350ns) 25V EPROM	14.95

NEW EEPROM

Part No.	Pins	Function	Price
2816A	24	2048x8 16K E²PROM 350ns. . .	12.95

Features: • On-board Address/Data Latches • Auto-Timed Byte Write (on chip timer) • 5V Erase/Write/Read • Optional High Voltage Erase/Program (12V-22V) • Power Up/Down Write Protection • Auto Erase before Write. The 2816A is an ideal nonvolatile memory providing in-system alterability with the same ease and with the same features as 2Kx8 Static RAMs.

Digitalker™

DT1050— Applications: Teaching aids, appliances, clocks, automotive, telecommunications, language translations, etc. The DT1050 is a standard DIGITALKER kit encoded with 137 separate and useful words, 2 tones, and 5 different silence durations. The words and tones have been assigned discrete addresses, making it possible to output single words or words concatenated into phrases or even sentences. The "voice" output of the DT1050 is a highly intelligible male voice. The DT1050 consists of a Speech Processor Chip, MM54104 (40 pin) and two (2) Speech ROMs MM52164SSR1 and MM52164SSR2 (24 pin) along with a Master Word list and a recommended schematic diagram on the application sheet.

DT1050 Digitalker™. . . . . **$29.95 ea.**
MM54104 Processor Chip. . . . . **$12.95 ea.**

DT1057—Expands the DT1050 vocabulary from 137 to over 260 words. Incl. 2 ROMs and specs.
Part No. DT1057 . . . . **$21.95 ea.**

INTERSIL

Part No.	Pins	Function	Price
FE0202D	40	4 Digit LCD Display for 7211IPL & 7211MIPL	14.95
FE0203D	40	3½ Digit LCD Display for 7106 & 7116	14.95
7045IPI	28	CMOS Precision Timer	14.95
7045EV/Kit	28	Stopwatch Chip, XTL (Evaluation Kit)	19.95
7106CPL	40	3½ Digit A/D (LCD Drive)	10.49
7106EV/Kit	40	IC, Circuit Board, Display (Evaluation Kit)	46.95
7107CPL	40	3½ Digit A/D (LED Drive)	10.95
7107EV/Kit	40	IC, Circuit Board, Display (Evaluation Kit)	46.95
7116CPL	40	3½ Digit A/D LCD Dis. HLD	10.95
7201IUS		Low Battery Volt. Indicator	2.25
7205IPG	24	CMOS LED Stopwatch/Timer	14.95
7205EV/Kit	24	Stopwatch Chip, XTL (Evaluation Kit)	16.95
7206CJPE	16	Tone Generator	4.95
7206CEV/Kit	16	Tone Generator Chip, XTL (Evaluation Kit)	7.95
7207AIPD	14	Oscillator Controller	5.95
7207AEV/Kit	14	Freq. Counter Chip, XTL (Evaluation Kit)	8.49
7211IPL	40	4 Digit LCD Display Decoder/Driver (TTL compatible)	7.95
7211MIPL	40	4 Digit LCD Display Decoder/Driver (Microproc. compat.)	8.95
7215IPG	24	4 Func. CMOS Stopwatch CKT	16.95
7215EV/Kit	24	4 Func. Stopwatch Chip, XTL (Evaluation Kit)	19.49
7216AIJI	28	8 Digit Univ. Counter C.A.	31.49
7216DIPI	28	8 Digit Freq. Counter C.C.	21.49
7217IJI	28	4 Digit LED Up/Down Counter C.A.	10.95
7217AIPI	28	4 Digit LED Up/Down Counter C.C.	9.95
7224IPL	40	LCD 4½ Digit Up Counter DRI	10.95
7226AEV/Kit	40	5 Function Counter Chip, XTL (Evaluation Kit)	99.95

30009 1983 INTERSIL Data Book (1356p.) **$9.95**

MICROPROCESSOR COMPONENTS

MICROPROCESSOR CHIPS

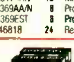
Part No.	Pins	Function	Price
D765AC	40	Floppy Disk Controller	16.95
D3242	28	Addr. Multiplexer & Refresh Counter	7.95
TMS5501	40	Synchronous Data Interface (SIRC)	14.95
Z80, Z80A, Z80B, Z8000 SERIES			
Z80	40	CPU (MK3880N)(780C) 2.5MHz	2.75
Z80-CTC	28	Counter Timer Circuit	3.49
Z80-DART	40	Dual Asynchronous Rec./Trans.	8.95
Z80-DMA	40	Direct Memory Access Circuit	12.49
Z80-P10	40	Parallel I/O Interface Controller	2.95
Z80-S10/0	40	Serial I/O (TxCB and RxCB Bonded)	11.49
Z80-S10/1	40	Serial I/O (Lacks DTRB)	11.49
Z80-S10/2	40	Serial I/O (Lacks SYNCB)	11.49
Z80-S10/9	40	Serial I/O	11.49
Z80A	40	CPU (MK3880N-4)(780C-1) 4MHz	2.95
Z80A-CTC	28	Counter Timer Circuit	3.95
Z80A-DART	40	Dual Asynchronous Rec./Trans.	9.95
Z80A-DMA	40	Direct Memory Access Circuit	12.95
Z80A-P10	40	Parallel I/O Interface Controller	3.95
Z80A-S10/0	40	Serial I/O (TxCB and RxCB Bonded)	11.95
Z80A-S10/1	40	Serial I/O (Lacks DTRB)	11.95
Z80A-S10/2	40	Serial I/O (Lacks SYNCB)	11.95
Z80A-S10/9	40	Serial I/O	11.95
Z80B	40	CPU (MK3880N-6) 6MHz	8.95
Z80B-CTC	28	Counter Timer Circuit	11.95
Z80B-DART	40	Dual Asynchronous Rec./Trans.	19.95
Z80B-P10	40	Parallel I/O Interface Controller	10.95
6500/6800/68000 SERIES			
6502	40	MPU with Clock (1MHz)	4.95
6502A	40	MPU with Clock (2MHz)	5.25
6502B	40	MPU with Clock (3MHz)	7.95
6520	40	Peripheral Inter. Adapter	2.75
6522	40	Versatile Inter. Adapter	4.95
6551	28	Async. Comm. Interface Adapt.	6.95
6800	40	MPU	2.95
6802	40	MPU with Clock and RAM	5.95
6809	40	CPU — 8-Bit (On Chip Oscillator)	6.95
6809E	40	CPU — 8-Bit (External Clocking)	8.49
68B09E	40	CPU — 8-Bit (Ext. Clocking) 2MHz	11.49
6810	24	128x8 Static RAM	2.75
68B10	24	128x8 Static RAM (2MHz)	5.95
6821	40	Peripheral Inter. Adapt. (MC6820)	2.75
68B21	40	Peripheral Interface Adapter (2MHz)	4.95
6845	40	CRT Controller (CRTC)	9.95
68B45	40	CRT Controller (CRTC) 2MHz	14.95
6850	24	Asynchronous Comm. Adapter	2.95
6860	24	0-600bps Digital MODEM	6.95
68000L8	64	MPU 16-Bit (8MHz)	19.95
68488P	40	General Purpose Int. Adapter	9.95
68661	28	Enhanced Prog. Comm. Interface (2661)	8.95
8000/80000 SERIES			
8031	40	Control Oriented CPU w/RAM & I/O	12.95
8035	40	MPU — 8-Bit	4.95
8039	40	CPU—Sgl. Chip 8-Bit (128bts. RAM)	4.95
8060	40	CPU — 8-Bit NMOS	12.95
8073N	40	CPU w/Basic Micro Interpreter	29.95
8080A	40	CPU	3.95
8085A	40	CPU	3.95
8085A-2	40	CPU-8 Bit N-Channel (5MHz)	10.95
8086-2	40	CPU 16-bit 8MHz	19.95
8087	40	Arithmetic Processor (5MHz)	119.00
8087-2	40	Arithmetic Processor (8MHz)	125.00
8088	40	CPU 8/16-Bit	14.95
8116	18	Dual Baud Rate Generator	9.49
8155	40	HMOS RAM I/O Port-Timer	4.95
8156	40	RAM with I/O Port and Timer	5.95
8202	40	Dynamic RAM Controller	19.95
8203	40	64K Dynamic RAM Controller	29.95
8205	16	Hi Speed 1 out of 8 Binary Decoder	3.95
8212	24	8-Bit Input/Output (74S412)	2.25
8224	16	Clock Generator/Driver	2.19
8228	28	Sys. Cont./Bus Driver (74S428)	3.95
8237-5	40	High Perf. Prog. DMA Cont. (5MHz)	12.95
8238	28	System Controller (74S438)	4.95
8243	24	I/O Expander for 48 Series	3.95
8250A	40	Async. Comm. Element	9.95
8250B	40	ACE (IBM PC or XT Software Compatible)	10.95
8251	28	Prog. Comm. I/O (USART)	3.25
8251A	28	Prog. Comm. Interface (USART)	3.49
8253-5	24	Prog. Interval Timer	6.49
8254	24	Programmable Interval Timer	13.49
8255	40	Prog. Peripheral I/O (PPI)	3.95
8255A-5	40	Prog. Peripheral I/O (PPI) 5MHz	4.25
8257-5	40	Prog. DMA Controller	6.95
8259	28	Prog. Interrupt Control	5.95
8259-5	28	Prog. Interrupt Controller	6.95
8272	40	Sgle/Dble Density Floppy Disk Cont.	16.95
8274	40	Multi-Protocol Serial Cont. (7201)	14.95
8275	40	Prog. CRT Controller	14.95
8279	40	Prog. Keyboard/Display Interface	5.49
8279-5	40	Prog. Keyboard/Display Interface	5.95
8282	20	Octal Latch	6.49
8284	18	Clock Generator/Driver	5.49
8286	20	Octal Bus Transceiver	6.49
8287	20	Octal Bus Transceiver (Inverted)	6.49
8288	20	Bus Controller	13.95
8289	20	Bus Arbiter	24.95
3741	40	8-Bit Univ. Peripheral Interface	19.95
8748	40	HMOS EPROM MPU	19.95
8749	40	MPU 8-Bit (EPROM Version of 8049)	19.95
8751	40	CPU w/4Kx8 EPROM & 128x8 RAM	29.95
8755	40	16K EPROM with I/O	19.95
80186	68	High Integration 16-Bit MPU	19.95
80188	68	High Integra. 16-Bit MPU (8-Bit Data Bus)	49.95
80287	40	Numeric Processor Ext.	195.00
SPECIAL FUNCTION			
MC3470P	18	Floppy Disk Read Amp System	4.95
MM5321N	16	TV Camera Sync. Generator	9.95
MM58167AN	24	Microprocessor Real Time Clock	8.95
MM58174AN	16	Micro. Compatible Time Clock	8.95
MM5369AA/N	8	Prog. Oscillator/Divider (60Hz)	1.79
MM5369EST	8	Prog. Oscillator/Divider (100Hz)	1.95
MC146818	24	Real-Time Clock Plus RAM	7.95

DYNAMIC RAMS

Part No.	Pins	Function		Price
1103	18	1024x1	(300ns)	.99
4027	16	4096x1	(250ns)	1.49
4116N-15	16	16,384x1	(150ns)	1.39 — 8/10.95
4116N-20	16	16,384x1	(200ns)	.79-8/6.29
4116N-25	16	16,384x1	(250ns)	.69-8/5.49
4164N-150	16	65,536x1	(150ns)	1.22-9/10.95
4164N-200	16	65,536x1	(200ns)	1.11-9/9.95
MM5261	18	1024x1	(300ns)	.35 — 8/1.95
MM5262	22	2048x1	(365ns)	.35 — 8/1.95
MM5270	18	4096x1	(250ns)	4.95
MM5280	22	4096x1	(200ns) 2107	3.95
MM5298-3	16	8192x1	(200ns)	.59
8118	16	16,384x1	(120ns) (+5V Only Req.)	.99
41256-150	16	262,144x1	(150ns)	6.49
41256-200	16	262,144x1	(200ns)	5.95
4128	16	131,072x1	(250ns)	8.95
STATIC RAMS				
2101	22	256x4	(450ns) 8101	1.95
2102	16	1024x1	(350ns)	.89
2102-2L	16	1024x1	(250ns) L.P. (91L02)	1.49
2111	18	256x4	(450ns) 8111	2.49
2112	16	256x4	(450ns) MOS	2.49
2114N	18	1024x4	(450ns)	1.29 — 8/9.95
2114N-L	18	1024x4	(450ns) L.P.	1.65 — 8/12.95
2114N-2	18	1024x4	(200ns)	1.39 — 8/10.95
2114N-2L	18	1024x4	(200ns) L.P.	1.69 — 8/13.49
2147HN	18	4096x1	(70ns)	4.49
2148HN	18	1024x4	(70ns)	4.95
TMS4045	18	1024x4	(450ns)	3.95
TMS40L47-45	20	1024x4	(450ns)	1.95
5101	22	256x4	(450ns) CMOS	2.95
MM5257	18	4096x1	(450ns) 4044	4.95
HM6116P-2	24	2048x8	(120ns) CMOS	4.95
HM6116LP-2	24	2048x8	(120ns) L.P. CMOS	6.49
HM6116P-3	24	2048x8	(150ns) CMOS	3.75
HM6116LP-3	24	2048x8	(150ns) L.P. CMOS	3.95
HM6116P-4	24	2048x8	(200ns) CMOS	3.49
HM6116LP-4	24	2048x8	(200ns) L.P. CMOS	3.69
HM6264P-12	28	8192x8	(120ns) CMOS	7.25
HM6264LP-12	28	8192x8	(120ns) L.P. CMOS	7.95
HM6264P-15	28	8192x8	(150ns) CMOS	6.95
HM6264LP-15	28	8192x8	(150ns) L.P. CMOS	7.49
27LS00	16	256x1	(80ns) L.P.	3.95
7489	16	16x4	(50ns) 3101	2.25
74C921	18	256x4	(250ns) CMOS	5.95
74C930	18	1024x1	(250ns) CMOS (6518)	5.95
74S189	16	16x4	(35ns) 93405	2.95
74S289	16	16x4	(35ns) 3101	2.95
82S10	16	1024x1	(50ns) O.C. (93415)	3.95
82S25	16	16x4	(50ns) O.C. (74S289)	2.25
PROMS/EPROMS				
1702A	24	256x8	(1µs)	3.95
TMS2516	24	2048x8	(450ns)	4.95
TMS2532	24	4096x8	(450ns)	5.49
TMS2564	28	8192x8	(450ns)	10.95
2708	24	1024x8	(450ns)	3.95
TMS2716	24	2048x8	(450ns) 3 voltage	7.95
2716	24	2048x8	(450ns)	3.95
27C16	24	2048x8	CMOS	9.95
2716-1	24	2048x8	(350ns)	4.95
2716Q-5	24	2048x8	(550ns)	3.75
2732	24	4096x8	(450ns)	4.25
2732A-20	24	4096x8	(200ns) 21V	9.95
2732A-25	24	4096x8	(250ns) 21V	5.95
2732A-45	24	4096x8	(450ns) 21V	4.49
27C32	24	4096x8	CMOS	11.95
27C32A-30	24	4096x8	(300ns) 21V (CMOS)	22.95
2764-20	28	8192x8	(200ns) 21V	6.95
2764-25	28	8192x8	(250ns) 21V	5.09
2764A-25	28	8192x8	(250ns) 12.5V	5.95
2764-45	28	8192x8	(450ns) 21V	4.95
27C64	28	8192x8	CMOS 21V	11.55
27128-25	28	16,384x8	(250ns) 128K 21V	5.95
27128A-25	28	16,384x8	(250ns) 128K 12.5V	7.95
27256-25	28	32,768x8	(250ns) 256K (14V)	11.35
68764	24	8192x8	(450ns) 25V	12.95
68766	24	8192x8	(350ns) 25V	14.95
74S188	16	32x8	PROM O.C. (6330-1)	1.75
74S287	16	256x4	PROM T.S. (6301-1)	1.79
74S288	16	32x8	PROM T.S. (6331-1)	1.79
74S387	16	256x4	PROM O.C. (6300-1)	1.95
74S471	20	256x8	PROM T.S. (6309-1)	4.95
74S472	20	512x8	PROM T.S. (6349-1)	4.95
74S473	20	512x8	PROM O.C. (6348)	4.95
74S474	24	512x8	PROM T.S. (DM87S296N)	4.95
74S475	24	512x8	PROM O.C. (6340)	4.95
74S476	18	1024x4	PROM T.S.	6.95
74S478	24	1024x8	PROM T.S.	9.95
74S570	16	512x4	PROM O.C. (6305)	2.95
74S571	16	512x4	PROM T.S. (6306)	2.95
74S572	18	1024x4	PROM O.C. (6352)	4.95
74S573	18	1024x4	PROM T.S. (82S137)	4.95
82S23	16	32x8	PROM O.C. (27S18)	2.95
82S115	24	512x8	PROM T.S. (27S15)	9.95
82S123	16	32x8	PROM T.S. (27S19)	2.95
82S126	16	256x4	PROM O.C. (27S20)	2.95
82S129	16	256x4	PROM T.S. (27S21)	2.95
82S130	16	512x4	PROM O.C. (27S12)	3.95
82S185	18	2048x4	PROM T.S. (TBP24S81)	9.95
82S191	24	2048x8	(80ns)	14.95
DM87S181N	24	1024x8	PROM T.S. (82S181)	9.95

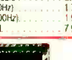
DATA ACQUISITION

Part No.	Pins	Function	Price
DC10		Mostek DC/DC Converter +5V to −9V	2.95
ADC0801	20	8-Bit A/D Converter (1/4LSB)	14.95
ADC0803	20	8-Bit A/D Converter (±1/2LSB)	4.95
ADC0804	20	8-Bit A/D Converter (1LSB)	3.49
ADC0808	28	8-Bit A/D Conv. w/8-Channel Analog	9.95
ADC0809	28	8-Bit A/D Converter (8-Ch. Multi.)	4.49
ADC0816	40	8-Bit A/D Conv. w/16-Channel Analog	14.95
ADC0817	40	8-Bit A/D Converter (16-Ch. Multi.)	9.49
DAC0806	16	8-Bit D/A Converter (0.78% Lin.)	1.95
DAC0807	16	8-Bit D/A Converter (MC1408-7)	1.49
DAC0808	16	8-Bit D/A Converter (MC1408-8)	2.25
DAC0830	20	8-Bit Up D/A Conv. (.05% Lin.)	5.95
DAC0831	20	8-Bit Up D/A Conv. (.10% Lin.)	4.49
DAC1000	24	10-Bit D/A Conv. Micro. Comp. (0.05%)	7.95
DAC1008	20	10-Bit D/A Conv. Micro. Comp. (0.20%)	6.95
DAC1022	16	10-Bit D/A Conv. (0.20% lin.)	5.95
DAC1222	18	12-Bit D/A Conv. (0.20% Lin.)	6.95
DAC1230	20	12-Bit Up D/A Conv. (.05% Lin.)	14.95
DAC1231	20	12-Bit Up D/A Conv. (.10% Lin.)	13.95
AY-3-1015D	40	25K Baud UART	4.25
AY-5-1013A	40	30K Baud UART (TR1602)	3.95



Low Profile (Tin) Sockets

Part No.	1-9	10-99	100-up
8 pin LP	.16	.14	.13
14 pin LP	.17	.15	.14
16 pin LP	.19	.17	.16
18 pin LP	.26	.24	.23
20 pin LP	.30	.27	.25
22 pin LP	.31	.28	.26
24 pin LP	.33	.30	.28
28 pin LP	.40	.37	.35
40 pin LP	.49	.46	.43



Soldertail (Gold) Standard

Part No.	1-9	10-99	100-up
8 pin SG	.39	.35	.29
14 pin SG	.49	.45	.39
16 pin SG	.55	.49	.45
18 pin SG	.65	.59	.51
20 pin SG	.75	.65	.59
22 pin SG	.79	.69	.65
24 pin SG	.79	.69	.65
28 pin SG	.95	.85	.75
36 pin SG	1.25	1.15	.99
40 pin SG	1.39	1.25	1.15

Wire Wrap Sockets (Gold) Level #3

Part No.	1-9	10-99	100-up
8 pin WW	.55	.49	.45
10 pin WW	.69	.65	.59
14 pin WW	.75	.69	.65
16 pin WW	.79	.72	.65
18 pin WW	.95	.85	.75
20 pin WW	1.19	1.09	.95
22 pin WW	1.29	1.19	1.05
24 pin WW	1.35	1.19	1.09
28 pin WW	1.69	1.55	1.39
36 pin WW	1.89	1.79	1.69
40 pin WW	2.29	1.95	1.79

Header Plugs (Gold)

Part No.	1-9	10-99	100-up
14 pin HP	.65	.59	.55
16 pin HP	.69	.65	.59
24 pin HP	1.15	.99	.89

Header Covers

Part No.	1-9	10-99	100-up
14 pin HC	.15	.13	.12
16 pin HC	.19	.17	.15
24 pin HC	.29	.25	.22

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74HC HIGH SPEED CMOS

Part No.	Pins	Price	Part No.	Pins	Price	Part No.	Pins	Price
74HC00	14	.59	74HC139	16	1.05	74HC245	20	2.59
74HC02	14	.59	74HC147	16	1.29	74HC251	16	.99
74HC03	14	.89	74HC151	16	.99	74HC253	16	1.09
74HC04	14	.59	74HC153	16	1.09	74HC257	16	.99
74HCU04	14	.69	74HC154	24	2.65	74HC259	16	1.69
74HC08	14	.59	74HC157	16	.99	74HC266	14	.89
74HC10	14	.59	74HC158	16	.99	74HC273	20	2.79
74HC11	14	.69	74HC160	16	1.39	74HC280	14	4.59
74HC14	14	.89	74HC161	16	1.39	74HC299	20	5.59
74HC20	14	.59	74HC162	16	1.39	74HC366	16	2.59
74HC27	14	.59	74HC163	16	1.39	74HC367	16	2.59
74HC30	14	.69	74HC164	14	1.35	74HC373	20	2.69
74HC32	14	.79	74HC165	16	2.15	74HC374	20	2.69
74HC42	16	1.09	74HC166	16	2.49	74HC390	16	1.59
74HC51	14	.89	74HC173	16	1.29	74HC393	14	1.59
74HC58	14	.89	74HC174	16	1.09	74HC533	20	2.69
74HC73	14	.79	74HC175	16	1.09	74HC534	20	2.69
74HC74	14	.79	74HC190	16	1.59	74HC595	16	3.19
74HC75	16	.99	74HC191	16	1.59	74HC688	20	3.59
74HC76	16	.79	74HC192	16	1.49	74HC4024	14	1.75
74HC85	16	1.69	74HC193	16	1.49	74HC4040	16	1.49
74HC86	14	.75	74HC194	16	1.19	74HC4049	16	.89
74HC107	14	.79	74HC195	16	1.19	74HC4050	16	.89
74HC109	16	.79	74HC221	16	2.95	74HC4060	16	1.49
74HC112	16	.79	74HC237	16	1.49	74HC4075	14	.59
74HC123	16	2.29	74HC240	20	2.29	74HC4078	14	.59
74HC125	14	1.75	74HC241	20	2.29	74HC4511	18	1.95
74HC132	14	1.29	74HC242	14	2.15	74HC4514	24	4.19
74HC137	16	1.59	74HC243	14	2.15	74HC4538	16	2.59
74HC138	16	1.19	74HC244	20	2.29	74HC4543	16	3.75

74HCU04 is unbuffered

74C—C/MOS

Part No.	Pins	Price	Part No.	Pins	Price	Part No.	Pins	Price
74C00	14	.29	74C107	14	.79	74C240	20	1.95
74C02	14	.35	74C151	16	2.19	74C244	20	1.95
74C04	14	.35	74C154	24	3.25	74C373	20	2.29
74C08	14	.35	74C157	16	1.75	74C374	20	2.29
74C10	14	.35	74C160	16	1.19	74C901	14	.59
74C14	14	.59	74C161	16	1.19	74C902	14	.79
74C20	14	.35	74C162	16	1.19	74C903	14	.59
74C30	14	.35	74C163	16	1.19	74C906	14	.59
74C32	14	.39	74C164	14	1.29	74C907	14	.89
74C42	16	1.19	74C165	16	1.29	74C911	28	8.95
74C48	16	1.79	74C173	16	.89	74C912	28	8.95
74C73	14	.69	74C174	16	1.19	74C915	18	1.19
74C74	14	.59	74C175	16	1.19	74C917	28	8.95
74C85	16	1.39	74C192	16	1.39	74C922	18	4.49
74C86	14	.29	74C193	16	1.39	74C923	20	4.95
74C89	16	5.95	74C195	16	1.29	74C925	16	5.95
74C90	14	1.09	74C221	16	1.75	74C926	18	5.95
74C93	14	1.09				80C95	16	.69
74C95	14	1.19				80C97	16	.69

LINEAR

Part No.	Pins	Price	Part No.	Pins	Price	Part No.	Pins	Price
DS0026CN	8	1.95	LF355N	8	1.09	LM747N	14	.69
TL071CP	8	.79	LF356N	8	1.09	LM748N	8	.59
TL072CP	8	1.09	LM358N	8	.59	uA760HC		9.95
TL074CN	14	1.95	LM359N	14	1.79	LM1456V	8	1.95
TL081CP	8	.59	LM370N	14	4.95	LM1458CN	8	.59
TL082CP	8	1.19	LM373N	14	4.95	LM1488N	14	.69
TL084CN	14	1.95	LM377N	14	1.95	LM1489N	14	.69
LM109K		5.95	LM380CN	8	1.09	LM1496N	14	.99
LM301CN	8	.39	LM380N	14	.89	LM1605CK		9.95
LM302H		2.49	LM381N	14	1.79	LM1871N	18	2.95
LM304H		1.95	LM382N	14	1.49	LM1872N	18	3.25
LM305H		.99	LM384N	14	1.95	LM1877N-9	14	2.95
LM307CN	8	.49	LM386N-3	8	.89	LM1889N	18	1.95
LM308CN	8	.69	LM387N	8	1.39	LM1896N	14	1.59
LM309K		1.25	LM389N	18	1.19	LM2002T		1.95
LM310CN	8	1.95	LM391N-80	16	1.19	ULN2003A	16	1.49
LM311CN	8	.59	LM392N	8	.59	XR2206	16	3.95
LM312H		2.79	LM393N	8	.45	XR2207	14	2.49
LM317T		1.19	LF398N	8	3.95	XR2208	16	1.79
LM317K		3.49	LM399H		5.95	XR2211	14	2.95
LM318CN	8	1.59	LF412CN	8	1.95	LM2877P		1.95
LM319N	14	1.49	TL494CN	16	2.79	LM2878P		2.95
LM320K-5		1.35	TL496CP	8	1.59	LM2901N	14	.79
LM320K-12		1.35	NE531V	8	1.79	LM2902N	14	.89
LM320K-15		1.35	NE540H (C540H)		2.95	LM2907N	14	2.49
LM320K-24		1.35	NE544N	14	1.95	LM2917N	8	1.95
LM320T-5		.85	NE550A	14	1.95	LM3900N	14	.59
LM320T-12		.85	NE555V	8	.35	LM3905CN	8	1.19
LM320T-15		.85	XR-L555	8	.69	LM3909N	8	.89
LM320T-24		.85	LM556N	14	.79	LM3914N	18	2.39
LM322N	14	1.49	NE558N	16	1.59	LM3915N	18	2.39
LM323K		4.95	NE564N	16	1.95	LM3916N	18	2.39
LM324N	14	.59	LM565N	14	.99	RC4136N	14	1.25
LM329DZ		.65	LM566CN	8	1.49	RC4151NB	8	1.95
LM331N	8	3.95	LM567V	8	.99	RC4193NB	8	1.95
LM334Z		1.19	NE570N	16	2.95	RC4195TK		5.95
LM335Z		1.29	NE571N	16	2.49	LM4250CN	8	1.49
LM336Z		1.09	NE592N	14	1.19	NE5532	8	1.69
LM337MP		1.15	LM703CN	8	1.49	NE5534	8	1.39
LM337T		1.89	LM710N	14	.69	78L05A		.39
LM338K		6.95	LM711N	14	.79	78L12A		.39
LM339N	14	.69	LM723N	14	.49	79L05A		.59
LM340K-5		1.35	LM733N	14	.89	79M05AH		1.29
LM340K-12		1.35	LM739N	14	1.95	ICL8038	14	3.95
LM340K-15		1.35	LM741CN	8	.39	LM13080N	8	1.19
LM340K-24		1.35				LM13600N	16	1.19
LM340T-5		.75				75477	8	.99
LM340T-12		.75				76002	14	1.95
LM340T-15		.75				76477	28	3.95
LM340T-24		.75						
LF347N	14	1.49						
LM348N	14	.89						
LM350K		4.79						
LF351N	8	.59						
LF353N	8	.89						

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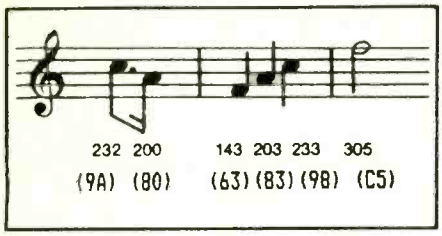

Fig. 3. Opening bar music for the "Star Spangled Banner".

fore soldering them into place, and don't forget the wire jumpers at locations W1 and W2. Use sockets for all ICs, but don't install the ICs in their sockets until you've performed the initial checkout procedure.

Should you choose to mount the TIP120 transistors on heat sinks, be sure to electrically isolate them from the sinks. That is, place a mica insulator, liberally coated on both sides with silicone heat-transfer paste, between transistor and heat sink.

Checkout

Connect the negative test lead of a dc voltmeter set to the 10-volt range to ground test point TP5 in the Mello-Phone circuit (use this test point as the ground, or common, reference for all voltage checks). With the ICs still not installed in their sockets, apply power to the circuit via the 9-volt adapter. Touching the positive test probe of the meter to TP1 should yield a reading of +9 volts, and touching it to TP2 should yield a reading of +5 volts.

If you don't obtain a proper reading, check to make sure that the 9-volt adapter is indeed delivering 9 volts dc when not connected to the Mello-Phone. If it is, check the wiring of *VR1* to make sure you haven't reversed the lead order during installation. Correct any wiring error and/or replace any defective components before proceeding.

Once you obtain the proper readings at TP1 and TP2, disconnect power from the Mello-Phone and install the ICs in their respective sockets, making absolutely certain to properly index them. Also, since synthesizer *U3* and EPROM *U4* are sensitive to damage from static electricity, use safe handling procedures during installation.

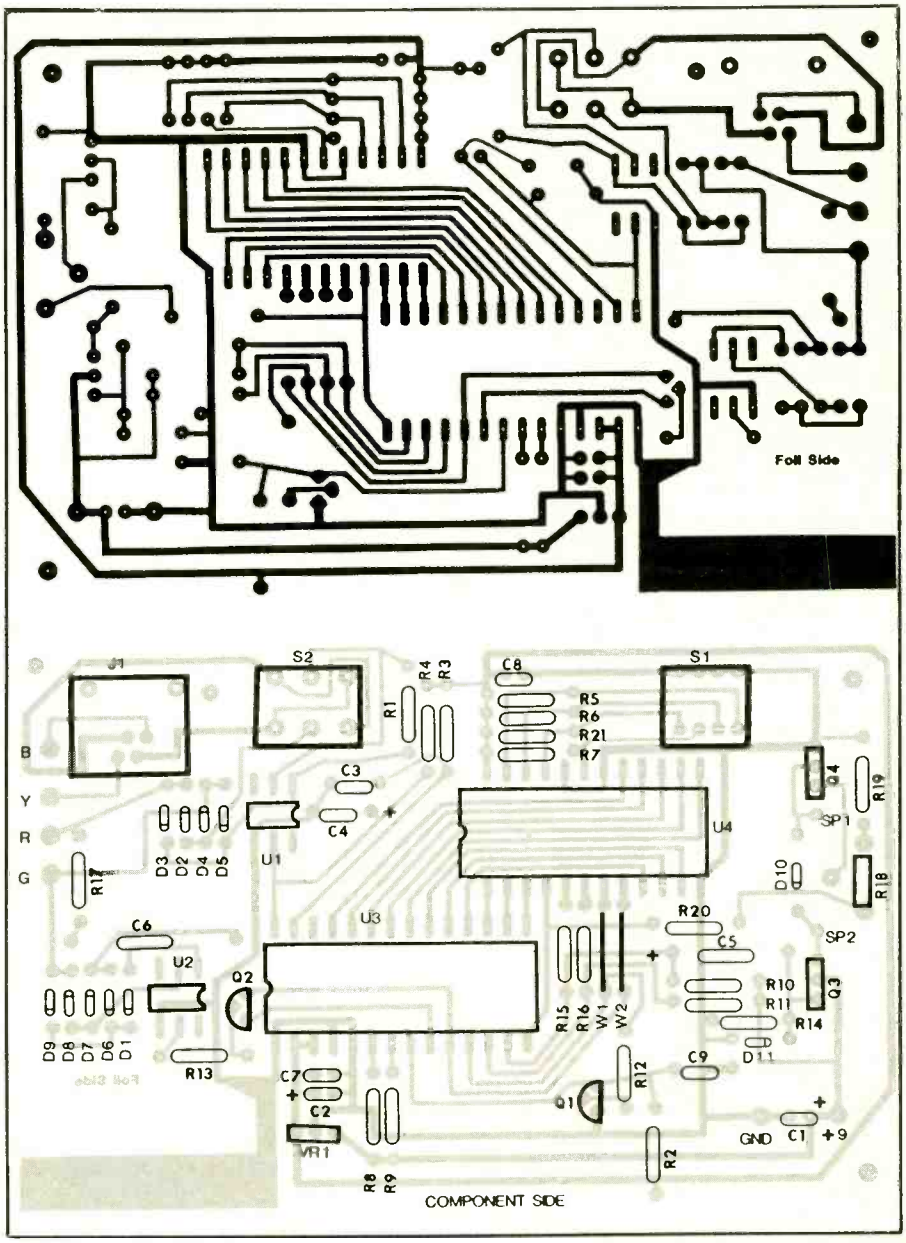

Fig. 4. Shown at the top is the actual-size etching-and-drilling guide to use if you fabricate your own printed-circuit board. Underneath is the components-placement/orientation diagram to use when wiring the circuit board.

Power up the Mello-Phone once again and momentarily short TP4 to ground to cause a tune to start playing through the speaker. After a few notes have sounded, momentarily short TP3 to ground to stop the tune.

If you obtain these results, the Mello-Phone is ready to be installed. Just plug your telephone into the jack on the pc board and plug the cord from the Mello-Phone into your telephone wall receptacle. (Note: FCC Rules prohibit the use of this type of ringer with party lines and coin-operated telephones.)

One last test is required if you have

Touch-Tone service. The tone dialer in a Touch-Tone set is powered by dc, which must flow in the proper direction for correct dialer operation. To test this operation, install the Mello-Phone, lift your telephone handset and dial out. If you find that you can't dial out, the bridge circuit in the Mello-Phone has reversed the voltage polarity required by your telephone. To correct this, set *S2* to its alternate position.

In Conclusion

Some final notes concerning operation of the Mello-Phone. Firstly, a test feature is built in. With the Mello-Phone powered up and plugged into the telephone line, lifting and replacing the handset results in a "beep" from the phone ringer, indicating that it is functional and ready for an incoming call. Secondly, when you change tune selection with *S1*, be sure to perform this test routine to reset the memory pointer. If you don't, the first ring burst will result in some random sounds or a partial tune. This condition is only temporary, however, and will correct itself if you forget to run the test routine. Lastly, you might want to house the circuit in a metal or plastic enclosure that can be mounted on a wall or be placed near your telephone. **ME**

LETTERS *(from page 4)*

talkie, but found out that he only gets half of our present 2-meter band.

Gordon West, WB6NOA
Costa Mesa, CA

Gorden West is a well-known communications columnist and writes a monthly column on survival communications for our sister publication, Popular Communications. *His advice is on target, too.—Ed.*

A Reader's "Input"

• "Using Voltage Comparators" (May 1985) is the first electronic circuit I have ever completely understood. And now that I know so much, I say there's an error in the text. The second sentence under the "Time Delay Circuit" heading on page 37 should begin: "When the comparator's *input* (not output, as printed) goes from 0 volt to V+, . . ." Please comment.

Paul LaCroix
Mt. Clemens, MI

You're absolutely correct. Sorry.—Ed

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11302	14	.59	.54	.45
11303	16	.64	.58	.48
11304	18	.73	.66	.55
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11306	22	1.12	1.02	.85
11307	24	1.25	1.14	.95
11308	28	1.52	1.38	1.15
11309	40	2.05	1.86	1.55

TI LOW PROFILE SOCKETS Tin plated copper alloy 688 contact pins with gas tight seal

Stock No.	No Pins	1-24	25-99	100-999
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11202	14	.14	.13	.12
11203	16	.16	.15	.14
11204	18	.18	.17	.15
11205	20	.20	.18	.16
11206	22	.22	.20	.18
11207	24	.24	.22	.20
11208	28	.28	.26	.25
11209	40	.40	.37	.33

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Stock No. 47007

Stock No.	Description	1	10
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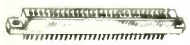

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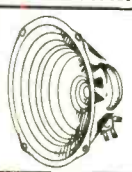

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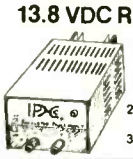

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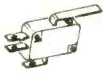

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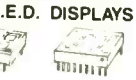

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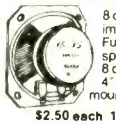

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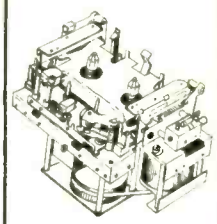

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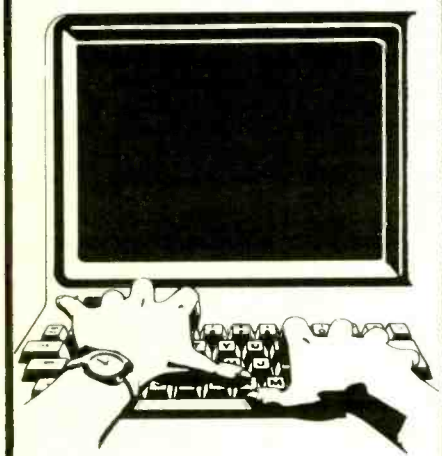

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CIRCLE NO. 103 ON FREE INFORMATION CARD

FAST AND EASY

THE MARK III

HV CIRCUIT SCANNER

- ★ Checks the horiz output circuit for open / shorts,
- ★ Checks the flyback, yoke, PC, and HV mult,
- ★ Checks all scan derived B + sources,
- ★ Checks all circuits that rely on scan derived B + voltage,
- ★ Checks for open safety capacitor,
- ★ Checks the emitter circuit of the horiz output,

THEN,

- ★ Provided the green normal light is lit, the Mark III will safely power up the TV set so that **you** can "look" for open circuits by examining the picture on the CRT.
- ★ Circumvents all start up and horiz drive related shut down circuits.

APPLICATIONS: The Mark III will analyze the horiz, flyback, hi-voltage, scan derived B + sources, yoke, pin cushion, HV multiplier circuits in any TV set that employs either an **NPN** transistor or a single **SCR** for its horiz output device. This applies to any age, any model, any chassis, any brand - - - including Sony.

In brief, the "test" function scans for shorts, the "run" function permits you to observe any "open" circuits via the symptoms that appear in the CRT screen.

HOOK - UP: Simply remove the set's horiz output device and replace it with the scanner's interface plug. No wires to disconnect, no other connections required (not even a ground connection).

MISTAKE PROOF: No damage will result if an error is made during hook up. The scanner simply won't turn on until the error is corrected.

PUSH THE TEST BUTTON Just one of the four lights will lite.

RED OPEN LIGHT means the emitter circuit of the horiz output stage is open (no ground path).

YELLOW SHORT LIGHT means the flyback primary, HV multiplier, vertical output, horiz driver, and R-B-G color output stages are **not** shorted. Instead, a circuit that normally draws a small amount of current is shorted (i.e. the tuner, IF, AGC, video chroma, matrix, vertical or horiz oscillator).

RED SHORT LIGHT means either the flyback, the HV multiplier, the vertical output, horiz driver or one of the **R-B-G** output transistors is shorted.

GREEN NORMAL LIGHT means the TV set's entire flyback circuit is totally free of shorts. It also means that it is safe to power up the TV set with the "run" button so that you can look for open circuits by observing the symptoms on the CRT screen.

FEATURES: All **start up** circuits and all horiz drive related **shut down** circuits are automatically circumvented by the Mark III during all test and run functions. During the test function all flyback secondary output is limited to approx 80% of normal. 2nd anode voltage is limited to approx 5 KV.

This means all circuits that are not shorted will have some 80% of their normal B + voltage during the "test" phase. It also means that any shorted circuit will have zero DC volts on it. This feature makes any short easy to isolate.

The MARK III sells for only 595^{00}

The money you are now spending for unnecessary flybacks alone will easily pay for your Mark III. Why not order yours today!

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CIRCLE 99 ON FREE INFORMATION CARD

- ★ Checks the horiz output stage for opens / shorts,
- ★ Checks flyback, yoke, PC, and HV mult,
- ★ Checks all scan derived B + sources,
- ★ Checks for open safety capacitors
- ★ Checks for open ground path for horiz output stage
- ★ Checks for open primary LV supply,
- ★ Checks for error in interface connections,
- ★ Checks for proper LV regulation,
- ★ Checks for proper start up circuit operation,
- ★ Checks for shorted horiz driver transistor,
- ★ Checks the operation of the horiz osc / driver circuits,
- ★ Checks B + "run" supply for the horiz osc / driver circuits,
- ★ Checks all circuits in the TV set that rely on scan derived B +,
- ★ Automatically circumvents all start up circuits and horiz drive related shut down circuits.

HOOK UP: (Identical to Mark III)

OPERATION: Turn the Mark V on, turn the TV set on, then, simply look at the lights.

RED "HOOK UP" LIGHT means that you have made an error in hook up. No damage has been done, correct the problem then continue.

RED "EMITTER" LIGHT means that the ground path for horiz output stage is open. Correct the problem then continue.

RED "B + OPEN" LIGHT means that the primary LV supply in the TV set is open. Correct the problem then continue.

No "top row lights" equals normal.

Look at the middle row of lights

RED "START UP" LIGHT means that the start up circuit in the TV set is not working (no start up pulse).

GREEN "START UP" LIGHT means the start up circuit in the TV set is working normally. Yes, it is 100% accurate. Even on Zenith's single pulse start up circuit !

RED "HORIZ DRIVE" LIGHT with a green start up light means that the horiz driver transistor in the TV is shorted (E to C).

GREEN HORIZ DRIVE LIGHT means that the horiz oscillator and driver circuits are operational.

READ THE DC VOLTAGE METER THEN,

PUSH THE TEST BUTTON

If the meter comes up to, or, falls back to, factory specified DC collector voltage, the LV regulator circuit is working. If it fails to do so, it is not working!

RED "B + RUN" LIGHT means that the B + source that normally keeps the horiz osc / driver circuits running after the start up B + pulse has been consumed has become open.

GREEN "B + RUN" LIGHT means that the B + resupply voltage (scan derived) is being provided. All is normal if all three lights are now green.

The scan circuit short detector in the Mark V is identical in all ways to that which is used in the Mark III. Operation is also identical. Both units are virtually indestructable when simple directions are followed. Both units carry a full year's warranty against defects in materials and workmanship (parts and labor). Either unit can be easily repaired by almost any technician in his own shop.

If the green "circuits clear" light is now lit

It is now safe to push the "run" button and examine the symptoms that appear on the CRT screen, for the purpose of isolating any "open" circuits.

Except for hook up and CRT filament warm up time, this test can easily be completed in two to five seconds!

The Mark V sells for only $995^{00}

Stop losing money on start up / shut down scan derived B + problems; order your Mark V today!

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Scan the airwaves with a number of programmable scanning functions.

Plus you get keyboard frequency entry. An LCD display for easy readout. A SINPO signal graph. Computer interface capability for advanced listening functions. Two 24 hour clocks. Recording functions. And much more to make your listening station complete.

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CIRCLE 19 ON READER SERVICE CARD

Dealer inquiries invited.

Prices and specifications subject to change without notice.
FRG-9600 SSB coverage: 60 to 460 MHz.