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MODERN ELECTRONICS™

MARCH 1986 $1.95
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THE MAGAZINE FOR ELECTRONICS & COMPUTER ENTHUSIASTS

- **Ni-Cd BATTERIES Myths & Mysteries**
- **TELEPHONES How They Work & ...leshooting**

Tes...ts

- F... Ace 2200 Computer
- S...uxe 8-mm Camcorder
- B... GameWorks Software

How to Build a:

- 64K Printer Buffer For $50
- Wireless TV Audio Mute
- Tuneable Field-Strength Meter

Franklin's Apple II-Compatible Ace 2000 Computer (p. 14)

Sony's New Deluxe "Video 8" 8-mm camcorder (p. 19)

Also: • Forrest Mims: "How to Assemble Miniature Circuits"
• Don Lancaster: Pressure Transducers . . . Adapting Surplus Drives
• Eric Grevstad: Tandy's Model 600 Laptop Computer . . . Bourbaki's 1dir Menu Program . . . • Ed Noll: More Scanner Chatter

KENWOOD

...pacesetter in Amateur radio

Scan the World

R-2000

All-mode receiver.

- Covers 150 kHz–30 MHz in 30 bands.
- All mode: USB, LSB, CW, AM, FM.
- Digital VFO's. 50-Hz, 500-Hz or 5-kHz steps. F. LOCK switch.
- Ten memories store frequency, band, and mode data. Each memory may be tuned as a VFO.
- Lithium batt. memory back-up.
- Memory scan.
- Programmable band scan.
- Fluorescent tube digital display of frequency (100 Hz resolution) or time.
- Dual 24-hour quartz clocks, with timer.
- Three built-in IF filters with NARROW/WIDE selector switch. (CW filter optional.)
- Squelch circuit, all mode, built-in.
- Noise blanker built-in.
- Large front mounted speaker.
- RF step attenuator. (0-10-20-30 dB.)
- AGC switch. (Slow-Fast.)
- "S" meter, with SINPO scale.
- High and low impedance antenna terminals.
- 100/120/220/240 VAC operation.
- RECORD output jack.
- Timer REMOTE output (not for AC power).
- Muting terminals.

Service manuals are available for all receivers and most accessories.
Specifications and prices subject to change without notice or obligation.

R-1000 High performance receiver • 200 kHz-30 MHz in 30 bands • AM, CW, SSB • 3 IF filters • noise blanker • RF attenuator • S-meter • 120-240 VAC • muting terminals • built-in speaker • digital display/clock/timer

R-600 General coverage receiver • 150 kHz-30 MHz in 30 bands • AM, CW, SSB • IF filters • noise blanker • RF attenuator • S-meter with SINPO scale • front mounted speaker • 3 antenna inputs • 100-240 VAC operation • record jack • muting terminals • digital display

Optional accessories:

- VC-10 VHF converter for R-2000 covers 118-174 MHz
- YG-455C 500 Hz CW filter for R-2000
- HS-4 Headphones
- HS-5 Deluxe headphones
- HS-6 Lightweight headphones
- HS-7 Micro headphones
- DCK-1 DC cable kit for 13.8 VDC operation
- AL-2 Lightning and static arrester

Additional information on Kenwood all-band receivers is available from authorized dealers.

25th Anniversary

KENWOOD

TRIO-KENWOOD COMMUNICATIONS
1111 West Walnut Street
Compton, California 90220

CIRCLE NO. 139 ON FREE INFORMATION CARD

MODERN ELECTRONICS

THE MAGAZINE FOR ELECTRONICS & COMPUTER ENTHUSIASTS

MARCH 1986 VOLUME 3, NUMBER 3

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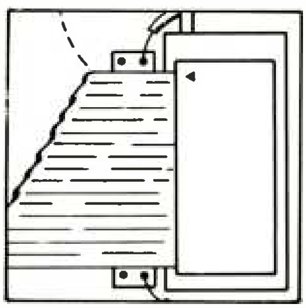

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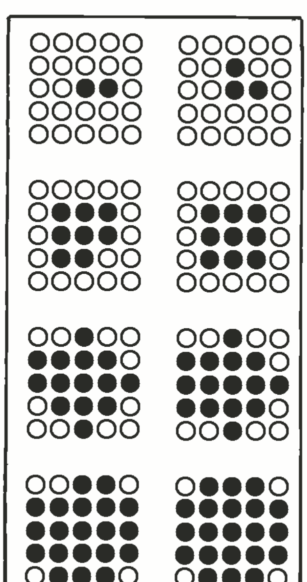

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Offices: 76 North Broadway, Hicksville, NY 11801. Telephone: (516) 681-2922. Modern Electronics (ISSN 0748-9889) is published monthly by Modern Electronics, Inc. Application to mail at second class rates pending at Hicksville, NY and other points. Subscription prices (payable in US Dollars only): Domestic - one year $16.97, two years $31.00, three years $45.00; Canada/Mexico - one year $19.00, two years $35.00, three years $51.00; Foreign - one year $21.00, two years $39.00, three years $57.00. Foreign Air Mail - one year $74.00, two years $145.00, three years $216.00.

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CIRCLE 23 ON FREE INFORMATION CARD

EDITORIAL

The Seeds

Enormous research and development efforts in the electronics field continually produce new product shoots from its seeds. Some of these open up brand new fields that never existed before, others evolutionary advances, and, naturally, many lead to nowhere. Observing reports on research advances can be an interesting pastime since it enables one to speculate on the future shape of electronics and computer products.

Once out of the basic and engineering research stage, even impressive developments may take a long time to reach a marketable state, if ever. For example, it took about nine years for Xerox to develop and introduce its local area network (LAN), Ethernet. IBM's recently introduced token-ring net awaited a three-year development period for chips by Texas Instruments. The DOD's Ada software is still wandering about, while Bell Labs' Unix operating system, too, has not hit full force after many years of promise. And how many years did it take to adapt Xerox's exciting Smalltalk graphics and "mouse" control concepts to the real world through Apple computer's Macintosh? Look, too, at Videotex, which promised to bring computer information banks to every home TV with the addition of a decoder. We're still waiting.

Nonetheless, enough new developments are transformed into viable products to change the face of electronics and computers as we know them to justify large investments in research by scientists and engineers. Without this commitment, we'd be standing still. Without this commitment, Japan could not rely on us in many areas to allow them to create new products that they can make and sell to us. (They now pay about ten times as much to us on patent licenses as we do to them.) Without this commitment, the Soviet Union would have to cut back on its industrial spy force.

With the industrial world so dependent upon us for fundamental knowledge, we had better intensify our support of research, don't you think? Of course we should, but not for the tongue-in-cheek reason cited. Research efforts should be strengthened and more focused, but there's got to be a better way to deal with its results than is being done at present in order to become more internationally competitive. Only birds eat seeds.

Art Salsberg

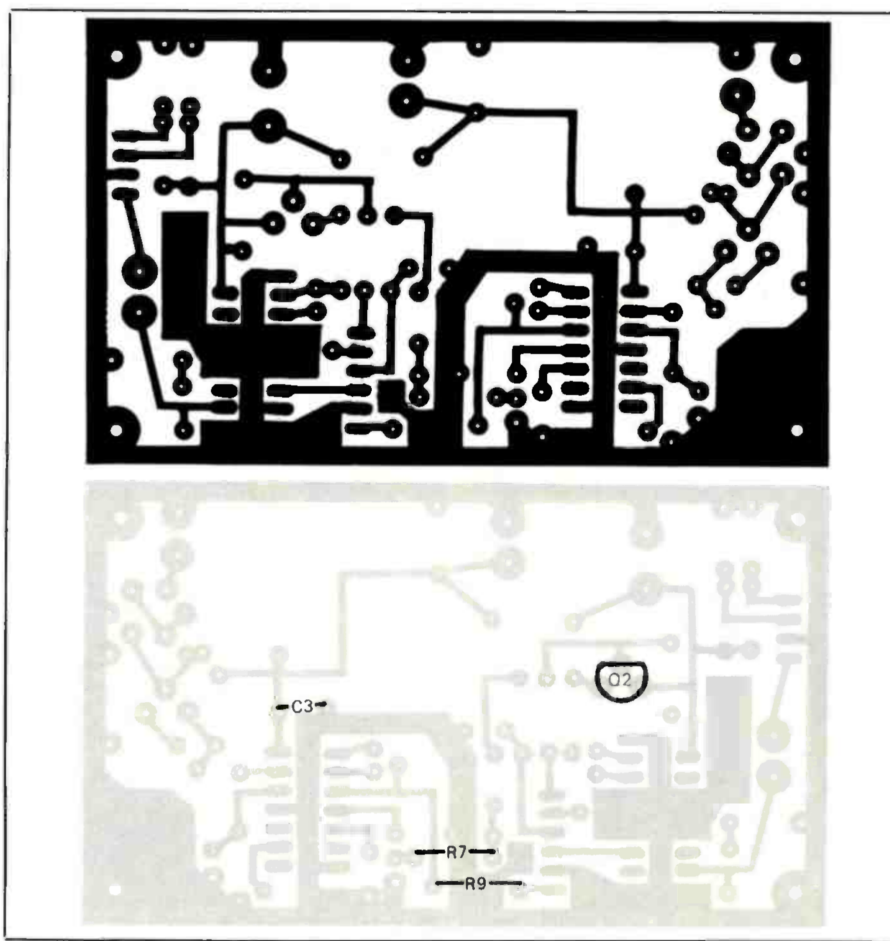
LETTERS

Why Doesn't It Work?

•I can't get my "Discover the 'Hidden World' of FM Broadcasting" decoder (December 1985) to operate properly. In comparing the component-layout guide against the schematic, I noticed some discrepancies. Having corrected what I could, I still can't get the decoder to work properly. So why doesn't it work?

W. Ford
New York, NY

You and other readers have fallen victim to "gremlins"—this time in the form of stick-on artwork that didn't. Some tiny pieces of the etching-and-drilling guide seem to have fallen off and gotten lost at the film house, and one got misplaced on the components guide. Rather than try to talk you through the corrections, we're including here a corrected Fig. 3 (in reduced size). There are two other corrections to be made in Fig. 2: change the value of R7 to 100K and that of C10 to 0.1-µF.—Ed.



Spelling Checker, Please

•Love your magazine. Lots that's interesting and pertinent. Forrest Mims' series on laser diodes is a real winner; well-

(Continued on page 59)

NEW! Lower Price Scanners

Communications Electronics,™ the world's largest distributor of radio scanners, introduces new lower prices to celebrate our 15th anniversary.

Regency‡ MX7000-DA

List price $699.95/CE **price $394.95/SPECIAL**
10-Band, 20 Channel • Crystalless • AC/DC
Frequency range: 25-550 MHz. continuous coverage and 800 MHz. to 1.3 GHz. continuous coverage
The *Regency* MX7000 scanner lets you monitor military, F.B.I., Space Satellites, Police and Fire Departments, Drug Enforcement Agencies, Defense Department, Aeronautical AM band, Aero Navigation Band, Fish & Game, Immigration, Paramedics, Amateur Radio, Justice Department, State Department, plus thousands of other radio frequencies most scanners can't pick up. The *Regency* MX7000 is the perfect scanner for intelligence agencies that need to monitor the new 800 MHz. cellular telephone band. The MX7000, now at a special price from CE.

Regency® Z60-DA

List price $379.95/CE **price $179.95/SPECIAL**
8-Band, 60 Channel • No-crystal scanner
Bands: 30-50, 88-108, 118-136, 144-174, 440-512 MHz
Hear Police, Aircraft and the FM Broadcast Bands.
The Regency Z60 covers all the public service bands plus aircraft and FM music for a total of eight bands. The Z60 also features an alarm clock and priority control as well as AC/DC operation. Order today.

Regency® Z45-DA

List price $329.95/CE **price $159.95/SPECIAL**
7-Band, 45 Channel • No-crystal scanner
Bands: 30-50, 118-136, 144-174, 440-512 MHz
The *Regency* Z45 is very similar to the Z60 model listed above however it does not have the commercial FM broadcast band. The Z45, now at a special price from Communications Electronics Inc.

Regency® RH250B-DA

List price $613.00/CE **price $329.95/SPECIAL**
10 Channel • 25 Watt Transceiver • Priority
The *Regency* RH250B is a ten-channel VHF land mobile transceiver designed to cover any frequency between 150 to 162 MHz. Since this radio is synthesized, no expensive crystals are needed to store up to ten frequencies without battery backup. All radios come with CTCSS tone and scanning capabilities. A monitor and night/day switch is also standard. This transceiver even has a priority function. The RH250 makes an ideal radio for any police or fire department volunteer because of its low cost and high performance. A UHF version of the same radio called the RU150B covers 450-482 MHz. but the cost is $449.00. To get technician programming instructions, order a service manual from CE with your radio system.

NEW! Bearcat® 50XL-DA

List price $199.95/CE **price $114.95/SPECIAL**
10-Band, 10 Channel • Handheld scanner
Bands: 29.7-54, 136-174, 406-512 MHz.
The Uniden Bearcat 50XL is an economical, hand-held scanner with 10 channels covering ten frequency bands. It features a keyboard lock switch to prevent accidental entry and more. Also order part # **BP50** which is a rechargeable battery pack for $14.95, a plug-in wall charger, part # **AD100** for $14.95 and also order optional cigarette lighter cable part # **PS001** for $14.95.

NEW! JIL SX-400-DA

List price $799.95/CE **price $399.95/SPECIAL**
Multi-Band, 20 Channel • No-crystal Scanner
Search • Lockout • Priority • AC/DC
Frequency range 26-520 MHz. continuous coverage
With optionally equipped RF converters 150KHz -3.7 GHz
To celebrate our 15th anniversary, when you order the *JIL* SX-400 synthesized scanner before March 31, 1986, from CE, you'll get your choice of the RF-8014-DA or RF-5080-DA converter *free*. Or if you prefer, you can get the RF-1030-DA converter for only $50.00 more with your SX-400 order. The *JIL* SX-400 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. You may also order the following RF converters for your SX-400 scanners separately at these prices **RF-1030-DA** at $234.95 each for frequency range 150 KHz.-30 MHz. USB, LSB, CW and AM. (CW filter required for CW signal reception); **RF-5080-DA** at $194.95 each for 500-800 MHz.; **RF-8014-DA** at $194.95 each for 800 MHz.-1.4 GHz. Be sure to also order **ACB-300-DA** at $99.95 each which is an antenna control box for connection of the RF converters. The **RC-4000-DA** data interface at $259.95 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. Add $10.00 for shipping both the scanner and free converters. 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.

SPECIAL! JIL SX-200-DA

List price $499.95/CE **price $157.95/SPECIAL**
Multi-Band - 16 Channel • No-Crystal Scanner
Frequency range 26-88, 108-180, 380-514 MHz.
The JIL 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 read-outs 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 all for this special price.

NEW! Regency® HX1200-DA

List price $369.95/CE **price $219.95/SPECIAL**
8-Band, 45 Channel • No Crystal scanner
Search • Lockout • Priority • Scan delay
Sidelit liquid crystal display • EAROM Memory
New Direct Channel Access Feature
Bands: 30-50, 118-136, 144-174, 406-420, 440-512 MHz.
The new handheld *Regency* HX1200 scanner is fully keyboard programmable for the ultimate in versatility. You can scan up to 45 channels at the same time including the AM aircraft band. The LCD display is even sidelit for night use. Order **MA-256-DA** rapid charge drop-in battery charger for $68.95 plus $3.00 shipping/handling. Includes wall charger, carrying case, belt clip, flexible antenna and nicad battery.

NEW! Bearcat® 100XL-DA

List price $349.95/CE **price $209.95/SPECIAL**
9-Band, 16 Channel • Priority • Scan Delay
Search • Limit • Hold • Lockout • AC/DC
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!
Included in our low CE price is a sturdy carrying case, earphone, battery charger/AC adapter, six AA ni-cad batteries and flexible antenna. Order your scanner now.

Bearcat® 210XW-DA

List price $339.95/CE **price $209.95/SPECIAL**
8-Band, 20 Channel • No-crystal scanner
Automatic Weather • Search/Scan • AC/DC
Frequency range: 30-50, 136-174, 406-512 MHz.
The new Bearcat 210XW is an advanced third generation scanner with great performance at a low CE price.

NEW! Bearcat® 145XL-DA

List price $179.95/CE **price $102.95/SPECIAL**
10 Band, 16 channel • AC/DC • Instant Weather
Frequency range: 29-54, 136-174, 420-512 MHz.
The *Bearcat* 145XL makes a great first scanner. Its low cost and high performance lets you hear all the action with the touch of a key. Order your scanner from CE today.

NEW! Bearcat® 800XLT-DA

List price $499.95/CE **price $317.95**
12-Band, 40 Channel • No-crystal scanner
Priority control • Search/Scan • AC/DC
Bands: 29-54, 118-174, 406-512, 806-912 MHz.
The Uniden 800XLT receives 40 channels in two banks. Scans 15 channels per second. Size 9¼" x 4½" x 12½."

OTHER RADIOS AND ACCESSORIES

Panasonic RF-2600-DA Shortwave receiver	$179.95
Panasonic RF-B300-DA Shortwave receiver	$195.95
RD95-DA *Uniden* Remote mount Radar Detector	$128.95
RD55-DA *Uniden* Visor mount Radar Detector	$98.95
RD9-DA *Uniden* "Passport" size Radar Detector	$239.95
BC 210XW-DA *Bearcat* 20 channel scanner **SALE**	$209.95
BC-WA-DA *Bearcat* Weather Alert™	$49.95
DX1000-DA *Bearcat* shortwave receiver **SALE**	$349.95
PC22-DA *Uniden* remote mount CB transceiver	$99.95
PC55-DA *Uniden* mobile mount CB transceiver	$59.95
R1060-DA *Regency* 10 channel scanner	$98.95
MX3000-DA *Regency* 30 channel scanner	$198.95
XL156-DA *Regency* 10 channel scanner **SALE**	$129.95
UC102-DA *Regency* VHF 2 chan 1 Watt transceiver	$124.95
RH250B-DA *Regency* 10 ch. 25 Watt VHF transceiver	$329.95
RH600B-DA *Regency* 10 ch 60 Watt VHF transceiver	$454.95
RU150B-DA *Regency* 10 channel UHF transceiver	$449.95
RPH410-DA 10 ch. handheld no-crystal transciever	$399.95
P1405-DA *Regency* 5 amp regulated power supply	$69.95
P1412-DA *Regency* 12 amp regulated power supply	$119.95
BC10-DA Battery charger for *Regency* RPH410	$79.95
MA256-DA Drop-in charger for HX1000 & HX1200	$68.95
MA257-DA Cigarette lighter cord for HX1200	$19.95
MA917-DA Ni-Cad battery pack for HX1200	$34.95
EC10-DA Programming tool for *Regency* RPH410	$24.95
SMRH250-DA Service man. for *Regency* RH250	$24.95
SMRU150-CA Service man for *Regency* RU150	$24.95
SMRPH410-DA Service man for *Regency* RPH410	$24.95
SMMX7000-DA Svc. man. for MX7000 & MX5000	$19.95
SMMX3000-DA Service man for *Regency* MX3000	$19.95
B-4-DA 1.2 V AAA Ni-Cad batteries (set of four	$9.00
A-135C-DA Crystal certificate	$3.00
FB-E-DA Frequency Directory for Eastern U.S.A.	$12.95
FB-W-DA Frequency Directory for Western U.S.A.	$12.95
TSG-DA "Top Secret" Registry of U.S. Govt. Freq	$14.95
TIC-DA Techniques for Intercepting Comm.	$14.95
RRF-DA Railroad frequency directory	$10.95
CIE-DA Covert Intelligenct, Elect. Eavesdropping	$14.95
A60-DA Magnet mount mobile scanner antenna	$35.00
A70-DA Base station scanner antenna	$35.00
USAMM-DA Mag mount VHF/UHF ant. w/ 12' cable	$39.95
USAK-DA ¾" hole mount VHF/UHF ant. w/ 17' cable	$35.00
USATLM-DA Trunk lip mount VHF/UHF antenna	$35.00

Add $3.00 shipping for all accessories ordered at the same time.
Add $12.00 shipping per shortwave receiver.
Add $7.00 shipping per scanner and $3.00 per antenna.

BUY WITH CONFIDENCE

To ***get the fastest delivery from CE*** of any scanner, send or phone your order directly to our Scanner Distribution Center.™ Michigan residents please add 4% sales tax or supply your tax I.D. number. Written purchase orders are accepted from approved government agencies and most well rated firms at a 10% surcharge for net 10 billing. All sales are subject to availability, acceptance and verification. All sales on accessories are final. Prices, terms and specifications are subject to change without notice. All prices are in U.S. dollars. Out of stock items will be placed on backorder automatically unless CE is instructed differently. A $5.00 additional handling fee will be charged for all orders with a merchandise total under $50.00. Shipments are F.O.B. Ann Arbor, Michigan. No COD's. Most products that we sell have a manufacturer's warranty. Free copies of warranties on these products are available prior to purchase by writing to CE. Non-certified checks require bank clearance.

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CIRCLE 31 ON FREE INFORMATION CARD

THE BEAT DOESN'T GO ON. Greenwich Mean Time, the timekeeping standard in Great Britain since 1675, will be shut down within a year or so. Seems that the six atomic clocks are too costly to maintian (about $100,000 per year). The clocks aren't located in Greenwich anymore, nor does the world depend on their timekeeping now since timekeeping standards are based on readings of 150 atomic clocks spread around the world by a Paris-based organization. Nor is "Greenwich" time called by that name now. It has been Coordinated Universal Time (abbreviated out of alpha order as UTC) for some time. Another tradition down the drain.

VIDEO CAMERAS SLIP. Video camera sales dipped almost 33% in November '85; 13% Jan. - Nov. '85. This appears to reflect the growing sales of camcorders (VCR-camera combinations using the 8-mm format). Color TV receivers were up 4.3% in the same period as compared to 1984, while home VCRs led all video products with a 56.7% year-to-date increase.

ELECTRONIC CALCULATOR PRODUCTION MILESTONE. Sharp Electronics recently rolled off its assembly line in Japan the 200 millionth electronic calculator just five years after automating production. During the company's first decase of electronic calculator production, which started in 1964, it averaged 100,000 units per year. Now it spews out 30 million a year or one calculator every second.

300,000 WORDS/SECOND SCANNER. A computer information retrieval system powerful enough to scan ten years of back issues from a major daily newspaper in 12 minutes and "read" the Bible in three seconds has been announced by the Scottish Development Agency. Developed by Memex, Ltd, East Kilbride, Scotland, the $200,000 Unix-based mini, called the Hypersearch, requires no indexing of the data base, no key words, no limit on data-base size, unlike conventional data bases do.

NEW "POWER STICK" BATTERY. GE has introduced a new rechargeable battery called "The Power Stick" that can replace several C- or D-size batteries in portable TV sets and stereo cassette recorders. It comes with a charging ring that connects to a separately installed positive electrical contact to recharge the battery automatically whenever the product is plugged into an ac outlet.

CAR SEAT REMEMBERS YOU. A tiny on-board computer, about the size of two packs of cigarettes, remembers your seat-adjustment position plus one other person's. Its an option on 1986 Cadillacs, working in conjuction with ITT's six-way power seat adjustor. To use after programming, the driver simply pushes a numbered button on the door panel.

COMMUNICATIONS TECHNICIANS ASSOCIATION. The Association of Communications Technicians (ACT) was formed July 1985 by the National Association of Business and Educational Radio (NABER) and, as of September '85, has 285 members. All comtechs are eligible for General membership, while certified members can join as Senior Members. Information on benefits, how to join, etc., can be received by calling NABER at 202-833-3956.

SECURITY ALERTER FOR WANDERING ELDERLY. With longevity extended in the U.S., there are more and more people who "wander" due to Alzheimer's disease or just plain senility. A new electronic device to monitor the security of these people was introduced by Cortrex Electronics (Southern California). Called "Kare Alert," it consists of small, FM-linked units that keep tabs on whereabouts of up to two persons simultaneously. The units have a water alarm, range settings, and an emergency call button.

career servicing computers.

fine tune your computer skills. And you also get over $1,000 worth of software, including WordStar and CalcStar.

Learn to service today's computers

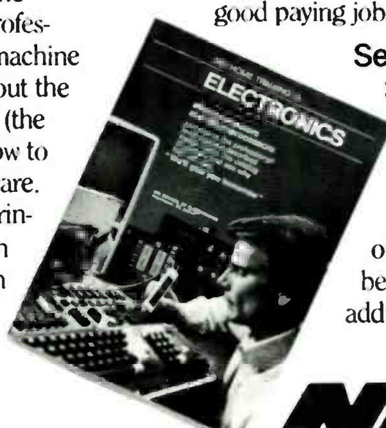
As you train with your Sanyo, you'll gain the knowledge you need to become a computer professional. You'll learn to program in BASIC and machine language. You'll use utility programs to check out the operation of the Sanyo's 8088 microprocessor (the same chip used in the IBM PC). You'll learn how to debug programs and write your own new software.

Most importantly, you'll understand the principles common to all computers. Only a person who fully understands all the fundamentals can hope to be able to tackle all computers. NRI makes sure that you'll get the training you need to maintain, troubleshoot and service computers.

Learn at home in spare time

With NRI training, you'll learn at home on your own time. That means your preparation for a new career or part-time job doesn't have to interfere with your current job. You'll learn at your own pace, in the comfort and convenience of your own home. No classroom pressures, no rigid night school schedules. You're always backed up by the NRI staff and especially your NRI instructor, who will answer questions, give you guidance and be available for special help if you need it.

Let others worry about computers taking their jobs. With NRI training, you'll soon have computers making good paying jobs for you.



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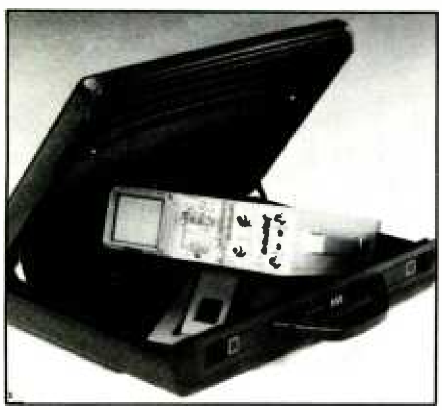
NEW PRODUCTS

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

Miniature Oscilloscope

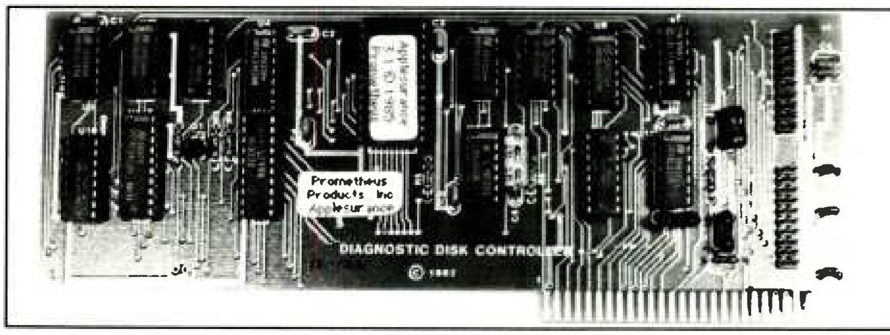
New from Leader Instruments Corp. is the Model LBO-325, a 2-channel, 60-MHz attache-case-size oscilloscope. The full-featured scope has a large 8 × 10 division, 3.5″ rectangular CRT with internal graticule and a 12-kV accelerating voltage for sharp, clear and bright trace display. A dual timebase with calibrated delay and



alternate sweep allows any portion of a waveform to be expanded for detailed observation while still displaying the main timebase. Comprehensive triggering facilities include alternate triggering for a stable display of two asynchronous signals, video sync separators, variable trigger holdoff, level and preset controls.

The vertical input section offers 1-mV sensitivity and add and subtract modes. A channel-1 output is available on the rear panel to drive other less-sensitive equipment. A signal delay line is provided to permit observation of sharp leading edges. The 8-lb. LBO-325 comes with carrying handle and fold-away tilt stand. $1500.

CIRCLE 25 ON FREE INFORMATION CARD



Apple II Diagnostic Disk And Controller Card

Jameco Electronics has just introduced its Model JE877 "Applesurance" diagnostic disk controller card for Apple II, II + and IIe computers. The new assurance/maintenance tool and dual-disk drive controller can verify and check the operating hardware of an Apple system each time the computer is turned on.

On power-up, the system checks RAM and ROM memory, the CPU and the disk drives. The diagnostic routines can be canceled with the touch of a keyboard key. The package comes with complete user instructions. $69.95.

CIRCLE 26 ON FREE INFORMATION CARD

Portable CD Player

Magnavox's new Model CD-9510 super-compact disc player measures only 7.46″D × 4.96″W × 1.57″H

for convenient carry-along listening. This personal Compact Disc player offers a 10-track music memory and repeat, forward and reverse track skip, forward/reverse music search, play/pause control and a nine-function display.

Additional features include a stop/clear function, an open-door key, a power key and a mode key. There are also a Remain key that selects the display of either elapsed or remaining time and a Program key that can be used to store or cancel tracks in the 10-track music memory.

In addition to operating on its own battery pack for portable use, the CD player can be used in a home-entertainment system using an ac adapter. $300 includes main unit, ac adapter and connecting cord; $60 for accessory pack that includes battery pack, carrying case, shoulder strap and digital headset.

CIRCLE 27 ON FREE INFORMATION CARD

Portable Charger/Power Pack

A hand-held rechargeable, self-contained power pack capable of charging a spent battery in 30 minutes or less has been introduced by Energy Exchange Systems. Called the "Charge It Power Pac," it is designed to be plugged into the cigarette lighter receptable in a vehicle to restore a weak battery to starting condition without leaving the vehicle.

In addition to recharging batteries, the Charge It can be used as a portable power supply for any appliance that runs on 12 volts dc. Each unit comes with a 12-volt adapter for use with any compatible accessory. Charge It is fully rechargeable; the GE Ni-Cd battery included in it can be replenished from either 117-volt

ac house current or a 12-volt dc source. Connections for both ac and dc charging are included.

Charge it measures 6″ × 3″ × 2″ and weighs 2 lbs., yet delivers 6 amperes of charging current. A zippered storing case is supplied with the device.

CIRCLE 28 ON FREE INFORMATION CARD

Professional-Grade DMM

A professional-grade digital multi-

meter with a 100-ms response time is available from Beckman Industrial as the Model 310B. It features an audible beeper that simplifies making continuity checks. Response time in this mode is 100 ms to beep turn-on. The DMM also features a 10-ampere current range, 0.25% dc voltage accuracy, a diode test function, a 10-kHz bandwidth on ac, and a 2000-hour battery life.

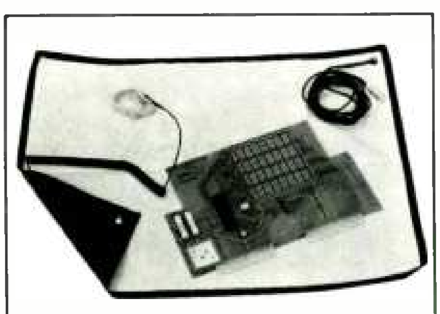
A single large rotary switch selects both function and range simultaneously for simplified operator use. Measurements appear in a large 3½-decade LCD window, along with a legend of the function selected. Overload protection is to 5 kV transients on all voltage ranges and to 600 volts on all resistance ranges. The 2-ampere current range is protected with a 2-ampere, 600-volt fuse, while the 10-ampere range is unfused and can withstand up to a 20-ampere overload for 30 seconds.

The 310B comes with test leads, battery, spare fuse and user's manual. $155.

CIRCLE 29 ON FREE INFORMATION CARD

Antistatic Workstation

A new low-cost antistatic workstation from Wescorp (Mountain View, CA) has been designed with electronics hobbyists in mind. The Model



WS9001 workstation includes an 18″ × 24″ workbench cover, an adjustable wrist strap and a grounding strap. The conductive and dissipative fabric cover's black side protects products against sensitivity to electrostatic charges of 1000 volts or less. The green side extends static protection to the 1000-to-4000-volt range.

The adjustable wrist strap is made of elastic polyester with a buckle that can be adjusted to any wrist size without leaving a "tail." Insulation on the outside of the attachment protects the user against electrical shock from contact with equipment.

A 10-ft. retractable wrist-strap cord has a banana jack at the end that mates with a banana plug on the mat. A 10-ft. conductive plastic grounding cord with an alligator clip connects to the opposite corner of the bench cover. Both wrist and grounding straps have built-in 1-megohm safety resistors. $39.95.

CIRCLE 30 ON FREE INFORMATION CARD

Satellite TV Receiver Kit

Dick Smith Electronics is now marketing a price-busting satellite TV receiver kit designed for easy assembly and alignment. Once the kit is assembled, only a received signal and

a multimeter are required to get it properly tuned for clean reception. Everything needed to assemble the kit is provided, including all components, hardware, silk-screened front and rear panels, and enclosure. The fiberglass printed-circuit board is solder masked and has a components-placement overlay. $100.

CIRCLE 31 ON FREE INFORMATION CARD

Deluxe Radar Detector

Sparkomatic's dual-conversion su-

(Continued on page 80)

Franklin Ace 2200 Computer:

A cross between the IIe and IIc with an IBM-style keyboard

No matter what model of computer you have, there are certain features that you wish you could change. For Franklin Computer, which was the first major Apple-clone maker, its new ACE 2200 computer may well be your answer, since it presents a blend of some of the best features of the Apple IIe, IIc and IBM PC.

The 2200 system consists of the main unit, which houses a motherboard and two floppy drives, a detachable keyboard, with a 6-ft. coiled cord, and high-resolution monitor. The system is compatible with most Apple II software and has suggested retail prices of $999 for the computer and $139 for the monitor. A single-drive ACE 2100 model retails for $849, while an ACE 2000 model with no drives has a suggested retail price of $699.

Overview 2200

The Franklin ACE 2200 has many of the same standard features as the Apple IIc. It has 128K RAM, 80-column capability, a 65SC02 microprocessor (the functional equivalent of the 65C02) and an I/O port. But rather than two serial ports, as on the IIc, the Franklin includes a single parallel port with a DB-25 interface as on the IBM PC, giving the machine greater versatility for mating a dot-matrix printer to it.

The sleek looking main unit, made of sturdy metal, is predominantly beige with a black front. LEDs on the front indicate power, diagnostics, CPU activity (judged by brightness and blinking rate), disk errors and double hi-res graphics. To open the unit, you unscrew two screws and lift one side up. The motherboard on the 2200 contains two Apple-compatible hardware slots. This is two more than the IIc, though five less than the IIe. But contrasting the 2200 with the IIe, some important functions, such as 80-column capability, extra RAM, the floppy-disk interface, and printer interfaces are either included on the motherboard or on a card that connects to the board, instead of being options. And the 2200's price is still less than the IIe's without the options.

The two slots function as slot #2, the usual slot for a serial card, and either #4 or #7, depending on the position of a jumper connector. There is 64K of RAM on the 2200 motherboard and an additional 64K on a "daughter-board" card that connects to the board. Franklin recently announced memory cards of either 320K ($139) or 512K ($199) RAM that can replace the 64K card, increasing user memory from 128K to either 384K or 576K. Either replaces the daughter board so that an extra slot is not used up. The printer interface supports printers from Epson, Okidata, C. Itoh, and Star Micronics. For those who really need extra slots, there is a bus connector on the motherboard that can be connected to a four-slot expansion chassis. A serial port board can also be added for data communications purposes.

Memory can be used as a solid-state disk drive for high-speed work. A utility diskette that comes with the Franklin computer includes a software program for this purpose. The extended memory card is also compatible with software for Ramworks or Titan cards. The chip population on the motherboard is more like that of the Apple II+ than the IIe. However, it is expected that Franklin will soon be using custom chips that will replace many of the chips now on the board as Apple has done.

The main unit contains two 5.25" half-height floppy-disk drives mounted side by side. Disks can be formatted with 35 or 40 tracks and store up to 165K. Storage on Apple II disks is 143K.

For game players, there is a 9-pin joystick port at the rear of the main unit. The old 16-pin DIP game connector is still around, though; it's located on the motherboard. This connector, like the IIe's, does not support a mouse. A built-in speaker and adjustable volume control are included.

The system unit contains a power supply rated at 67.1 watts, which is much higher than that of the Apple IIe. This higher capacity might allow such components as an internal hard disk to be

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5¼" DSQD Soft Sector (96 TPI)	6501-CA	0.99
5¼" Same as above, but bulk pack w/o envelope	6507-CA	0.84
5¼" DSHD for IBM PC/AT - bulk pack	6667-CA	2.07
3½" SSDD (135 TPI) - bulk pack	6317-CA	1.67
3½" DSDD (135 TPI) - bulk pack	6327-CA	1.99

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

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mounted in the main unit. To avoid any heating problems, there is a built-in fan (which gives off a low hum) that Apple IIe's do not provide as standard.

A Generous Keyboard

The 220 uses a black-and-gray 90-key detachable "capacitive-switch" keyboard with an IBM Selectric layout. In addition to the regular "qwerty" keyboard, there are a numeric keypad and 12 function keys. The function keys are automatically programmed when booting Franklin DOS, but can be reprogrammed through BASIC commands. "Caps Lock" and "Num Lock" keys have on/off LEDs.

The keyboard has a professional feel to it, but differences of key placement with the Apple IIe keyboard might require getting familiar with the changes in an office that uses both computers. Franklin's version of the "open-Apple" and "closed-Apple" keys are open and closed F keys, located at the top right-hand side of the keyboard. For programs such as Appleworks, which makes extensive use of these keys, the Franklin keys are somewhat out of position.

The cursor keys are on the numeric keypad and form a diamond shape, similar to the IBM PC keyboard. Though an improvement over the IIe and IIc keyboards, people who use both computers could experience some problems.

There are certain functions you can perform with the Franklin keyboard that can't be done on the IIe or IIc. For example, keys to list and run BASIC programs are available on the numeric keypad. There are also special editing keys such as ENTER, CLS (clear screen), CLRL (clear line), INSC (insert character), DELC (delete character), and CPES (copy entire screen line). This last function is especially helpful to programmers who can make changes in a program line and then copy the rest of the line with a single keystroke.

The function keys give an extra dimension to the keyboard. Up to 233 characters can be preset. When Franklin DOS is booted, each key is given a special function. For example, pressing the F4 key turns on printer output (PR#1) and F5 switches from 80- to 40-column text. If you want to perform functions other than those given, any of the keys can be reprogrammed through BASIC.

Franklin Ace 2000 keyboard features alphabetic, numeric, punctuation, special-character, 12 function, nine special editing, and numeric/cursor-control keys. LEDs are built into the Caps Lock and Num Lock keys.

Franklin DOS, BASIC, and Compatibility

According to Franklin, "The Franklin DOS2 operating system is functionally compatible with the Apple DOS 3.3 and PRODOS operating systems." Nonetheless, buyers should check that the programs they want to use with the 2200 will work. I found that popular programs such as Appleworks and SuperCalc 3a ran without problems. However, Franklin publishes a list of programs that will and will not work on the 2200. The most notable program on the "will not work" list is Applewriter IIe.

The Franklin 2200 contains the standard characters of the IIe as well as the mouse characters of the Apple IIc. A switch at the rear of the main unit lets you choose the applicable character set. Thus, the 2200 will run programs like MouseCalc. Most of the incapatibilities are caused by Integer BASIC programs, programs that produce lowercase characters in an unconventional manner, and programs that interact with the operating system in non-standard ways. A final note on compatibility is that Apple's PRODOS runs on this machine.

Franklin DOS2 allows you to format disks with either 35 or 40 tracks. The DOS is also much faster than DOS 3.3 in terms of disk access. For example, a 51-sector BASIC program loaded in 14.9 seconds under DOS 3.3 and 5.2 seconds under Franklin DOS2.

Once DOS2 has been loaded, certain keyboard commands are available to the user. For instance, with an appropriate control sequence, you can do a screen dump of either text or graphics. But these functions are generally useful only to programmers since applications for this computer will more than likely be under control of an operating system other than Franklin DOS2.

Franklin BASIC is in ROM. The language is equivalent to Applesoft BASIC, but the addition of special editing keys makes it easier to work with. Franklin BASIC differs from Applesoft in that it supports and displays lowercase letters, and it does not support commands that control cassette tape drive storage. (Disk is the only way to go anyway.)

Double Hi-Res Display

The Franklin 2200, like the IIe and IIc,

Ace 2200 Details

Name: Ace 2200
Manufacturer: Franklin Computer, Route 73 Haddonfield Rd., Pennsauken, NJ 08110 (609) 488-0666
Microprocessor: 65SC02
RAM: 128K
I/O: Parallel Centronics port
Dimensions: 16"W × 13.5"D × 4.5"H
Storage: Dual 5.25" floppy drives; 164K formatted capacity
Operating system: Franklin DOS2 v. 5.0
Compatibility: Apple IIc, IIe, II+

can display double hi-res graphics, which allows a display of 560 × 192 pixels on the screen. Standard video output, like with the IIe and IIc, is composite color. If an RGB output is desired, an adapter board that connects to a special 24-pin connector on the motherboard is available from Franklin. It's said to support RGB monitors that are IBM or Apple compatible. Further, the card is selectable for positive or negative sync and composite or separated sync. An optional r-f modulator is available for using a television receiver as a display.

For text display, Franklin manufactures a high-resolution 22-MHz monochrome monitor with 1000-line resolution capability, which uses a non-glare 12" flat screen and has its own tilt and swivel base. Unfortunately, we were not able to obtain a unit in time for this review, which is offered at a special "bundled" price below its $139 suggested one.

Comments/Conclusions

I used the Ace 2200 to run such programs as Appleworks, SuperCalc 3a, and a number of game programs. Since I do not use Appleworks as my main integrated program, I had little trouble becoming accustomed to the position of the open-F key, which is used often by the program. However, a person considering the Franklin as a backup to an Apple, might have problems with this.

Although the Franklin keyboard provides considerable utility, it is hard to realize its full potential, since programs like Appleworks do not recognize the function keys. I found the best features of the keyboard to be the numeric keypad and the fact that the keyboard is separate from the main unit.

After Apple Computer stomped on Franklin Computer for cloning too close to its parents, Franklin went into Chapter

PRODUCT EVALUATIONS...
Franklin Ace 2200 continued . . .

11 of the bankruptcy law. It has obviously reorganized and emerged from it with the financial backing of Renaissance Technologies, New York. The company is now a tightly run operation with about 50 people as compared to about 750 employees at its earliest zenith.

According to a company spokesperson, Franklin now has more than 500 computer dealers nationwide carrying its products. The company has a very appealing warranty policy—a 90-day over-the-counter *exchange* should anything be wrong. This is beautiful, as anyone who ever had a new product with a defect and had to wait until it was repaired will heartily appreciate.

To summarize my views on the Ace 2200 computer after thoroughly examining it, the machine is a fine computer for home use and small-business applications for anyone with a modest budget. It offers fewer internal expansion slots than the Apple IIe (though using them more efficiently to make up for it), but incorporates all the extras that one needs for serious computer work and still comes up at a price under the basic Apple IIe without the costly options. In this respect it's more like the Apple IIc, but has much, much more in the way of flexibility since the IIc is a closed system with a 128K user memory maximum and no expansion facilities for those desirable extra boards to expand a machine's utility. And it has a nice separate keyboard, to boot, as well as operating much faster than Apples do.

Though the Ace won't run odd integer BASIC programs written for Apples, it handles all the most popular Apple software. Thus, one can start out quickly with a wide choice of applications in any important area. The machine is certainly a good buy, though I'd be sure to get one from a reliable local dealer authorized to carry the Franklin line in order to take advantage of its warranty exchange policy. For more memory past the 128K standard, a dealer can exchange 64K-bit chips for 256K ones at a later date rather than switching a whole board. (Or buy the chips and plug them in yourself.)

Franklin Computer sold many machines in the past by providing a capable home/small-business system at an affordable price. The 2200, brimming with features that are usually costly optional items, is a fine example of Franklin's continuing commitment to its heritage.

—Joe Desposito.

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Video

Sony's New Model CCD-V8AFU "Video 8" Camcorder

Sony has forsaken the Beta videocassette system it devloped and fostered, but it's apparently covering its future by making a commitment to 8-mm camcorders. It now has a few 8-mm camcorder models, one of which is the deluxe Model CCD-V8AFU Video 8 reviewed here. This model has most of the amenities one would expect a deluxe portable to have, including power zoom lens, automatic/manual focus, high-speed picture search, sensitive charge-coupled device (CCD) image pickup, built-in electronic viewfinder, microphone, and record and direct playback on a TV receiver, among the many features it provides. The audio section comes in for special treatment, employing audio frequency modulation with up to 70 dB of dynamic range.

Measuring 13.375"L × 7.5"H × 5.5"D, the CCD-V8AFU Video 8 weighs 5 lbs. 17 ozs. Thus, it's one of the largest and heaviest 8-mm camcorders around. Its suggested retail price of $1795 includes battery pack, battery charger, shoulder strap, and blank 30-minute P6-30 metal-powder tape. (This camcorder can handle tapes with up to 120-minute capacity and in a future release will be available with a long-play, or LP, mode to provide up to 4 hours of record/play time.) Available options include a battery pack; a tuner/timer for recording programs off the air,

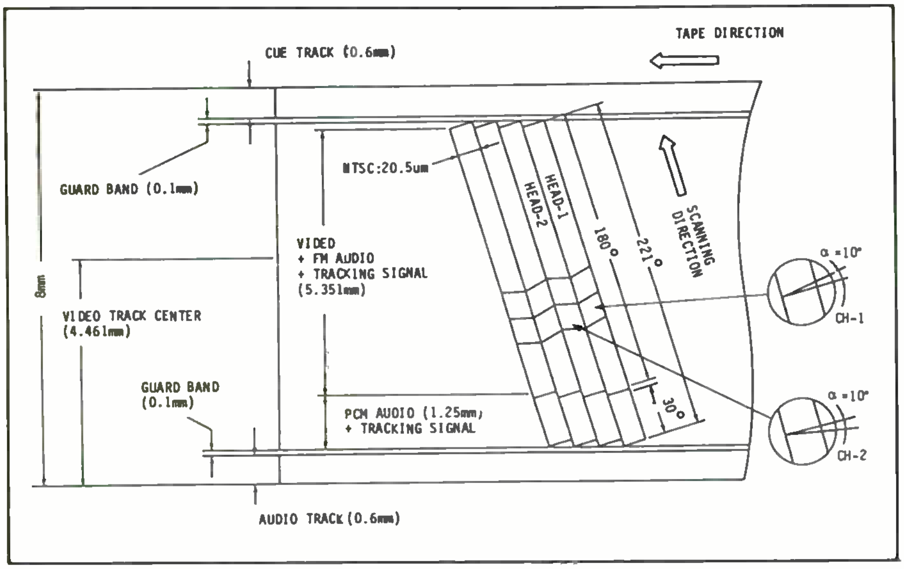


Fig. 1. The 8-mm video tape format shows dual video head tracking, including FM audio and the tracking signal, with reserved cue and audio tracks running horizontally at the top and bottom of the narrow 8-mm tape.

even unattended; a video editing controller; a Remote Commander remote controller; and an ac battery recharger.

General Description

As expected at the Model CCD-V8AFU's price, size and weight, this camcorder is loaded with features. Its solid-state CCD imaging device is complemented by a 6× power zoom lens with a 12- to 72-mm range at f/1.4 to f/1.7. User-selected auto/manual is available. The imaging/lens system has an illumination range of from 19 to 100,000 lux, or from 1.8 to 9294 footcandles (fc).

There are three record/play heads in the camcorder. Two rotary scanning M&F (Micro and Fine) recording heads process FM video, while the third head is for FM audio signal processing. A flying erase head provides noise-free picture transitions and smooth insert editing. Tape speed is 1.43 cm/s, and record/play time is 2 hours (which will soon be 4 hours). The camcorder can be used to record any NTSC video/audio signal. Programs can be recorded from either a TV screen or through any TV monitor's audio and video outputs, and live performances (including home video candids) can be taped, too, of course.

About the only things you can't do without optional extras are remotely control this Video 8 model and make it handle specially lighted scenes and receive timed TV programs or stereo sound. However, there's no problem in swapping 8-mm tapes with your neighbor, since 127 manufacturers around the globe have agreed upon 8-mm format standards *before* a single camcorder or tape was ever released for sale.

Digging deeper, you'll find an electronic viewfinder with 1" black-and-white picture tube. Inside the viewfinder housing are low-light, tape-ending and low-battery LED indicators. The viewfinder slides and rotates to accommodate right- or left-eye operation and has a rubber-protected, adjustable eyepiece and lateral adjust control, and can be detached from the camcorder, if desired.

Below the viewfinder is a detachable electret capacitive microphone; above it is a connector for a low-drain floodlight when additional illumination is needed. On the left side are manual/auto focus buttons; a manual/auto white balance control; normal/black/light light-setting and camera-power switches; and a button for reviewing in the viewfinder several seconds of the last recorded scene.

On the camcorder's rear panel are a 5-pin remote-control connector, a miniature earphone jack, and an electronic LCD tape counter with memory, moisture condensation, low-battery, no-cassette-inserted, and tape-end indicators. Also located on this panel are the VCR power button and the usual play, record, pause rewind, fast-forward and eject buttons that work the same as those on a standard videocassette recorder.

Finally, an Edit switch, lets you increase gain when editing tapes for minimum loss in picture definition through successive generations. It's like having a built-in video enhancer that's usually an extra-cost accessory with full-size VCRs.

Tiny LEDs light when record, play, pause, eject, and VTR and camera power functions are engaged. There's also a LED on the counter insert function when dubbing from a previously recorded tape.

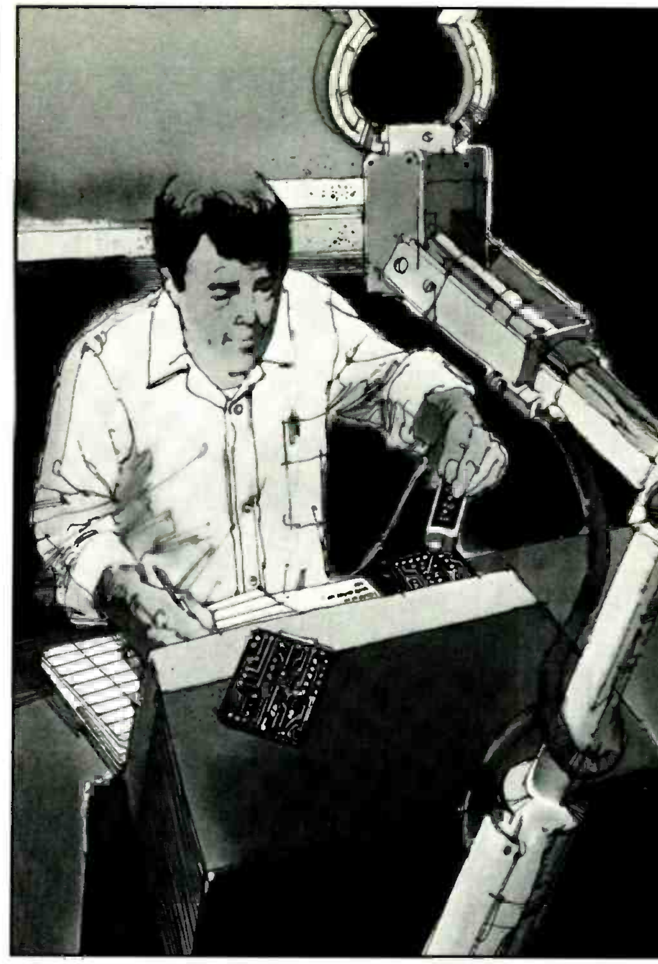
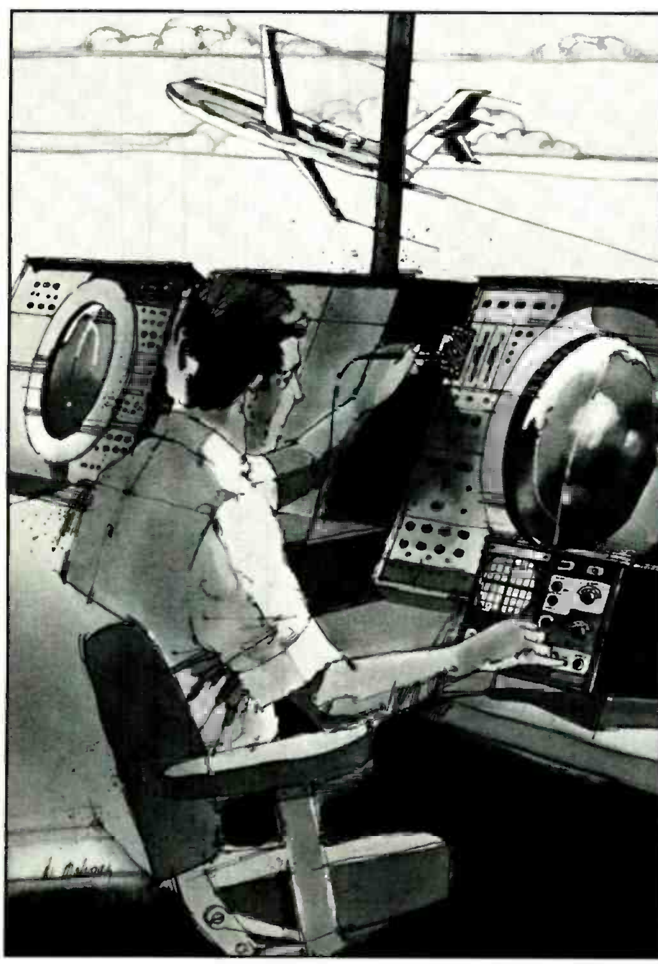
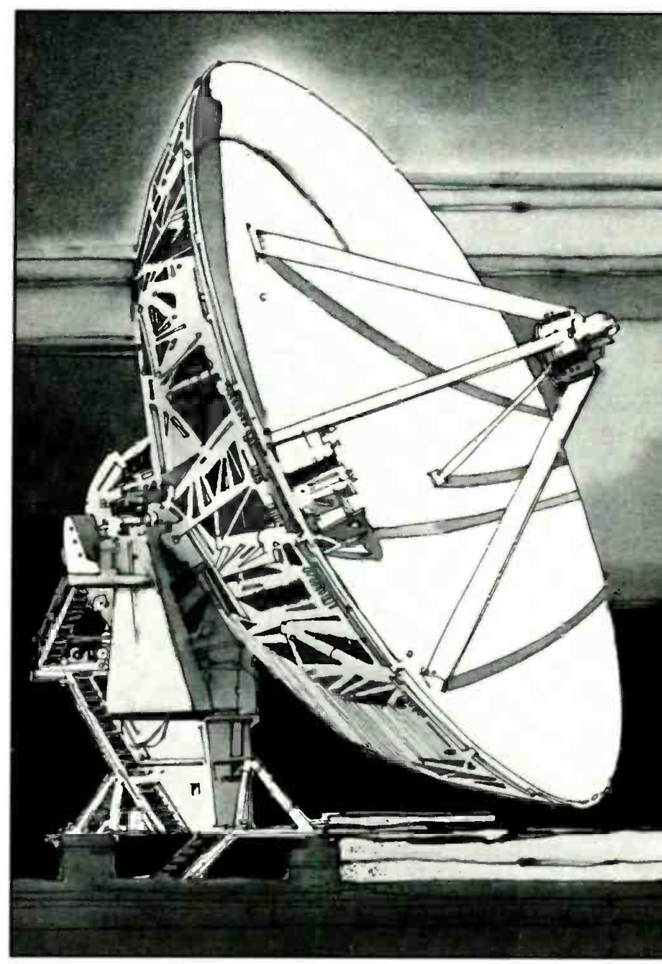
A full-view cassette well is located on the right side of the camcorder, along with an adjustable hand grip, a wide-angle/telephoto lens selector switch and separate start/stop Record buttons for thumb and forefinger.

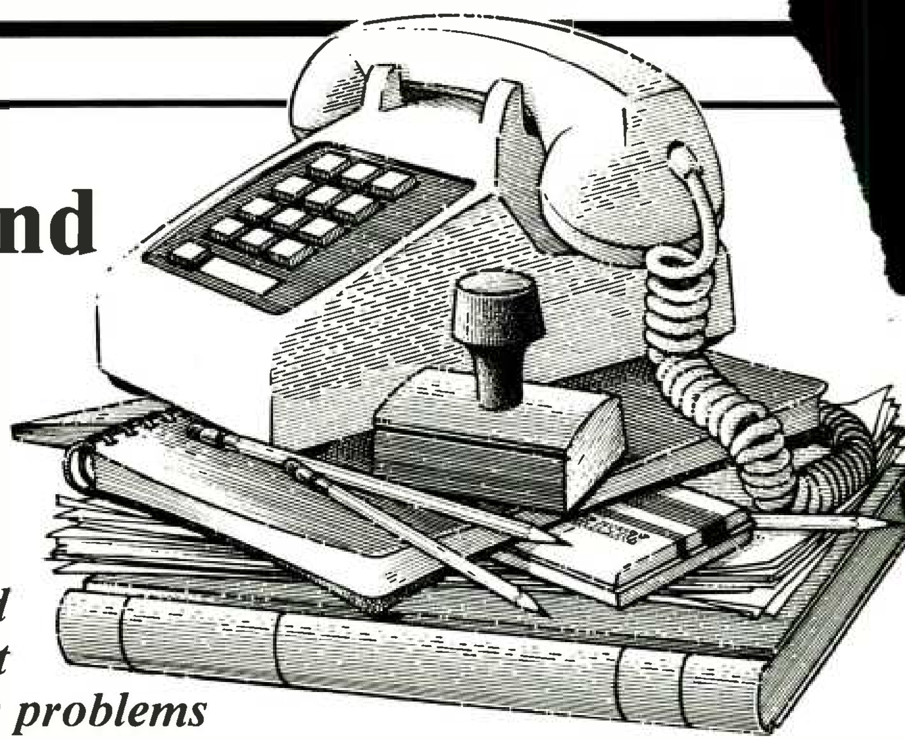
Technical Details

The semiconductor CCD imaging device used in the Model CCD-V8AFU is divided into 510 horizontal and 492 vertical elements (a total of almost 250,000 pixels). To produce color, the red, green and blue filters over the pixels are alternately sampled between fields to produce odd and even line interlacing and, because of the solid-state structure, don't lag, bloom or require warm-up time.

Images are helically scanned at high speed as the tape moves along at low speed. The 8-mm format tape is divided into four sectors for recording (Fig. 1). Rotating video heads scan two sectors on the 20.5-micron-scanned slant tracks. A 1.25-mm area is available for pulse-code modulated (FM) sound, while 6-mm top and bottom longitudinal areas can be used in the future for editing directions and special cues.

(Continued on page 85)



Telephones and Their Repair

Part 1

How telephones work and how you can troubleshoot and correct most common problems

By TJ Byers

With the words, "Mr. Watson, come here, I want you," Alexander Graham Bell established forever a revolutionary way of communicating.

For most of us, the telephone has become such an indispensible part of daily living that when something goes wrong with it, we view it as a crisis situation. Fortunately, telephones and telephone systems aren't difficult to repair. Armed with an understanding of basic electricity and a few details about the telephone system and how it works will help you get an ailing phone or line back into working condition in almost no time at all.

Basic Telephone Technology

Since its introduction, the basic design of the telephone hasn't changed much. In fact, today's telephones work pretty much the same as did Bell's invention 100 years ago.

Basically, the telephone consists of a carbon microphone in series with a battery and a remote speaker (Fig. 1). The mike works by varying the resistance of a loosely-packed carbon granules. A thin diaphragm across the carbon granules alternately compresses and expands the granules, varying the resistance according to the frequencies and amplitudes of the sounds intercepted. As the resistance varies, there's a proportional change in the current flowing through the circuit to the speaker. This current, in turn, is translated into mechanical motion (cone movement) to reproduce the original sounds in the speaker.

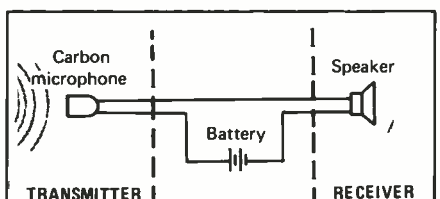


Fig. 1. The telephone is basically a carbon microphone in series with a battery and a remote speaker. Sound pressure on the carbon element varies its resistance and, thus, the current flowing through the circuit. The speaker translates these currents back into sound.

In actuality, the microphone/speaker combination is no longer in use. In modern systems, the circuit has been rearranged (Fig. 2). Now, the battery is in a central location called an *exchange*, from which the phone company runs two wires to each subscriber and selectively switches between them to complete the loop when a call is placed.

At the subscriber's end of the line is a pair of wires with a voltage across them. The telephone company calls these the "tip" and "ring" wires. (These names have deep-rooted meaning in telephone history but have little significance today.) The open-circuit voltage across this line is approximately 48 volts, but this can range from 42.75 to 52.50 volts.

In the most elementary terms, when you place a call, all you're really doing is connecting a microphone across your particular tip-and-ring wire pair. All else is accomplished at the phone company.

In reality, things are a bit more complicated than that. For instance, the phone company must be able to detect when you wish to go on-line. It does this with a current-sensing relay at the exchange.

Since the telephone is essentially a current-operated device, when you go on-line, current flows through your instrument, into the central exchange, and through your intended party's instrument, to create the loop required for communications. Limited at the exchange, the current is nominally 30 mA but can vary from 20 to 80 mA.

When you lift your phone's handset, a switch inside the instrument closes a circuit that causes current to flow. A relay at the central exchange detects the current and puts you on-line. A load of 600 ohms (which just happens to be the impedance of the telephone handset's carbon mike) or less is needed to assure that sufficient current flows to trip the relay.

Once the circuit is made, the central exchange acknowledges the off-hook condition by emitting a dialtone. The dialtone consists of 350- and 440-Hz signals. It remains in effect for approximately 10 seconds as long as there's no activity. At the end of the 10 seconds, if no activity occurs, the phone company issues an off-hook warning signal made up 1400-, 2060-, 2450-, and 2600-Hz tones that are pulsed at a rate of five times per second.

If a call is placed before the off-hook warning, the central exchange rings your party with a high-voltage ac signal. The ringer signal is a 20-Hz voltage superimposed across the ring and tip lines and is nominally 86 volts but can vary in amplitude from 65 to 130 volts ac. The ring voltage is also normally pulsed by an *interrupter* that provides a short burst of ringing with a pause between burst sequences. Although the ringing sequence varies from company to company, it is generally 2 seconds on followed by 4 seconds off. When the answering party lifts the receiver, the second leg of the current loop is completed and the ringer voltage is discontinued. The exchange then connects the two parties together.

Should the called phone already be on-line when a call is placed to it, a busy signal consisting of 440- and 620-Hz tones is fed back to the caller. The busy signal is pulsed at a 50-percent duty cycle, with 0.5-second on and off times.

As you can see, the telephone system is no more complicated than a simple dc circuit with a little ac superimposed on it from time to time. The system is so simple, in fact, that it takes little more than a multimeter and some common sense to fix most telephone problems. This being the case, let's take a look at the more common ailments.

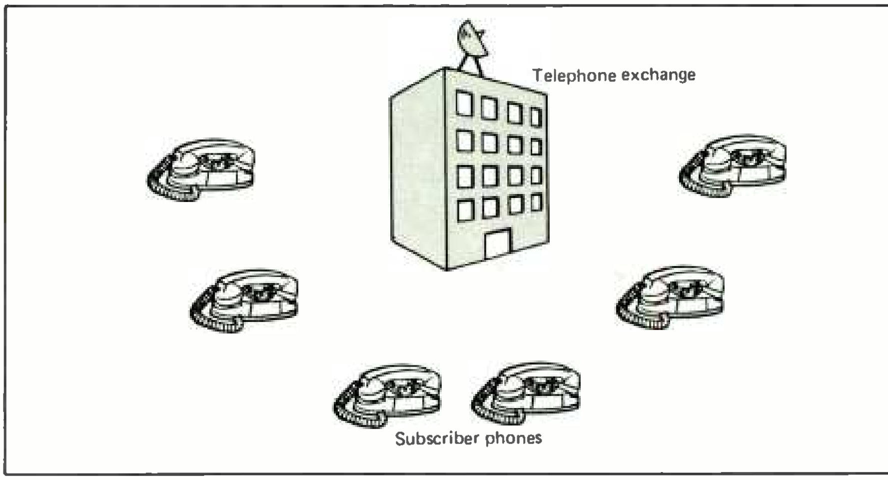


Fig. 2. A central telephone exchange is used to connect together subscriber phones. Inside the exchange is a bank of batteries and the switching circuits needed to connect together the phones.

No Dialtone

The most common complaint, absence of a dialtone, can be created by a number of conditions. These include deliberate discontinuation of service by the phone company for any of a number of reasons or interruption of service as a result of a storm or other circumstance. Bear in mind that the phone company reserves the right to discontinue service at any time if you connect equipment that interferes with its system. So make sure you have service *before* jumping to conclusions.

If you have no dialtone, suspect the telephone instrument first. More often than not, it's the source of the problem. Your best service tool in this situation is an auxiliary telephone. A "cheapie" phone like those selling for $10 or so is an adequate piece of test equipment in this case. While the tonal quality of these instruments leaves much to be desired, they do serve the purpose and sure beat the $25 or so most companies charge for a service call.

You begin troubleshooting by removing the suspected telephone and replacing it with your test phone. If the system you're servicing isn't equipped with a standard RJ-11 or RJ-14 modulator outlet, now is a good time to install one. (See the "Installing Modular Jacks" box.) If you hear a dialtone in the test phone, you've narrowed the problem to the original telephone or its cord.

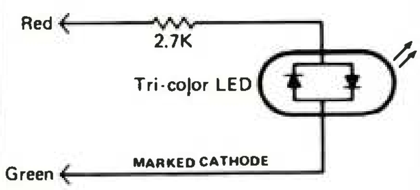
Should the test phone also be dead,

Installing Modular Jacks

If your system doesn't presently have modular outlets, you should convert to them. The conversion involves a simple installation procedure. (Modular outlets can be purchased from any number of places, including your local telephone center or Radio Shack. A good jack will run you about $2.00.)

To install the modular jack, remove and discard the plastic cover of the block where your telephone wires go into the wall. Remove the telephone wires from the block. Do *not* remove the incoming system wires. Now connect the wires from the modular jack to the screw terminals of the wall block, carefully matching the colors. Finally, mount the modular cover in place of the original block cover.

An Inexpensive Line Tester



A simple line tester can be made using a single resistor and a tricolor LED (the LED actually contains a red LED and a green LED wired in reverse parallel). Depending on the nature of the voltage applied, the LED will glow one of three colors—red, green or yellow.

If line polarity and voltage are correct, the LED tester glows green. Reverse polarity causes the LED to glow red. An ac signal, such as a ring voltage, causes both LEDs to light on alternate half-cycles, producing a yellow glow.

you'll have to go into the system itself for further troubleshooting. Begin by removing the outlet cover to gain access to the phone company's wires. Residential lines have red, green, yellow, and black wires, while commercial lines have these plus an additional two wires (six altogether) for a second line.

The red and green wires are identified as ring and tip, respectively. In some systems, the yellow wire is ring ground return. To avoid confusion, simply short the yellow and green wires together.

With the telephone disconnected from the circuit, measure the voltage across the red and green lines; it should be approximately 50 volts. (Not all systems adhere to the green/red color code. So check all possible combinations for the source voltage.) If you don't obtain a 50-volt reading, the problem is further up the line. In installations with more than one outlet, check the voltage at each outlet. The problem could be a broken line between extensions.

Trace the problem as far as you can, all the way up to the terminal junction box (where the phone line enters your house), if necessary. If the problem appears to be beyond the junction box, responsibility for repair lies with the phone company, at no charge to you. If there's no voltage coming into the terminal box, call the phone company's repair service.

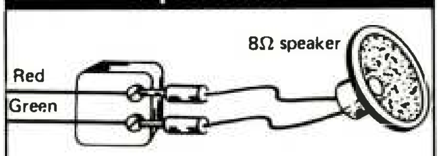
If you have voltage at the outlet but still no dialtone, the problem can be two-fold. It might be that the polarity of the line (green and red wires) is reversed or that not enough load is being placed across the line to activate the off-hook relay.

A quick way to test for dialtone is to clip a small 8-ohm speaker across the phone line and listen for a tone. The speaker's low impedance will allow maximum current to flow to activate the system. Additionally, the speaker isn't polarity sensitive.

If you hear a tone through the speaker, reverse the green and red wires and try your test phone again. Still no dialtone means that the problem is somewhere in the relay located at the central exchange or in the lines leading to it, like that caused by a high-resistance splice. It's best to perform this test at the terminal box —not an outlet—as the problem may lie in the wiring between the terminal junction and your outlet. If you really want to get technical, use the ammeter function of a multimeter to test your line; you should obtain a reading of 18 mA minimum. This is the triggering current that activates the off-hook relay.

Static on the line can also be attributed to bad connections. They're a little more difficult to detect, but the ammeter method works well when the noise is severe. It can tell you if the problem is before or after the terminal junction in most cases. A fluctuating line current normally indicates a bad connection that can lead to static. But don't be fooled by periodic signal changes, such as those created by an off-hook warning.

Tips & Tricks



A quick way to test for presence of a dialtone without elaborate equipment is with a small 8-ohm speaker. Simply connect the speaker across the incoming line. The speaker's low impedance represents a virtual short circuit, which guarantees to engage the off-hook relay. Besides, the speaker isn't polarity-sensitive.

No Ring

Remember that the ring function is activated by a high-voltage ac signal put on the line over the dc voltage. It's never less than 65 volts and can be as high as 150 volts. There are two ways to test for a ring signal, both requiring the assistance of a second party, either the operator or a friend. First gain access to the wiring and have another person call you.

In the first method, you simply substitute the test phone for the original instrument. If it fails to ring, chances are there's a problem in the system, since the ringer isn't polarity sensitive. If you do obtain a ring with the test phone, you've pinpointed the problem to the original telephone. Not all telephones respond equally to ringer voltage, however; so it could be that the ringer voltage may activate one phone but not another.

To test this theory, a second, more sophisticated test must be used, shown schematically in Fig. 3. Measure the voltage across the incoming line with the phone disconnected. Each time a ring signal is received, the voltmeter will indicate a voltage somewhere in the range between 60 and 200 volts.

If it appears that the ring voltage is too high or too low, contact your local phone company representative and ask what the voltage should be. An out-of-spec ring voltage should be reported to your telephone repair service facility after you've thoroughly tested the system. Because different voltmeters measure ac voltage differently, tread lightly

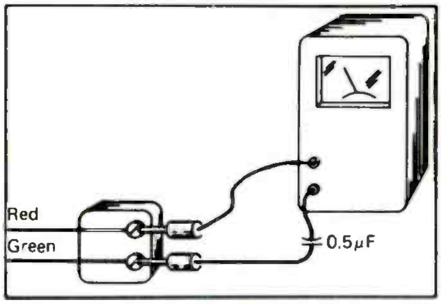
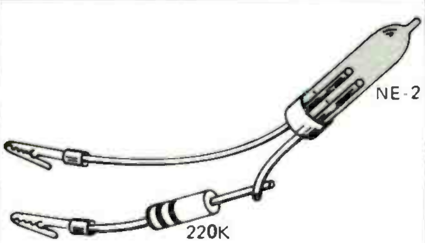


Fig. 3. Use a multimeter and capacitor to measure ring voltage.

here—a misdiagnosed problem could cost you a service call. The best meter for the job is a cheap multimeter with an rms scale.

Also be aware that extension phones can create ring problems. Ring current is limited. In most cases, the phone company guarantees to service only five extensions—and balk at that. If you have several extensions with ringers, begin eliminating them one by one until the problem is resolved. If necessary, you can permanently disconnect the bell without affecting performance of the telephone.

Tips & Tricks



A neon lamp in series with a limiting resistor makes a simple ring detector. Neon lamps like the NE-2 have a threshold potential of approximately 65 volts and, therefore, respond to only the higher ringing voltages.

Coming Next Month

This ends Part 1 of this article. In next month's conclusion, we'll zero in on what to do if the problem is isolated to the telephone instrument. ME

The Ni-Cd Battery

Myths and mastery of nickel-cadmium rechargeable batteries are explored

By Anthony J. Caristi

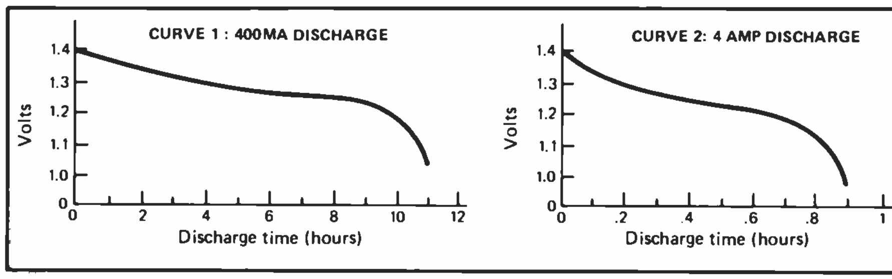


Fig. 1. Discharge curves of typical 4-ampere-hour D cell when discharged at 10-hr (curve 1) and 1-hr (curve 2) rates. The 1-hr rate yields fewer AH of service.

More and more households use Ni-Cd batteries to power their portable radios, photo flash guns and other equipment due to their recharging attributes. Unfortunately, Ni-Cds are often discarded before their useful life is over. This article will show you how to bring "dead" Ni-Cd batteries back to life, as well as clear up some misconceptions about these popular power sources.

The Ni-Cd cell has several important advantages over the common dry cell, such as the zinc-chloride and alkaline types. The most obvious one is that the Ni-Cd can be recharged over and over again while the others cannot be successfully recharged back to their original capacity. Manufacturers of Ni-Cds estimate that ordinary Ni-Cd batteries have a charge/discharge cycle life of about 1000 times before capacity is reduced to below 80% of their original value.

The Ni-Cd can deliver much higher energy levels are compared to dry cells and provides an almost constant 1.2-volt output over most of its discharge cycle. It can deliver an awesome short-circuit current that is so powerful that it can easily burn delicate wiring or printed-circuit conductors if improperly handled. For example, a 4-ampere-hour D size Ni-Cd cell can deliver currents of 50 amperes and more!

How Ni-Cds Are Rated

When a single cell is freshly charged its terminal voltage will be about 1.4 V, which quickly reduces to 1.2 V when the cell is placed in service. You'll see Ni-Cd batteries rated at 2.4 volts or more, of course. These consist of two or more cells connected in series. Technically speaking, a battery is two or more cells connected in series to produce a voltage which is higher than that available from a single cell. However, it is common to refer to a single cell as a battery.

Ni-Cds are rated in ampere hours (AH): the product of current in amperes and time in hours. However, the amount of energy that can be extracted from a given Ni-Cd battery is a function of the total amount of discharge time. This is illustrated in Fig. 1, which shows two discharge curves of the same D-size Ni-Cd cell rated at 4 AH. Note that the total number of ampere hours delivered by the cell is greater when it is discharged over an 11-hour period at 400 milliamperes than when it is discharged over a 54-minute period at 4 amperes.

In order to compare one Ni-Cd cell to another, especially those from different manufacturers, you must consider the discharge rate as well as the cut-off voltage when the cell is considered to be totally discharged. In the case of Ni-Cds, the voltage falls

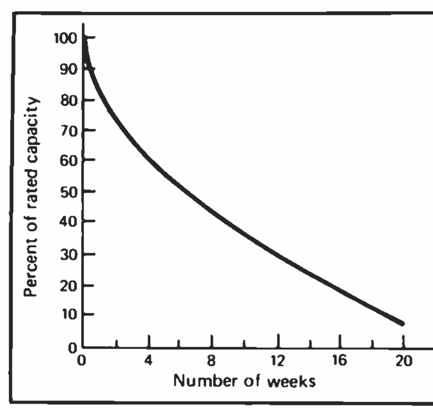


Fig. 2. Typical self-discharge curve of Ni-Cd cell at 70° F (21° C). Fully charged cell retains about 10% capacity when unused for about 20 weeks.

dramatically below 1.2 volts when the cell becomes discharged, so cut-off voltage is not a critical parameter.

To illustrate how one manufacturer rates Ni-Cds, the capacity is specified as the current that can be delivered by the cell for a one-hour period to a cut-off voltage of 1.0 volt. Obviously, another manufacturer could rate the exact same cell at the 10-hour rate and come up with a higher ampere-hour rating.

Like all batteries, Ni-Cds will lose a percentage of their charge when left idle. This loss in charge is heavily dependent upon ambient temperature . . . and increases as temperature rises. Figure 2 illustrates the loss in charge of a typical Ni-Cd cell at room temperature. Not all Ni-Cds will lose the same amount of charge in the same time; you probably will find differences between brands of Ni-Cds. Although a Ni-Cd will, theoretically, not be damaged if left for long periods of time in an uncharged state, it is recommended that it be brought up to full charge at least twice a year so that it will always be in some state of charge and therefore won't tend to develop short circuits.

Ni-Cd Memory Phenomenum

"Memory" is a characteristic of Ni-Cd cells that prevents full deep discharge of the cell after repeated shallow discharges. In recent years, battery manufacturers have been able to reduce the memory effect to a relatively small amount, as shown in Fig. 3. Shown here is the initial deep discharge of a full charged cell.

After this curve was taken, the cell was subjected to 100 shallow discharges of 40% of capacity. The cell was then recharged and given a deep discharge, which is illustrated by the second curve. Note that the cell could deliver less than full capacity due to memory effect. Subsequent recharges, followed by deep discharges, would eventually wipe out the memory and bring the cell back to its original capacity.

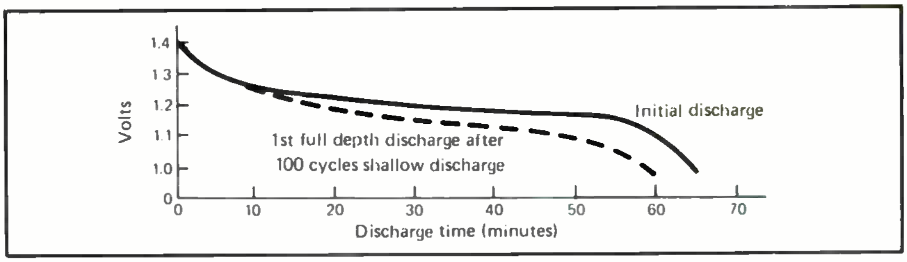


Fig. 3. Memory effect of Ni-Cd cell. First full-depth discharge after 100 cycles of 40% discharge yields only about 80% of rated capacity of typical Ni-Cd cell.

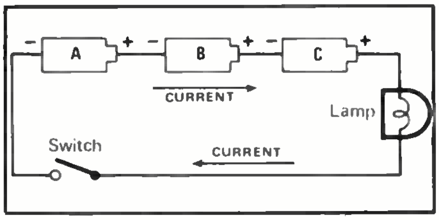


Fig. 4. This is the circuit of a three-cell flashlight.

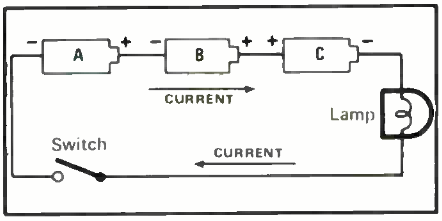


Fig. 5. Shown here is a depleted C cell being reverse charged.

Cell Polarity Reversal

It might seem, after noting memory effect above, that it would be a good idea to run Ni-Cd batteries down to zero voltage before recharging them. This can lead to two significant problems: cell polarity reversal and shorted cells.

Battery manufacturers recommend that Ni-Cds not be left in a zero state of charge for any length of time, even though there is no theoretical damage done to the cell in this state. But a cell that has no charge can develop a short circuit much more readily than a partially or fully charged one. The reason for this is that short circuits that may develop within a cell could start out as a "whisker" that grows from one of the electrodes and touches the other. If the cell has no charge this whisker could become firmly implanted and result in a shorted cell. But if there is charge remaining in the cell, the short circuit will be vaporized away as it is happening. The moral to this story is: Keep your Ni-Cds fully charged at all times, except when they are being used, of course.

The second problem that may occur if you run a Ni-Cd battery down to zero voltage is the possibility of polarity reversal. This can happen in a battery consisting of two or more cells connected in series. Consider the following: Figure 4 is a circuit diagram of three cells connected in series, as you would have in a typical three-cell flashlight. If the flashlight is operated until the light produced is obviously dim due to exhausted cells, the following develops:

One of the cells must have started out with less capacity than the other two, since no two cells can have exactly equal capacities. Let's assume that cell C has less capacity than cell A or cell B. This means that C will reach a zero state of charge before A and B, and its terminal voltage will be zero. Let's redraw the circuit to illustrate what happens (see Fig. 5).

Note that the remaining charge in A and B is driving current into C, but in such a direction that C is being charged backwards. Its negative electrode becomes positive and its positive electrode becomes negative. You can easily visualize this since the direction of current through C is opposite to a normal charging current, which would be fed into the positive side, not the negative.

When a Ni-Cd becomes reverse polarized in this manner, gas pressure is generated within the cell and it will eventually vent or burst. Some battery manufacturers have designed their Ni-Cds to withstand some amount of polarity reversal, but if the cell should vent, some of its precious fluid will be lost forever, reducing cell capacity. Thus, when your flashlight or other equipment indi-

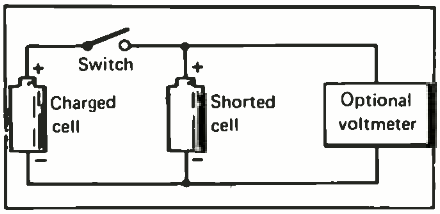


Fig. 6. Shorted cell can be restored by current from freshly charged cell.

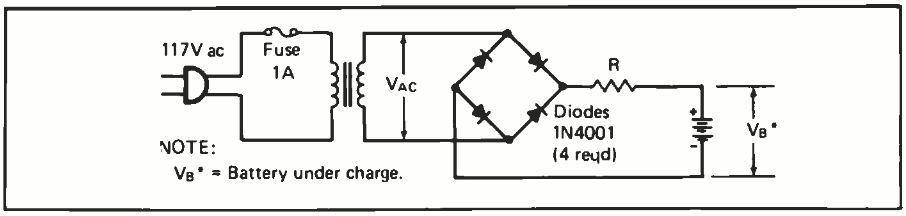


Fig. 7. Recommended constant-current charging circuit; V_{ac} across the transformer's secondary should be about twice V_B at the output.

cates that battery voltage is low, recharge immediately.

Shorted Cells: Not Necessarily The End!

Although you may place a discharged Ni-Cd cell in a charger and its terminal voltage remains at zero regardless of how long you leave it on charge, the cell is not necessarily bad. What has happened is that the cell is shorted, but perhaps not permanently. The problem here is that the charger current is not sufficient to overcome the short and begin charging the cell.

The best and easiest way to cure a shorted cell is to take another cell of the same size, freshly charged to full capacity, and connect it in parellel with the shorted cell. The connection is shown in Fig. 6. Note that plus is connected to plus; minus to minus. Use heavy wire for the connection since the current delivered to the shorted cell will be very high until the short circuit is burned away. Once this happens, the current will automatically reduce to a very low value. Then place the cured cell in a charger right away to fully charge it.

This method of restoring a shorted cell is safe because the driving voltage of the charged cell is the same as the terminal voltage of the discharged cell (once the short is burned away). However, it is possible that this one-to-one treatment will not work for a stubborn cell, and it must be "zapped" by a larger voltage.

To do the foregoing, you could take two fully charged cells, connect them in series, and use this 2.4-volt battery to restore the shorted cell. When attempting this two-for-one method do not apply the current for more than a few seconds, especially if the shorted cell does not respond. The heavy current will heat up both the driving cells and the driven cell. If they should get too hot, there is the possibility of them bursting. If your shorted cell does not respond to this, it is probably beyond repair.

Charging Ni-Cds

Probably the most misinformation on Ni-Cd batteries relates to recharging. Unless you use special precautions to monitor the temperature of a Ni-Cd while it is being charged at a rate higher than C/10, Ni-Cds should be charged only by a constant current source at a rate of C/10 or less. C/10 is the capacity of the cell or battery in ampere hours, divided by 10. Thus, a 4-ampere-hour battery should be charged at 400 milliamperes. When using the C/10 rate, the charger should be left on for 14 to 16 hours to ensure that the Ni-Cd is brought up to full charge. At the C/10 rate, it is permissible to overcharge the Ni-Cd for two or three days without damage, since the gases produced on overcharge are recombined within the cell and, thus, venting should not occur. When a Ni-Cd reaches full charge as it is being charged at the C/10 rate, it generally will feel warm to the touch.

It is not recommended to use a charger that delivers a current very much less than the C/10 rate, since totally discharged Ni-Cds may not take on any charge at all no matter how long they are left on charge. This will give the false impression that the Ni-Cd is defective, when it is not. Low-capacity chargers are designed to be used for "trickle charging," which we'll discuss later.

Ni-Cd cells should not be charged in parallel unless you use series resistors for each cell to ensure that each one receives no more than the C/10 rate. Without such resistors it is possible that one or more of the cells will be charged at an excessive rate and will overheat when it reaches full charge. This would lead to gas venting and possibly a burst cell. Always connect your Ni-Cds in series to charge them, and be sure not to mix cells of different capacity.

Ordinary Ni-Cd batteries such as used in consumer appliances should be charged with a constant-current charger. Figure 7 illustrates such a circuit. It's called a constant-current circuit because the open-circut voltage of the charger (when it is not connected to a battery) is much greater than the terminal voltage of the battery it is to charge, and a resistor is used to determine the value of the current. Thus, the current delivered to the battery will remain almost constant as the Ni-Cd cells increase in voltage from 1.2 to 1.4 as the battery reaches full charge. In comparison, a constant-voltage charger, such as used for lead-acid batteries, would not have the resistor and would deliver a large current when first connected to a discharged battery. The current would then taper off to a small value as full charge is reached.

Figure 8 illustrates the value of resistor *R* in the circuit of Fig. 7 for several different batteries and charging currents, using a common 12.6-volt transformer available at any electronics parts supplier. (Example: Ra-

Nominal Voltage	No. of Cells	Charging Current		
		50 mA	120 mA	400 mA
1.2	1	85 Ω	40 Ω	13 Ω
2.4	2	80 Ω	37 Ω	11 Ω
4.8	3	75 Ω	32 Ω	9 Ω

Fig. 8. Select appropriate resistor value when using Fig. 7 circuit, which requires a 12-volt transformer.

dio Shack #273-1505.) Bear in mind that the transformer secondary rms current rating for this circuit (and that of Fig. 9) must be at least 2.5 times the desired dc current fed to the battery. A transformer will overheat if the current rating is too small and, possibly, produce less current than desired.

Should you wish to build a charging circuit different than that illustrated in Fig. 8, you can easily do so by using the following guidelines: Use a transformer with a secondary voltage rating of about twice the voltage of the battery you want to charge. Resistor *R* may then be selected to deliver the required C/10 rate. The current through *R* can be calculated using the expression I = E/R, where *E* is the voltage measured across *R* using a dc voltmeter. Even though the current through *R* is not pure dc, the voltage measurement will yield an accurate calculation of the current. Once you have determined the resistor value, be sure to calculate the power dissipated in the resistor using the expression, $P = I^2R$. Employ a resistor that has a power rating of about twice what is calculated.

If you would like to build a more sophisticated constant-current charging circuit that's independent of the number of cells placed on charge, use the cirucit of Fig. 9. This is a constant-current circuit that uses a readily available fixed 5-volt IC regulator chip. The current delivered by this circuit into the battery will always be equal to 5/*R*, as long as there is sufficient voltage at the input of the chip. The required input voltage will be equal to maximum battery voltage you wish to charge plus 8 volts.

This circuit will deliver a fixed current for any number of cells placed on charge, up to the maximum you have selected. To make this circuit even more useful, you could use a multiposition selector switch to change the value of *R* for different constant currents. Then you would have an all-purpose charger that can handle every kind of Ni-Cd you own.

Trickle Charging

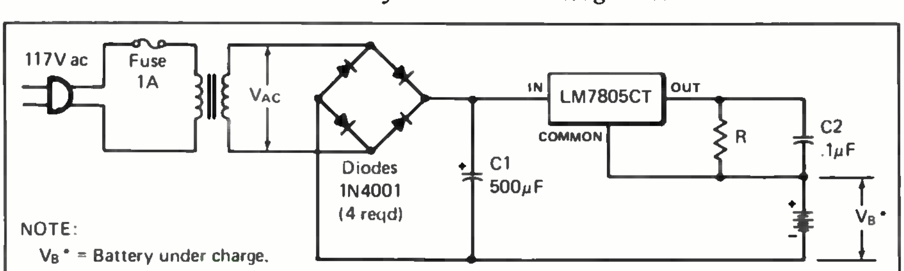
The charging circuits described discuss charging your Ni-Cds at the C/10 rate, which brings them up to full charge in 14 to 16 hours. But once you have fully charged your batteries, how do you keep them from losing their charge as a result of self discharge? The answer to this is the trickle charger, which keeps Ni-Cds in a fully charged state until they are placed in service.

Manufacturers of Ni-Cds specify that these batteries may be trickle charged at a C/30 to C/50 rate continuously without deterioration of the cells. One manufacturer has shown that a constant trickle charge for two years resulted in no loss of battery capacity when it was subjected to the first full discharge.

To calculate the proper current for trickle charge, divide the ampere hour rating of the Ni-Cd by 30 or 50. The resulting current is the proper trickle charge for that battery. For example, if you have a 1.2 ampere hour battery, the proper trickle charge will be between 24 and 40 milliamperes, respectively.

It is a simple matter, therefore, to have the charging circuits of Figs. 7 and 9 deliver the required trickle charge by using the correct resistor value. The best way is to include a single-pole, double-throw toggle switch that can select either one of two resistor values, one for normal charging and one for trickle charging. That way you can have the best of both worlds. **ME**

Fig. 9. This constant-current charging circuit delivers same current to one or more cells connected in series. Dc voltage across C1 should be at least V_B + 8 volts. Resistor R yields 5 volts/charge current.



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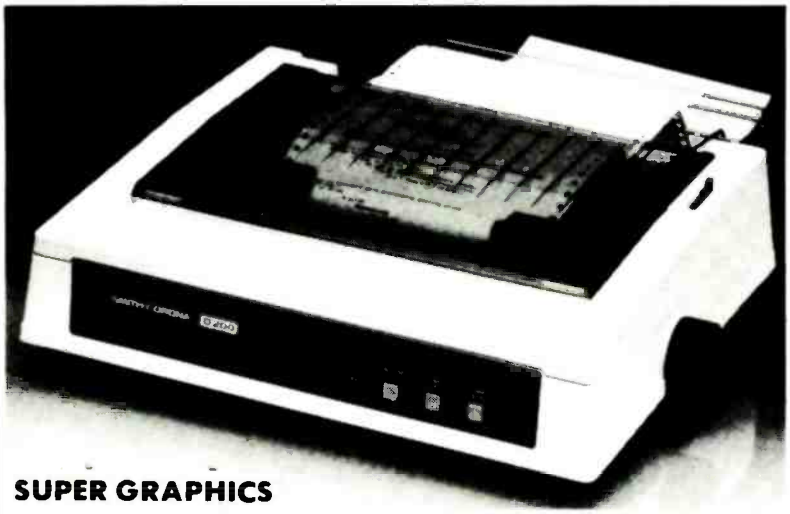

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This is a sample of our near-letter-quality print. **emphasized**

italic print. There is standard data processing quality print

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120 CPS 10" Printer

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SPECIFICATIONS

(IBM — Commodore) **(Apple — Atari — Etc.)**

Size/Weight
Height 5.04" Width 16.7"
Depth 13.4" Weight 18.7 lbs.
Internal Char. Coding
ASCII Plus ISO
Print Buffer Size
120 CPS: 132 Bytes (1 line)
120/160 CPS Plus LQM: 2K
No. of Char. In Char. Set
96 ASCII Plus International
Graphics Capability
Standard 60, 72, 120 DPI
Horizontal 72 DPI Vertical
Pitch
10, 12, 16.7, 5, 6, 8.3, Proportional Spacing
Printing Method
Impact Dot Matrix

Char. Matrix Size
9H x 9V (Standard) to 10H x 9V
(Emphasized & Elongate)
Printing Features
Bi-directional, Short line seeking, Vertical Tabs, Horizontal Tabs
Forms Type
Fanfold, Cut Sheet, Roll (optional)
Max Paper Width
11"
Feeding Method
Friction Feed Std.; Tractor Feed Std.
Ribbon
Cassette — Fabric inked ribbon
Ribbon Life
4 million characters

Interfaces
Parallel 8 bit Centronics compatible
120/160 CPS Plus NLQ: RS232 Serial inc.
Character Mode
10 x 8 Emphasized; 9 x 8 Standard; 10 x 8 Elongated; 9 x 8 Super/Sub Script (1 pass)
Character Set
96 ASCII
11 x 7 International Char.
Line Spacing
6/8/12/72/144 LPI
Character Spacing
10 cpi normal; 5 cpi elongated normal; 12 cpi compressed; 6 cpi elongated compressed; 16.7 cpi condensed; 8.3 cpi elongated condensed; 5.12.5 cpi elongated proportional

Cartridge Ribbon — List $19.95. **Sale $12.95.**

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IBM $89.00 **Apple $59.00** **Atari $59.00** **Commodore $39.00**

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- 12" Amber Monitor $79.95

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* C128 DOUBLE SIDED DISKS 79¢ EA.

Get these 5¼" Double Sided Floppy Disks specially designed for the Commodore 128 Computer (1571 Disk Drive). 100% Certified, ***Lifetime Warranty***. Automatic Lint Cleaning Liner included. 1 Box of 10 - $9.90 (99¢ ea.), 5 Boxes of 10 - $44.50 (89¢ ea.), 10 Boxes of 10 - $79.00 (79¢ ea.).

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The COMSTAR 10X gives you a 10" carriage. 120-140 CPS, 9 x 9 dot matrix with double strike capability for 18 x 18 dot matrix (near letter quality), high resolution bit image (120 x 144 dot matrix), underlining, back spacing, left and right margin setting, true lower decenders with super and subscripts, prints standard, italic, block graphics and special characters. It gives you print quality and features found on printers costing twice as much!! (Centronics Parallel Interface) List $399.00 **Sale $148.00.**

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Paperback Dictionary	$24.95	$14.95	$10.00
The Print Shop	$44.95	$27.95	$26.95
Halley's Project	$39.95	$25.95	$24.95
Practicalc (spread sheet)	$59.95	$19.95	$14.95
Programmers Reference Guide	$24.95	$16.95	$12.50
Nine Princes in Amber	$32.95	$24.95	$21.95
Super Bowl Sunday	$30.00	$19.95	$17.95
Flip & File Disk Filer	$24.95	$14.95	$12.95
Deluxe Tape Cassete (plus FREE game)	$89.00	$44.95	$34.95
Pro Joystick	$19.95	$12.95	$10.00
Computer Care Kit	$44.95	$29.95	$24.95
Dust Cover	$ 8.95	$ 6.95	$ 4.60
Injured Engine	$39.95	$27.95	$24.95
Pitstop II (Epyx)	$39.95	$22.95	$19.95
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64K Printer Buffer for $50

The "Bufferette" project described here can free your computer for other tasks as a document is being printed

By Bill Green

Tired of waiting to resume computing as your printer grinds out a long document? Only fifty bucks and some quick assembly time will relieve you of this for printing a moderate-size document. The buffer (which we call the "Bufferette") described here will handle 64K bytes of text in a single gulp and free up your computer for other tasks as it independently handles transfer of data to the printer.

In its most basic form, the Bufferette is a fine printer buffer with no bells or whistles. However, inexpensive options can be added to it to enhance its utility and flexibility. Among these are "Memory Remaining" LED indicators and a switch that will allow you to select between either of two printers you may wish to use with your system.

If you don't need to print enormous-size manuscripts or save lots of data through a modem, the Bufferette can be a Godsend to most computer users at a welcome low cost.

About the Circuit

At the heart of the Bufferette is a Z80 microprocessor (*IC1* in Fig. 1), chosen for its low cost and ease of interfacing with dynamic random-access memory (DRAM). Because the Bufferette contains a relatively large amount of memory, microprocessor control is mandatory. The 64K-byte memory space is filled with the 64K × 1 dynamic RAM chips designated in Fig. 1 as *IC3* through *IC10*.

BASIC PARTS LIST

Semiconductors
D1—1N4001 rectifier diode
IC1—Z80 microprocessor
IC2—Preprogrammed 1363 ROM
IC3 thru IC10—4164 64K RAM
IC11,IC12—74LS157 quad 2/1 multiplexer
IC13—74LS32 quad 2-input positive OR gate
IC14—74LS260 dual 5-input NOR gate
IC15,IC24—7404 hex inverter
IC16—74LS175 quad D flip-flop
IC18 thru IC20—74LS373 octal transparent latch
IC21—74LS74 dual D flip-flop
IC22—74LS00 quad 2-input NAND gate
IC23—74LS138 3/8 decoder
IC26—7805 +5-volt regulator

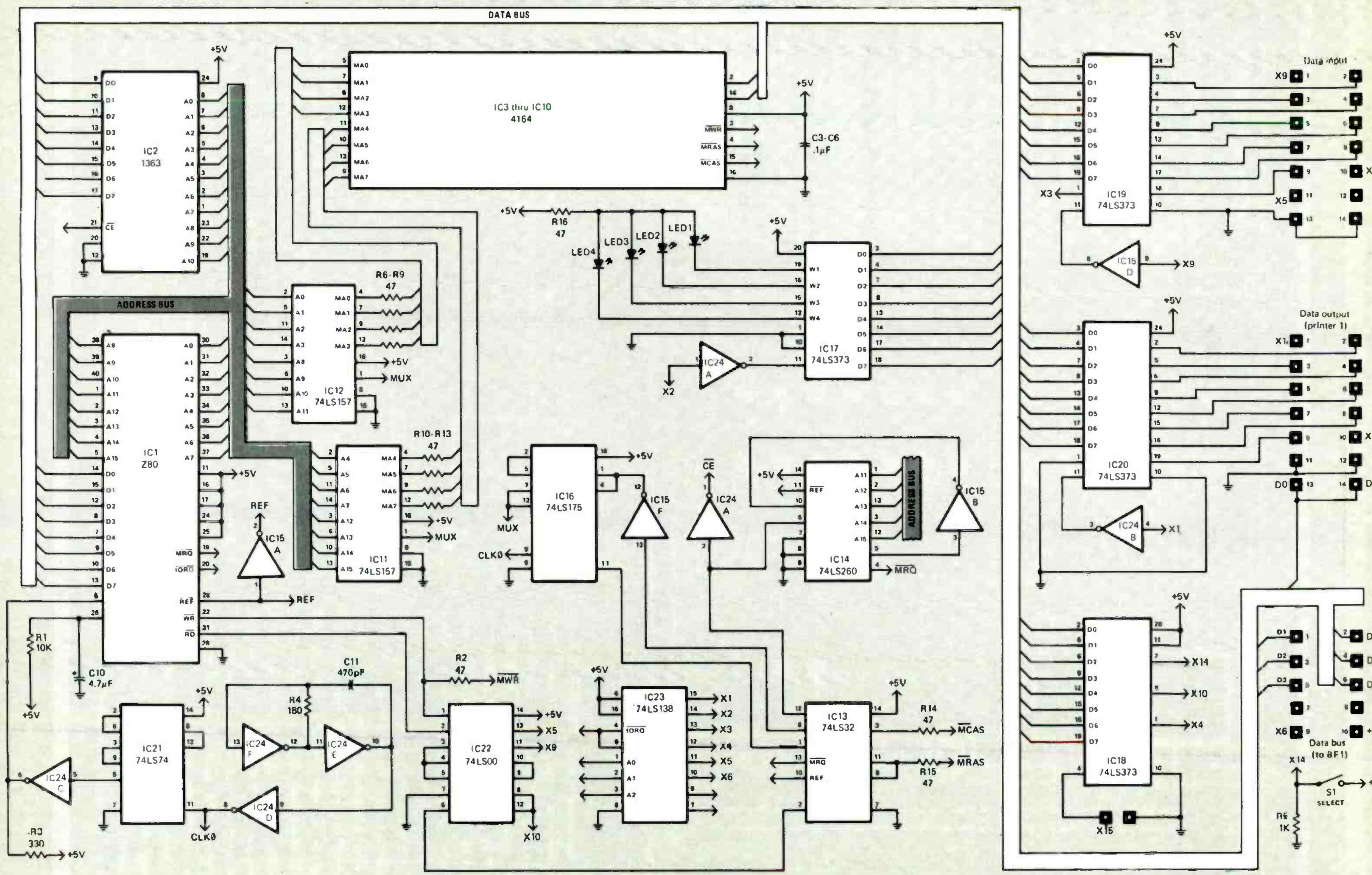
Capacitors
C1—1000-μF, 25-volt electrolytic
C2 thru C9—0.1-μF, 12-volt disc
C10—4.7-μF, 12-volt disc
C11—470-pF ceramic disc

Resistors (all ¼-watt, 10%)
R1—10,000 ohms
R2,R6 thru R15—47 ohms
R3—330 ohms
R4—180 ohms
R5—1000 ohms

Miscellaneous
F1—1-ampere pigtail fuse
S1—Normally open spst pushbutton switch
S2—Spst toggle switch
T1—12-volt, 1-ampere ac wall-mount transformer
Cables with connectors to mate with those on your computer and printer(s); double-sided main printed-circuit board (Alpha No. BF2); sockets for ICs; heat sink for IC24; machine hardware; hookup wire; solder; etc.

Note: See Note in Options Part List for kit and parts availability.

Fig. 1. This is the overall schematic diagram of the buffer.



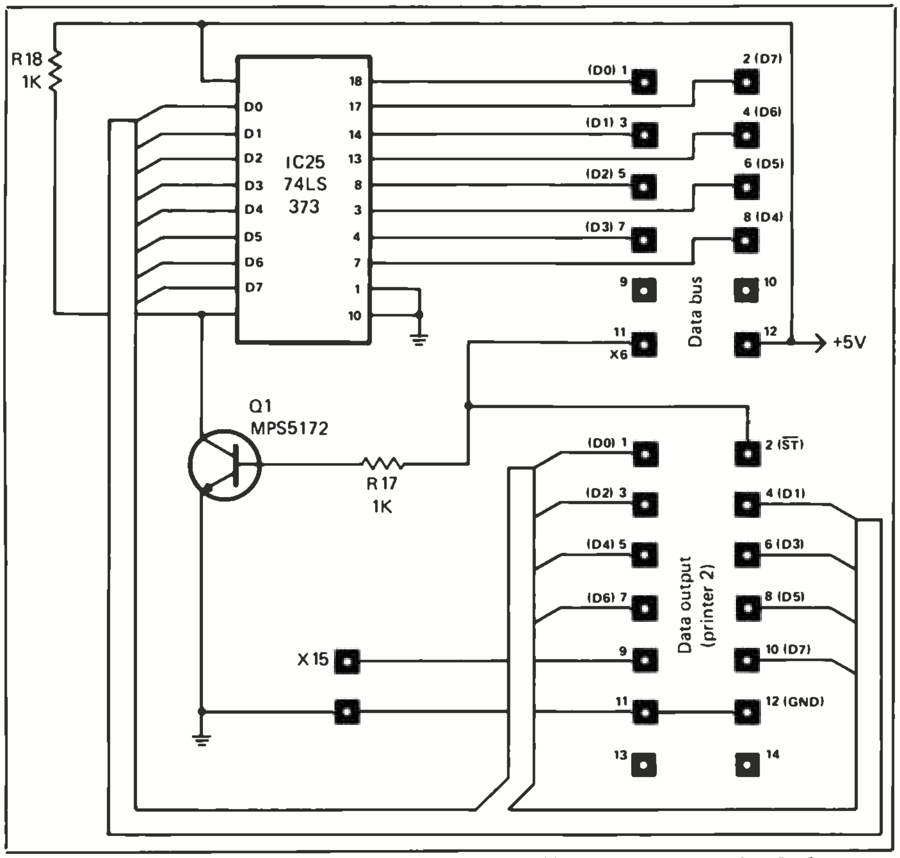


Fig. 2. This is the schematic diagram of the buffer's power supply. It features half-wave rectification and voltage regulation, the latter via a + 5-volt 7805 chip.

OPTIONS PART LIST

IC17,IC25—74LS373 octal transparent latch
LED 1 thru LED4—Red T-1¾ light-emitting diode
Q1—MPS5172 transistor
R16—47-ohm, ¼-watt, 10% tolerance resistor
R17,R18—1000-ohm, ¼-watt, 10% tolerance resistor
S1—Normally open spst pushbutton switch

Misc.—Printed-circuit board (Alpha No. BF-1); suitable case (Pactec No. CM6-225 or similar) with front and rear panel labels; male and female header pins; machine hardware; hookup wire; solder; etc.

Note: The following items are available from Alpha Electronics, P.O. Box 1005, Merritt Island, FL 32952: Basic buffer kit (includes all items in Basic Parts List except IC sockets, hardware and cables) for $49.95 plus $6.00 P&H; options package (available only with complete kit) for $20.00; preprogrammed 1363 ROM for $22.00 plus $2.00 P&H; preprogrammed 1363 ROM and BF1 and BF2 pc boards for $38.00 plus $3.00 P&H. Florida residents, please add sales tax.

Contained inside PROM *IC2* are the machine-code instructions for the Z80. The ROM occupies 2K bytes in the address area, from 0000H to 07FFH, and locations 0800H to 081FH are reserved for the stack pointer and temporary scratchpad storage. This reduces available RAM to 63,456 bytes, which is still a healthy figure for moderate files.

The 16 address lines are multiplexed onto the RAM bus via *IC11* and *IC12*. All of *IC13, IC14* and *IC16* and half of *IC22* provide the timing for the address multiplexers, generate the RAS and CAS (row and column address select, respectively) for the RAM, and provide the enable for the PROM.

Three of the inverters in *IC24*, along with capacitor *C11*, provide the buffered clock for refresh timing. This clock train is divided by *IC21* to provide the 1-MHz clock used by the Z80 microprocessor.

Integrated circuits *IC18, IC19* and *IC20* provide input/output (I/O) interfacing and the status ports. Some of the inverters in *IC15* and *IC24* invert the port-enable strobes from I/O port decoder *IC23*. The remaining half of *IC22* is wired as an RS latch to provide the busy signal for the input port when strobed by the computer. They busy line is cleared under software via enable pin 11 of *IC23*.

The "Memory Remaining" option provided by *IC17* returns the cathodes of *LED1* through *LED4* to ground, turning on the LEDs under

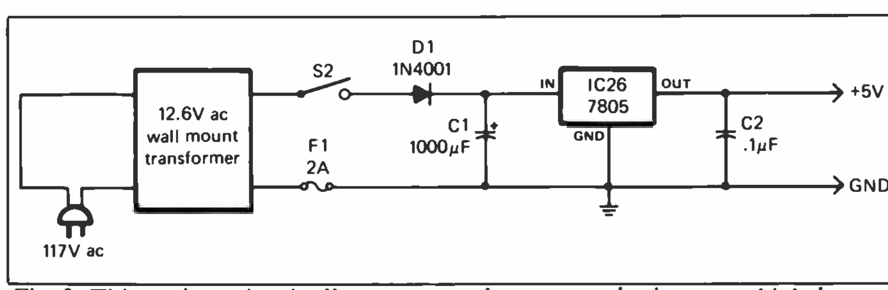
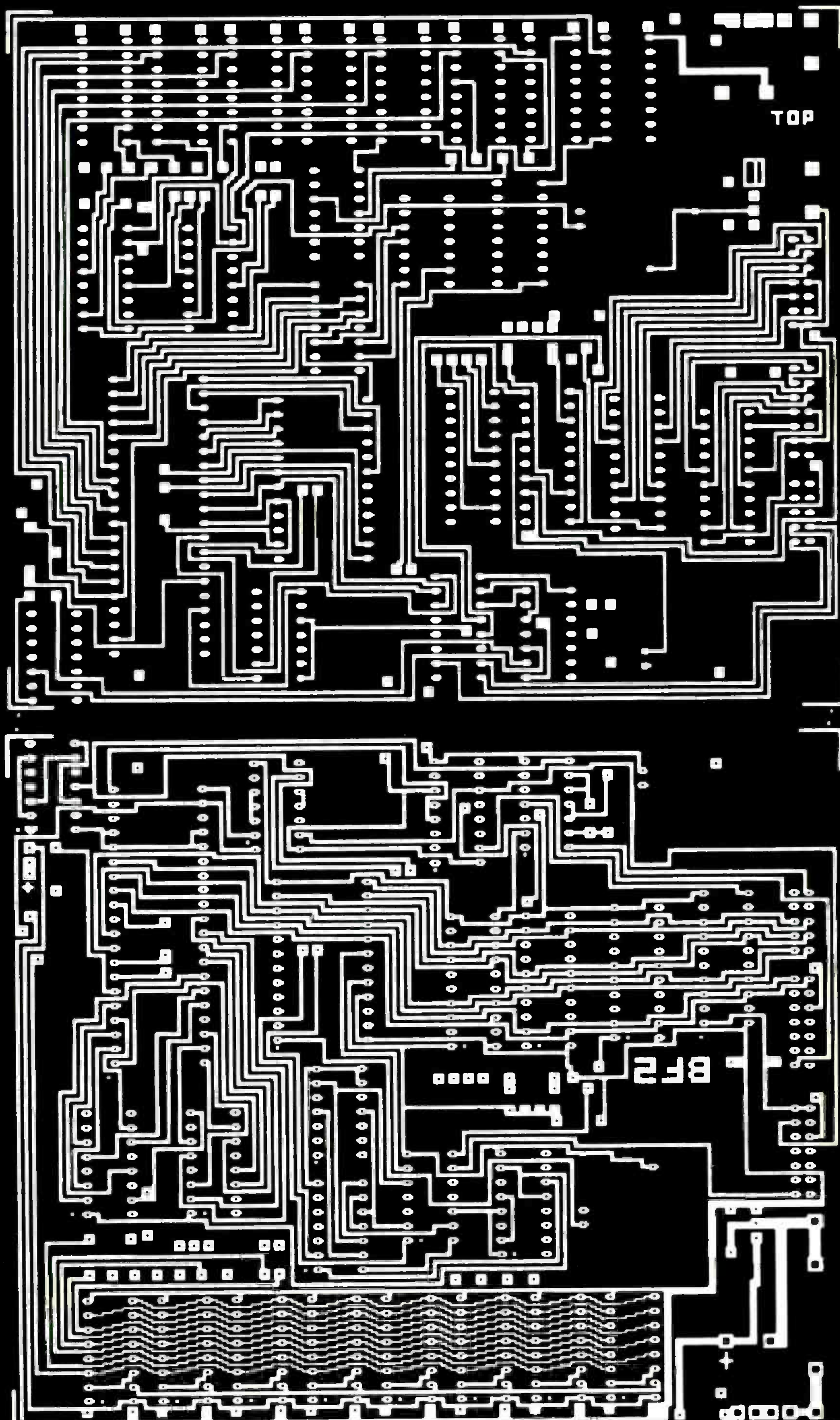


Fig. 3. This options circuit allows you to select a second printer to which data can be sent for hard-copy printout. It mounts on a separate pc board of its own.

Fig. 4. These are the actual-size etching-and drilling guides for the main printed-circuit board.


TOP

program control. This IC latches the data bus to the second printer. Transistor *Q1* inverts the latch-enable strobe from *IC23*.

Power-up reset for the Z80 microprocessor is provided by *R1* and *C7*. The eight 0.1-microfarad capacitors in the circuit provide for decoupling of the +5-volt power supply line.

System power is provided by a simple half-wave rectifier (*D1* in Fig. 2) from a wall-mounted 12.6-volt power transformer. The rectified voltage is passed through 5-volt regulator *IC26*.

On power-up, the Z80 microprocessor is instructed by the ROM to set its stack pointer and initialize the I/O (input/output) ports. The busy lines to the computer and printer(s) are used to synchronize the data flow. When the sending computer strobes data to the buffer, the busy latch is set. The Z80 then reads the byte through *IC19* and stores it in memory. It then checks to see if the active printer is busy and if not sends the byte to *IC20*, and so on.

The four optional MEMORY REMAINING light-emitting diodes (*LED1* through *LED4*) indicate the amount of free memory space in about 12K blocks. Incoming data is sent to the selected output device whenever the device is ready to receive it.

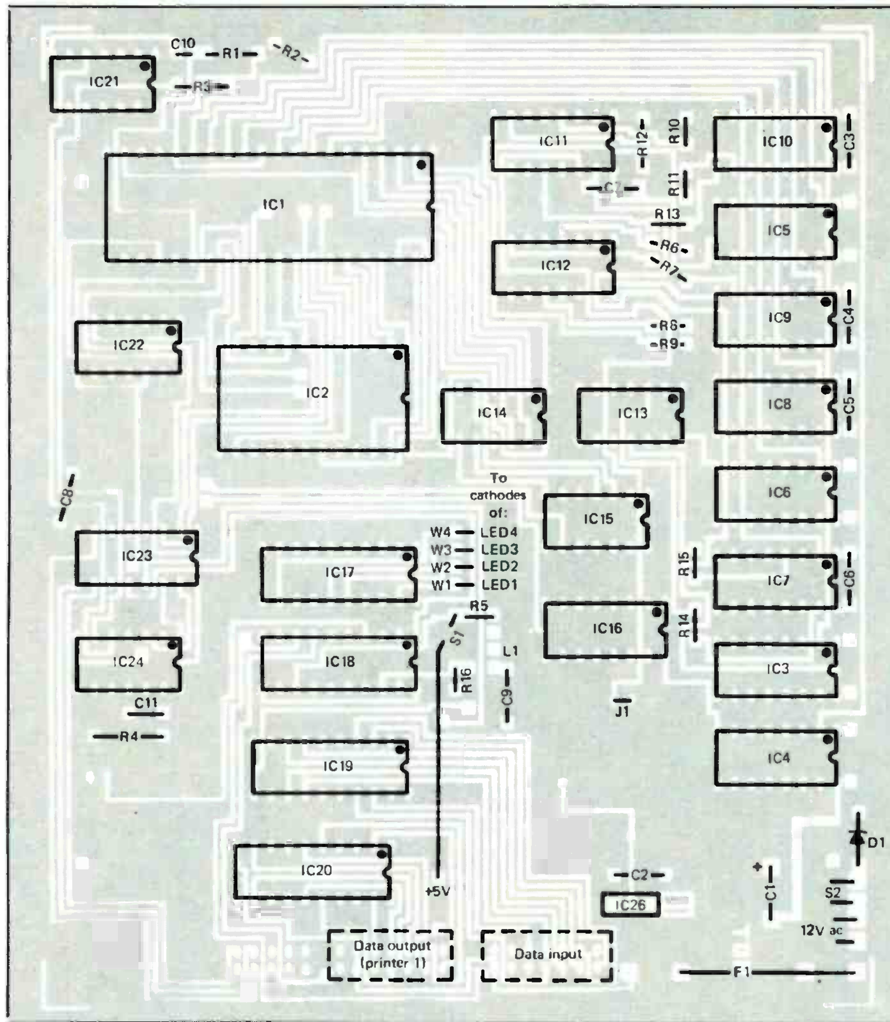


Fig. 5. Almost all of the components that make up the buffer mount on the main pc board as shown here. Sockets are recommended for all ICs in this project.

Construction

Because this project contains more than two dozen ICs, printed-circuit board assembly is almost mandatory for the main board for compact size and to simplify construction and reduce the possibility of wiring errors. You can buy a ready-to-use pc board from the source given in the Parts List or fabricate your own from the actual-size guides given in Fig. 4. Unless you are very experienced in fabricating pc boards, we recommend that you buy this board ready to use.

If you make your own board, you will not be able to plate-through the holes that connect to copper traces on both sides of the board. Therefore, you will not be able to use standard IC sockets (a virtual must for this project), because the sockets will not permit access to the pads on the top of the board to which the IC pins must be soldered. In this case, you will either have to forego the use of sockets altogether (and thus lose the convenience of being able to replace one or more ICs should they go bad in the future) or use Molex Soldercons in place of them to obtain top-of-the-board access for soldering. Also, if you use a home-brewed board, make sure you solder all connections on *both* sides of the board as you install components.

Refer to the main circuit board components installation and orientation diagram in Fig. 5. Install sockets for all ICs (except regulator *IC26*) and an insulated jumper wire in the appropriate locations. Do not install the ICs in their sockets until called for. You can wire your computer and printer cables directly to the pads on main pc board BF2 or install optional connectors on the rear panel of the cabinet that will house the Bufferette and connect them to the appropriate pads on the board with short lengths of wire. A final alternative here is to install right-angle male header pins in the holes at the rear of the main board and optional printer switch board if you plan to use the latter. These should be 14-pin headers.

(Continued on page 81)

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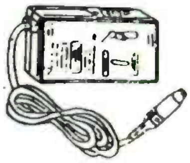
TI 99-4A SURPLUS



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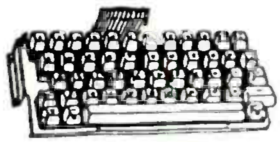
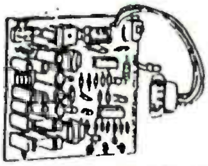


KEYBOARD

PN 900181 — 48 keys. Measures 4"x9". Terminates to a 15 pin connector $3.75

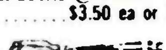


SWITCHING POWER SUPPLY

INPUT: 14 VAC to 25.5 VAC.
OUTPUT: +12VDC @ 350MA.
+5VDC @ 1.2AMP.
PS-4A .... $3.50 ea

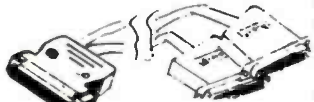
WALL PLUG ADAPTER

TN-21 — used with the above power supply. Output 21VAC @ 45VA.
TN-21 .... $3.50 ea or 10/$19.95



CASSETTE INTERFACE CABLE

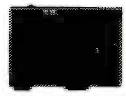
CIC-93 — has DB-9 connector on one side to 3 RCA phono jacks on the other end .... $1.50 ea or 10/$10.00



TI GAME CABLE

CAB-15 — one end has a DB25 female going to 2 DB15 female connectors. Cable is 6' long $4.00

RADIO-SHACK COMPUTER SURPLUS



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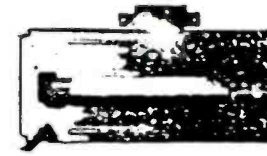

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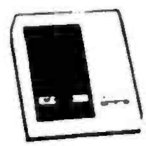

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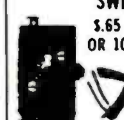

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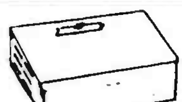

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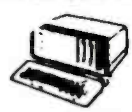

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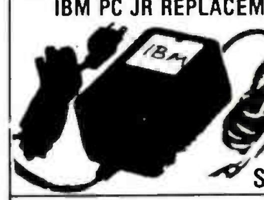

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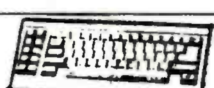

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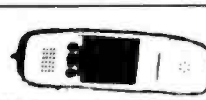

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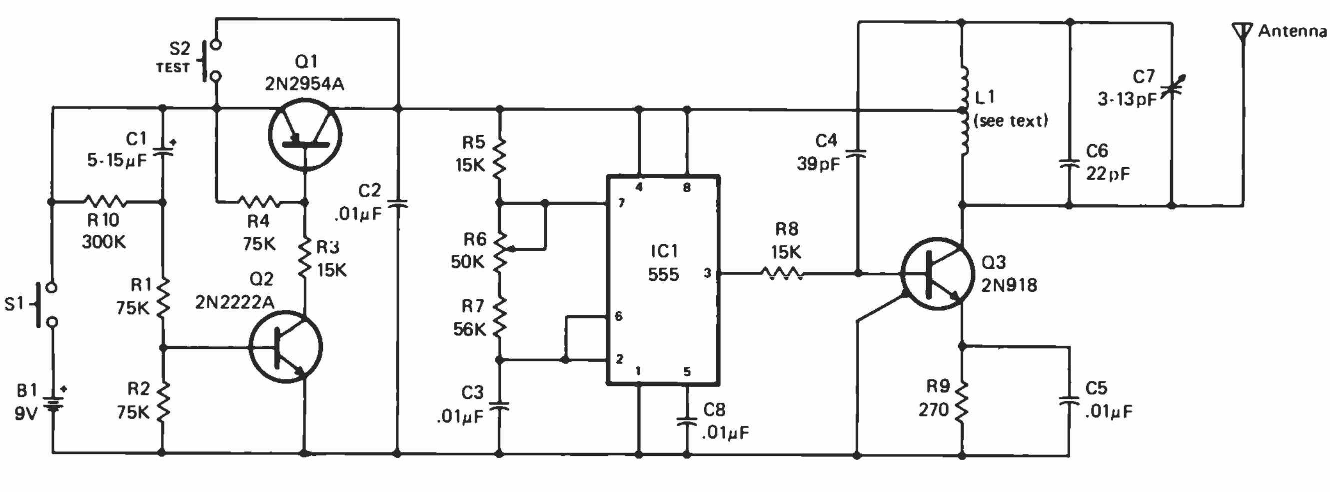
A Wireless TV Audio Mute

This one-button project mutes the sound of any TV receiver that does not have wireless remote-control facilities

By Desi Stelling

TV commercials can be annoying in more ways than one. If they're not irritatingly louder than normal program material, they're repeated so often that the annoyance factor seems to be overwhelming. If you're not fortunate enough to have a remote-controlled TV receiver with an audio mute function, you either have to suffer through the commercials or make frequent trips to your set to turn down the volume when the commercials start and turn it up again when the program resumes.

Having been a long-time sufferer of annoying TV commercials, one evening I had had enough and decided to liberate my family and myself by designing and installing in my set a wireless audio mute function. Putting the old thinking cap on, I came up with a neat one-button Wireless Audio Mute system that

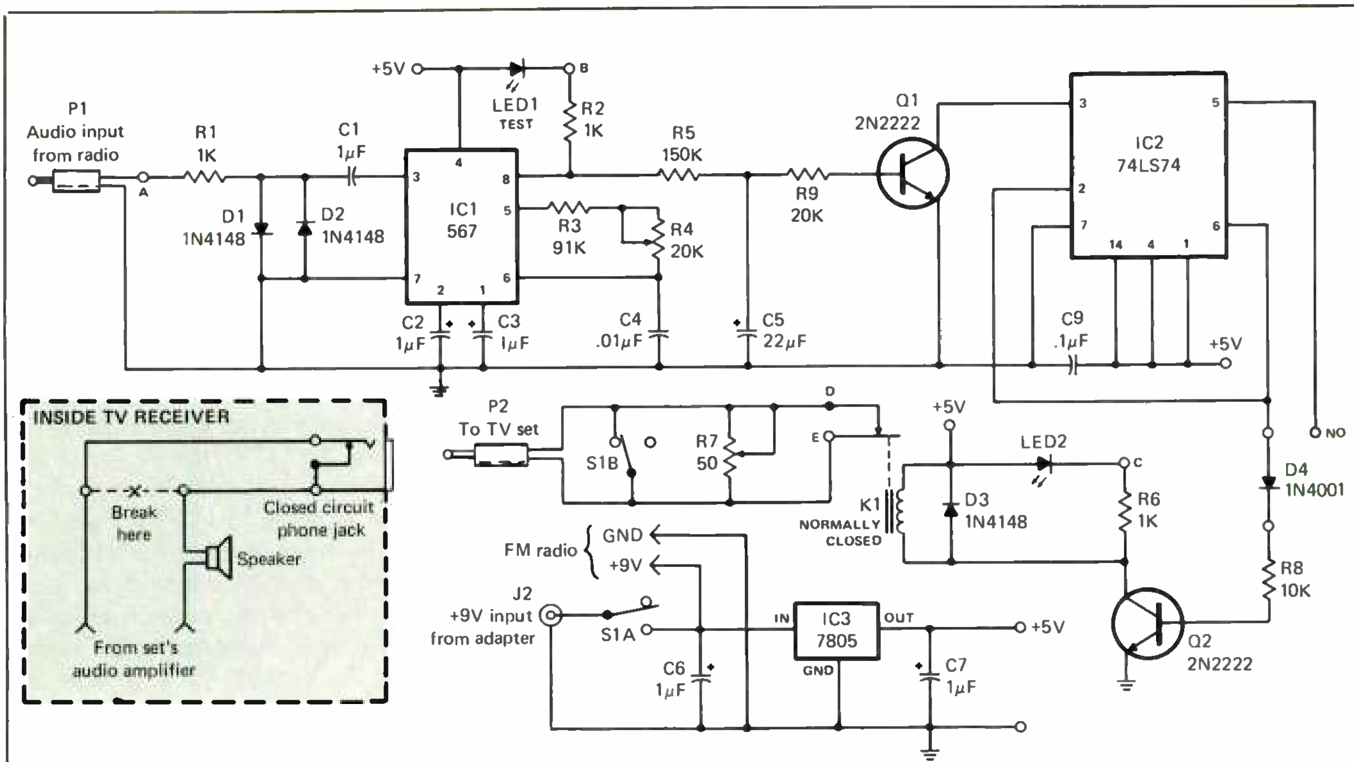


TRANSMITTER PARTS LIST

Semiconductors
IC1—555 timer
Q1—2N2945A transistor
Q2—2N2222A transistor
Q3—2N918 transistor
Capacitors
C1—5- to 15-μF, 15-volt electrolytic
C2,C3,C5,C8—0.01 μF
C4—39 pF
C6—22 pF
C7—3-to-13-pF trimmer
Resistors (¼-watt, 10% tolerance)
R1,R2,R4—75,000 ohms
R3,R5,R8—15,000 ohms
R7—56,000 ohms
R9—270 ohms
R10—300,000 ohms
R6—50,000-ohm, linear-taper potentiometer
Miscellaneous
B1—9-volt transistor battery
L1—Coil (printed on circuit board; see text)
S1—Magnetic spst switch
S2—Miniature normally open spst pushbutton switch
Printed-circuit board; antenna; 9-volt battery connector; plastic case; machine hardware; hookup wire; solder; etc.

Note: The following items are available from DDS Systems, P.O. Box 5715, Glendale, AZ 85312: transmitter pc board for $6.95; other transmitter parts on request; complete kit of decoder parts for $34.95; decoder pc board for $7.95. Add $3.50 P&H. Arizona residents, please add sales tax.

Fig. 1. This is the complete schematic diagram of the transmitter. It is very compact and draws very little power from its 9-volt transistor battery.



DECODER PARTS LIST

Semiconductors
D1,D2,D3—1N4148 diode
D4—1N4001 diode
IC1—567 tone decoder phase-locked loop
IC2—74LS74 dual D flip-flop
IC3—7805 voltage regulator
LED1,LED2—Light-emitting diode
Q1—2N2222 transistor
Q2—2N2219 transistor

Capacitors
C1—1-μF nonpolarized
C2,C3,C7— 1-μF, 15-volt electrolytic
C4—0.01-μF disc
C5—22-μF, 15-volt electrolytic
C6—100-μF, 25-volt electrolytic
C8—0.1-μF disc

Resistors (¼-watt, 10% tolerance)
R1,R6—1000 ohms
R2—2000 ohms
R3—91,000 ohms
R5—150,000 ohms
R8—10,000 ohms
R9—20,000 ohms
R4—20,000-ohm pc-type trimmer potentiometer
R7—35-ohm, 5-watt resistor or equivalent potentiometer

Miscellaneous
K1—5-volt dc spst relay
P1,P2—Subminiature phone plug
S1—Dpdt slide or toggle switch
Pc board; IC sockets (optional); subminiature phone jack; plug-in 9-volt dc power adapter; suitable case; pocket FM radio; machine hardware; audio cable or speaker cord; machine hardware; hookup wire; solder; etc.

Note: See Transmitter Parts List for availability of items for the decoder assembly.

Fig. 2. This is the complete schematic of the decoder. Note the modification of the TV receiver's speaker circuit in the boxed-off area and the power supply that can be used with both the decoder and the FM pocket radio.

operates on r-f FM modulation, rather than the usual infrared.

The Transmitter

The Wireless Audio Mute system consists of a compact, hand-held FM transmitter and a remote receiver/decoder. The transmitter radiates r-f energy at a power level of less than 100 mW. Hence, it doesn't require FCC licensing to build and use. Instead of having to build your own FM receiver, which would be a time-consuming and expensive project (not to mention that it would require a battery of expensive test equipment to align once built), an inexpensive pocket FM radio is used to feed the control signal into a decoder.

Being that this is an FM tone-modulated r-f remote-control system, it allows you to operate the mute function from anywhere in your home—not just in the same room as your TV set is located, as would be the case with the usual infrared system.

The Fig. 1 transmitter circuit has an automatic-shutoff feature that removes power 5 to 10 seconds after *S1* is closed and held that way. This prevents rapid battery rundown if the transmitter accidentally gets caught between a seat cushion and the side of an easychair. A magnetic-type switch is recommended for *S1* to assure long operating life and positive closure. Ordinary spring-contact switches will not bear up to everyday use.

Carrier frequency for the transmitter is tunable between 88 and 108 MHz to keep it within the standard FM broadcast band and to make it possible for it to be set to an unoccupied spot on the FM dial. The r-f signal is gated on and off at a 1-kHz rate by 555 timer *IC1*. This IC provides precision timing with the help of only four external components (*C3, R5, R6* and *R7*), thus reducing the cost of the project and keeping it to compact dimensions.

Resistor *R9* sets the current through output transistor *Q3*, assuring less than 100 mW is radiated by the antenna. Coil *L1* is a center-tapped inductor that is part of the printed-circuit board's conductor pattern. Making *L1* part of the pc pattern has two benefits: it simplifies project construction, and—more importantly— assures greater stability and accuracy. R-f tuning is accomplished with trimmer capacitor *C7*.

Built into the transmitter is a test feature that is activated by pressing *S2*. When *S1* and *S2* are closed simultaneously, the *Q1/Q2* circuit is bypassed and battery power is delivered directly to the *IC1* circuit. This lets you quickly check whether or not the 555 timer and r-f output transistor *Q3* sections are operating properly.

The tone-encoded r-f output from the transmitter is radiated to the receiver via the antenna, which consists of a 3″ length of insulated hookup wire contained inside the transmitter's plastic case. Power for the transmitter is supplied by 9-volt transistor battery *B1*.

The Receiver/Decoder

At the receiving end of the system is the pocket FM radio that feeds the Fig. 2 tone-decoder circuit. The decoder, in turn, makes and breaks one of the speaker lines in your TV receiver via the contacts of relay *K1*. With the FM radio on, the audio tone that modulates the r-f carrier from the transmitter is fed to the radio's earphone output jack and into the decoder via INPUT jack *J1*, where it is clamped to a safe level by diodes *D1* and *D2*. From there, it is coupled into tone-decoder phase-locked loop (PLL) *IC1*.

Once the tone is present at input pin 2 of *IC1*, internal circuitry decodes it and sends it to output pin 8, pulling this pin low. If the tone is present for longer than a second, the charge on *C1* drops below 0.5 volt.

As the charge on *C5* drops below 0.6 volt, *Q1* cuts off, causing pin 3 of divide-by-two flip-flop *IC2* to go high. The first rising edge toggles the output one way, and the next rising edge toggles it the other way, allowing *K1* to be either a normally closed or a normally open relay. The arrangement shown in Fig. 2 is for a normally closed relay and, hence, has the anode of *D4* connected to the "N.C." point in the circuit. If the relay were normally open, the anode of this diode would be connected to the point labeled "N.O."

When *K1*'s contacts are closed, the resistance in series with the TV set's speaker is zero, allowing the sound to be at the level to which the TV receiver's volume control is set. Opening *K1*'s contacts puts potentiometer *R7* in series with the speaker and reduces the volume of the sound. (If you wish, you can substitute a 35-ohm, 5-watt resistor for the potentiometer.) The potentiometer (or resistor) prevents the audio output drive circuit in your set from being damaged.

Note the TV receiver's circuit modification shown in the boxed-off shaded area in Fig. 2. To make this modification, the set's back panel must be removed to provide access to the speaker wires coming from its internal audio amplifier. This is the dashed line with "X" through it. Once this line is cut, and the subminiature shorting-type phone jack shown is installed, a convenient means for accessing the TV set's speaker is made. *(Caution: Turn off the set's power and unplug its cord from the ac line before attempting to remove the back panel. Potentially lethal voltages are present inside the set, even with power removed; so exercise extreme caution.)*

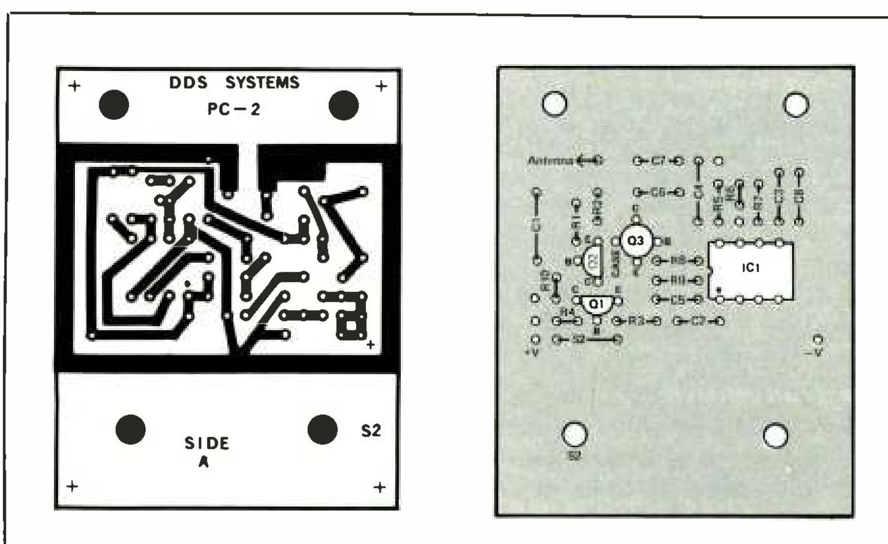


Fig. 3. At left is shown the actual-size etching-and-drilling guide for the transmitter circuit. At right is the components-placement diagram for wiring this board.

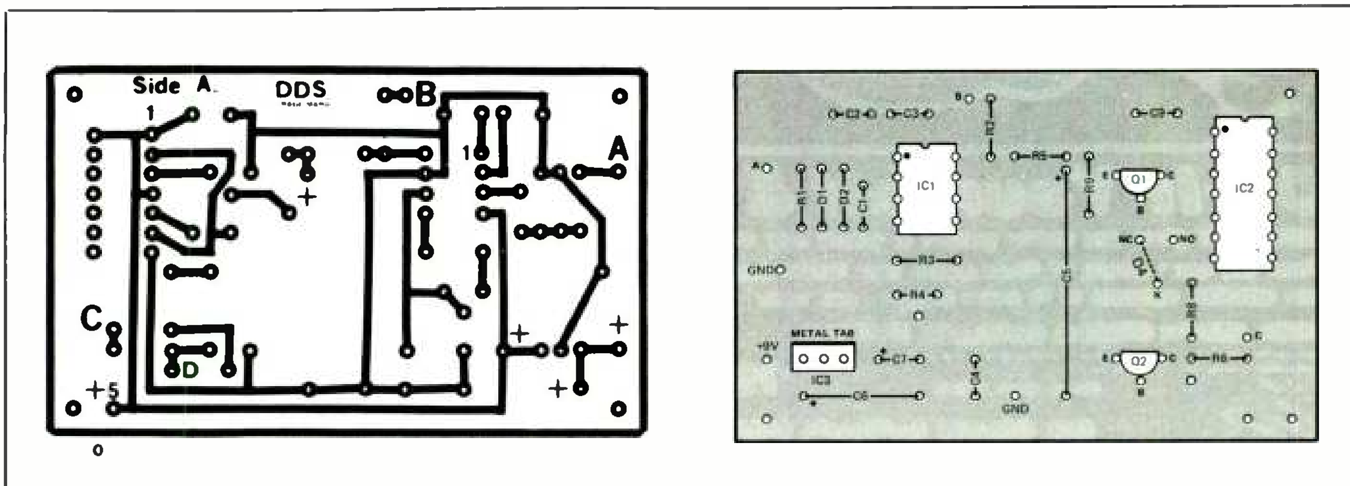


Fig. 4. Shown here are the actual-size etching- guide (left) and components-placement diagram (right) for the decoder.

When the set's speaker circuit is wired as shown, the break in the speaker line is bridged by the shorting action of the jack when the decoder is not plugged in and the set operates as normally. Plugging in the *J2* cable from the decoder transfers speaker control to the contacts of the relay.

Two light-emitting diodes are incorporated into the decoder. The first, *LED1*, comes on when the TEST button is pressed in the transmitter and tells you when the tone that activates the mute function is present and the PLL decoder chip is operating properly. The second, *LED2*, turns on when mute is on.

Power for the decoder can be obtained from either of two sources. The most convenient is the battery in the FM pocket radio. However, this may exhaust the radio's battery too quickly. Therefore, you have the option of using a standard 9-volt dc adapter that plugs into the ac line. In either case, power for the circuit enters through POWER jack *J2*. Note, too, that you can power both the FM radio and the decoder circuit from the adapter, obviating the need to periodically replace the battery in the pocket FM radio.

Construction

The transmitter must be assembled on a single-sided epoxy-fiberglass pc board, the actual-size etching-and-drilling guide and components-placement diagram for which are shown in Fig. 3. Mount the parts exactly as shown, making sure they're as close to the board as possible. Also, keep excessive solder off *L1* (the heavy conductor that surrounds the component area) to prevent the inductance of the coil from changing. Mount potentiometer *R6* and trimmer capacitor *C7* on the copper-trace side of the board.

You can assemble the decoder in any accepted breadboard manner, though it would also benefit from pc construction. (For the actual-size etching-and-drilling guide and components-placement diagram for the decoder, refer to Fig. 4.) Because this circuit handles only audio-frequency signals, there are no critical construction procedures to be followed.

(Note: though sockets are not necessary, use of them is recommended in both the transmitter and the decoder to facilitate easy replacement should any of the ICs go bad in the future.)

Select cases for the transmitter and decoder to be just large enough to accommodate the circuit boards and, in the case of the transmitter, the 9-volt battery. Machine the cases as needed. For the transmitter, this means drilling holes for mounting the switches and antenna, providing tuning-wand access to trimmer capacitor *C7* and the mounting of the circuit board and battery *B1*. For the decoder, drill mounting holes for the circuit board, power jack, switch, and LEDs and for exit of the wires to the FM radio and your TV receiver's speaker circuit. Also, drill several small holes through the decoder case's end wall to permit heat built up by *R7* to escape.

You can use either coaxial audio cable or standard speaker cable for the input to the decoder from the FM radio and for the output from the decoder to the jack connected to your TV set's speaker. Terminate both cables with standard subminiature phone plugs. Make absolutely sure to insulate *all* connections you make inside your TV receiver.

In Closing

Using the Wireless Audio Mute system described here with your TV receiver does wonders to relieve the annoyance and stress that result from too-loud and too-frequently-repeated TV commercials. Just the press of a button silences irritating sounds, while another touch restores normal sound when the program returns—from the comfort of your easychair. **ME**

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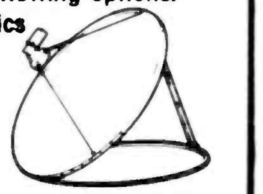

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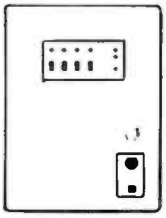

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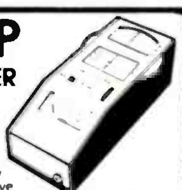

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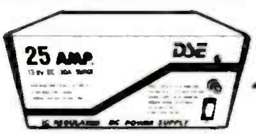

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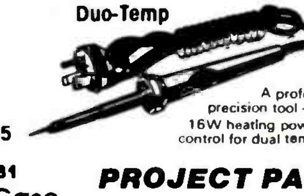

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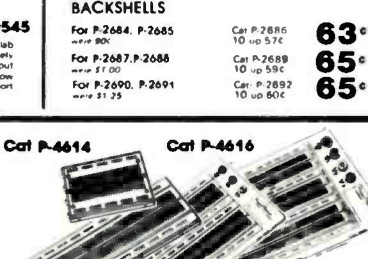

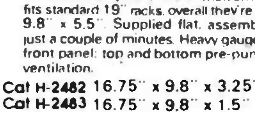

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Everything you could want in a case!

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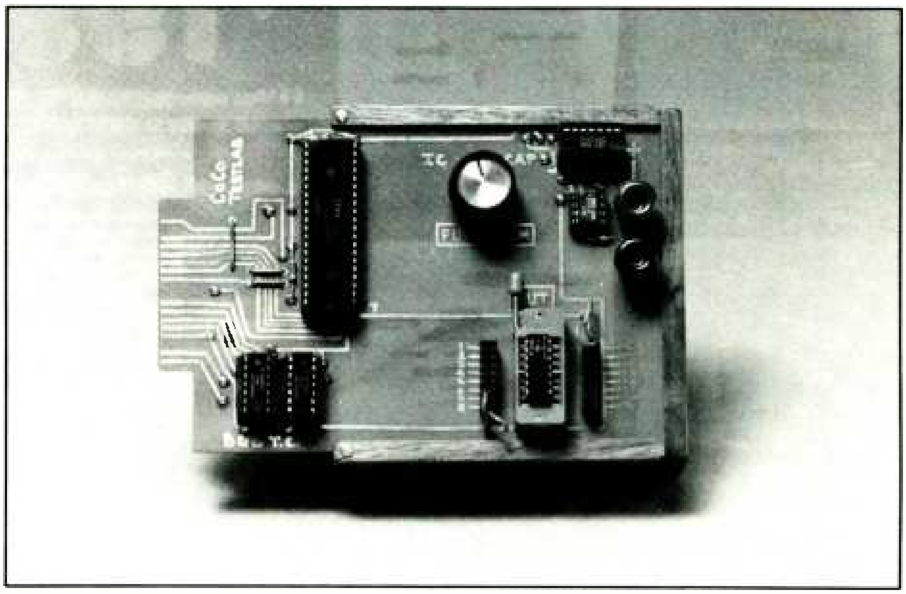
Build a CoCo Testlab

Part 2 (Conclusion)

Use a Radio Shack Color Computer to test ICs, transistors, diodes and capacitors

By Jim Barbarello & Jack Boyle



Last month, in Part 1 of this article, we discussed construction of this useful peripheral. This month, we show you how to actually use the Testlab to test TTL and CMOS digital ICs, transistors and diodes, and measure the values and condition of capacitors.

Digital IC Pre-Test Phase

Regardless of family type, all standard digital ICs have some common characteristics: inputs, outputs, ground references (V_{ss} or V −) and positive voltage references V_{dd} or V +). Most digital ICs are also either 14- or 16-pin devices housed inside dual-in-line packages (DIPs).

CMOS ICs are denoted by 4xxx or 74Cxx series numbers. TTL ICs start off with a basic 74xx or 54xx series number, but can have as few as four and as many as seven characters. Typical TTL numbers are 7400, 74S15, 74LS74 and 74LS194, with the "L" and "S" referring to "low-power" and high-speed "Schottky," respectively. Data sheets for these devices, available from the dealer or manufacturer, detail the minimum standards.

To specify a proper test, you should be able to initialize each IC to be tested so that it always starts in the same condition as any other like IC. The test should then perform a sufficient number of state changes on all inputs in proper sequence to assure that all IC functions are verified. The procedure is as follows:

(1) Insert the IC to be tested into the ZIF socket (*SO1*) on the Testlab.

(2) Connect the red + wire to the V + pin, the black − wire to the V − pin of the ZIF socket, via *SO2* or *SO3*, for the given IC type.

(3) Identify each pin of the test IC as input (I), output (O), +, −, or not used (N).

(4) Determine and execute the state changes required to initialize the IC being tested.

(5) Determine and execute the state changes required to exercise all functions; note if the results are what they should be.

Steps (1) through (3) are straightforward, though to perform them, you will need a data sheet for the IC to identify each pin's function and requirements. Steps (4) and (5) require some thought, but the needed information is also contained in the data sheet, in the form of block diagram and truth table (or timing diagram). Simply put, you must know what the IC does before you can test it.

To illustrate how the IC test function is used, we will run through typical test procedures for a 7408 TTL quad 2-input NAND gate and a 4017 CMOS decade counter.

Thorough testing starts with an IC Test Programming Sheet like that shown in Fig. 5. This is used to set up a well-planned and complete test sequence. The upper portion of the Programming Sheet has important information about the IC to be tested and special instructions relating to the test. All but the special instructions can be found on the data sheet for the 7408.

The "SKT #" title row identifies

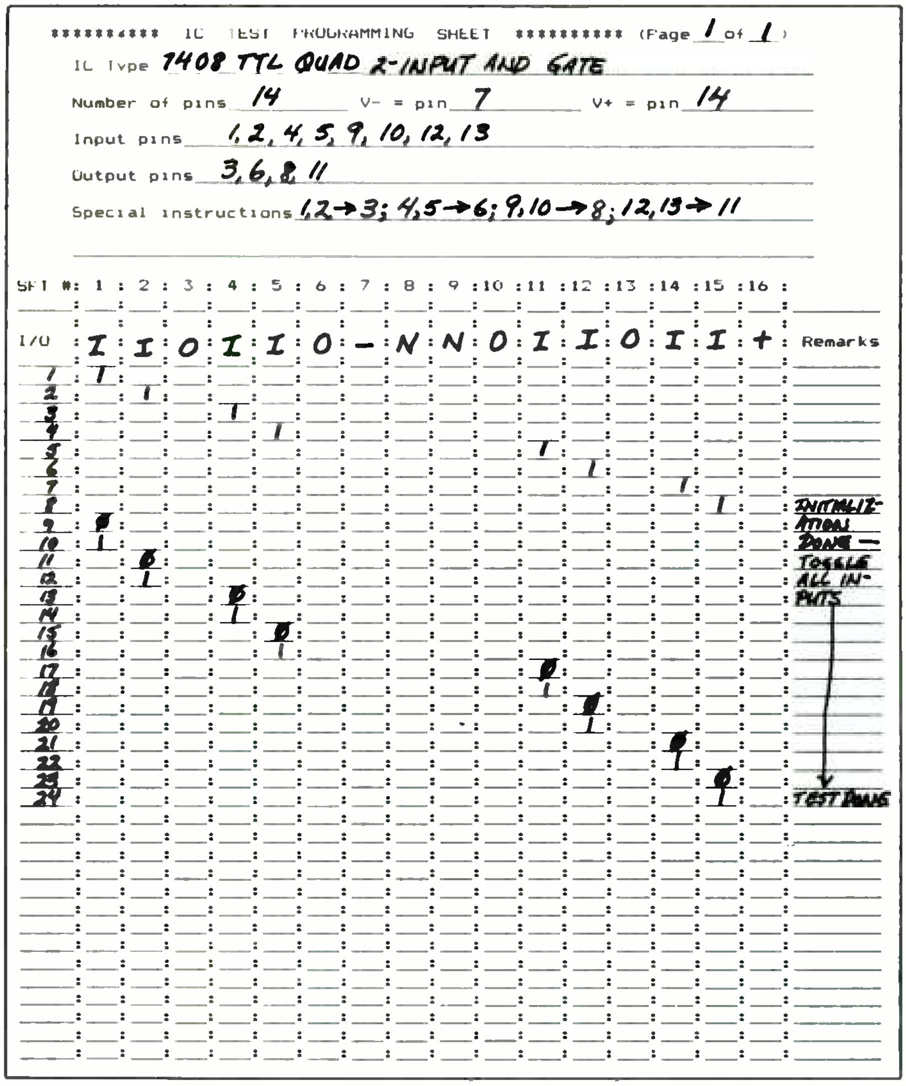


Fig. 5. Example of a Programming Test Sheet for a 7408 TTL quad 2-input NAND gate IC.

the 16 pins of the ZIF socket, with the farthest-right column reserved for remarks. The I/O (input/output) row is where you identify the function of the pin of the IC to be tested according to the associated ZIF socket position. For instance, the header identifies pin 8 as an output (O), but I/O shows ZIF socket position 8 as "N" (not used).

The ZIF socket has 16 positions, but the 7408 has only 14 pins. When you insert the 7408 into the socket, positions 8 and 9 at the bottom of the socket will be empty and pin 8 of the 7408 will be in position 10 of the ZIF socket (for an offset of 2). When the I/O row is completed, the *ZIF socket positions*—not the IC pins—are to be programmed as inputs and outputs. For an IC with less than 16 pins, therefore, you must define the ZIF socket positions properly to allow for the offset.

Below the I/O legend, the rows are numbered sequentially, starting with 1. These are the test steps, the first of which is initialization. In test step 1, pin 1 is forced high; step 2 forces pin 2 high; and so on, until all input pins have been forced high as programming proceeds through step 8, completing initilization, as indicated in the "Remarks" column.

The 7408 IC contains four identical AND gates. By forcing all inputs to high, a condition is set up that is the same for any 7408 you attempt to test with the Testlab.

Step 9 begins the actual test. The simplest way to test such a logic gate is to change the logic level on each of the input pins in turn and observe how the output behaves. Steps 9 through 24 accomplish this. With all possibilities checked, the Remarks column for step 24 indicates that the test sequence is completed. With just 24 steps, you have insured that each of the functions of each of the four AND gates have been exercised.

Figure 6 is the programming sheet for the 4017 CMOS decade counter. This 16-pin IC has no pin offset when plugged into the ZIF socket. A review of the 4017's data sheet reveals that pins 13, 14 and 15 are the enable, clock and reset, respectively.

The 4017 also has 10 count and one carry outputs. If the level on the reset to pin 1 is raised, the 4017 resets (its first output of 0 goes to 1, all other outputs go to 0 and the carry goes to 1). The 4017 remains in this state until both the reset and enable pins are reset to 0. If a positive transition is applied to the clock pin, the count will increment (the 0 output goes low and the 1 output goes high). This process continues for subsequent positive transitions of the clock. If at any time the enable pin is raised to a 1, the clock will be disabled. After half the total count is completed, the carry output goes low.

Once you know how the 4017 works, you can test it. Steps 1 and 2 in Fig. 6 reset the enable and clock pins. Steps 3 and 4 provide an IC positive-pulse reset. With initialization done, the clock input is pulsed 10 times to check all outputs and the carry bit (steps 5 through 24).

In step 25, the enable pin is brought high and a test is performed

********** IC TEST PROGRAMMING SHEET ********** (Page 1 of 1)

IC Type 4017 CMOS DECADE COUNTER

Number of pins 16 V− = pin 8 V+ = pin 16

Input pins 13, 14, 15

Output pins 1-7, 9-12

Special instructions RESET (HI) = Pin 15; ENABLE (LO) = Pin 13, CLOCK (⎍) = Pin 14; CARRY (LO on outputs 1-5) = Pin 12

SKT #:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
I/O	O	O	O	O	O	O	O	−	O	O	O	O	I	I	I	+	Remarks
1													0				RESET
2														0			ENABLE &
3															1		CLOCK PINS.
4															0		RESET IC
5														1			
6														0			CYCLE
7														1			THROUGH
8														0			ALL 10
9														1			OUTPUTS
10														0			
11														1			
12														0			
13														1			
14														0			
15														1			CARRY
16														0			CHANGES
17														1			HERE
18														0			
19														1			
20														0			
21														1			
22														0			
23														1			
24														0			
25													1				DISABLE ON,
26														1			CHECK THAT
27														0			IT'S WORK-
28													0				ING. DIS-
29														1			ABLE OFF,
30														0			CHECK IT
31															1		
32															0		RESET IC. TEST DONE.

Fig. 6. Example of a Programming Test Sheet for a 4017 decade counter IC.

to determine if the IC is disabled (steps 26 and 27). After resetting the enable pin in step 28, one output is cycled through so that the reset that follows changes the IC's state. To end the test process, steps 31 and 32 reset the IC.

Testing the IC

With the Testlab plugged into your computer and its function switch set to IC, load and run the BASIC Listing for IC Tester Program. The initial screen displays the socket-pin-define setup phase. It has 16 numbered socket pin columns and a list of setup commands. The last line indicates that your computer's < and > keys move the cursor; test cursor movement by pressing < and >. Whenever an allowable key (I, O, +, −, N, E, < or >) is pressed, you will hear a key click.

Define the pins as indicated on your Programming Sheet (Fig. 6). Bring the cursor to pin 1 and press "O" on your computer's keyboard; an O should appear in the pin-1 column. Move the cursor to the next pin and again press O. Repeat for pins 3 through 12. Figure 6 shows that pin 8 should be −, not an output. To correct this, move the cursor back to pin 8 and press the − key. Then move the cursor to pin 13 and press "I." Repeat for pins 14 and 15. Finally, move the cursor to pin 16 and press −. Check the pin definitions. When you are sure they are correct, press "E" to end the define phase; you will hear a short beep.

At the bottom of the next screen (IC Initilization) are directions and an indication of the current step, plus a message that tells you that the maximum number of permissible steps is 100. The cursor points to the first defined input (pin 13 for the 4017). Press the > and < keys and note that the cursor moves between only the defined inputs. Below the pin definitions is the current status (0 or 1) of each pin.

Place the IC to be tested in the ZIF socket and plug the red and black power-supply wires on the board into the appropriate points of *SO2* and/or *SO3*.

Starting with step 1 on the Fig. 6 Programming Sheet, bring the cursor to pin 13 and press 0. The "step" indication changes to 1. Move the cursor to pin 14 and press 0 and then to pin 15 and press 1 and then 0. Note that pins 3, 12 and 15 indicate a 1 and all other pins indicate a 0; a correct reset results.

If you note that the pins already show a 0 do not assume that you can just skip initialization. Keep in mind that not all ICs start in this condition. To insure that each IC starts in the same condition, and thus creates the same responses, initialization *must* be performed.

With initialization done, press E. You will hear a short beep and notice that the screen changes slightly. The new IC Testing screen has slightly different definitions, indicating that you should press E to end the testing phase. Using the Fig. 6 Programming Sheet, enter steps 5 through 32, making sure you move the cursor to the

BASIC Listing For IC Tester Program

```
  1 REM ** IC TESTER (IC)
  2 REM ** V1:0, 17 AUG 1985
  3 REM ** (C) 1985, B&B T.C.
  4 REM ** AUTO TEST VERSION
  5 REM
 10 CLS
    :CLEAR  1000
    :P = 129
    :DO$ = STRING$ (16,"N")
    :DIM I1(100),I2(100),O1(100),O2(100)
    :Q1 = &HFF80
    :Q2 = &HFF82
    :BL$ = STRING$ (32,128)
    :CM$ = "+-NIOE" + CHR$ (8) + CHR$ (9)
 20 DIM C$(22)
    :C$(0) = "0 0 0 0"
    :C$(1) = "0 0 0 1"
    :C$(2) = "0 0 1 0"
    :C$(3) = "0 0 1 1"
    :C$(4) = "0 1 0 0"
    :C$(5) = "0 1 0 1"
    :C$(6) = "0 1 1 0"
    :C$(7) = "0 1 1 1"
    :C$(8) = "1 0 0 0"
    :C$(9) = "1 0 0 1"
 30 C$(17) = "1 0 1 0"
    :C$(18) = "1 0 1 1"
    :C$(19) = "1 1 0 0"
    :C$(20) = "1 1 0 1"
    :C$(21) = "1 1 1 0"
    :C$(22) = "1 1 1 1"
 40 FOR I = 0 TO 7
    :P(7 - I) = INT (2 > I)
    :NEXT
    :SOUND 100,1
    :POKE  &HFF23, PEEK (&HFF23) OR 8
 50 L$ = " 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 2 3 4 5 6 7 8 9 0
     1 2 3 4 5 6 - - - - - - - - - - - - - - - - - - - - -"
 60 PRINT "SETUP PHASE:  DEFINE SOCKET PINS";L$
    :PRINT BL$;BL$;BL$
 70 PRINT @264, "SETUP COMMANDS:"
    :PRINT " I=INPUT PIN" TAB( 18)"O=OUTPUT PIN"
    :PRINT " -=VSS (GND)" TAB( 18)"+=VDD (PWR)"
    :PRINT " N=NOT USED" TAB( 18)"E=END DEFINE"
    :PRINT
    :PRINT " LEFT/RIGHT ARROWS MOVE CURSOR"
    :PRINT  BL$; STRING$ (31,128);
    :POKE   1535,128
    :PRINT @32,;
 80 PRINT @P - 1, CHR$ (207);
    :FOR J = 1 TO 50
    :NEXT
    :PRINT @P - 1, ">";
 90 A$ = INKEY$
    :IF A$ = "" THEN 90
    :ELSE  CM = INSTR (CM$.A$)
100 IF  CM = 0 THEN 90
    :ELSE   POKE  &HFF20,0
    :POKE  &HFF20,254
    :ON  CM GO TO  130,130,130,130,130,140,110,120
110 IF P > 129 THEN PRINT @P - 1, " ";
    :P = P - 2
    :GO TO 80
120 IF P < 159 THEN PRINT @P - 1, " ";
    :P = P + 2
    :GO TO 80
130 MID$ (DO$.(P - 127) / 2.1) = A$
    :PRINT @P.A$;
    :GO TO 90
140 SOUND  200,1
    :CLS
    :PRINT @238,"wait"
    :CM$ = CHR$ (8) + CHR$ (9) + "1OE"
    :POKE  &HFF23. PEEK (&HFF23) OR 8
150 FOR I = 1 TO 8
    :IF  MID$ (DO$,I,1) = "I" OR MID$ = (DO$.I,1) = "N" THEN N
      = N + P(I - 1)
160 NEXT
    :PA = N
    :POKE Q1 + 1.0
    :POKE Q1.PA
    :POKE Q1 + 1,4
    :N = 0
170 FOR I = 9 TO 16
    :IF MID$ (DO$,I,1) = "I" OR MID$ (DO$,I,1) = "N" THEN N =
      N + P(I - 9)
180 NEXT
    :PB = N
    :POKE Q2 + 1.0
    :POKE Q2.PB
    :POKE Q2 + 1,4
190 CLS
    :MS$ = "        IC INITIALIZATION          "
    :PM = 0
    :GO SUB 660
    :PRINT @32,L$
    :PH$ = "I"
    :STP = 0
    :PRINT @266,"DIRECTIONS"
    :PRINT @298,"----------"
200 PRINT "  MOVE CURSOR WITH LEFT OR RIGHT ARROWS. CHANGE INP
    UTS BY TYPING 1 OR 0. BRING IC TO INITIALIZED STATE, THEN
    PRESS " CHR$ (34)"E" CHR$ (34)"."
    :PRINT BL$;
    :MS$ = " STEP:              (MAX STEPS=100)   "
    :PM = 480
    :GO SUB 660
210 PRINT @128,;
    :FOR I = 1 TO 16
    :PRINT " "; MID$ (DO$,I,1);
    :NEXT
220 FOR I = 1 TO 16
    :IF MID$ (DO$,I,1) = "I" THEN PRINT " "; CHR$ (94);
    :ELSE PRINT "  ";
230 NEXT
    :FOR P = 193 TO 223 STEP 2
    :IF PEEK (P + 992) < > 94 THEN NEXT
240 PRINT @192,;
    :N = PEEK (Q1)
    :GO SUB 620
    :N1 = N
    :PRINT N$;
    :N = PEEK (Q2)
    :GO SUB 620
    :N2 = N
    :PRINT N$;
250 IF PH$ = "I" THEN I1(STP) = 999
    :I2(STP) = 999
    :ELSE I1(STP) = N1
    :I2(STP) = N2
260 STP = STP + 1
    :PRINT @486. USING " ###    ";STP - 1;
270 PRINT @P - 1,">";
280 A$ = INKEY$
    :IF A$ = "" THEN 280
    :ELSE CM = INSTR (CM$,A$)
    :IF CM = 0 THEN 280
290 POKE &HFF20,0
    :POKE &HFF20,254
    :ON  CM GO TO  300,330,350,350,390
300 IF P = 193 THEN 270
310 FOR I = P - 1 TO 193 STEP - 2
    :IF PEEK (I + 991) < > 94 THEN NEXT
    :GO TO 270
320 PRINT @P - 1," ";
    :P = I - 1
    :GO TO 270
330 FOR I = P + 2 TO 223 STEP 2
    :IF PEEK (I + 992) < > 94 THEN NEXT
    :GO TO 270
340 PRINT @P - 1," ";
    :P = I
    :GO TO 270
350 N = PEEK (P + 1024)
    :N = VAL (A$) + 112 - N
360 PRINT @P,A$;
    :PA = (P - 193) / 2
370 IF PA > 7 THEN N2 = N2 + N * P(PA - 8)
    :ELSE N1 = N1 + N * P(PA)
380 POKE Q1,N1
    :POKE Q2,N2
    :O1(STP) = N1
    :O2(STP) = N2
    :GO TO 240
390 SOUND 225,1
    :POKE &HFF23, PEEK (&HFF23) OR 8
    :IF  PH$ = "I" THEN PH$ = "O"
    :PM = 6
    :MS$ = "       IC TESTING      "
    :GO SUB 660
    :PRINT @393,"PRESS @ TO END TESTING PHASE.";
    :PRINT
    :GO TO 270
    :ELSE STP = STP - 1
400 CLS
    :MS$ = "         AUTO TESTING PHASE            "
    :PM = 0
    :GO SUB 660
410 PRINT @64,"TEST ANOTHER DEVICE (Y/N)...";
420 A$ = INKEY$
    :IF  A$ < > "Y" AND A$ < > "N" THEN 420
    :ELSE  IF  A$ = "Y" THEN  440
430 PRINT
    :PRINT
    :PRINT "PROGRAM ENDED."
    :PRINT
    :END
440 CLS
    :PRINT @7,"<<< TEST PHASE >>>"
    :PRINT BL$
    :PRINT "INSERT NEXT DEVICE TO BE TESTED."
    :P = 131
    :GO SUB 640
```

```
450 PRINT @96,"TESTING. STEP:"
    :PRINT " "
    :N = 0
460 FOR I = 1 TO 8
    :IF MID$ (DO,I,1)      "0" THEN N = N + P(I - 1)
470 NEXT
    :PA = N
    :POKE Q1 + 1,0
    :POKE Q1,PA
    :POKE Q1 + 1,4
    :N = 0
480 FOR I = 9 TO 16
    :IF MID$ (DO,I,1) <    "0" THEN N = N + P(I - 9)
490 NEXT
    :PB = N
    :POKE Q2 + 1,0
    :POKE Q2,PB
    :POKE Q2 + 1,4
500 FOR I = 1 TO STP
    :PRINT @110,I;
    :IF I1(I) = 999 OR I2(I) = 999 THEN POKE Q1,O1(I)
    :POKE Q2,O2(I)
    :NEXT
510 S = I
    :FOR I = S TO STP
    :PRINT @110,I;
    :POKE Q1,O1(I)
    :POKE Q2,O2(I)
520 IF PEEK (Q1) < > I1(I) OR PEEK (Q2) < > I2(I) THEN 540
    :ELSE NEXT
530 PRINT @96,"PASS. IC PERFORMS AS EXPECTED."
    :P = 484
    :GO SUB 640
    :GO TO 400
540 PRINT @71,"IC FAILS AT STEP";I
    :PRINT BL$:
    :PRINT "    PIN # (I=INPUT, O=OUTPUT)"
    :PRINT " 0 0 0 0 0 0 0 0 0 1 : 1 1 1 1 1 1 2 3 4 5 6 7 8 9
     0 1 2 3 4 5 6 - - - - - - - - - - - - - - - - -";
550 FOR J = 1 TO 16
    :PRINT " "; MID$ (DO$,J,1):
    :NEXT
560 PRINT TAB( 8)"EXPECTED RESPONSE"
570 N = I1(I)
    :GO SUB 620
    :PRINT N$:
    :N = I2(I)
    :GO SUB 620
    :PRINT N$:
580 PRINT TAB( 8)"OBSERVED RESPONSE"
590 N = PEEK (Q1)
    :GO SUB 620
    :PRINT N$:
    :N = PEEK (Q2)
    :GO SUB 620
    :PRINT N$:
600 P = 484
    :GO SUB 640
    :GO TO  400
610 REM ** CONVERSION ROUTINE
620 N$ = "0" + HEX$ (N)
    :N$ = " " + C$( ASC ( MID$ (N$, LEN (N$) - 1,1)) - 48 + "
     " + C$( ASC ( RIGHT$ (N$,1)) - 48)
    :RETURN
630 REM ** RESPONSE ROUTINE
640 PRINT @P,"PRESS enter WHEN READY...";
650 A$ = INKEY$
    :IF  A$ = "" THEN 650
    :ELSE IF ASC (A$) < > THEN 650
    :ELSE RETURN
660 FOR I = 1 TO LEN (MSG$)
    :MS = ASC ( MID$ (MSG$,I,1)) AND  191
    :POKE  PM + 1023 + 1,MS
    :NEXT
    :RETURN
```

proper pin as required. As you proceed through each step, make sure the IC is responding as it should. When you are done, press E to end the test phase.

The next screen, the Auto Testing Phase, asks "Test Another Device (Y/N?)" Pressing "Y" puts on-screen the message "Insert Next Device To Be Tested. Press ENTER To Begin." Pressing ENTER causes the message "Testing" to appear. If there is any flaw in the IC being tested, the sequence stops and the program shows you what was expected and what actually occurred. You can then press ENTER to return to the Auto Testing Phase, which can be ended simply by responding with an "N" when asked if you wish to test another device.

Capacitance Meter Function

The Testlab can test both polarized electrolytic and tantalum and nonpolarized ceramic disc, dipped Mylar, etc. capacitors. When testing polarized capacitors, the + lead must go to + binding post *BP1*, and the – lead must go to – binding post *BP2*. Nonpolarized capacitors can be connected to the binding posts in either direction.

In addition to measuring the actual value of a capacitor, the Testlab can also give you an indication of dielectric quality. If the dielectric is reasonably good, the capacitor's value will remain stable; if not, its value will vary with each charge/discharge cycle. The capacitance meter function allows you to repeatedly charge a capacitor and note if its value remains constant or nearly so.

Before making an actual test, it is a good idea to calibrate the Testlab's capacitance-measuring function for maximum accuracy. To do this, plug the Testlab into your computer's cartridge port slot, and set Testlab's function switch to CAP and turn on the power. Then load and run the BASIC Listing for Capacitance Meter Program. When the system is ready, a "meter" will appear on your monitor's screen.

Five functions are available: L for low range, A for auto range, M for measure, R for ready and O for off. When the program is first run, the meter comes up in auto range and ready function.

Measuring accuracy depends on stray capacitance and the actual values of *R3* and *R4*. Line 10 of the program listing contains the variables R(1), R(2) and C(1). By adjusting these values, you can calibrate for maximum accuracy.

To do this, temporarily remove *IC4* and *IC5* from the Testlab. Measure the values of *R3* and *R4* and convert them to megohms (say, *R3* = 9.98 and *R4* = 0.0325). Then reinstall *IC4* and *IC5*. Still with no capacitor connected to *BP1* and *BP2*, run the capacitance meter program and select M (measure). After obtaining a reading (or an <OUT OF RANGE> message), press BREAK on the computer's keyboard. Type PRINT M and press ENTER. Note the displayed value (say, 18). Now edit line 10 of the program to include the values of *R3*, *R4* and M in the variables R(1), R(2) and C(1), respectively. In our example, line 10 of the program would be revised to read R(1) = 9.98, R(2) = 0.325 and C(1) = 18. Save the revised program.

Measuring Capacitance

With the Testlab plugged into the CoCo's cartridge slot and FUNCTION switch *S1* set to CAP, turn on the power and load and run the capacitance meter program. The meter will come up in the auto and ready functions. Connect the capacitor to be tested between *BP1* and *BP2*, observing polarity if it is polarized. Press M, and in a few seconds, the capacitance reading or the message <OUT OF RANGE> will be displayed. Pressing R clears the screen. It is not necessary to clear the screen between successive readings. (The ready function is optional). Pressing O turns off the meter, clearing the screen and ending the program.

Capacitors between about 0.1 and 1 μF can be measured in both the low (L) and high range of the capacitance meter. In auto (A), the meter uses the high range for these values. However, you can switch off auto by selecting the L range, which can provide a slightly more accurate reading.

Checking a capacitor's stability is easy to do. Simply make a number of successive tests and note the measured results.

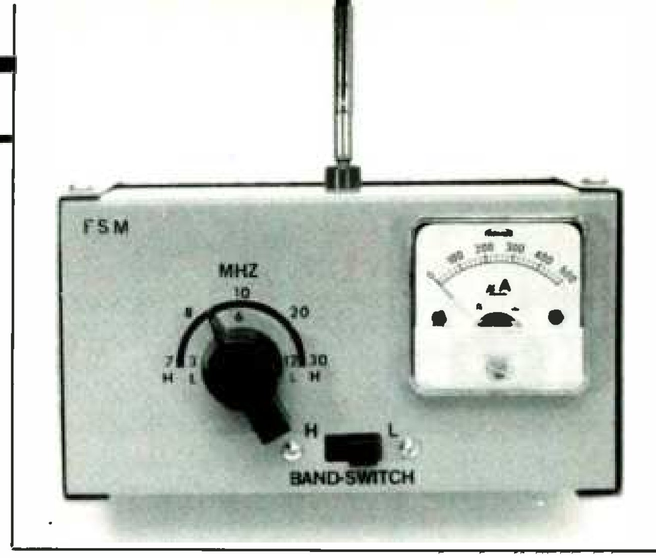
Testing Other Devices

Transistors and diodes are two other devices that can be checked with the Testlab. For this function, you will need a standard 16-pin DIP jumper cable and a solderless breadboard in addition to the Testlab itself. Plug one end of the jumper cable into the

(Continued on page 92)

BASIC Listing For Capacitance Meter Program

```
  1 REM ** COLOR CAP METER PROG.
  2 REM ** NAME: CAP
  3 REM ** V4.1, 4 AUG 1985
  4 REM ** (C) 1985, B&B T.C.
  5 REM ** FOR USE WITH COCO                        IC/CAP HARDWARE.
 10 CLS
    :CLEAR  200,&H3EFF
    :DEF USR = &H3F00
    :R(1) = 10.09
    :R(2) = .0316
    :C(1) = 11
 20 REM **SET HARDWARE PIA'S
 30 POKE  &HFF83,0
    :POKE &HFF82,160
    :POKE &HFF83,4
 40 DS$ = "##.######"
    :OP$ = "LARMO"
 50 REM **LOAD M/L CODE
 60 FOR I = &H3F00 TO &H3F76
    :READ M
    :POKE I,M
    :NEXT I
 70 REM **FORMAT SCREEN
 80 CLS 1
    :AA$ = STRING$ (20,32)
 90 FOR I = 38 TO 358 STEP  32
    :PRINT @I,AA$;
    :NEXT
100 PRINT @0, STRING$ (4,128);
    :FOR I = 28 TO 481 STEP  32
    :PRINT @I, STRING$ (8,128);
    :NEXT
    :PRINT @508. STRING$ (3,128);
    :POKE 1535,128
110 PRINT @42,"CAPACITANCE";
120 PRINT @77,"METER";
130 PRINT @104, STRING$ (16,255);
    :PRINT @136, CHR$ (255);
    :PRINT @151, CHR$ (255);
    :PRINT @168, STRING$ (16,255);
140 PRINT @148,"UF";
150 PRINT @233,"RANGE: LO AUTO";
160 PRINT @329,"MEASURE  READY";
170 PRINT @390, STRING$ (20,143);
    :PRINT @422,"  PRESS L, A, M, R  ";
    :PRINT @454,"  OR O TO TURN OFF  ";
180 REM **REVERSE SCREEN, RESET M/L CODE TO REVERSE DISPLAY
     ONLY
190 DEF USR = &H3F60
    :X = USR (0)
    :POKE &H3F62,136
    :POKE &H3F72,4
    :POKE &H3F73,156
200 PRINT @243,"A";
    :RNG = 2
210 PRINT @338,"R";
    :POKE  1353,13
220 IF PEEK (1264) = 76 THEN  RNG = 1
    :POKE  &H3F5D,1
230 A$ = INKEY$
    :IF A$ = "" THEN 230
240 IF  M < = C(1) THEN  PRINT @137,"              UF ";
    :X = USR (0)
250 OP = INSTR (OP$,A$) + 1
    :ON  OP GO TO  230,260,270,280,300,350
260 PRINT @240,"I";
    :POKE  1267,1
    :POKE  &H3F5D,1
    :RNG = 1
    :GO TO 230
270 POKE  1264,12
    :POKE  &H3F5D,0
    :PRINT @243,"A":
    :RNG = 2
    :GO TO 230
280 PRINT @338,"R";
    :POKE  1353,13
290 PRINT @138, STRING$ (9,32);
    :X = USR (0)
    :GO TO 230
300 PRINT @329,"M";
    :POKE 1362,18
310 GO SUB 600
    :M = PEEK (&H3F5B) * 256 + PEEK (&H3F5C)
    :RNG = ( PEEK (&H3F5D) / 32) + 1
    :POKE &H3F5B.0
    :POKE &H3F5C,0
    :POKE &H3F5D.0
320 IF  M < = C(1) THEN  PRINT @137,"<OUT OF RANGE>";
    :X = USR (0)
    :GO TO 340
330 PRINT @138.;
    :GO TO 700
340 POKE &HFF82,160
    :GO TO  210
350 CLS
    :END
490 REM **M/L CODE
500 DATA 182,63,93,129,0,38,30,134,32,183,255,130,198,1,142,0,
     0.134,160,183,255,130,134,224,180,255,130,129,160,39,43,58
     ,140.0.0.38.241,134,128,183,255,130,134,0,183,255,130,198,
     1,142,0,0,134,128,183,255,130,134,192,180,255,130,129,128,
     39
510 DATA  13,58,140,0,0,38,241,32,5,140,0,10,37,214,134,32,180,
     255,130,191,63,91,183,63,93,57,0,0,0.0
520 DATA  0,142,4,32,166,132,129,32,39,6,129,127,34,2,132,191,1
     67,128,140,5,255,38,237,57
590 REM **CAP READING FUNCTION
600 POKE  &HFF03,( PEEK (&HFF03) AND 254)
    :PRINT @137, STRING$ (10,32);
    :X = USR (0)
    :DEF USR = &H3F00
    :X = USR (0)
    :POKE &HFF03,( PEEK (&HFF03) OR 1)
    :DEF USR = &H3F60
    :RETURN
690 REM **DISPLAY READING
700 VL = (M - C(RNG)) / (45000 * R(RNG))
    :L = LEN ( STR$ ( INT (VL * 1E6)))
    :L = 10 - L
    :MID$ (DS$,5,5) = "*****"
    :IF L > 5 THEN 720
710 MID$ (DS$.4 + L,6 - L) = "      "
720 PRINT USING  DS$;VL:
    :X = USR (0)
    :RETURN
```



Build a Tuneable Field-Strength Meter

Lets you quickly check how much relative r-f signal is being radiated between 3 and 30 MHz

By John Richards

A tuneable VHF FSM (*F*ield *S*trength *M*eter) is a handy gadget to have around the shack because is gives a quick and dirty check of how much relative r-f is being radiated by anything: an antenna or its feeder, an r-f amplifier, an oscillator—just about anything. Although tuneable FSMs are no longer sold by your local parts distributor unless he has discovered some old stock buried back in the basement, you can easily build one in less than an evening from "surplus" and "junk box" parts.

Basically, this instrument is simply a device that sniffs out the presence of radio frequencies and rectifies it to dc for display on a sensitive meter. If you were, for example, tuning an antenna for maximum forward gain, you could place the FSM several wavelengths from the front of the antenna and simply adjust the antenna for the highest possible reading on the FSM's meter. Or you might use it to sniff our vhf *spuri* generated by the transmitter: If the transmitter's output is supposed to be on the 40-meter band (approximately 7 MHz) and an FSM indicates output on 7 MHz *and* 18 MHz, you know you've got "Big Trouble."

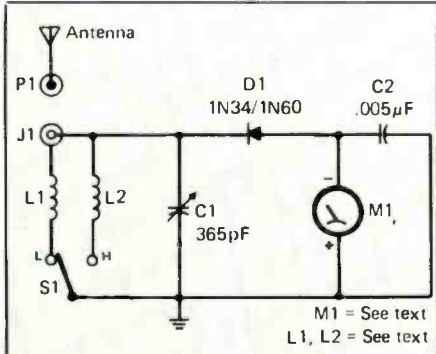
Ordinarily, you could detect the presence of r-f signals with a piece of wire, a rectifier and a dc meter. Unfortunately, the sensitivity of such a device is almost nil and it might take anywhere from a half to a full gallon (0.5 to 1 kW) just to budge the meter's pointer off its rest. To boost the sensitivity of the FSM, we must first feed r-f into a tuned circuit, use a rectifier diode with a low barrier voltage rating to rectify the r-f, and finally pass the dc to a rather sensitive microammeter. With this combination, the FSM could indicate the r-f generated by a flea's burp.

The nice part about a tuneable FSM is that it's self-powered, requiring neither a transistor amplifier nor a battery. You can carry one in the trunk of your car for years, alternately baking it in the summer and freezing it in the winter, and when you take it out it's ready to go.

Figure 1 is the schematic for the tuneable FSM shown in the photographs. The antenna couples an r-f sample to a tuned circuit consisting of *L1/C1* (3 to 12 MHz) or *L2/C1* (8 to 30 MHz). The voltage developed across the tuned circuit is rectified by diode *D1* and displayed by meter *M1*. Capacitor *C2* serves only as a filter to keep r-f out of the meter.

Theoretically, it's a simple enough device. Practically, however, it's something else. The overall sensitivity of the FSM really is primarily determined by the type of diode and the sensitivity of meter *M1*. A 500 μA meter movement will work fine with high-power transmitters but will hardly budge, if at all, when testing a flea-power QRP rig. For all-around use, a 100 μA or even a 50 μA meter, however, will usually be pinned by an insect's squeek, but the meter reading is easily restored on-scale by detuning variable capacitor *C1*.

Regardless of what's used for meter *M1*, for maximum sensitivity



PARTS LIST

C1—365-pF miniature Polyvaricon capacitor with modified shaft (see text)
C1—0.005-μF Mylar or disc capacitor
D1—1N34, 1N60 or equivalent germanium diode
J1—Insulated banana jack
L1,L2—R-f coil (see text)
M1—0-to-100-μA dc meter (see text)
PL1—Banana plug
S1—Spst slide switch
Misc.—Telescoping antenna; suitable enclosure; panel-labeling kit; machine hardware; hookup wire; solder; etc.

Note: A 365-pF Polyvaricon capacitor with hollow spacer is available for $5.75 in the U.S. from Speciality Parts, Box 22, West Hempstead, NY 11552. New York residents, please add sales tax.

Fig. 1. This is the complete schematic diagram of the field-strength meter. The coils are hand-wound, and the diode is a germanium type. See text for details on capacitor.

diode *D1* should be *germanium* rather than silicon because the germanium barrier voltage averages 0.3 volt while silicon diodes usually require 0.5 to 0.7 volt. In practical terms, it means that a weak r-f signal that's barely strong enough to produce a meter reading using a germanium dide won't even get past a silicon diode, let alone produce a meter reading. A Silicon diode should be used only if your transmitter's output r-f is so strong it consistently pins the meter. (Sometimes, with powerful r-f fields, detuning to unpin a meter is too critical.)

Unfortunately, the price of components being what they are today, you could drop a bundle of cash just on the meter movement, assuming you could ever locate the coils and tuning capacitor. Fortunately, by winding the coils yourself, and by using "surplus" parts that have been floating around the marketplace for years but which are still generally available, you can build the tuneable 3 to 30 MHz FSM shown for well under $25.

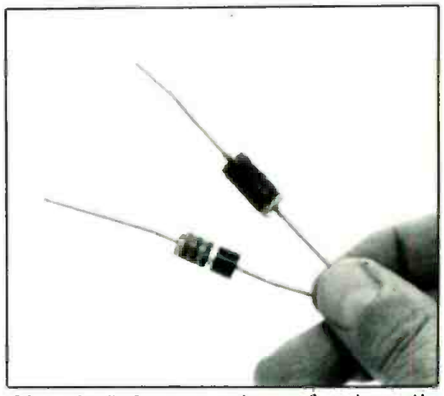
Construction

Let's go over the circuit in Fig. 1 first so you don't think there's a mistake in the schematic. Diode *D1's* polarity is shown reversed from the way it's usually drawn because its *anode*, the negative dc output, is feeding the meter. Usually, this circuit is shown with the *cathode*, the positive dc output, feeding the meter.

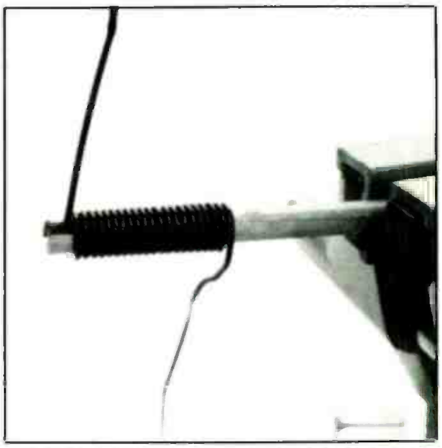
It makes no difference how the diode is installed as long as it connects to the correct meter terminal. Since the meter used for the FSM shown in the photographs had its negative (−) terminal closest to the diode, the diode was "reversed" for shortest possible connection.

The FSM prototype was assembled on the U-section of an aluminum cabinet approximately 4¼"×3¼"×2⅛". You can substitute any metal cabinet as long as you retain a similar parts layout. Antenna jack *J1* is a conventional insulated banana jack. The antenna is a short, telescopic type salvaged from a discarded transistor pocket radio that has been cross-threaded into *PL1*, a standard banana plug. I had to cross-thread the antenna because it's mounting screw is metric while the jack is threaded ASA (American).

Meter *M1* is a 1½"-square minimeter. While meters of this type usually sell for $15 to $20 as virgin stock, the marketplace has a good selection of "surplus" and discontinued ¾" to 1½" mini-meters priced around $5.

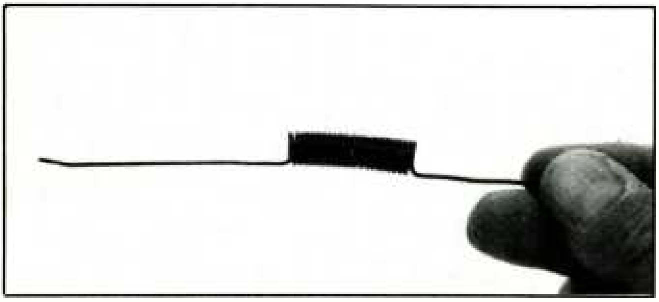


Use a 5/16" (2-watt resistor) for the coil form when winding low-band coil L1. Complete coil is shown at top.

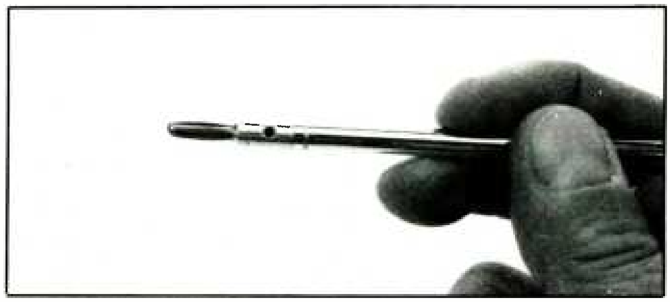


The No. 16 wire used for high-band coil L2 is difficult to wind into a coil unless the free end is secured. This is easily done by cutting a small notch to hold the wire in the form.

Locating tuning capacitor *C1* will be something of a hassle (*C1* must be 365 pF). It can be the r-f section from a miniature capacitor salvaged from a transistor radio, but bear in mind that the r-f section of some transistor radio tuning capacitors is approximately 150 pF, and 150 pF won't provide the FSM's specified frequency coverage. Years ago, miniature 365-pF tuning capacitors, with a short shaft for a knob, were an almost standard item. No so today. The best we can likely do is a miniature tuning capacitor whose shaft is a short stub that was originally intended for a tuning dial rather than a



Coil L2 is finished by sliding it off the wood form and then bending the leads axially.



This telescoping antenna was salvaged from an old transistor radio. It is cross-threaded into a banana plug.

knob, and even these miniature tuning capacitors are difficult to locate. (A dependable source at the time this article was prepared is given in the parts list.)

The photos show how to convert a stub to a conventional shaft for a tuning knob. First, remove *C1*'s mounting nut and make certain the nut that secures the capacitor itself is secure. Don't overtighten or you will break the assembly. Place the capacitor on it's back. Cut the tapered tip off a round wood toothpick and then cut a ½" section of toothpick. Mix up a small quantity of epoxy and put a tiny drop on one end of the toothpick and insert the end into the threaded hole of the stub shaft. The section of toothpick will be used as a centering device for a ¼" D × ¾" L hollow plastic spacer: The spacer becomes the tuning shaft. (Note: The source for *C1* given in the Parts List supplies the spacer with the capacitor.)

Place a single drop of epoxy into the spacer and a very small single drop on the matching end. Place the spacer over the toothpick, carefully make certain the spacer is centered on the capacitor's shaft (there might be some play around the toothpick), and using another toothpick wipe any excess epoxy from around the end of the shaft. Let the assembly set undisturbed for about 24 hours. *Warning!* Be extremely careful that no epoxy squishes out from under the spacer and flows down the capacitor's shaft because it will glue the shaft in place.

Try to install *C1*'s mounting nut after the epoxy has set. It's a snug fit around the spacer, but it will "thread down." If the nut can't get past the spacer-to-stub joint there's probably a bit of epoxy sticking out from under the spacer. Simply remove it with a knife or a file. The ¼" diameter spacer-shaft will accommodate a conventional knob. The capacitor's mounting hole is ⁵⁄₁₆".

The specified tuning capacitor has a stub shaft originally intended for a tuning dial. You extend the shaft to accommodate a conventional knob by cementing a hollow spacer on the stub. A short section of toothpick in the stub serves as a centering device for the spacer.

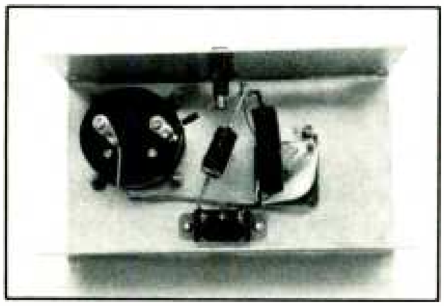
Winding Coils

Tuning coils *L1* and *L2* are wound from solid enamel-insulated wire. Do not use stranded or bare wire. Tensilize the wire before winding the coils to avoid having the coils "unwind" when you release the tension on the wire (a coil wound with tensilized wire will not unwind). To tensilize the wire, unwind a few inches more than you will need, clamp the free end in a vise, and pull firmly on the wire until you feel it go "dead slack." Stop pulling the instant you feel the wire go slack! If you continue to pull on the wire you will cause the enamel insulation to pop loose or flake.

Coil *L1* consists of 40 turns of No. 30 enameled wire close-wound on a ⁵⁄₁₆" diameter form. If you use any old form you might get extra-thin, easily damaged leads flopping from the ends of the coil. You can get stiff leads by using a 2-watt carbon resistor (27,000 ohms or higher) as the coil form. (Since the value of the resistor is much higher than the reactance of the coil, it won't affect the tuned circuit; the resistor functions only as a support for the coil.)

Using a small triangular file, cut a small groove at each end of the resistor; sort of angle through the edge. Scrape about ½" of insulation from one end of the No. 30 wire, tin the wire, wrap it around one resistor lead close to the body of the resistor and solder. Lead the wire through the notch (the notch holds the wire), and wind 40 turns starting about ⅛" in from the end of the resistor.

Lead the wire out the other notch, scrape the insulation from the wire, tin, and solder the free end to the other resistor lead. Coat the coil with a thin layer of radio-TV cement (to



While parts layout is not fussy, mounting of individual components is critical. Make certain that each is well soldered and secure. Cold-solder joints or flopping parts will produce unstable meter readings.

hold the coil in place) and allow the cement to thoroughly dry before handling the coil.

Coil *L2* is 30 turns of No. 16 wire close-wound on a ¼" form. Use ordinary ¼" wood dowel sold in hardware stores and lumber yards for the form. No. 16 wire is heavy stuff and will fight you if you just try to wind it around the form, so lock the starting end in place. This is done by cutting a short slot (about ¼" deep) in one end of the dowel and then clamping the dowel in a vise. Allow about 3" of free wire, pass the wire through the notch, and then wind the coil. The notch will keep the wire from turning. When you're finished, simply slide the coil out of the notch and off the form. Then bend both ends of the coil outward so they form axial leads. Later, you can reform the axial leads to fit your component layout.

Keep the coils as far away as possible from the metal cabinet. If you can locate them in the approximate center of the cabinet, do so.

The frequency calibrations shown on the FSM in the photographs are only approximate. If you want a precise calibration, couple a dip meter to each coil, set the meter to the desired frequency and adjust the FSM's tuning for a peak meter reading. Then mark the FSM's panel with the dip meter's frequency. Don't worry if you don't have access to a dip meter, though. For most experimenters the relative kind of calibration shown will be adequate.

The exact tuning range of the FSM will depend on how precisely you wound *L1* and *L2* and their position within the cabinet. The design tuning range is from slightly below 3 MHz to about 34 MHz, so even if the coils are sloppy you should get a 3-to-30-MHz range. If the precise range of the unit you build doesn't come out the way you want it, simply modify the coils accordingly. Adding turns (one or two at a time) lowers the frequency of the tuning range; removing turns increases the tuning range.

Doing all this, you'll wind up with a handy r-f meter type that's virtually impossible to purchase in assembled form. **ME**

LETTERS *(from page 3)*

done. You need some proofreading help though when I see "Mimms" instead of Mims and "Chauffer" instead of Chauffeur in your January '86 issue.

Nicholas Bodley
New York, NY

Ringing the Bell

•I appreciate articles like "The Touchmaster" by Daniel C. Gifford and "The Laser at Twenty-five" by Forrest M. Mims.

Dr. William H. Holmes
Billings, MT

•Your new magazine is terrific and fills a great need. We need more articles like "Thermometer" and "Using Op Amps." Lancaster is also terrific.

John Hanson
Hawthorne, CA

Keep Them Whole

•I would like to say that I join many others in congratulating you on your magazine, as I have been through the "others." I do have one complaint. Regarding your December issue, I don't mind the fact that you have a "Part I" for the Electronics Notebook series. Continuing this type of article is OK. However, I sure hate to see a construction article in parts, such as the article on the SCA adapter. For a person like me who generally picks up your magazine at the newsstand, this appears to be a way of making sure a person will buy the next issue. It also delays building the project in that I must wait a month to obtain construction details and setup and operation instructions. Other than this one area, I enjoy many of your articles and wish you continued success.

Jerry A. True, KA9UDU
Greenfield, IN

P.S. Being from a rural area of Indiana, I really like the name of the town of your home office [Hicksville].

Unfortunately, some articles are just too long to run in a single issue.—Ed.

Epson's Even Better

•It's great! . . . The magazine you've put together. It's all I had expected of the old PE before disastrous format change. Hallelulah! Keep going.

Eric Grevstad missed the mark, slightly, in his review of Epson's new SPECTRUM LX-80 printer (October 1985). He stated it will print over 100-odd typestyles. The one I have does *160* combinations of draft quality and enhanced font styles from the 5 character-per-inch double-spaced pica down to a quite legible compressed elite sub/superscript at 20 cpi. Then don't forget the near-letter-quality combos—eight of them. And the built-in graphics that adds to the computer's, the special characters for 10 languages plus US English, and on and on. It's quite a machine.

The feature that I like best, though, is one Mr. Grevstad never mentioned: the cut-sheet feeder accessory. It's smooth and nearly fully automatic. The best part is that is has cut the cost of computer paper to nil. It works like a charm on all that scrap photocopy paper the typical office produces. I expect my feeder to pay for itself in a couple of months at the rate I'm using paper.

R.H. Meyer
Berlin, CT

How to Assemble Miniature Circuits

By Forrest M. Mims III

Since I began building transistor radios in the mid-1950s, I've been fascinated by miniaturized electronic circuits. Even in this area of tiny high-tech products like pocket computers and television receivers, digital watches and credit card-size radios and calculators, there are still plenty of circuits left for experimenters to miniaturize.

In this column, I'll describe some of the tips and techniques I have used over the years to assemble miniaturized electronic circuits. I've not yet seen some of these techniques described in published form, so I hope they will prove helpful to the readers of *Modern Electronics.*

Do-It-Yourself Circuit Assembly

Solderless breadboards have made design, evaluation and testing of do-it-yourself electronic circuits simple, fast and convenient. Moreover, modifications are easily made before a breadboarded circuit is transformed into a permanent version. Unfortunately, fabrication of a permanent circuit remains relatively time consuming.

Many articles and books have covered circuit assembly methods in depth. If your personal electronics library doesn't include any of these sources, your circuit assembly skills will be greatly enhanced by a visit to a good library and a look through some of the many publications that cover this subject.

Miniature Electronic Circuits

Tools and techniques for building miniature circuits are often very different from those used to assemble conventional circuits. Also, sometimes the assembly of miniature circuits can be particularly difficult. Though the active components of such circuits are usually very small, it can be difficult for the average experimenter to find miniature switches, potentiometers, battery holders and enclosures.

In a future article I'll describe in detail how experimenters can use tiny surface-mount components to assemble miniature versions of complex circuits. First, let's explore some straightforward ways to assemble miniature circuits using readily available tools and components.

The Tools

The most important tool for assembling miniature circuits is a good-quality, low-wattage soldering iron. Generally a small chisel or needlepoint tip is best for miniature circuit assembly. The iron's tip should be well tinned and kept free of excess solder and dross during soldering. The best way to keep the tip clean is to pull it across a damp sponge, preferrably one specifically designed for this purpose. For best results, be sure to use small-diameter, rosin-core solder.

A magnifying glass can prove very helpful. With it, you can find tiny solder balls and bits of wire that might cause short circuits. It's also helpful in locating solder bridges that can easily occur when soldering closely spaced component leads and printed-circuit lands.

Pointed tweezers are ideal for holding small components and removing bits of loose wire from crowded circuit boards. They are also handy for twisting wrapping wire around component leads prior to soldering the wire in place.

Pliers and wire cutters are required for virtually every electronic construction project. For best results when assembling miniature circuits, use the smallest needlenose pliers and diagonal cutters you can find.

Screwdrivers are also a must. A set of both standard and crosspoint drivers is indispensible for miniature projects.

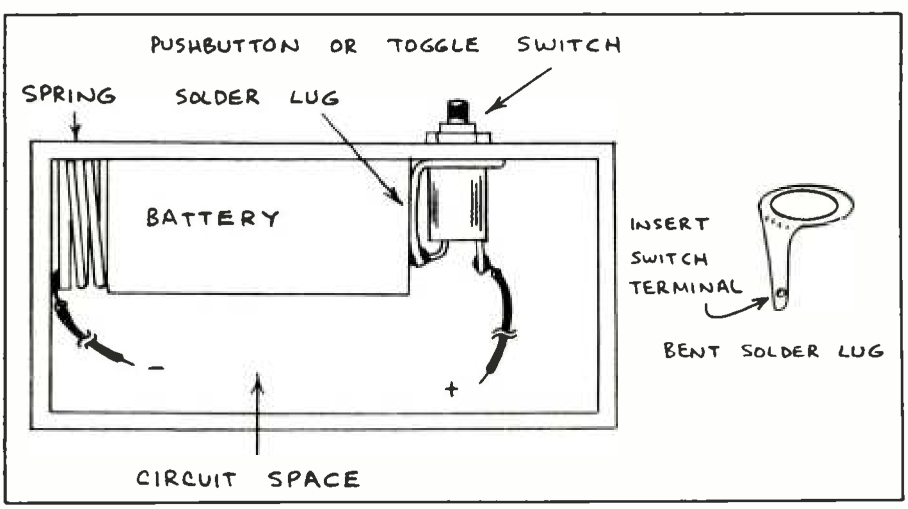
Finally, an effective method for drilling small holes is required. You can use a small drill for this purpose. Or you may find that most holes can be formed by twirling the blade of a hobby knife into the material to be drilled.

Depending on your needs, you may wish to add additional tools to your miniaturization toolkit. For instance, a can of compressed air comes in handy for blowing away bits of wire and other debris that often hide under the components of a newly assembled circuit board. Soldering probes can be used to remove accumulated solder rosin; a nibbling tool can be used to cut pieces of circuit board to size; and a reamer can be used to enlarge holes.

The Enclosures

A wide variety of miniature enclosures designed specifically for electronic projects is available from electronics parts suppliers. Radio Shack, for instance, sells several such cases. Catalog number 270-220 is the smallest of a series of sturdy

Fig. 1. A miniature battery holder with a built-in switch.



all-plastic cases that includes internal slots for circuit boards. Catalog number 270-291 is a somewhat larger enclosure that comes with a pc board on which are 483 solder-ringed holes, two front-panel labels, snap-in rubber feet and hardware. Some parts suppliers that advertise in this magazine also sell enclosures.

As for smaller circuits, like most other experimenters, I've used a wide assortment of pill bottles, fishing tackle boxes, tie tac boxes and the like. A few years ago, however, I discovered a line of compact plastic boxes that are ideal for miniature projects. These have removable lids and are available in clear or tinted (red, pink, yellow and green) plastic. These boxes are sold by craft shops and specialty stores.

These boxes come in three sizes, each of which is slightly more than 0.7 inch thick. The largest is 2 inches square and the smallest is 1 inch square. The third is a rectangle measuring 1 × 2 inches.

Regular readers of this column may recall drawings of circuits assembled in the two larger versions of these handy enclosures. I have assembled various other circuits in these boxes, one of which will be described below.

Batteries

When transistors first became available to experimenters, the choice of a battery to power a miniature do-it-yourself circuit was very limited. For really small circuits, mercury hearing aid batteries could be used. Otherwise, N or AAA penlight cells were used.

Because the choice of batteries was so limited, some experimenters made their own power cells. One common technique was to wrap a small piece of copper with a section of paper towel that had been soaked in a salt water solution and allowed to dry. The towel was then wrapped with a layer of zinc or aluminum foil. The cell was activated by placing a drop or two of water on an exposed portion of the salt-impregnated paper.

In the late 1950s experimenters turned to selenium and silicon solar cells as a power source. In those days, silicon solar cells were very expensive. Solar cells are very thin, and even very small cells supply sufficient power to operate simple transistor radios, oscillators and the like. Widespread use of low-power components, particularly CMOS integrated circuits, has made solar cells an even more viable power source for miniature electronic circuits. Moreover, solar cells are now much cheaper and more readily available.

Battery Holders

Though dozens of miniature batteries are available to electronics experimenters, the choice of battery holders is much more limited. In fact, some battery holders designed for miniature button cells are much larger than the cell they are designed to hold.

After many years experimenting with do-it-yourself battery holders, I've settled on two basic approaches. Both designs are smaller than commercial battery holders and incorporate a built-in on/off switch, and both are built into a small housing with room to spare for a circuit and other components.

Details of the simpler of these do-it-yourself battery holders are in Fig. 1. This design is well-suited for circuits installed in small plastic boxes like the kind described above. Its key ingredient is a subminiature pushbutton or toggle switch and a solder lug.

You can assemble this battery holder by first bending a solder lug as shown in Fig. 1. Place the large hole of the lug over the switch's threaded neck. Then bend one of the switch terminals toward the lug and gently force it through the small hole in the end of the lug. Solder the lug to the switch terminal.

Next, solder a length of hookup wire to a small spring. Use a spring salvaged from a commercial battery holder, or take a battery holder to a hardware store and ask where you can buy lengths of spring similar to that used in the holder.

Finally, place the spring and battery in the intended portion of the box as shown in Fig. 1. Press the switch lug assembly against the free end of the battery until the tension feels right, and then mark the side of the box directly under the switch's pushbutton or toggle. Complete the battery holder by drilling a hole in the box and installing the switch.

Incidentally, you can omit the switch from this battery holder if you prefer. Just attach the bent solder lug directly to the inside of the plastic case with 4-40 or 6-32 hardware. Be sure to solder a length of hookup wire to the lug before installing it. Otherwise you might melt the side of the box with your soldering iron.

Figure 2 gives details of the second do-it-yourself battery holder. This holder is much more difficult to make, but it is well suited for ultra-compact circuits installed in short lengths of tubing. I originally developed this holder for use in an experimental infrared travel aid for the blind and housed it in two 3.5-inch lengths of brass tubing installed on eyeglass frames.

Construction and assembly details for the second holder are shown in Fig. 2. Though the holders I have built all follow this general design, you can modify the basic concept to best suit your needs or the materials you have on hand. For instance, the subminiature slide switch can be replaced by a toggle switch if you prefer. You can also use different kinds and sizes of tubing.

You should be prepared to spend a good deal of time making a battery holder like the one in Fig. 2. You will also need access to miniature files and cutting tools to make the necessary slots and holes. Exercise caution when making the battery holder, since it's easy to injure a finger.

Make sure you have all the required materials before beginning work. You'll need two lengths of telescoping brass (best) or aluminum tubing. The bulkheads can be cut from solid acrylic rod (best) or wood dowels. Be sure the bulkheads fit snugly inside the smaller of the two metal tubes.

I use metal tubing since it is conductive and provides the connection between the on-off switch and the circuit. This means the circuit installed inside the tube should be well insulated or placed inside an insulating sleeve to avoid accidental short circuits.

Circuit Boards

For the utmost in miniaturization, etched-

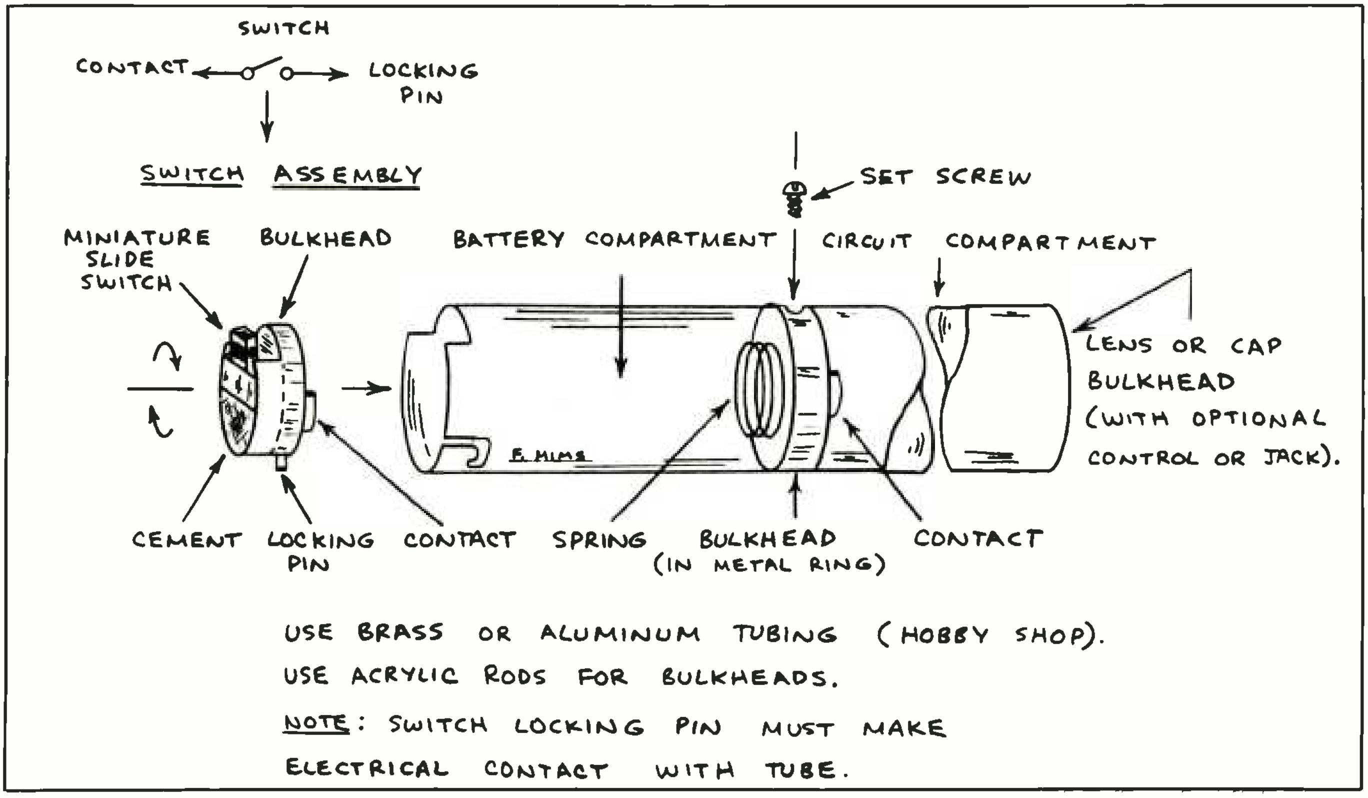


Fig. 2. Details of a tubular housing for miniature circuits.

or printed-circuit boards are almost always necessary. Were it not for a pair of tiny etched circuit boards, I would never have been able to install the receiver circuitry, lens and battery for an infrared travel aid for the blind inside a tube measuring only 0.5 by 3.5 inches.

Many books and articles have described in detail the various ways printed circuits can be fabricated. For best results, use very thin copper-clad board, the kind that can be cut with scissors. If this kind of board isn't available from local electronic parts dealers, ask for advice about possible suppliers. You might also check with a nearby university or technical school that offers electronics courses.

Should fabricating your own etched circuit boards prove to be too time-consuming or inconvenient, it's possible to assemble reasonably compact circuits using standard point-to-point wiring. The key here is to use a perforated board which has pre-etched copper rings, preferrably pretinned with solder, around each hole. The leads and pins from the various components can be connected to one another by wrapping wire. With a little planning, many connections can be more easily made by placing in adjacent holes leads and pins to be connected. Bend the pin from one component over the solder ring surrounding the adjacent pin or lead and solder in place.

You can reduce the thickness of circuits made in this fashion by stroking the bottom side of the board across a file, being careful to avoid removing too much solder. Afterwards, you must remove all solder filings with a brush and a few puffs of compressed air. Otherwise, stray solder particles may cause a short circuit.

A Miniature LED Pulse Transmitter

The best way to become familiar with the miniaturization tips and techniques described here is to build a fully functional miniature circuit. You might recall that many of the techniques described here were used in the construction of the miniature laser-diode systems described in the December 1985 and January 1986 *Electronics Notebook* columns.

Figure 3 shows the circuit diagram for a miniature LED pulse transmitter you can assemble with room to spare inside a 0.7 by 1 by 2-inch plastic housing like those described above. This circuit can be used as an optical transmitter for a short-range remote control unit, break-beam object detector, or an intrusion alarm. It can also be used as a source for an optical-fiber continuity tester. And it's very handy as a workbench source of fast optical pulses for testing various kinds of lightwave receiver systems.

The Fig. 3 circuit is a two-transistor multivibrator that delivers a stream of high-current pulses to a high-efficiency red light-emitting diode. Any read LED

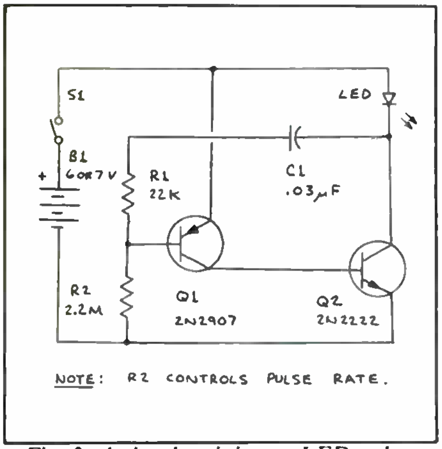


Fig. 3. A simple miniature LED pulse transmitter circuit.

can be used. For best results, however, use one of the new high-efficiency LEDs such as Stanley's H1K (1 candela) or H2K (2 candela). If you can't find either of these super-bright LEDs, a good substitute is Radio Shack's catalog number 276-066 LED. This new LED, which should be in Radio Shack stores about the time this column appears, delivers 300 millicandelas. Though not as bright as the Stanley units, it's much brighter than standard LEDs, reasonably priced and readily available.

Begin assembly of the circuit by installing the oscillator components on a piece of peforated circuit board measuring ⅜ by 1 inch (4 holes by 10 holes). Try to orient the components so that connections can be made with only a minimal use of wrapping wire.

Next, refer to the pictorial view of the completed circuit in Fig. 4 and assemble the battery holder in accordance with the procedure outlined above. Though I did not incorporate the switch in the holder, you may prefer to do so.

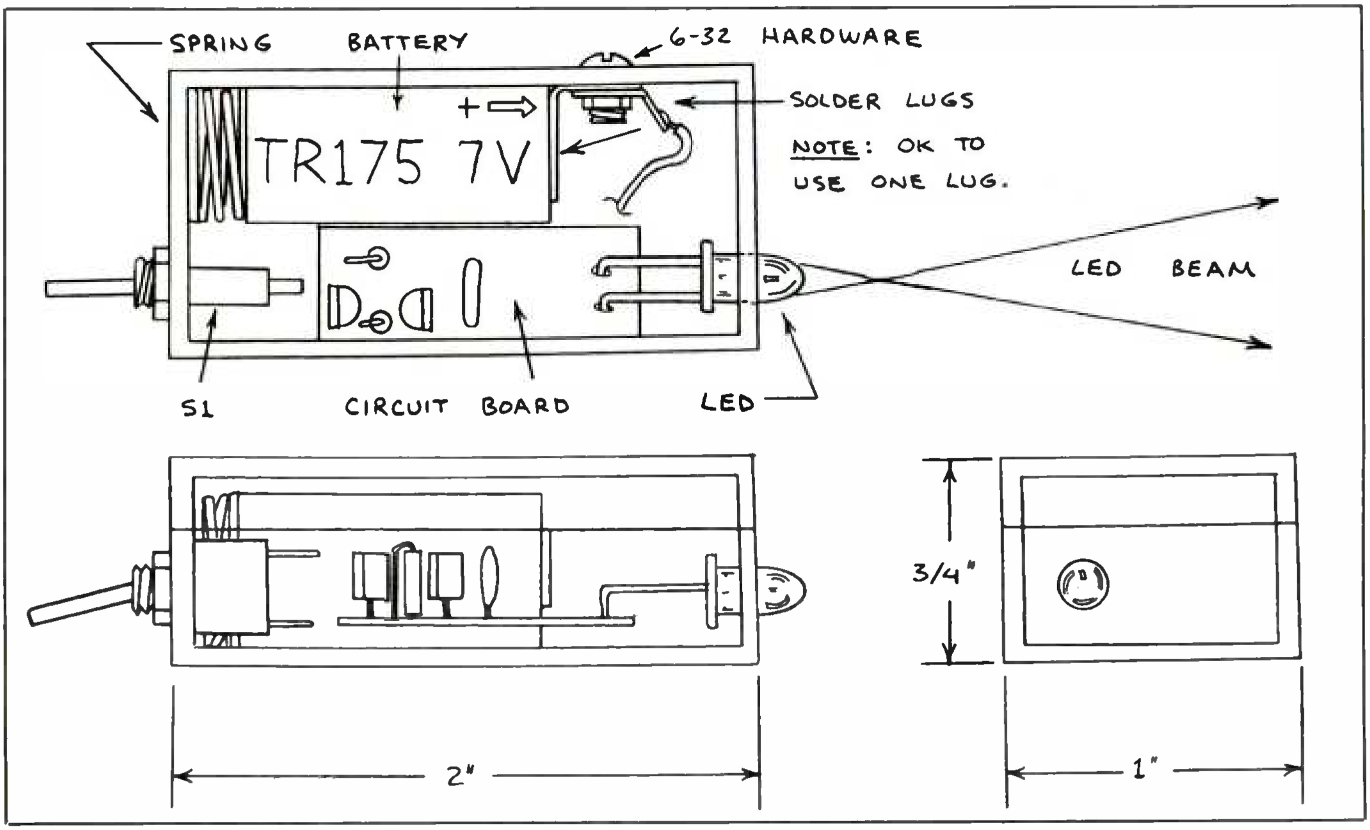
Drill holes in the box to receive the on/off switch and LED. Then install the circuit and switch, taking care to avoid breaking any of the connection wires. Install a 6- or 7-volt battery and flip the on/off switch to the on (closed) position. The LED should glow brightly with a slightly discernible flicker.

You can transform the flickering light from the LED into an audible tone by pointing the LED at the detector of an optical receiver. You can easily make such a receiver by connecting a silicon solar cell, photodiode or phototransistor to the input of a small amplifier. For details about various kinds of lightwave receivers (and transmitters) see *The Forrest Mims Circuit Scrapbook"* (McGraw-Hill, 1983).

More About Laser Safety

Now that its's possible for experimenters to assemble laser-diode transmitters using readily available, low-cost components, it's important to be aware of the op-

Fig. 4. Assembly details for a miniature LED pulse transmitter.



erating precautions that apply to such lasers. In my December 1985 column, I discussed some of the safety precautions associated with the use of laser diodes.

A few months ago I attended the International Congress on Applications of Lasers and Electro-Optics in San Franciso to give a paper on the surreptitious interception of conversations using lasers. While there I renewed acquaintances with R. James Rockwell, Jr., one of the foremost experts on laser safety. I first met Mr. Rockwell in 1968 when he was involved in some pioneering work in the medical applications of lasers.

Mr. Rockwell is now president of Rockwell Associates, Inc., a company that specializes in laser safety products (signs and protective eyewear) and training courses. Recently he sent me a thick package of literature related to laser safety, along with a cover letter that included the following observations:

"The hazards to the eye associated with near-infrared laser diodes are generally considered 'less' than those associated with visible laser wavelengths, but hazards are possible—especially if one views the diode directly and captures the beam with a collecting optic (such as a pair of jewelers 'loops') so as to put *all* of the output into the eye.

"For example, for a CW diode operating at 850 nm, in the condition of optically unaided viewing at a distance, the 'allowed' irradiance incident on the eye is 0.64 mW/cm. Therefore the 'worst case' power limit into the eye is 0.26 mW (7 mm pupil diameter)."

Mr. Rockwell then observed that ". . . viewing an emitting diode under magnification may be the more hazardous viewing condition, even though the retinal image of the source is larger. Obviously, one recommends caution when working with any laser source to never look directly into the beam and, with diode lasers, *never* observe the emission using magnifying optics."

This is good advice. For additional information about laser safety, see the December 1985 *Electronics Notebook* column. You might also want to contact Rockwell Associates at the address given above and the Laser Institute of America (5151 Monroe St., Toledo, OH 43623).

More About Pressure Sensors

Several readers have written about the column on pressure sensors (Nov. 1985). Franlin Eventoff, president of Interlink Electronics (331 Palm Avenue, Santa Barbara, CA 93101) sent a sample of his company's force sensing resistor kit. This kit includes five plastic sheets imprinted with various force sensing resistor patterns. Each sheet utilizes a different formulation to provide different resistance values. Also included is an array of interleaved switch patterns. For additional information and prices, contact Interlink Electronics.

I also heard from Scott A. Ellner with regard to the use of pressure sensors in the sore-prevention evaluation cushion he has developed. Mr. Ellner, whose name was misspelled in the earlier column, is interested in developing a method for calibrating the 260 pressure-controlled comparators in his system by means of a single 100K potentiometer, rather than the 260 individual pots he now uses. Interested readers can contact Mr. Ellner at the Nina Eaton Center, 777 Seaview Ave., Bldg. D, Staten Island, NY 10305.

ME

HARDWARE HACKER

Using pressure transducers, call progress detectors, adapting surplus drives, electronic halftone secrets

By Don Lancaster

We've gotten quite a bit of mail involving several of our previous columns. Lots of you have asked for more sources of cubic spline information. One good reference is *Fundamentals of Interactive Computer Graphics* by J. Foley And A. Van Dan, published by Addison Weseley.

Several others have asked for additional information on pressure transducers, so we'll try to pick up on that topic this month. I am working up a construction project or two on this, but lately I have been up to my ears in laser printing, so it may take a while.

Don't forget that I still have lots of freebies for you. These include laser printer demo packs, word processing utilities, shaft encoder software, EPROM programming adaptors, and bunches more. Just write or call the helpline number listed at the column's end.

On to this month's goodies . . . .

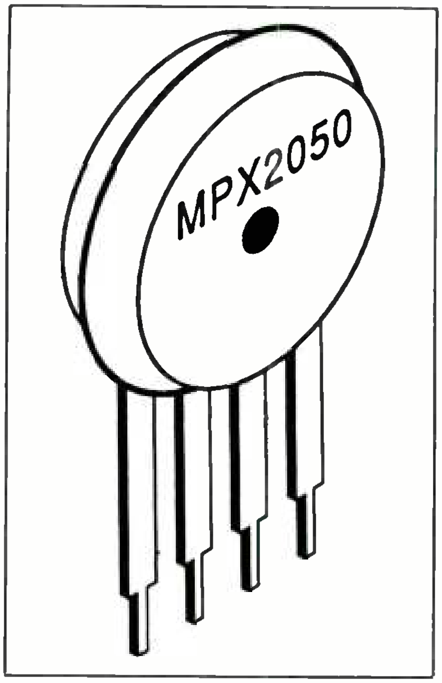


Fig. 1. A pressure transducer.

Tell me more about pressure transducers

A pressure transducer is any device that will accurately convert a pressure difference into a proportional current or voltage. As we saw two columns back, one important use of pressure transducers involves stream gauges. Other uses include weather forecasting, cave surveying, altimetering, tactile robotic sensing, auto emission controlling, medical instrumentation, weighing, and industrial process controlling.

While not yet super cheap, some pressure transducers have dropped enough in price that they have become most interesting and most challenging hacker components. Some sensors are now priced in the $20 to $30 range, and this is almost certain to drop further.

How can you measure pressure?

One very old method uses a column of mercury working against a vacuum. As the column moves up and down, column height can be measured and then related to atmospheric pressure. Another method requires a sealed bellows. The bellows expands or contracts with pressure variations. Bellows position can then be measured and related to pressure.

The modern electronic way of sensing pressure involves a new family of integrated circuits called silicon pressure transducers. Two of the leading suppliers are *Motorola* and *Micro Switch*, although there are a few others.

Important advantages of silicon pressure transducers include their repeatability, relatively low cost, high accuracy, and the ability of some models to internally compensate against fluctuations in temperature.

Figure 1 shows a typical pressure transducer. There are many different packages available, depending on what kind of pressure is to be sensed and the kind of environment in which they are used.

A silicon sensor is actually very simple. A piece of silicon is etched so it forms a very thin diaphram, somewhat similar to a drumhead. As the pressure on one side changes, the diaphragm flexes and changes its size. This flexing is sensed by a resistance strain gauge bridge implanted directly on the diaphragm. Laser-trimmed resistors are sometimes added for calibration and to compensate for temperature variations.

As pressure changes, the diaphragm flexes, the resistor values change, and a differential output voltage is produced. You typically get 40 or 50 millivolts out for full-scale deflection.

The sensor is connected as a simple bridge. You apply a regulated + 10 volts. A small differential voltage appears across the positive and negative outputs. This voltage is proportional to pressure. The common-mode (fixed offset) voltage at these outputs is typically one-half the supply voltage.

Normally, the output signal is isolated and single-ended with a first operational amplifier stage and is then offset and amplified with a second stage. The 0-to-5-volt dc output level can be A/D converted or used directly as an analog signal or fed to a meter.

There are three fundamentally different types of pressure transducers. A *relative* transducer measures the pressure difference between its two sides. If both sides of the transducer are made available, you can measure the relative difference between two pressures.

A second type of transducer is called a *gauge* transducer. With a gauge transducer, the second port is vented to ambient air. The pressure difference between your input and the current atmospheric pressure is then measured.

A gauge transducer can be either *vacuum ported* or *pressure ported*, depending on whether you want to measure pressures above or below that of ambient.

The third, and rarest, sensor is called an *absolute* pressure transducer. With this type of transducer, one port is permanently connected to the best possible vacuum attainable. The output signal then measures absolute input pressure.

Note that most silicon pressure transducers start out as relative devices. Giving access to the second side leaves you with a relative transducer. Venting the second side to ambient gives you a gauge transducer, while sealing the second side in a

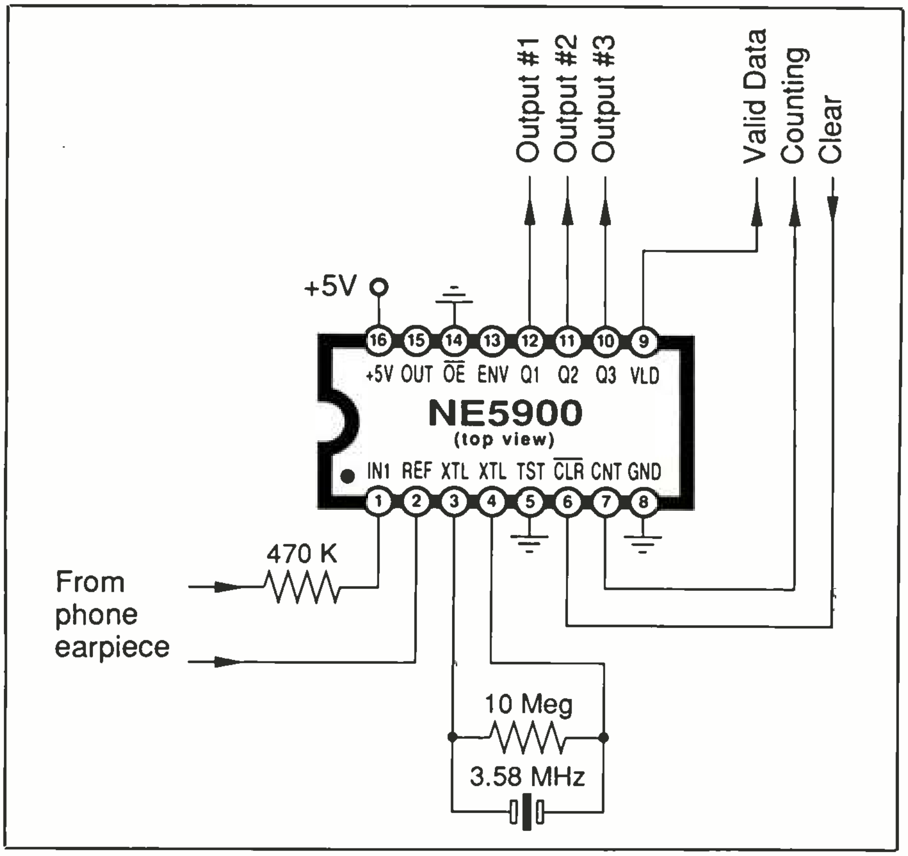


Fig. 2. How to use an NE5900 call progress detector.

good vacuum gives you a way to measure absolute pressures.

Full-scale range varies with your choice of pressure transducer. Motorola's MPX2050 series is rated at 0 to 7.5 psi—an ideal range for stream gauges, electronic emission controls and robotic sensors. Other full-scale ranges are available for other uses.

Normally, you are limited to a 100-percent overload before the transducer will fail, so you always want to pick the most sensitive unit you can, consistent with the maximum pressure with which you want to work. The transducer itself is protected with a silicone gel coating that apparently resists clean water, some other liquids, and many weaker chemicals.

Tellyawhat. Let's have a contest. A free *SAMS* book to the best five hacker ideas that involve pressure transducers. The overall winner gets both an all-expense paid tinaja quest for two (FOB Thatcher, AZ) and some cash-type money if the idea is good enough to qualify as a *Modern Electronics* construction project article.

Fair enough?

Can 80-track disk drives be made Apple compatible?

I've sure gotten a lot of calls on this lately. The quick answer is yes and no. Yes, a knowledgeable hacker can adapt anything to anything if he puts his mind to it. No, I know of no quick and simple way to save time and/or money with these bargain drives.

First, there are the physical differences. *Apple* drives normally use 35 (or rarely 36) tracks, but certain protection schemes on some Apple software make use of half tracks, quarter tracks, and may even use track arcing techniques.

Even if you could get the tracks to line up, it is very unlikely that you could reliably run any and all existing Apple software on the new drive.

The way in which the drives are accessed is fundamentally different as well. On an 80-track drive, much of the operating system that accesses the disk is provided for in hardware inside the drive itself. On an Apple system, most of the operating system is provided for in software residing in the Apple main RAM.

These two different methods of controlling a disk mechanism are philosophically and fundamentally different. It would seem to be a real bear to get between the two.

Note that many Apple programs often make slight to major changes in the operating system they use. This is sometimes done for "protection," whatever that is, and at other times to speed up access or pick up more storage, or whatever.

As a conservative guess, there are probably several hundred or more different Apple disk operating systems in use today. A hardware-based operating system would have to know about all of them and be able to serve them all equally well. Sounds tricky.

A lot of people have also asked where they can get the schematic for the super-secret IWM, or Integrated Woz Machine custom disk controller used in the Apple IIc. This is nothing but an adaptation of the plain old "slot six" disk controller card. The schematic of this card appears in any of the earlier DOS 3.3 manuals.

There are also problems in adapting standard 3.5-inch drives to the IIc or the Macintosh. Most non-Apple 3.5-inch drives spin at a constant speed. Apple spins their 3.5-inch drives at a variable and track-dependent speed. This lets you get more data on the disk, since more ones and zeros can be crammed onto the longer outside tracks.

So, if you are looking for a quick way to save a buck on disk drives, forget it. On the other hand, if you can find a plug-and-go hardware adaptor that is guaranteed compatible, go for it. Better yet, design the adaptor yourself. *If* you can make it simple and cheap enough, there is a big market out there waiting for you.

What is a call progress detector?

When most people make a telephone call, they are usually swift enough to figure out for themselves when the phone is ringing or if the line is busy. This same ability is needed by modems, alarms, auto-dialers, and many microcomputers involved in any sort of telecommunications. Finding out exactly how far a call has gotten is called *call progress detection*, and the electronics needed to supervise a call going through often goes by the name of a *call progress decoder*.

Call progress detection used to be very complex and expensive, but today *Signetics* has a simple and easy-to-use IC called the NE5900 Call Progress Decoder.

Figure 2 shows how to connect the NE5900. This IC needs a single +5-volt supply and ground. A stock color TV crystal generates the 3.58 MHz needed for internal timing. Two input lines come from the telephone receiver earpiece by way of a 470k resistor. A clearing input is routed from your microcomputer or other controlling electronics every time you want to check on the call status.

There are three main output lines. The binary code on these lines tells you the status of the current call in progress. Figure 3 shows the output codes involved.

There are four likely responses when a call is being placed. The *dialtone* is a continuous tone pair that tells you the line is available. The *audible ring* is a two-note tone that is on for two seconds and off for four seconds. The *busy signal* is a two-note tone that is on for half a second and off for half a second. There is also a possible supervisory *reorder* two-note tone that continuously is on for 0.2 second and off for 0.3 second.

The exact frequencies in use for each response depend on the age of the phone equipment. Fortunately, the time duration of each response is constant and predictable, no matter the age of the phone system. The NE5900 measures the time interval, or more precisely, the cadence of each response.

The chip first does a sloppy bandpass filtering job, using the external resistor and a pair of internal capacitors. A more precise filtering to a passband of 300 to 640 Hz is then done with a precision switched-capacitor filter. The filter's output is then detected digitally, yielding the envelope of whatever tones are present.

To use the chip, you first bring the clear input low. Do this every time you want to find the status of a call being placed. This starts a 2.3-second timeout that begins as soon as a tone of any type is received. During the next 2.3 seconds, the input envelope is tested. If it is continuous, the dialtone status code is outputted.

If the envelope is on for only two seconds, the ring status code is outputted. Note that most modem tones are well above the filter passband and will be rejected. If the envelope alternates half a second on and half a second off, the busy code is outputted. Should the envelope alternate 0.2 second on and 0.3 second off or so, then the supervisory reorder status code is outputted.

Finally, if there is extreme noise on the line or if someone is talking, an overflow code is produced. This tells the computer or the controlling electronics that the NE5900 was unable to do its job.

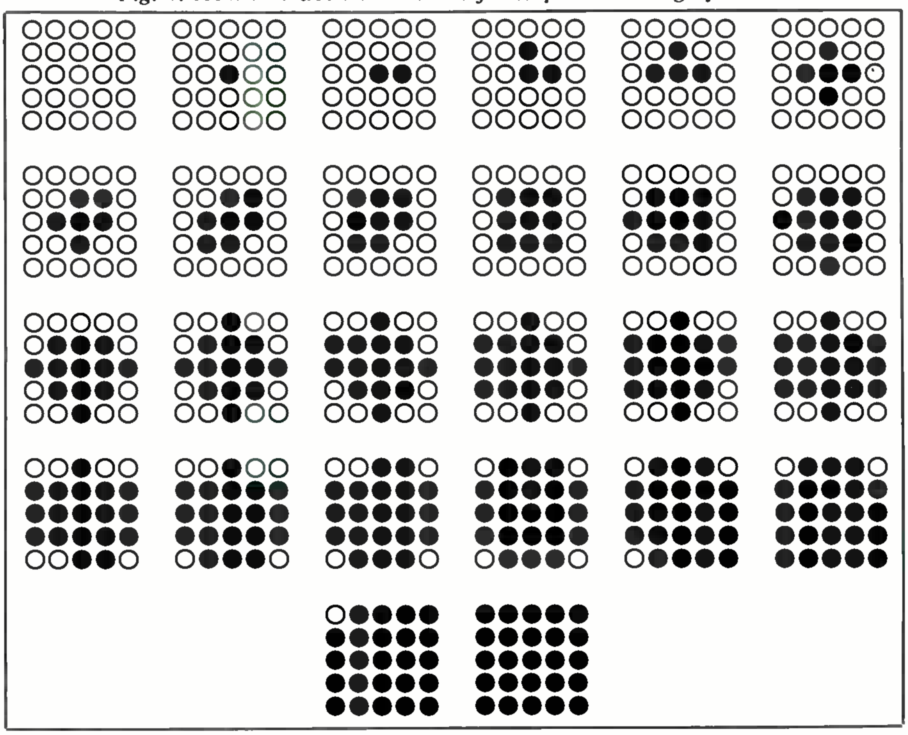
	Q1	Q2	Q3
Dial Tone	0	0	0
Ringing	1	0	0
Busy	0	1	0
Reorder	0	0	1
Overflow	1	1	1

Fig. 3. The call status codes.

There are several other pins on the package that may be of interest to advanced users. An "envelope" output is available that lets you do your own testing for oddball responses. An "enable" pin lets you turn off and on the three status outputs and the envelope line. The enable pin is brought low to activate the outputs. This is handy for tristate bus use on a microcomuter's data bus.

There's also a "data valid" output that

Fig. 4. How a 25 dot electronic halftone produces 26 gray levels.



NAMES AND NUMBERS

Addison Weseley
Microcomputer Books
Reading, MA 01867
(800) 238-3801

Motorola
Box 20912
Phoenix, AZ 85036
(602) 244-6900

Micro Switch
11 West Spring Street
Freeport, IL 61032
(815) 235-6600

SAMS
4300 West 62nd Street
Indianapolis, IN 46206
(800) 428-SAMS

Signetics
811 East Arques Avenue
Sunnyvale, CA 94088
(408) 739-7700

can be used to interrupt a microcomputer, as well as an "analog" output that has only been filtered. A final pin is used for testing and must be held at ground.

One gotcha: that input 470k resistor is a critical value, since it is used as part of an internal bandpass filter.

How do electronic halftones work?

Today's printers are offering better and better resolution, so it is only a matter of time until you will routinely be able to print your own superb quality photographs or video images. Even today, the *Laserwriter* is capable of directly printing multi-tone images to "fair" quality. If you are willing to 2:1 reduce your final laser artwork, you can easily upgrade this to "good" quality. By a good image, I mean 106 or so gray dots per inch of 33 possible gray levels.

The key to printing an apparent gray scale with a printer that can print only a black or a white dot involves an *electronic halftone*. To understand how you print gray images, you must know just what an electronic halftone is and how it works.

Suppose you absolutely had to have something truly gray appear on a printed page. The only possible way to do this would be to use gray ink. Should you need several shades of gray, several passes through the press would be needed.

There has to be a better way—and there is. Instead of really printing gray, you print a bunch of tiny black dots. You make the size of the dots larger for darker grays, smaller for lighter areas. The dots are made so small that they exceed the eye's angular resolution. Instead of seeing dots, the eye averages out, or *integrates* the black and white areas, and produces a gray blur.

To prove this to yourself, just drag out a good magnifier and look at some of the photos right here in *Modern Electronics.* Note that there is no gray used *anywhere* in this magazine; it is all done with black and white dots.

In traditional printing, grays are photographed through a magic screen that produces a halftone image. In electronic printing, we fake grays through a somewhat similar electronic halftone process.

Let's throw a couple of terms at you. The *resolution* of the screen is normally specified in dots per inch, or dpi. For instance, a 120-dpi screen gives you 120 dots horizontally and 120 dots vertically for a total of 14,400 dots per square inch.

The number of *gray levels* in a particular screen is set by how many distinct black dot sizes are possible. This is more or less a continuous function with traditional screens. With electronic halftones, you must trade off resolution against gray scale, as we will shortly see.

Halftone screens are normally rotated at a screen angle of 45 degrees. This minimizes any visual distraction the screen might produce. Other angles are sometimes used for special effects or custom work.

Most electronic printers are only capable of placing or not placing a dot in a specific location. Getting from here to an electronic halftone depends on what you want to call a dot. Let's use the Laserwriter as an example. This printer has a 300-dpi resolution, so it can print 90,000 dots per square inch. The trick to an electronic halftone is to use several of these dots bunched together to represent a single gray splotch on the final image.

One possibility is to use a gray splotch that is 5 dots wide and 5 dots high. As Fig. 4 illustrates, you can trick the eye into seeing any of 26 possible gray levels, depending upon how many of the dots are "lit" at any one tme.

Other "dots-per-splotch" values can be picked. The more dots you use, the greater the number of gray levels available, but the cruder the overall resolution. Fewer dots give you better looking and smoother grays, but will restrict the number of gray levels.

There are other restrictions to using very small numbers of dots per gray splotch. Very light grays are often desired. It is difficult to get these light grays with small splotches, first because there are only a few possible levels using only a few dots, and second because the dots tend to *overprint* for uniform line widths.

The order in which you blacken the dots in called the *spot function*. For electronic halftone use, the spot function starts out small and centered, and spirals itself larger with darker and darker grays. You can use any spot function you want for special effects, such as pattern screens, or patterned bit-mapped background fills.

You can easily and instantly change the Laserwriter halftone screens at any time. This is done with a simple text command. Sadly, halftone ability is conspicuously absent from most other low-end-priced laser printers.

Applewriter on an Apple IIe does some outstanding gray-scale work when combined with the Laserwriter. Typical cartoon characters can be done with a file the size of a business memo, and no expensive digitizer is needed. Write or call for a free demo or two. **ME**

NEED HELP?

Phone or write your Hardware Hacker questions directly to:

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

BOOKS

Digital Electronics by Byron W. Putman. (Prentice-Hall. Hard cover. 350 pages. $32.95.)

There are dozens of books on digital electronics, but this one is a cut above most. Written by a long-time instructor of digital electronics, it unfolds digital theory and practices in a way that is almost guaranteed to give you an intuitive grasp of the subject. It begins with digital electronics theory, goes on to applications and finishes with digital circuit and system troubleshooting procedures.

Each chapter comprehensively deals with a different topic. (To make coverage truly complete, even a chapter devoted to the investigation and troubleshooting of printed-circuit boards is included.) Typical design examples are supported by logic and timing diagrams, truth tables, etc. At the end of each chapter are review questions with answers for the odd-numbered ones given at the back of the book.

This large-format book is easy on the eyes, too. It has large, bold type and makes use of even bolder characters to highlight headings and subheads.

They All Laughed When I Sat Down at the Computer by Erik Sandberg-Diment. (Simon & Schuster. Hard cover. 224 pages. $16.95.)

This book recounts one writer's struggle to come to grips with the personal computing revolution—emerging as a seasoned veteran and recognized computer expert. It begins at the dawn of the new era, way back in 1976 with the Altair 8800 computer that started it all and when personal computing was so new that it was more a curiosity than a useful personal tool.

In recounting his trials, tribulations and triumphs, the author gives his account in a free-flowing style that is frequently witty, often serious and always interesting. As much a "history" of the personal computer field as it is a personal account, this book recounts the major milestones in software and hardware that have brought the personal computer to its present eminence. It goes beyond this by giving you a peek into the possible near future of personal computing, from an expert's viewpoint.

NEW LITERATURE

Maintenance/Service Equipment Catalog. PRint Products has announced availability of a 160-page full-line catalog in which are listed and described tools and supplies for electronics maintenance and service. Featured in this illustrated catalog are Pace desoldering and printed-circuit board repair products, Huntron test instruments, 3M static control products, PRint tool cases and many brand-name tools and instruments for repairs in the field and depot. For a copy, write PRint Products International, Dept. ME, 8931 Brookville Rd., Silver Spring, MD 20910.

Test Equipment Catalog. The 1986 Power Supply and Test Equipment Catalog describes VIZ's full line of laboratory and industrial dc power supplies, isolated ac sources, frequency counters, analog meters, signal generators, testers, digital meters and wattmeters. Each product section contains photos, technical descriptions and specifications. For a copy, write to: VIZ Test Equipment, 335 E. Price St., Philadelphia, PA 19144.

First Impressions: Bourbaki's 1dir menu program; Symantec's Q&A integrated software; Tandy's Model 600 16-bit laptop portable computer

By Eric Grevstad

It used to be that users who survived the hazing rituals of dBase II could lord it over freshman playing with PFS:File. Computing aplications were either powerful or easy to use, but not both; PC-DOS alone was enough to scare most novices, though it didn't cause the screaming nightmares of CP/M.

This month's products show a newer trend: simple products growing more powerful. Bourbaki's 1dir is a menu program that shields users from DOS while adding extra functions; Symantec's Q&A grafts the latest craze, artificial intelligence, to an English-speaking cousin of the PFS database. And Tandy has unveiled a full-powered successor to a famously convenient (but limited) computer, the popular Model 100 portable.

Hard Disks Made Easy

Once you accumulate 15 or 20 subdirectories and a couple of hundred files it's no shame for even a hard-disk veteran to get lost in DOS once in a while. If you've done so, consider the front-end program 1dir ($95). From its ads, I though 1dir was mainly for beginners who blanched at the A> prompt, but I've found it flexible as well as friendly. To a DOS addict, in fact, the 1dir display is as much fun as a Busy Toy Dashboard is to a baby.

Like SideKick (with which it works, though the combination's pretty weird), 1dir fits between DOS and your applications—taking 49K of memory, which you can trim to 37K by disabling the menu-creation feature or just 9K if you'll wait for 1dir to reload from disk after every command. (A first-rate utility program lets you change these and many other options any time, though 1 dir does require DOS 2.0 or above.)

The display lists the current directory, subdirectories, and files sorted by name, extension, date, or size, plus your choice

Tandy's Model 600 laptop computer has a 16-bit 80C88 microprocessor, a 16 by 80-character LCD display, 32K of RAM (expandable to 224K), parallel and serial ports, a 3.5" floppy-disk drive and firmware in ROM.

of file dates and times or a Chkdsk-style tally of memory and disk usage. Beginners can select a program with the arrow keys and run it (or change directories) by pressing Enter, or copy, type, rename, or delete a file or group of files by tapping a function key. To speed scrolling, pressing Alt and a letter moves the cursor to files beginning with that letter.

This automatic transmission is appealing, but you can do more from 1dir's command line—typing commands directly, or mixing them with filenames pulled from the menu. Two exceptionally handy features let you enter multiple commands, separated by single quotes, for batch processing or, to make a formal batch file for later reuse, turn on a "batch builder" that records commands to a file as you execute them.

Finally, to automate your system or create one for use by others, 1dir lets you create any number of password-protected menus—customizing the F1 through F8 keys, complete with on-screen labels and descriptions, to run programs, change directories, or summon submenus. (F9 toggles between 1dir's and DOS' function-key assignments, and F10 between 1dir menus.)

I'm still tinkering with my menu system; the otherwise helpful manual seems a little short on examples of using nested menus or commands with parameters pulled from a directory. But replacing the stark DOS prompt with a snazzy "control panel" is impressive enough; making your own control panel, while making DOS jump through hoops, is a pleasure. Given something like 1dir, maybe with a mouse for faster file-picking, I doubt we'd need fancy graphic interfaces like Microsoft Windows.

Do This, Show Me That

All the attention's going to its intelligent database query module, but I think the main appeal of Symantec's Q&A is more ordinary. For a reasonable price ($299), you get a package that integrates near-twins of Software Publishing Corp.'s PFS:Write, File, and Report (or its IBM Assistant Series clones) plus a ProKey-style macro recorder. The word processor's not WordPerfect and the database and report generator's no R:base 5000, but Q&A is a likeable light-to-medium-duty package.

The applications are very like the PFS programs that inspired them, with similar step-by-step menus aided by even more pop-up prompts and help screens, including custom screens you can create to guide data-entry typists. Write even lets you draw lines and boxes in or around text, though it also lets you accidentally move the cursor past the end of text to create documents with unformatted gaps.

But what really wins beginners' hearts —and leaves veterans more entranced than a video game—is the Intelligent Assistant, a module whose vocabulary (400-odd words plus the contents of your database) does a remarkable job of translating English sentences into program instructions.

Type a query like "List the customers from Ohio with orders over $2,000," or a

```
\WORDPROC\NEWWORD
 Drive C  | Name     | Ext | Size   | Statistics                 | Toggles
          | PREVIOUS | DIR |        |  ▶ Disk Usage ◀            | Main Menu
          | BISCUIT  |     | 12672  |  12 User files             | Caps  | Print
 Select ▶ | CONVERT  | EXE |  1152  |  3284992 bytes left        | Batch | Edit
          | FILTER   | COM | 20141  |  262144 bytes used         | Set-up
          | GRANDMA  |     | 12672  |  10592256 bytes total      | Pause   | On
          | LETTER   | ART | 12672  |                            | Sort    | Name
          | MODERN   | FEB |  3433  |  ▶▶ Memory Usage ◀◀        | Default | C:
          | MODERN   | MAR |  9984  |  574176 bytes left         | Display | C:
          | NOTES    | EPG | 12672  |  81184 bytes used          |
          | NW       | EXE | 54144  |  655360 bytes total        |
          | NWMSGS   | OVR | 52398  |                            |
          | NWPRINT  | OVR | 37248  |  ▶▶▶ Today Is ◀◀◀          |
          | WC       | COM |  1167  |  Sunday the 8th            |
          |          |     |        |  4:27:15pm                 |
C>NW MODERN.MAR ` copy MODERN.MAR ascii ` CONVERT ascii
 Compose | Copy | Type | Rename | Erase | Date | Mkdir | Options
 The 1 DIR Version 3.50E - Copyright (c) Bourbaki, Inc. 1984, 1985
```

The 1dir screen display lets you compose multiple commands, taking items from a menu (shown in uppercase here) or typing them directly.

command such as "Add 5% to Eric Grevstad's salary," and the Assistant's reverse-video "brain" blinks, flashes, and backtracks through the sentence until asking "Shall I do the following?" Most times, darned if it hasn't understood ("Change the database by setting Salary to 105 × Salary on all records where the Employee Name is Eric Grevstad," or whatever). If it hasn't, friendly menus guide you through adding vocabulary or editing your sentence.

This is a sample of a report generated with Q&A's Intelligent Assistant. This was the first question I asked the database, which I asked before opening the manual other than to obtain installation instructions.

```
Show me the female employees with salaries between $25,000 and $50,000,
sorted by department.

Department    Full name          Salary
----------    ---------------    ----------
ACCNT         Rays Martha        $35,000.00

ADMIN         Rutledge Nina      $35,000.00

OPS           Abrams Judy        $37,000.00

SALES         Guy Mary           $50,000.00
              Turledge Nina      $35,000.00
              Gyorfi Natalia     $31,000.00

employee.dtf
******************************  END OF REPORT  ******************************
Esc-Cancel     F2-Reprint     ( ← → ↑ ↓ PgUp,PgDn )-Scroll     F10-Continue
```

To be critical, Q&A is big and bulky (it requires 512K and virtually demands a hard disk) and the idea of adding intelligence to an already easy, nonrelational database is a little odd. The Report and File functions aren't that much harder than using the Assistant (enter criteria and press F10), and considerably faster—a simple fetch, "Get Mary Price's form," can be done in four seconds instead of 27 on my XT clone. Do many novices use PC ATs?

But as a way to overcome computer anxiety, Q&A is kind of fun, and the Write, File, and macro modules are good for genuinely productive use. I can't give a bad review to a program polite enough to say "shall" instead of "should."

A Laptop With the Works

The Tandy 600 is a desirable, well-designed machine, a fine extension of the idea behind the 100 (and the latter's slightly bigger brother, the 200). For many jobs, the 600 could serve as your only computer. It could be a blockbuster like the 100 was, if only it didn't cost so much.

Like its predecessor, the 10-pound Tandy keeps programs in ROM and user files in battery-backed RAM, but adds a quiet 3.5" microfloppy drive for safer storage. Except for the one-time job of moving Format and Diskcopy utilities into memory, the single-sided (353K) drive is just for data files now, but Tandy hopes vendors will write programs for the laptop's 80C88 CPU and 16-line, 80-column display. (The LCD is averagely bad in dim light but quite reasonable for a non-backlit panel; much better than other 80-column screens such as the NEC Starlet's.)

The 600 has the same parallel and serial ports and built-in modem as the 100/200 and a bus for a promised second disk drive. It's a fair traveler, running 11 hours per Ni-Cd charge, though disk access cuts that considerably and having to unplug it after precisely 14 hours' recharging is a minor nuisance.

PC PAPERS...

But the 600's best feature is its firmware: Microsoft Works, a blend of operating system and applications (Microsoft's Word, Multiplan, calendar, filer, and communications programs) plus alarm and calculator. Tandy's Works, unlike the diskless Heath-Zenith ZP-150's, lacks BASIC; if you want it, you'll have to buy a $99.95 chip that replaces the Multiplan ROM.

Works combines the layout of Microsoft's applications—the Esc key calls a command menu, space and tab select among options—with the Model 100 scheme of picking programs or files with the arrow keys. (Stiff arrow keys are my only gripes about the 600's otherwise fine keyboard.) It's not as effortless for beginners as the 100—there are nine filename extensions to remember when copying or renaming—but the 600 is very easy to use.

And the programs, except for being rather slow, are almost desktop caliber. Multiplan is a more or less complete version of the well-known windowing spreadsheet; Filer a spreadsheet-style database (records are rows, fields are columns) with respectable searching and sorting power. Word does everything from replacing text to automatically breaking paragraphs so as not to print single lines at page top or bottom, though it can't underline or boldface.

And Telcom is better than desktop caliber, with easy function-key commands for everything from Xmodem transfers to literally writing log-on scripts for you. Even with a 300-instead of 1200-bps modem, the Tandy is perhaps the best communications computer I've seen.

But a unit with 32K RAM (23K file space) lists for $1,599. You can expand to 128K or 224K, but each 96K module is another $399.95, so a 128K system will cost two grand. Compared to the wonderfully low prices of Tandy's 1000, 1200, and new 3000 (AT-compatible) desktops, the 600 cries out for a sale offer.

The Model 100 is a terrific computer; since its debut in 1983, it's proved a hard act to top. Tandy has tried twice, with the 200 and now the 600. Both are fine machines, but they're both named after the amount they're overpriced. ME

Names and Addresses

Bourbaki Inc.
P.O. Box 2867
Boise, ID 83701
208-342-5849

Symantec Corp.
10201 Torre Ave.
Cupertino, CA 95014
408-253-9600

Tandy Corp./Radio Shack
One Tandy Center
Fort Worth, TX 76102

More Channel Chatter

By Ed Noll, W3FQJ

Modern scanners are complex pieces of electronic equipment. They cover a wide frequency range using a multiple-band technique that accommodates FCC VHF/UHF frequency assignments for the land-mobile, marine and aviation radio services. You can punch in any one of these assigned frequencies and eavesdrop on conversations. But you can do much more with today's sophisticated gear.

You can put any one of the frequencies in a unit's memory and recall it at will by depressing the appropriate memory button. You can search (sometimes called "seek") and scan. In the latter procedure each of the frequencies in memory is scanned until an active one is found or scanning can be arranged to scan only specific frequencies stored in the memory.

In search operation the scanner seeks out an active channel and stops on it. When the conversation ends the scanner seeks out another in-use channel. Scan operation can be set to scan up-frequency or down-frequency. A scan procedure can also be programmed to search only between a specific low-frequency limit and specific high-frequency limit. For example, it can be made to search from one end of the marine band to the other and no more. In this mode it will continuously repeat a scan over the same range.

In January 1986 *Modern Electronics* various scanner activities outside usual fire, police and ambulance listening was emphasized. Preparation examples were given. This article continues the discussion with more practical procedures, concluding with some important antenna tips.

The business, industrial and land transportation services are a part of the work week and are therefore most active Monday through Friday. Table 1 is a workaday *potpourri* for memory storage that's designed to keep tabs on how things are going in an immediate area. Channel use peaks in the morning, but continues at good levels throughout the work day. Sometimes you can hear the mobiles, but not always. Base stations and repeaters, if they are used, deliver stronger signals a longer distance than the mobiles do. My list required some scanner searching on my own, although a good directory is a source of considerable assistance for radio services.

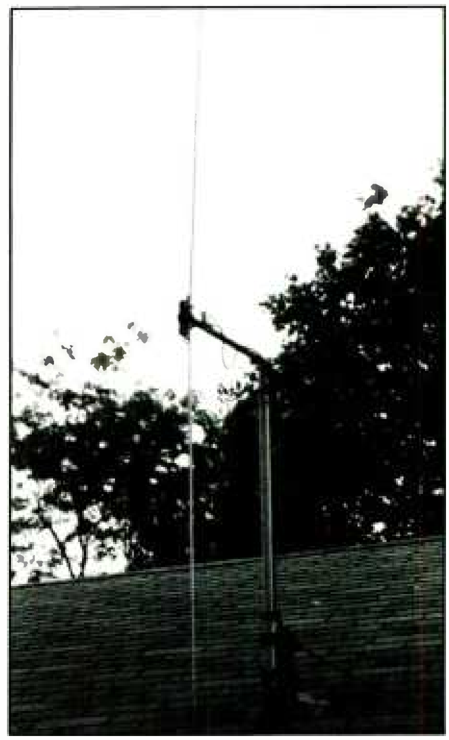
Table 1. Scanner Bands

29-29.7 MHz	10-Meter Amateur Band
29.7-50 MHz	Low Band
50-54 MHz	6-Meter Amateur Band
118-135.975 MHz	AM Aircraft
136-144 MHz	Military Land Mobile Band
144-148 MHz	2-Meter Amateur Band
148-174 MHz	High Band
406-420 MHz	Federal Gov't. Band
420-450 MHz	70-cm Amateur Band
450-470 MHz	uhf band
470-512 MHz	"T" Band

Table 2. Selected Scanning Opportunities

Truck transportation
PA Turnpike
Construction company and package delivery
Armored-car service
Helicopter traffic control
Department-store delivery
Local ham repeater
Keystone Auto Club
Metropolitan traffic service
Taxi dispatch
River Port Terminal
Radio dispatch
Local TV news dispatch
Local municipal dispatch
Radio marine operator
Local airport

A typical spread of bands is shown in Table 1. The last one is the 470-512 MHz "T" band. The T refers to television band. These allocations are to be found on TV channels 14 through 20. In metropolitan areas throughout the country these landmobile assignments are made in one or two of the unused UHF TV channels for that particular city, adjacent counties and beyond. The channels selected are such that they offer the least opportunity for interference with the UHF television broadcast service. Examples for four cities are given in Table 3. You may wish to contact your local FCC regional office to obtain similar information for the metropolitan area in which you live. With this, you can soon put together an appropriate chart of frequencies you may wish to plug into the memory band for your listening activity.



Grove omni antenna, roof mounted, showing drain loop of cable.

I live in a county adjacent to Philadelphia where there is a very busy channel 19. To begin a search of Channel 19, limit your scanner search operation between 500 and 506 MHz. (FCC allocations for 19 and 20 are given in Table 3.) Keep in mind that the FCC often changes allocations. Nevertheless, the chart gives you some idea of what to expect. You must dig out the information and keep up to date for your own area, of course. Note that the various services seem to be divided quite regularly. However, all does not run so smoothly in making frequency assignments in areas where there are a scarcity of available allocations.

The B and M notations refer to base and mobile. For example, in the public safety radio service both base and mobile

Table 3. Sample Chart for Scanning on uhf TV Channels Assigned to Landmobile Services

TV Channels	Mobile Assignment
14 470-476	Chicago 14 & 15
15 476-482	Los Angeles 14 & 20
16 482-488	New York 14 & 15
17 488-494	Philadelphia 19 & 20
18 494-500	
19 500-506	
20 506-512	

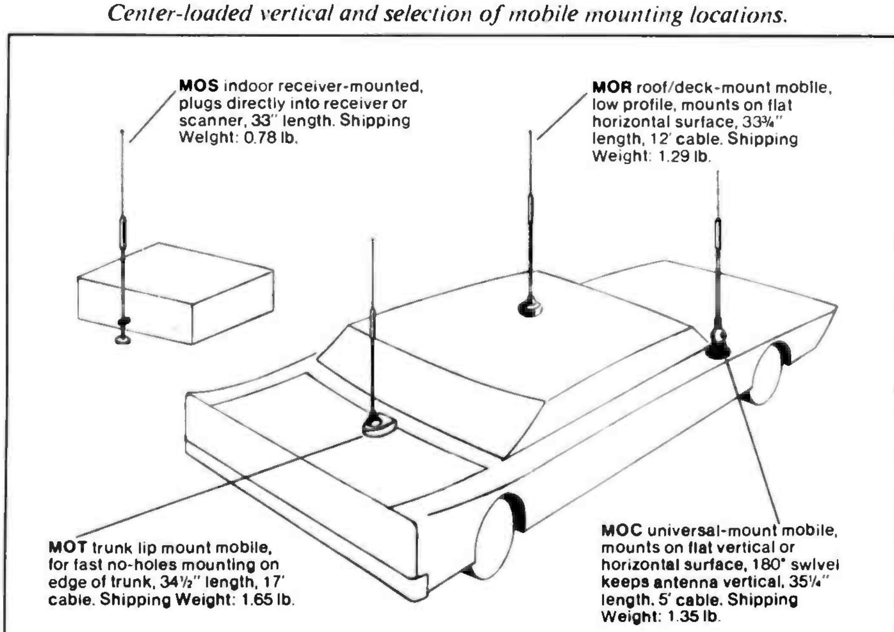
Philadelphia Allocations

TV Channel 19	TV Channel 20
Public Safety	**Business**
B&M 500.3125-501.1375	B&M 507.8125-508.3375
M 503.3125-504.1375	M 510.8125-511.3375
Special Industrial	**General**
B&M 501.4375-501.6125	B&M 506.3125-508.9875
M 504.4375-504.6125	M 509.3125-511.9875
Business	**General**
B&M 501.8125-502.3375	B&M 500.3125-502.9875
M 504.8125-505.3375	M 503.3125-505.9875
Land Transportation	
B&M 502.4625-502.7875	
M 505.4625-505.7875	

Note: B = base
M = mobile

Grove magnetic mobile antenna.

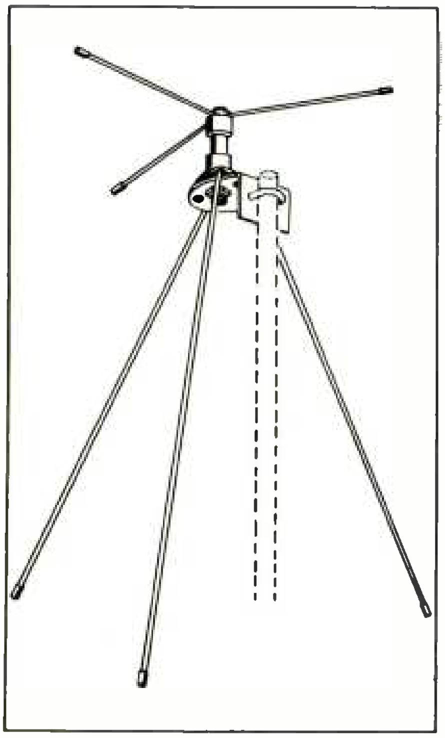
Center-loaded vertical and selection of mobile mounting locations.



(Courtesy Hustler Antennas)

stations operate between 500.3125-501.1375 MHz, while mobiles only operate 503.3125-504.1375. In the B/M assignments, both base and mobiles operate. Usually this situation provides simplex communications on the same frequency. When base and mobile stations operate on different frequencies the base station operates in the B/M spectrum whereas the mobiles are assigned to the M frequency range. If your scanner location is such that you can hear both the base and mobile stations operating on separate frequencies, 3-MHz apart, you can set your memory to scan these two frequencies only and hear both ends of the conversation despite the differing frequencies of the base and mobile signals.

There are two other listening possibilities that can be interesting. To a degree, the public correspondence mobile telephone services as well as radio dispatch and paging services are segregated in various bands. If you permit your scanner to limit search from 152 to 153 MHz, you



(Courtesy Hustler Antennas)

Wideband vhf/uhf antenna.

Uniden Bearcat's 11-band scanner with 16 memory positions.

can usually pick up these conversations. Be sure to obey the rules of secrecy, though, to avoid violating FCC rules. News media listening can be exciting, but it should not be shared with others.

Compose a memory bank chart for all of the local area radio and television stations. Many operate on the 450-MHz band. Include the newspaper frequencies as well, and don't forget the news-gathering and go-patrol 'copter frequencies. Commuter hours and just prior are often feverish periods of activity. Also tune in when "big events" occur locally.

Antennas

Scanning from your car is fine in most areas (though some very few local ordinances forbid it). You can drive into other counties and nearby states to give a listen to scanning activities. You can drive to busy aviation sites or along the shores of ocean or lakes to tune in to marine activities, too. Your scanner can be enjoyable and useful on a vacation trip, also.

My preference for mobile scanning is for a strictly temporary installation using the same scanner I have in my "radio room." Most companies have available an accessory power unit that can be inserted into the dashboard lighter for this purpose. The scanner rests on the front seat or on top of the dashboard if space is available. As mentioned previously, park and listen is safer and more enjoyable than drive and listen!

For a temporary antenna setup, choose a mobile antenna that can be dismantled quickly. The magnetic type serves this purpose, though it seems to be hard to come by. There's a Grove Enterprises model that is approximately 22" high (corresponding to a quarter-wave length on the 150-MHz band) and performs well on both 150 and 450. A helical winding helps out for lower-frequency reception.

Permanent antenna installations provide better performance, naturally. And real mobile scanning enthusiasts, who have a permanent mobile scanner installed in a car, should use such an installation.

Hustler, for example, makes available a center-loaded vertical approximately 34" in length that can be supplied with a variety of mobile mounts. Design includes the 37-40, 145-174, and 450-512 MHz bands. Radio Shack offers a wide variety of antenna types, too.

The best home listening results are obtained with an outdoor antenna, as you might suspect. You will gain the advantage of height in the reception of VHF and UHF signals. At the same time, the antenna length can be longer and there will be correspondingly more pickup, especially of the 30 to 50-MHz signals. Don't forget the loop in the transmission line to permit rain water to run away from antenna terminals and connectors.

Another possibility for limited-space mounting is an active power antenna such as the ACT-1 Hamtronics, Inc. mode. Only 25" high, it includes a built-in amplifier that increases signal level before it is applied to the transmission line that connects the antenna system to the scanner. It can be attached to the roof, side of house, window, porch railing or wherever you can place the small antenna and its amplifier. You may wish to put it in the attic, too. For this, choose a place as high as possible. **ME**

The Turbo GameWorks Package

By Art Salsberg

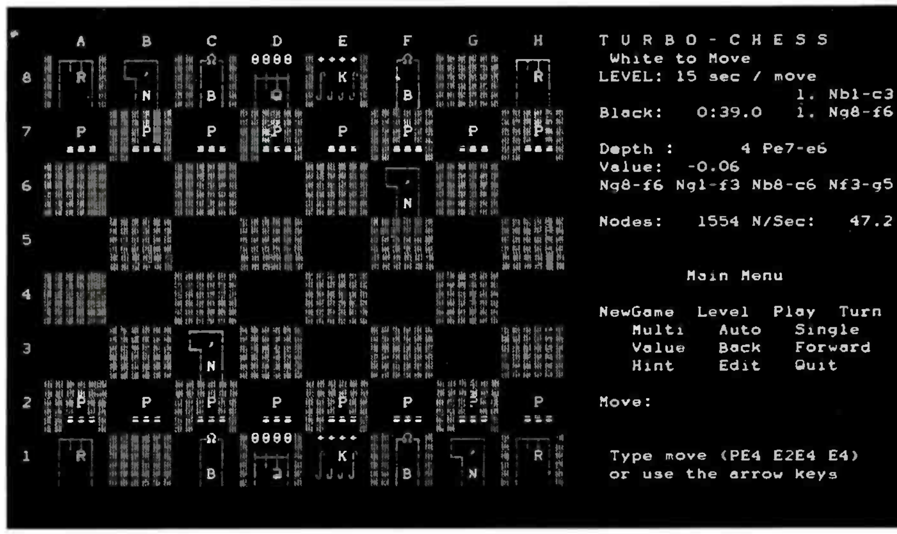


Fig. 1. A screen dump of Turbo-Chess's display is shown here. The computer thinks it's ahead with a value of – 0.06, but wait till the human gets going.

Turbo GameWorks by Borland International./For IBM PC and family and true compatibles./Two 5.25" disks and manual./PC-DOS (MSDOS) 2.0 or later and 192K minimum user memory required./ $69.95.

Computer games have always been popular, starting with the advent of the first microcomputer. Borland's GameWorks, however, is a bit different. Yes, it has games; three of them: Chess, Bridge and Go-Moku. They're written for the IBM PC and other family members and true compatibles, which is not terribly surprising. What is decidedly different, however, is that you can learn what makes the games tick in a programming sense and you can create your own games using the company's Turbo Pascal®.

Firstly, let's look at the chess game in its ready-to-play form. It's a nice program that does all you'd expect a basic chess program to do, including *En Passant* captures, pawn promotion, draws (by 50 moves, stalemate or third repetition), and so forth.

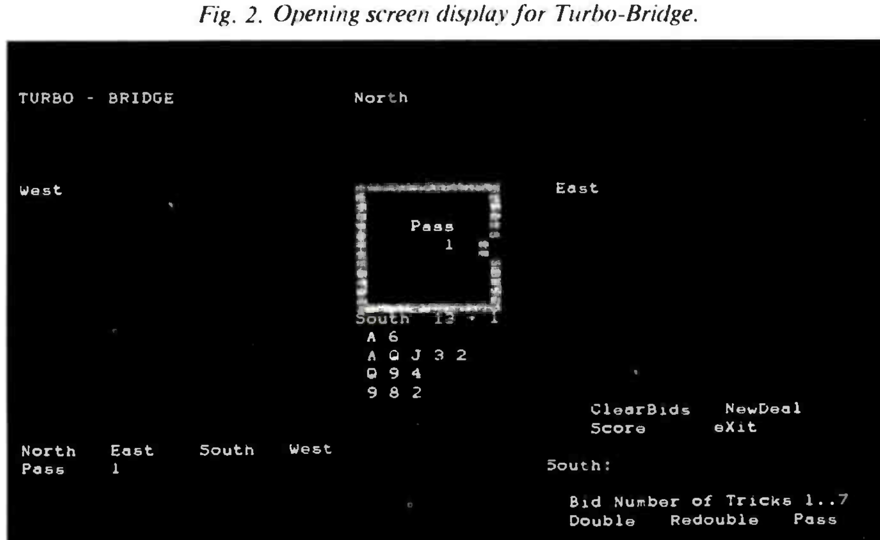
In addition to the foregoing, there are some thoughtful extras. For example, it will provide you with hints on what your next move should be if you press the letter H and hit return. You can also go back a move(s) and go forward (B-Return and F-Return). Just watch the chess icons jump! You can set internal chess clocks for each player, change sides, change color, and even change the location of pieces using the program's chessboard editor. Naturally, you play against the computer, but you can also have the computer play both sides if you wish, or even play both sides yourself or against another human player.

Among the "level" menu options are Mate, where the program looks for checkmate solutions; Ply search, where you can enter the number of plies (each side's move is ½ play) that your computer program will evaluate as it examines future moves and countermoves possibilities; and Quit, which returns you to the main menu.

While playing, you can watch the moves that the computer is mulling over since they continually appear in a right-top corner in notation form. It's sort of like reading the computer's mind while it's "thinking." Of great interest (and help), too, is a "value indicator" that let's you know who's winning and by how much. A positive number indicates the relative advantage the computer thinks you have, while a negative number shows what advantage the computer has. As a point of interest, the number of nodes (analyzed positions) are displayed. You'll be astonished at the great number of possible legal moves that are explored by the computer.

You can save games played to disk, with the program giving you this Y/N option when a game is ended. And you can print out this information, too. Moves

Fig. 2. Opening screen display for Turbo-Bridge.



are easy to make. The player has two choices. In one, which I prefer, you type the piece's first letter and the square it is to move to. For example, Pb4 moves a pawn in square b2 to b4 when you press Return. The alternate method uses a flashing bar positioned on the piece, where you press the space bar, and then move the bar to a square where you wish to move and press the space bar again.

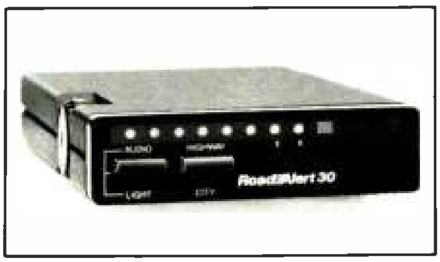
In all, this is a very nice computerized chess program. Not the best in raw game capability, but satisfactory. If you have a decent chess rating, you'll whip the computer every time if you don't have lapses. The chess piece graphics aren't the fanciest, but they're okay.

The game operated almost flawlessly. I say "almost" because once in a great while, the side whose turn it is to move gets hung up with, say, white to play when it is black's turn. To overcome this I had to go back a move to get it to operate properly. Also, the "hint" move suggested by the computer is not always the best move to make and could lead you into a losing position. Following the computer's suggestion, I was checkmated. Going back and making my own, different move, I won in a few more moves.

But though this is not the best computer chess game in town, although quite satisfactory, the programming strategy outlined in the GameWorks manual more than compensates for its minor inadequacies for most people. Detailed explanations are offered on chess game design, using the company's TurboPascal Ver. 3.0 (a $69.95 software package that can be supplemented by the $34.95 Turbo Tutor if you don't know how to work with Pascal). You'll learn the algorithms, about search trees, evaluation of pieces, and so on. It's an education in practical programming unto itself. With this in your back pocket, you can modify the chess program to your heart's desire, though you won't match the speed an assembler program can give you, which enables a computer to examine more prospective moves in a given time than Pascal can.

The bridge game offers more of the same. It's a more difficult game and has more unknowns than chess has. But the same attention to detail, all the source code needed, etc., is here, as well as the ready-to-play bridge game. The same goes for Go-Moku.

In sum, Turbo GameWorks is a delightful software package, with games that are fun to play as well as being able to improve your game. Equally important, you can learn about game theory and how to develop your own package. This is another winning piece of software from Borland at the right price, as usual. **ME** perhet X/K-band Road Alert 30 radar detector is designed to minimize false triggering. Its features include: LED signal-strength metering, illuminated X- and K-band indicators, and an indicator that lights when radar signals are received. A Highway/City switch prevents false alarms. An Alert Mode switch gives you a choice of audible, visible or combined alert.



Road Alert immediately tells you on power-up if it is operating properly. A variable audible alarm indicates signal strength and radar intensity. A photoelectric sensor automatically adjusts the brightness of the control panel for day and night driving.

The 4¼"D × 2¾"W × ¾"H Road Alert 30 mounts on visor or dashboard and plugs into the vehicle's cigarette-lighter receptacle. It comes with carrying case, coiled and straight power cords, cable retaining clips, and mounting hardware and tape. $199.95.

CIRCLE 32 ON FREE INFORMATION CARD

Home Controller/ Alarm System

Heath's new Model GD-3800 Smarthome I controls electrical appliances and lighting and provides sophisticated security protection. On/off (and dim/brighten for lamps) control is accomplished with commands distributed over the ac wiring. Command signals can be generated when the controller receives a signal from a sensor or from a handheld remote or by user programming via a transmitter supplied with the kit. (Optional software also allows you to program the system with selected computers.) Sensors monitor windows and doors and for smoke, movement in a room, etc. When a change in conditions is detected, a signal is transmitted to the

control unit that then sends the command to the appropriate module(s).

When used as an alarm center, the control unit determines when an emergency exists and sounds one of four different alarms. The alarm activated depends on the type of emergency. Priority is given in the case of a series of emergencies. $299.95; $99.95 for IBM PC and compatibles, H/Z-100, Apple II and Macintosh computer software.

CIRCLE 33 ON FREE INFORMATION CARD

1200-BPS Modem

ZOOM Telephonics' new ZOOM/Modem PC 1200 for IBM PCs, XTs and ATs is claimed to be fully compatible with, while offering features

not included in, the Hayes Smartmodem 1200B. Among the extra features are: call-progress code detection; Demon Dialing of busy numbers; touchtone detection; auto-answer touchtone password security; an audio input port; a RAM buffer for background electronic messaging; support of four COM ports; and a 16450 UART for compatibility with the IBM AT and clones.

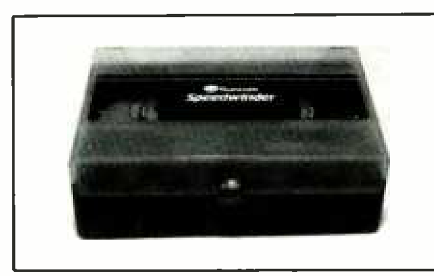
Security designed, the PC 1200 auto-answers and then remains quiet until the correct touchtone is entered and only then sends a carrier. Additionally, true dialtone detection improves security in auto-callback applications.

The RAM buffer can act as a data answering machine that operates in the background to send callers' modems a message and collect responses while the computer is used for other applications in the foreground. The Demon Dialer program provides a 24-number directory that comes with the information numbers for the most popular modem information services and ZOOM's technical support number.

CIRCLE 34 ON FREE INFORMATION CARD

VHS Videocassette Winder

Speedwinder from Suncom (Wheeling, IL) saves wear and tear on expensive videocassette recorder syn-



chronous motors by performing fast-forward and rewind functions outside the VCR. With the videocassette loaded onto Speedwinder's driven spindles and the accessory's cover closed, winding is said to be at a faster speed than is usually possible in VCRs. During winding, activity is indicated by a lighted "in use" indicator. Power for Speedwinder can be supplied either by four internal C cells (not provided) or by an optional ac adapter. $29.95.

CIRCLE 35 ON FREE INFORMATION CARD

64K Printer Buffer *(from page 40)*

Install the fuse and rectifier diode in the locations labeled F1 and D1, respectively. Then install the resistors, some of which are mounted vertically on the board. When installing *C3* through *C6*, do not cut off the leads that connect to the +5-volt bus. Instead, slip over them insulating tubing, bend them down, and install the free ends in the holes near pin 9 of *IC7* through *IC10* on the solder (bottom) side of the board. This is required to place the decoupling capacitors directly across the +5-volt power and ground for these ICs.

Install voltage regulator *IC26* and its heat sink. Then install filter capacitor *C1* about 3/16" above the surface of the board so that it clears the regulator's mounting screw.

If you are using the options referred to above, install the switches on the front panel of the case in which the Bufferette is to be housed. If you are using a case other than that supplied with the Bufferette kit in which to house the project, machine its front panel to accommodate the switch(es) and memory-status LEDs. Then mount the switch(es) and LEDs in the appropriate holes. Connect and solder a 6" length of 20-gauge zip-cord to the lugs on S2 and make sure that this switch's unused terminal is pointing up.

Identify the LED on the left as *LED4* and finish with *LED1* on the right. Connect together the long (anode) leads of these LEDs and a 5" hookup wire and solder the junction. In like manner, connect and solder separate 5" lengths of hookup wire to the cathode leads of each LED. Place the main circuit board assembly beside the case in which it will be installed, and connect and solder the wires from the switch(es) and LEDs to the appropriate points. For the LEDs, these are identified in Fig. 6 as "L1" for the common anode connection and "W1" through "W4" for the cathode connections from *LED1* through *LED4*, respectively. Install *IC17* in its socket, making sure it is properly oriented.

Pass the cord from the power transformer through a hole in the rear panel of the case, tie a knot in it about 5" from the free end inside the case, and connect it to the pads labeled "12V ac." Now carefully examine the entire circuit board, top and bottom, for unsoldered and poorly soldered connections and solder bridges, especially between the closely spaced pads for the ICs. If all looks okay, plug the transformer into a convenient ac outlet and switch on the power.

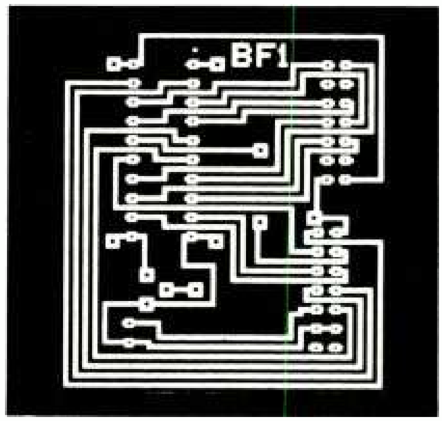


Fig. 6. This is the actual-size etching-and-drilling guide for the optional second printer switch circuit.

Measure the voltage between pin 16 of *IC16* and ground. If it registers between 4.8 and 5.2 volts, turn off the power and install a 7404 in the *IC24* socket. Turn on the power and use an oscilloscope, logic probe or frequency counter to check for the presence of oscillations at pin 8 of *IC24*. If you are using a frequency counter, it should register about 4 MHz. If all is still okay, power down the Bufferette.

Now install the remaining ICs in their respective sockets. Make sure they go into the correct sockets, that no pins are bent under or are overhanging the sockets, and that each IC is properly oriented before pushing it home. Also, keep in mind that some of the ICs are MOS types and must be handled appropriately to prevent them from being damaged by static electricity.

When all ICs are installed, once again turn on the power and check for activity at pin 6 of *IC1*. This is the Z80's clock pin and should register a frequency of about 1 MHz.

The options package mounts mainly on a separate pc board. Unlike the main pc board, the options board is quite easy to home fabricate, though it also is available from the same source as the main board.

If you plan to make your own options board, use the actual-size etching-and-drilling guide shown in Fig. 6. Then wire it exactly as shown in Fig. 7, observing the following. Start by installing *IC25* on the board *without* a socket. Then install *R17* and *R18*, the two wire jumpers and *Q1* as shown.

Next, install the two 7-pin female header strips side by side and the male 14-pin right-angle male header strip, or wire your cable or chassis-mount connector to the holes near the edge of the board. Install the 2-pin female header as shown.

Refer to the manual(s) that came with your printer(s) and computer for information on preparing the cables and connectors required to interconnect them. Exercise care when making these cables, since most operating difficulties are caused by improper connection to the computer and/or printer.

The input and output ports operate with negative strobe and acknowledge and positive busy signals. An extra ground pin is provided on the input connector for Paper Empty indication if needed. If you have in-

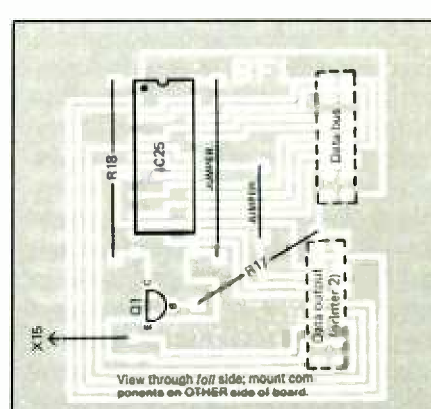


Fig. 7. Wiring the options board.

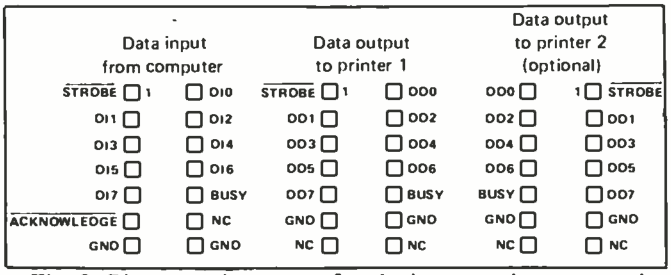
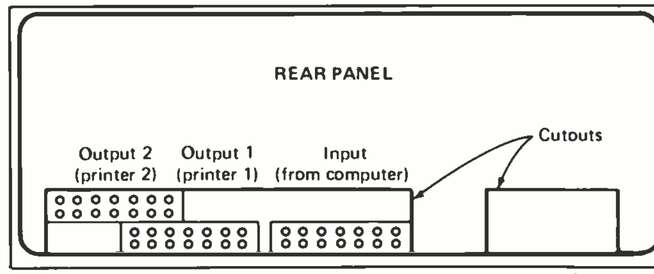


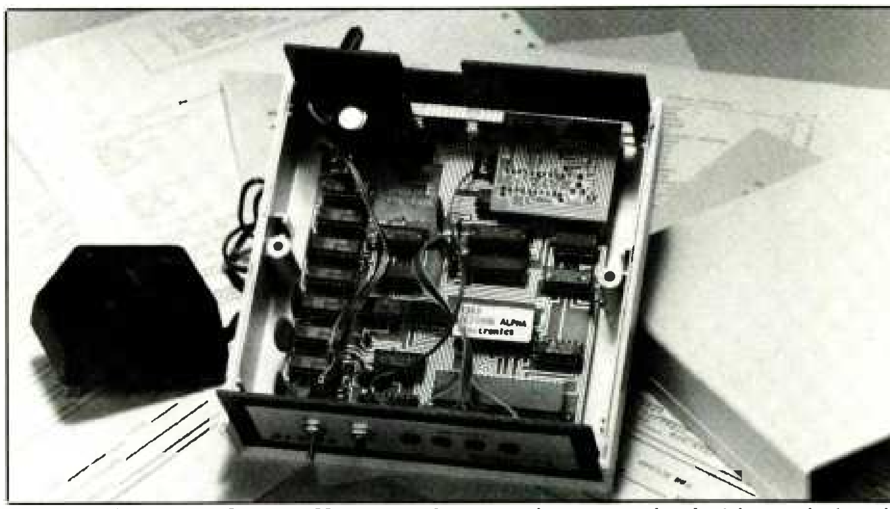
Fig. 8. Pinout assignments for the input and output pads on the top (component) side of the main board.



Drawing shows details of rear panel with second-printer options board installed.

stalled 14-pin right-angle male pins on the board, 14-pin female IDC (insulation-displacement connector) header connectors can be used with a flat ribbon cable. Use the appropriate connector if chassis-mount connectors have been installed on the rear panel of the Bufferette's case. The pinouts for the I/O connectors is shown in Fig. 8.

Install the finished board in the case with three screws. Use a plastic washer under the screw below *IC20*. Install the options board on the main board by pushing the female header strips on the pins of the main board. Install the front and rear panels and the top cover. Then secure the cover with screws and attach four rubber feet to the bottom of the case.



This interior view of the buffer shows how conductors on both sides and plated-through holes make it possible to achieve high-density IC population.

Using the Buffer

Connect the Bufferette to your computer and printer(s) with the appropriate cables. Turn on first your computer and printer(s) and *then* the Bufferette.

Printing begins as soon as data is dumped from the computer into the Bufferette. After printing is done, you can copy the buffer's contents by pressing and holding the SEL switch for a second and then releasing it. Keep in mind that the Bufferette, like other printer buffers, with a built-in Copy capability may occasionally have some copy missing at the beginning of each copy (not the original, however). This is caused by the stack pointer resetting to zero at the end of a print operation. If you cannot afford to lose those first few characters, you would be better off having your computer generate error-free multiple copies of a document instead of using the buffer's built-in copy feature.

If you wish to pause (temporarily interrupt) output from the buffer to the printer during a printing operation, briefly press and release the SEL switch. Repeat to resume printing. If your printer has its own built-in buffer, printing will continue until *its* buffer is emptied.

With the Memory Remaining option installed, all four LEDs on the front panel of the Bufferette will be on when the buffer's memory is empty. As soon as about 12K of data has been loaded into the buffer, the rightmost LED will extinguish. Then with the loading of each additional 12K of data into memory, the LEDs will successively extinguish from right to left, until all are off, indicating that just 12K of memory remains.

With the printer switch option installed, you can change from printer 1 to printer 2 and vice-versa by briefly pressing and releasing the SEL switch. (On power-up, printer 1 is on-line.) Do this only when the buffer is waiting for data from the computer and there is no data in the buffer to be printed. Each time the SEL switch is operated to change printers, the LEDs will flash off and then on.

In Closing

As you can see from the foregoing, the Bufferette is, indeed, a convenient accessory to add to your computer system, especially if you routinely print out moderate-size documents and do not want to wait a long time for your computer to be freed for other uses. This is a simple accessory to install into a computer/printer system. And at just $50, the cost of the Bufferette is particularly attractive. **ME**

PRODUCT EVALUATIONS • • • *(from page 23)*

Sony's "Video 8" Camcorder continued . . .

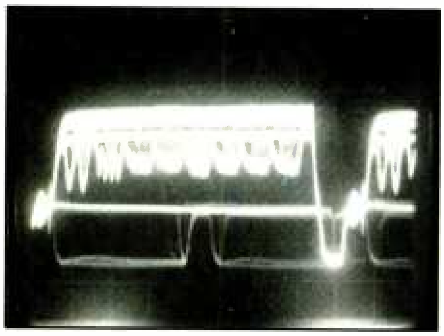


Fig. 2. Multiburst pattern oscillations visible to 2.5 MHz, confirming maximum video bandpass.

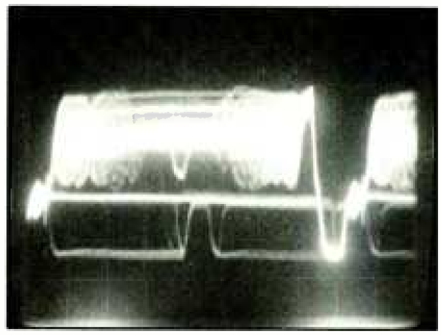


Fig. 3. Oscilloscope display of the radial resolution chart shows 300 lines vertical resolution.

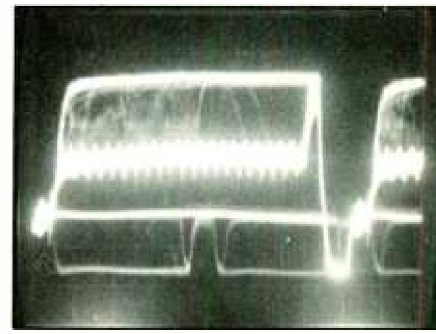


Fig. 4. Tektronix I-Q color evaluation chart was reproduced uniformily by the Model CCD-V8AFU camcorder.

Automatic Track Finding (ATF) eliminates manual adjustment, since it identifies both the video head and its proper track through a four-pilot frequency and servomechanism. Recorded 14 dB below the downconverted color signal level. ATF can identify a particular pilot and maintain field tracking throughout. In playback, the same pilot is identified and head tracking is adjusted so that crosstalk between adjacent pilots is kept equal and constant, resulting in minimal interference. When erasing previously recorded tape, the camcorder's flying erase head removes two video tracks simultaneously, leaving neither the spillover nor rainbows that are common to virtually all fixed erase heads.

Specified input and output signal levels are 1 volt peak-to-peak into 75 ohms unbalanced with negative sync in the video section and −10 dB in the audio section with 47K input and 2.2K output impedances. The low-impedance microphone input has a sensitivity of −66 dB.

Laboratory Results

In the laboratory, we're more interested in signal bandwidths than in what can be seen with the eye, since narrowband video and audio produce lackluster pictures and sound. For our lab analyses, we make extensive use of high-quality charts for everything except video and audio baseband response measurements and signal-to-noise ratio (S/N) measurements, since for all else the camera and lens become the limiting imaging factors.

For video analyses, multiburst (Fig. 2) and radial resolution (Fig. 3) charts usually deliver accurate results. As shown in Figs. 2 and 3, 300 (out of a possible 484) lines of vertical resolution were visible under strong lighting for the Video 8, which is about average for the 8-mm format. Multiburst measured a high-frequency bandwidth of some 2.5 MHz out of a possible 4 MHz. This isn't particularly good, though it's about average for many cameras and ½" Beta and VHS tabletop recorder/players. Total multiburst ranges from 0.5 to 4 MHz, and the positive white peaks denote spaces between the eight sets of frequency markers.

Tektronix's chrominance evaluation chart (Fig. 5) excites I and Q color channels and evaluates chroma-versus-frequency response. Responses with the Video 8 were uniform and satisfactorily offset, indicating that red, blue, magenta, yellow, cyan and green are all being correctly photographed and registered.

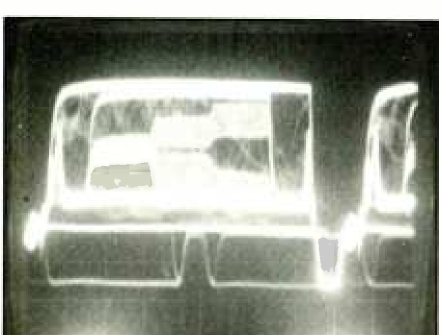


Fig. 5. Hale color coordination primary and complimentary colors were well matched, as shown here.

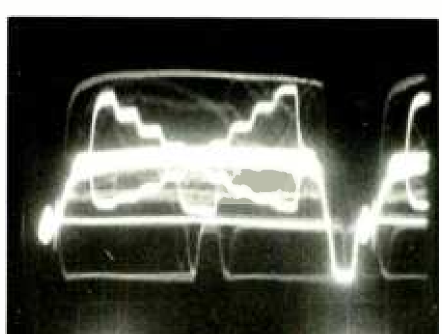


Fig. 6. Grayscale has slight low-frequency rolloff; linearity, center crossover, amplitudes are good.

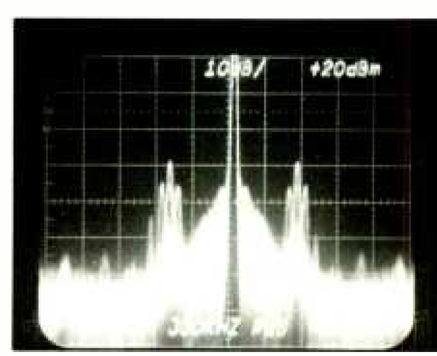


Fig. 7. This is the swept-chroma signal used to evaluate maximum video S/N measurement of 41 dB.

PRODUCT EVALUATIONS . . .

Sony's "Video 8" Camcorder continued . . .

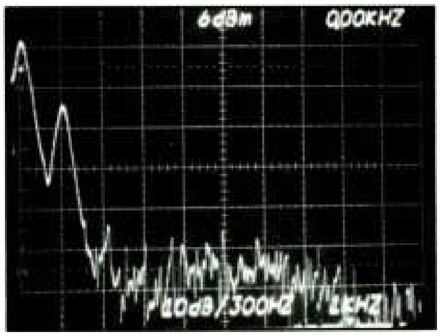


Fig. 8. As this trace display reveals, the measured audio signal-to-noise ratio at 1 kHz was 43 dB.

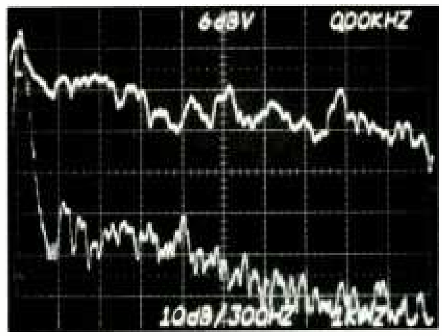


Fig. 9. Peak detection of audio in 1 (upper trace) and 2 (lower trace) kHz/division in superimposed photo.

The Hale color chart (Fig. 5) supplies vivid NTSC primaries and their complements, with a central 60% reflectance. Upper and lower color distributions are equivalent, denoting good chroma range reproduction. The Electronic Industries Association (EIA) grayscale resolution chart (Fig. 6) indicates reasonably linear staircase steps with just a little low-frequency sloppiness, but good crossovers and equal amplitudes.

Video S/N is also reasonable at 41 dB (Fig. 7), while audio S/N measured 43 dB (Fig. 8) at 1 kHz, marked at 10-dB/division intervals on the spectrum analyzer. Both are pretty good figures, compared to past test results of similar equipment. In Fig. 9, audio response is shown in two traces, with one trace continuing from the other. The upper and lower traces are at 1- and 2-kHz/division intervals, respectively. Interpreting the traces, you can see that audio is good out to 10 kHz at 10 dB down, with extension to 15 kHz if there's plenty of backup volume to bring up the additional level drop. It's not great "hi-fi," though it's a bit better than what we've been measuring with other models.

User Comment

The 8-mm format holds the promise for truly miniature camera/recorder combinations, like Sony's palm-size "Handycam" camcorder. However, don't expect the same kind of convenience with the Model CCD-V8AFU Video 8. Its size and weight are more akin to a full-size ½"-format camcorder like Sony's SuperBetamovie. Of course, with the Handycam you don't get the CCD-V8AFU's auto-focus system, electronic viewfinder, playback facilities, and bevy of controls that let you tape like a professional. Indeed, if you tally up all the odds and ends, you'll consider it a small wonder that everything this camcorder has to offer could be packed into such a small unit.

In actual use tests, the Model CCD-V8AFU's viewfinder and playback arrangement and fastforward and rewind functions were highly responsive. Auto-focus was peppy, too, taking only about a second to settle in, even when we rapidly panned between bright and dark scenes. The pickup sensitivity of the microphone was more than adequate in both forward and side directions.

We found very few faults with this camcorder. Perhaps the biggest of these is the fact that we had to take a bit of time to become familiar with the controls. This was due mainly to the fact that Sony labeled the controls on the rear panel with unfamiliar symbols, instead of the usual name identifiers. However, in just a short time we became quite comfortable with the controls.

Not so readily overcome is the fact that the supplied battery charger can't be used to simultaneously charge a battery and power the camcorder. This model can recharge three batteries in eight hours or a single battery in one hour, which is certainly very convenient. But it would have been much better if the system were designed to be just that little bit more flexible. As things stand, the simplest solution is to buy a second charger.

Minor shortcomings aside, we were delighted with this new offering from Sony. Its imaging and good color pickup in an environment with relatively little illumination were impressive. Its quiet motor,

A Serious Commitment

Developing improved tape formulations and longer-playing times are only a part of Sony's on-going commitment to the 8-mm format. The company has already introduced a 120-minute feature-length tape (P6-120) that will provide 4 hours playing time in transports equipped with a long-play (LP) speed mode. (Note that the Model CCD-V8AFU reviewed here does *not* have the LP mode in its present release, though we've been informed that a future release will have this facility.)

Just as important to the success of the new medium is the availability of "software" in the form of prerecorded movies and other programs. So, simultaneous with the release of the Video 8 family of products, Sony announced availability of a library of software at prices ranging from $16.95 to $49.95. The first titles released were:

Music

Jazzin' For Blue Jean (David Bowie)—$19.95

We're All Devo (Devo)—$29.95

Dancing on the Valentine (Duran Duran)—$16.95

Sheena Easton—$16.95

Live Hamp (Lionel Hampton)—$19.95

Alberta Hunter—$29.95

Video Pieces (Iron Maiden)—$16.95

Elton John—$16.95

Private Dancer (Tina Turner)—$16.95

Live Private Dancer Tour (Tina Turner)—$29.95

Children/Family

Curious George, Vol. 1—$24.95

The Hobbit—$34.95

The Snowman—$24.95

Voltron—Castle of Lions & Five Secret Keys—$49.95

Voltron—Battles Planet Doom—$49.95

By the time this appears in print, there should be other titles as well and more to come thereafter.

Sony Video 8 Camcorder Laboratory Analysis	
Low-light sensitivity	19 lux
Video response (maximum horizontal resolution)	2.5 MHz
Vertical resolution	300 lines
Video S/N at 3.0 MHz (swept)	41 dB
Grayscale tracking (floodlit)	good
I and Q color response and coordination	good
Color tracking (even at low light levels)	very good
Viewfinder	1" electronic
Lens (filter diameter = 52 mm)	f/1.4
Focus	auto/manual
Recording/playback time	120 minutes
Fast forward time (with 90-minute tape)	3 minutes
Tape speed (SP)	1.43 cm/s
Audio S/N at 1 kHz (signal generator)	43 dB
Audio response (at − 10 dB)	10 kHz
Power consumption	7.2 W

Note: Vertical resolution is not frequency related (horizontal resolution is). Therefore, maximum video response is specified in megahertz (MHz)—not "lines."

Test Instruments: Tektronix Models 7L15 and 7L12 spectrum analyzers; Hameg Model HM605 oscilloscope; B&K-Precision Models 1260 NTSC color-bar and 1653 ac power source; Data Precision Model 945 multimeter; Gossen Luna-Pro light meter; Tektronix C-5C Polaroid camera; Kodak E6-30 ME 8-mm videocassette.

good black-and-white viewfinder, adequate zoom range, good focus, good sound and reasonable video quality add up to make the Model CCD-V8AFU camcorder a nicely balanced system.

Whether or not you should shell out $1800 (less local retailer's discount) for this camcorder will depend on your needs and desires. If you're an avid "shutter bug" who wants all the bells and whistles, you aren't likely to find a better camcorder to use. If your taping is only occasional, like for family birthday parties and weddings, you might be better off investing in a far less sophisticated compact portable like the Handycam. If you already have a big investment in a full-size VCR, tapes and accessories, you may want to add just a camera to your system and avoid having to deal with another tape format.

People who are just now considering joining the video-tape revolution are the likeliest candidates for the Model CCD-V8AFU camcorder. This all-in-one camera/recorder/player system needs only an optional tuner/timer (and perhaps remote controller) to make it highly competitive with the 8-mm and ½" competition. The fact that it has built into it a full playback facility that directly drives a standard TV receiver is a major plus that must be taken into consideration when you compare prices. And Sony's commitment to the 8-mm format doesn't end with the camcorder—it extends to new tape development and prerecorded programs on tape just like there are for the Beta and VHS formats (see box). **ME**

—Stan Prentiss

Counterpoint

I agree that the 8-mm video machine holds the promise for truly "portable" camera/recorder combinations. But the Sony CCD-V8AFU one-piece 8-mm unit examined here betrays this potential with a size and weight that can be matched by some VHS and Beta portables.

Sure, this model is packed with nice features, but it is no great shakes when compared to many VHS and Beta models, especially if you already own a home deck that has one of the foregoing formats. Its CCD image sensor is certainly very sensitive and decidedly more rugged that its "tube" competitors, whether Saticon or Newvicon. The CCD is lighter in weight and has performance advantages in very bright light, too. But the non-solid-state pickups seem to provide better-quality pictures.

The rather bulky CCD-V8AFU doesn't have every feature there is, either, such as macrofocusing or a titler. Moreover if one uses an 8-mm portable as the only VCR in the house—and at this one's price it will likely be the case—who wants to wait and wait for many prerecorded rental movies to become available, which is a highly popular application of VCRs in the first place?

I can only conclude, therefore, that this deluxe 8-mm portable can do a lot of video things reasonably well and some very well, but its bulk and price turn me off. Avid live recording video tape enthusiasts deserve better. Perhaps a revised Sony "Handycam," the company's less-expensive 8-mm camcorder, with autofocusing added, would do it for most of us.

In my opinion, Sony forgot what the 8-mm format was all about when it produced this model. *—Art Salsberg*

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PAY TV and Satellite Descrambling. 5th edition. 73 pages. This is the most complete descrambling guide available and includes schematics for Anik and Fantasy etc. $12.95. Microwave, satellite, kits, catalog $1. Shojiki Electronics Corp., 1327 E. Niagara St., Niagara Falls, NY 14303. COD's 716-282-1001.

CABLE TV Secrets - the outlaw publication the Cable Companies tried to Ban. HBO, Movie Channel, Showtime, Descramblers, Converters, etc. Suppliers list included. $8.95. Cable Facts, Box 711-ME, Pataskala, OH 43062.

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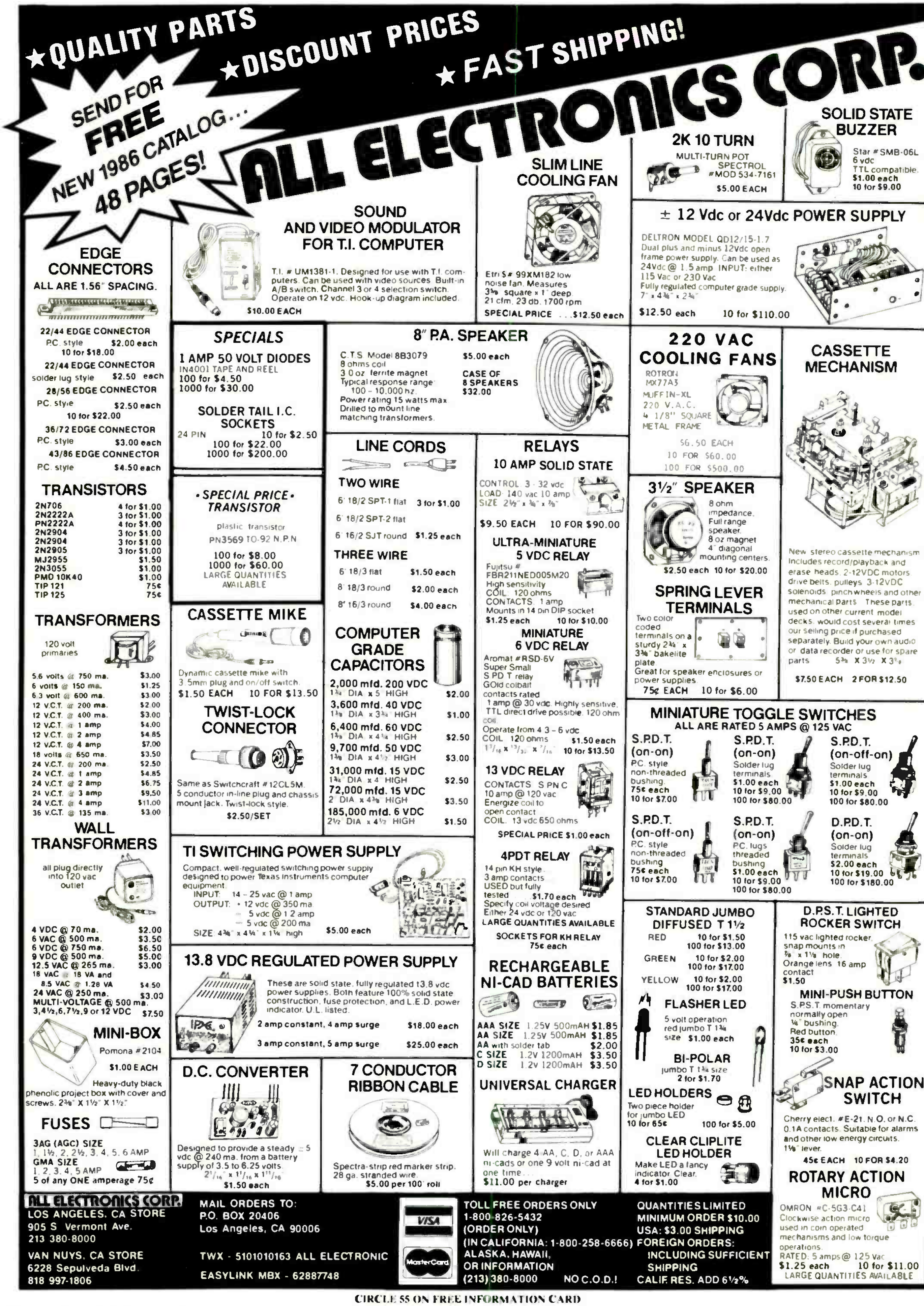

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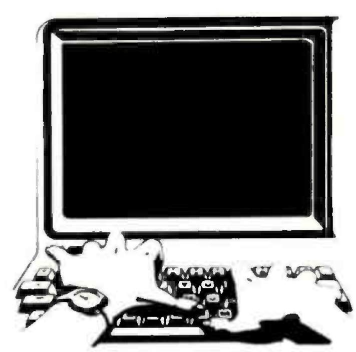

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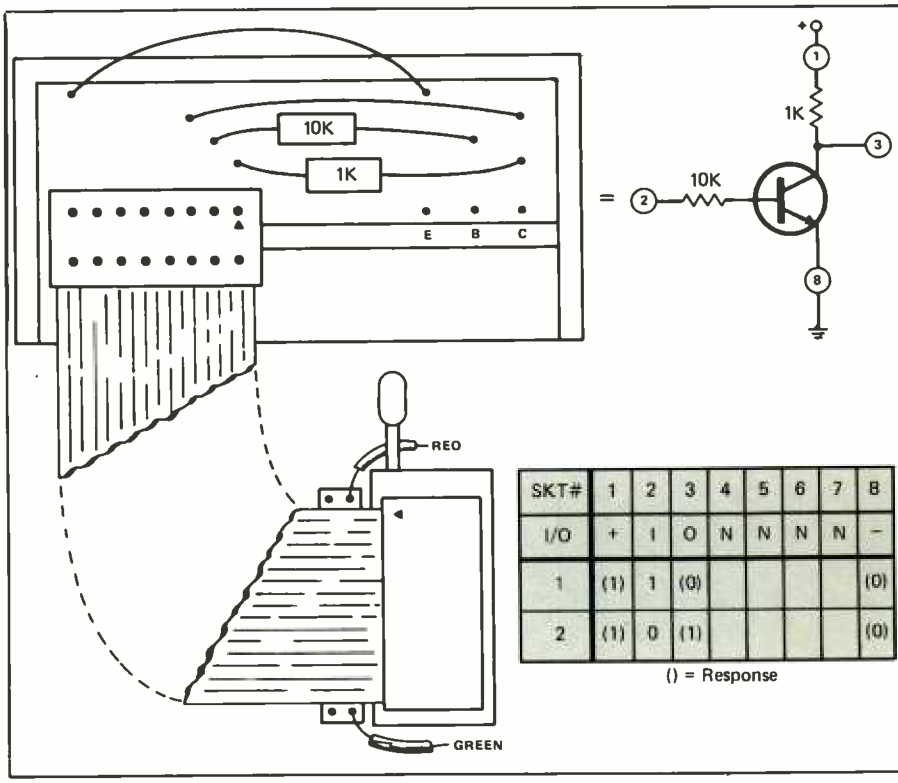
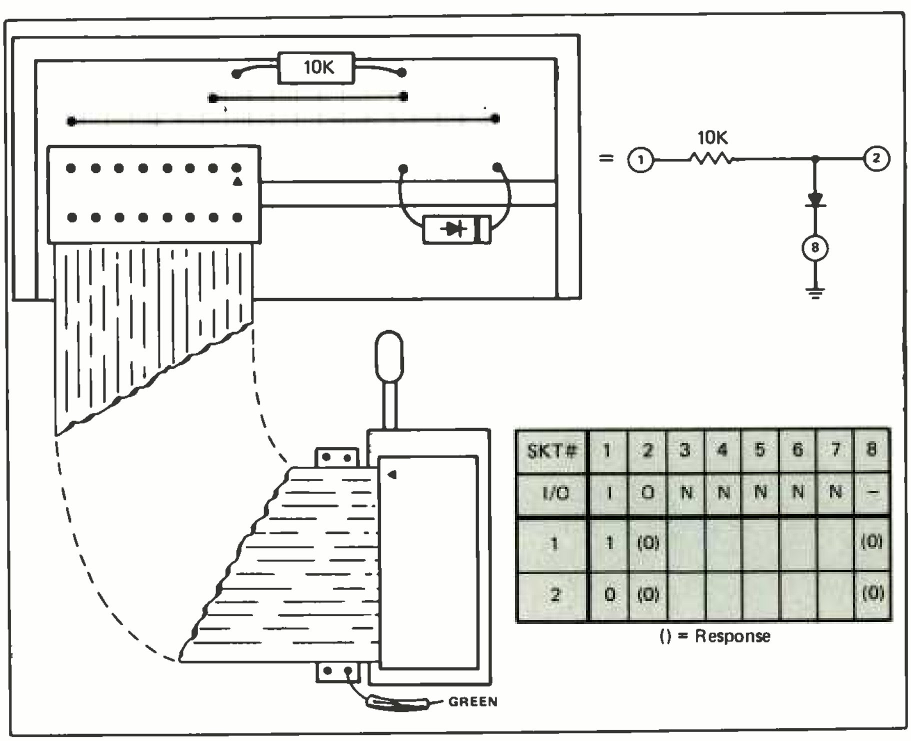
In Closing

As you can see from the foregoing, the Radio Shack Color Computer and the CoCo Testlab make a great team as a sophisticated test instrument. It has practical value for both the home experimenter/hobbyist and the professional technician. Just as importantly, if you already own a Color Computer, the cost of converting it into a sophisticated IC/diode/transistor/capacitor checker, using the Testlab, is minimal. (There is also a version of the Testlab for the Commodore 64 computer. For details, see the Parts List in Part 1.) ME



SKT#	1	2	3	4	5	6	7	B
I/O	+	I	O	N	N	N	N	−
1	(1)	1	(0)					(0)
2	(1)	0	(1)					(0)

() = Response



SKT#	1	2	3	4	5	6	7	8
I/O	I	O	N	N	N	N	N	−
1	1	(0)						(0)
2	0	(0)						(0)

() = Response

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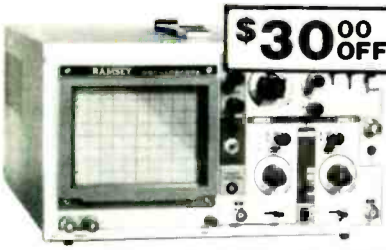

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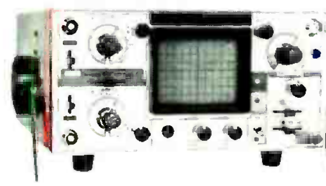

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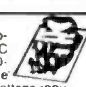

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