YOUR ONE-STOP SOURCE OF ELECTRONICS INFORMATION

ICD 08559

MODERN ELECTRONICS™

JULY 1987 $2.50
CANADA $3.50

THE MAGAZINE FOR ELECTRONICS & COMPUTER ENTHUSIASTS

- **Oscilloscope Measurements Guide**
- **How to Install Car Speakers**
- **Build A Wireless VCR Distribution Amplifier for Multi-TV Use**

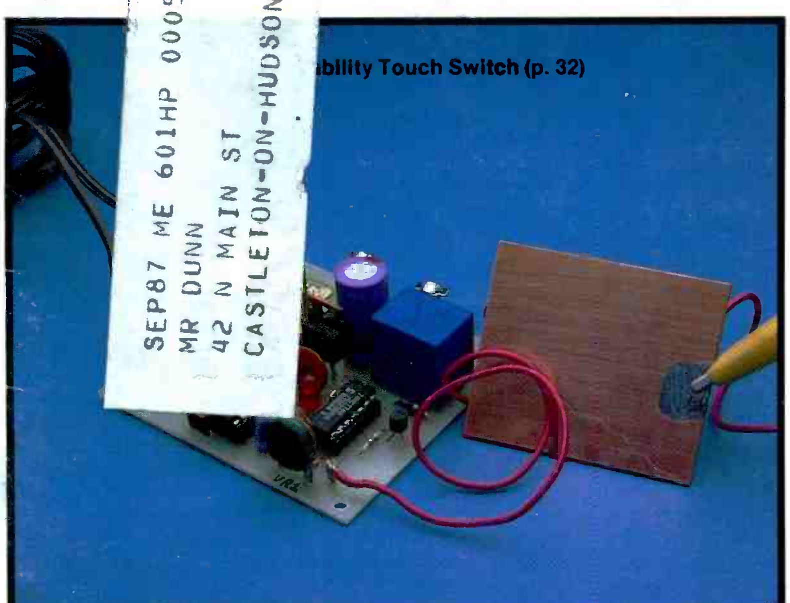
Complete Construction Plans:

- **High-Reliability Touch Switch**
- **A T...ture Probe For Multimeters**
- **A ... e Telephone Call Disconnector**

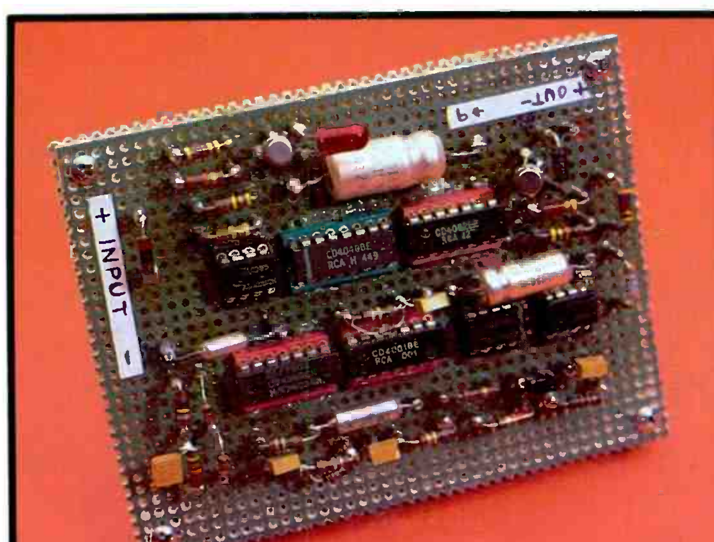
Plus

- **C... zed Project Decals**
- **R... in Old Video Monitor**

A Temperature-Probe Accessory For Multimeters (p.40)



...bility Touch Switch (p. 32)



A 10-Minute Telephone Call Monitor (p. 44)

Bulk Rate
Permit No. 79
U.S. Postage Paid
Gordonsville, VA 22942

Also: Forrest Mims' Experiments With Infrared Detectors ● Reviews: Find Your Fortune, Plan a Page, Fix a Disk, "Bookmark" Data-Protection Software, EGA "Wonder Board" ● Don Lancaster on Superconductivity Breakthroughs, Modem Eliminators and Sync Stripping Circuits ● Electronic & Computer News . . . and more.

Simpson Electric Company Introduces

mercer

The Ultimate in Low-Cost Test Equipment

At last! Here is your opportunity to take your pick from a new test equipment line that has all the features you need and more . . . and at a price that is unbelievably low. Here are six digital and two analog instruments . . . see them at your local distributor to make your choice.

MODEL 9670
Digital capacitance tester covering 0.1 pF to 20,000 µF
$99.00

MODEL 9340
Pocket size, 3½-digit DMM with 20 megohm range and 10 megohm input resistance
$44.00

MODEL 9370
3½-digit autoranging DMM with a memory mode and 0.5% basic DC accuracy
$59.00

MODEL 9301
3½-digit, hand-held DMM with 0.25% basic accuracy and 2,000-hour battery life
$69.00

MODEL 9120
Analog VOM with 12 A DC range and output jack
$39.00

MODEL 9401
4½-digit, full function, hand-held DMM with .05% accuracy and data hold
$129.00

MODEL 9701
digi-clamp™ compact AC clamp-on volt-ohm-ammeter with data hold
$69.00

MODEL 9101
Compact VOM with 27 ranges, including a 100 megohm range
$29.00

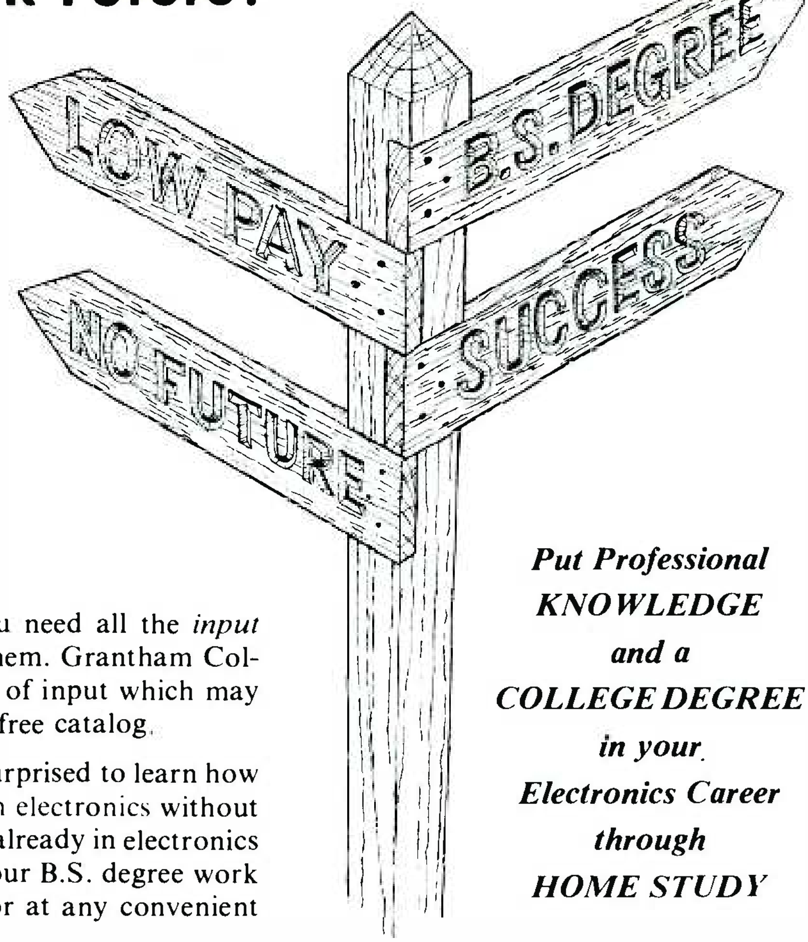
mercer
ELECTRONICS
Division of Simpson Electric Company
859 Dundee Avenue, Elgin, IL 60120-3090
(312) 697-2265 • Telex 72-2416

Mercer Electronics products reflect the design and quality standards established by Simpson Electric Company, an industry leader for over 50 years and known worldwide for its integrity and product excellence.

In Stock . . . Available Now! Stop in at your nearest distributor and see this new, complete line of Mercer test instruments. For the name of the MERCER distributor in your area, call (312) 697-2265, or send for our new line catalog.

CIRCLE 36 ON FREE INFORMATION CARD

Which Way To YOUR Future?



Are you at a crossroads in your career? Have you really thought about it? Are you *planning* for your future, or perhaps refusing to face the subject? Which way will you go — down the same old road? Or are you ready for something else?

In electronics you can't stand still. If you are not moving ahead, then you're falling behind. At the crossroads of your career, various choices are available — and, yes, *decisions* have to be made.

Which road will you take — one that doesn't go where you want to be, or one that leads to hard work *but also* to the better life? Ah, decisions, decisions!

Career decisions are so important that you need all the *input* you can get before locking-in on one of them. Grantham College of Engineering offers you *one* source of input which may help you in making that decision. It's our free catalog.

Ask for our free catalog and you may be surprised to learn how it is easily possible to earn a B.S. degree in electronics without attending traditional classes. Since you are already in electronics (you are, aren't you?), you can complete your B.S. degree work with Grantham while studying at home or at any convenient place.

Put Professional KNOWLEDGE and a COLLEGE DEGREE in your Electronics Career through HOME STUDY

But don't expect to earn that degree without hard work. Any degree that's worth your effort can't be had without giving effort to the task. And of course it is what you learn in the process, as much as the degree itself, that makes you stand out above the crowd — that places you in an enviable position, prestige-wise and financially.

Grantham offers this program, complete but without laboratory, to electronics technicians whose objectives are to upgrade their level of technical employment.

Recognition and Quality Assurance

Grantham College of Engineering is accredited by the Accrediting Commission of the National Home Study Council, as a degree-granting institution.

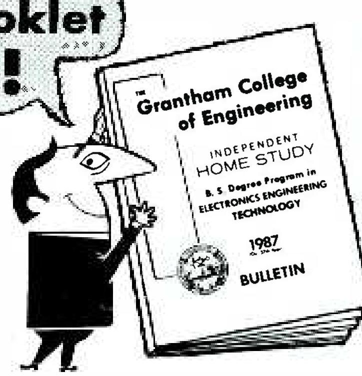
●

All lessons and other study materials, as well as communications between the college and students, are in the English language. However, we have students in many foreign countries; about 80% of our students live in the United States of America.

Grantham College of Engineering
10570 Humbolt Street
Los Alamitos, California, 90720

This booklet FREE!

This free booklet explains the Grantham B.S. Degree Program, offered by independent study to those who work in electronics.



for FREE Booklet CLIP COUPON and mail in envelope or paste on postal card.

Grantham College of Engineering M-7-87
10570 Humbolt Street, Los Alamitos, CA 90720

Please mail me your free catalog which explains your B.S. Degree independent-study program.

Name____________________ Age______

Address___________________________

City__________ State_______ Zip_____

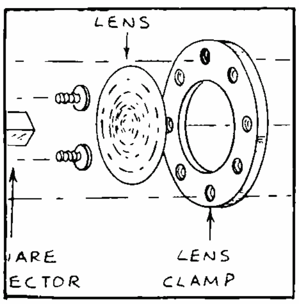
MODERN ELECTRONICS

THE MAGAZINE FOR ELECTRONICS & COMPUTER ENTHUSIASTS

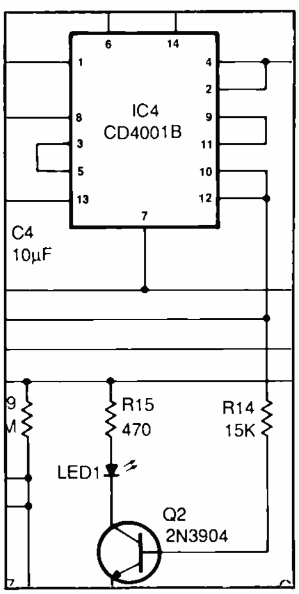
JULY 1987 — VOLUME 4, NUMBER 7

28

40



60



44

FEATURES

PRODUCT EVALUATIONS

COLUMNS

DEPARTMENTS

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 $17.97, two years $33.00, three years $48.00; Canada/Mexico—one year $20.00, two years $37.00, three years $54.00; Foreign—one year $22.00, two years $41.00, three years $60.00. Foreign Air Mail—one year $75.00, two years $147.00, three years $219.00.

Postmaster: Please send change of address notice to Modern Electronics, Inc., 76 North Broadway, Hicksville, NY 11801.

EDITORIAL

New Electronic Frontiers

Whether it's evolution or revolution, new electronic developments continue to be advanced at blazing speeds. Whenever one turns around there seems to be tradition-shaking changes on the horizon or already here for the taking: digital audio tape, high-definition TV, super video recorders, parallel-processing computers, smart power devices, application-specific ICs, surface-mounted components, billion-transistor chips, IBM's Personal System/2 series, etc.

The billion-transistor chip, among other futuristic promises, intrigues me. When it comes—and predictions are that it'll be here in about a decade—a new electronics/computer era will emerge that'll make the technical innovations whipped up by Chester Gould for his Dick Tracy comic strip look archaic.

Such ICs must also change the face of printed-circuit boards. After all, one couldn't lay down all those interconnections while taking advantage of such space-saving devices. It's thought, therefore, that pc boards will then serve largely for power and ground distribution. A host of developments would have to take place in order to make it possible to create such densely packed ICs, especially in computer-aided design technology.

When all this happens, ICs will essentially become whole systems on a chip; CAD and CAE machines will be a standard item in electronic companies, much as scopes are today; designs will likely be farmed out to chip "foundries," while most jelly bean IC makers will disappear; and so on.

What then will happen to home circuit brewers who build unique products from plans or their own designs? Will they disappear the way independent researchers have, giving way to monster-size corporate laboratories? I don't think so!

I remember when Dan Meyers of Southwest Technical Products predicted the demise of this breed in 1975 when ICs came on strong and personal computers came on the scene. I didn't agree with this at the time, either.

The way we operate will change, however, as it must in order to adapt to the new technology. Surface-mount components have already started to drive home brewers to buying new soldering tools and test clips, for example. More and more will do this as SMDs become more common. Down the road, instead of buying a timer or op amp IC, we'll be purchasing whole circuit sections on a single chip; even entire systems on a very few of them. Rolling your own circuits will, in fact, be easier than ever, I believe.

But how does one juggle various components to create customized circuits when so many ICs will be both application-specific and whole system blocks? Why, it'll be like buying a custom-made shirt. You give the fabricator your circuit specifications and he quickly makes it for you at a moderate price. Fabricators will have common circuit libraries that can be programmed to speedily set up for producing a custom chip. Enterprising companies and competition will drive the prices of custom chips way down, which we're experiencing right now.

Turning designs into silicon packages is the key to the future of electronics. European universities in West Germany and Great Britain, among other countries, have educational programs that enable engineering students to do just this—design ICs, give them to a fabrication service (funded by manufacturers), get back the packages, and test them out to see if they really work as they should. As a result, Europe is turning out 500 students a year with experience in IC design; their goal is to reach 1,000.

What European electronic educators are doing, therefore, is providing real-world training in the universities instead of depending on on-the-job industry training. But shouldn't such education have been instituted in the educational mills in the first place?

Art Salsberg

Overkill

• I have searched the world over looking for an 8-MHz 8237-2 DMA controller IC required for the "PC Express" project (May 1987). Please relieve my frustrations and give me a specific manufacturer's IC number and name. Or let me know if the IC required is really the 5-MHz 8237-5 that currently exists in my system.

Paul P. Drukker
Oak Park, IL

Sources for the 8-MHz 8237-2 made by NEC seem to have dried up. It was overkill anyway, advises the author, since the 5-MHz 8237-5 is working with a 5-MHz oscillator. His friend is using the 5-MHz DMA controller in a 10-MHz system and it works fine.—Ed.

A Small Gremlin

• It seems that a small gremlin appeared in Fig. 3 in my May 1987 article "Using Op Amps to Generate Signals." The oscillator will not work as shown. Either D1 or D2 must be inverted. If D1 is changed so that its cathode faces pin 7 of the amplifier, a positive-going sawtooth will be generated. Doing the same to D2 will invert the polarity of the ramp. The rest looks good.

Charles R. Fischer

When It Goes Bad

• I enjoyed the comments made in the January 1987 Editorial, "When it Goes Bad," regarding fixing personal electronic equipment.

Recently, I helped someone fix a full-featured Magnavox VCR. The color was out, though the picture was synchronized but looked dull. If I adjusted the TV tuner, I could get color but lost sound. In addition, when using the VCR's tuner, it would not lock onto the channel to which it was set. Instead, it scanned in and out of the channel as though the aft was oscillating.

I called the service center number given in the owners manual to request a service manual and was given another number to call. Calling that, I was greeted by an answering machine that was barely understandable. After two attempts, I was able to decipher yet another number to call, which reached a very courteous publications department. Within eight days, I had the service manual.

The color problem was the result of a faulty chrominance carrier, which was fixed by resoldering the 3.58-MHz crystal. The tuner problem wasn't so easy to fix. The tuner is controlled by one of two

(Continued on page 87)

GE & RCA PARTS MERGE. Marketing and sales of consumer electronic parts and accessories for both GE and RCA are now handled by the corporation's Distributor and Special Products depament. With RCA merged into General Electric, this consolidation move is not surprising, enabling reliance on one marketing source for purchase of both brands.

SNAPSHOTS OF SHOP FLOOR WORKSTATIONS. An information reporting system that can display a "snapshot" of the current status of information on shop floor workstations has been developed by RWT Corp., Mt. Prospect, IL. Using a networking system, management can collect reports on machine performance, order history, repair, idle time, etc., at the press of a button.

CONSUMER VIDEO WINNERS & LOSERS. Consumer video hardware products showed modest gains in 1987's first quarter, reports the EIA. VCRs registered only a modest 3.7% gain, while camcorders jumped 34%. Standard color TV sales decreased 8.2% during this period, while monochrome TV sets dropped 9.2%.

REAL-TIME CATALOG OF IC TEST SPECS. National Semiconductor Corp. has implemented the first real-time electronic catalog of military test specifications for ICs. Stored on the company's mainframe computer, it can be accessed by National's sales personnel across the U.S., with computer-printed copies supplied to customers at no charge. National's customers will be able to access the system directly by year-end, says National.

FORREST MIMS WINS AWARDS. Forrest Marion Mims, III, has added more accolades for his respected work. The Computer Press Association's annual Awards for excellence in high-technology journalism, jointly sponsored by Citizen America Corp., named our "Electronics Notebook" columnist a runner-up winner in the "Best General Non-Fiction Book" category for his "Siliconnections" book. (Robert Rivlin was the Winner for his "Algorithmic Image" book.) Mims also earned a Rolex chronometer as an "Honorable Mention Award Winner" of the Rolex Award for Enterprise 1987. This was bestowed for his electronic design of a miniature hand-held and eyeglass-mounted infrared travel aid for the blind.

BRITISH PHONE BILLS CATCHING UP. British telephone idiosyncracies are falling by the wayside since British Telecom was "privatized." Within a few years, it's expected that Britons will get an itemized list of their long-distance phone calls instead of receiving a "lump sum" bill every three months with no breakdown of charges for specific calls, reports International Resource Development, Norwalk, CT in its U.K. Telecommunications Market Opportunities study. Whoopee! Newer pay phones are being introduced, too, which do away with the necessity of constantly feeding coins to the box while talking, and substituting a simple credit-card reader that automatically (and silently) debits a card-holder's account. Cellular mobile telephone services, which are booming on the Island, still use two separate and incompatible sets of frequencies, however. Higher-frequency car phones, mostly used in the London area, cannot get a dial tone in many other parts of the country as a result of this system. On the other hand, car-phone owners, who use lower-frequency phones common in the provinces, get permanent busy signals if they try to phone while driving in London.

NEW! Turbo Scan™ Scanners

Communications Electronics,™ the world's largest distributor of radio scanners, introduces new lower prices to celebrate our 16th anniversary.

NEW! Regency® TS2-MA

Allow 30-120 days for delivery after receipt of order due to the high demand for this product.
List price $499.95/**CE price $319.95**
12-Band, 75 Channel • Crystalless • AC/DC
Frequency range: 29-54, 118-175, 406-512, 806-950 MHz.
The *Regency* TS2 scanner lets you monitor Military, Space Satellites, Government, Railroad, Justice Department, State Department, Fish & Game, Immigration, Marine, Police and Fire Departments, Aeronautical AM band, Paramedics, Amateur Radio, plus thousands of other radio frequencies most scanners can't pick up. The *Regency* TS2 features new 40 channel per second *Turbo Scan™* so you wont miss any of the action. Model **TS1-MA** is a 35 channel version of this radio without the 800 MHz. band and costs only $239.95.

Regency® Z60-MA

List price $299.95/**CE price $184.95/SPECIAL**
8-Band, 60 Channel • No-crystal scanner
Bands: 30-50, 88-108, 118-136, 144-174, 440-512 MHz.
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-MA

List price $259.95/**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.

Regency® RH250B-MA

List price $699.95/**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 *60 Watt* VHF 150-162 MHz. version called the **RH600B-MA** is available for $439.95. A UHF 15 watt version of this radio called the **RU150B-MA** is also available and covers 450-482 MHz. but the cost is $439.95.

Bearcat® 50XL-MA

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, handheld scanner with 10 channels covering ten frequency bands. It features a keyboard lock switch to prevent accidental entry and more. Also order the new double-long life rechargeable battery pack part # **BP55** for $29.95, a plug-in wall charger, part # **AD100** for $14.95, a carrying case part # **VC001** for $14.95 and also order optional cigarette lighter cable part # **PS001** for $14.95.

NEW! Scanner Frequency Listings

The new Fox scanner frequency directories will help you find all the action your scanner can listen to. These new listings include police, fire, ambulances & rescue squads, local government, private police agencies, hospitals, emergency medical channels, news media, forestry radio service, railroads, weather stations, radio common carriers, AT&T mobile telephone, utility companies, general mobile radio service, marine radio service, taxi cab companies, tow truck companies, trucking companies, business repeaters, business radio (simplex) federal government, funeral directors, veterinarians, buses, aircraft, space satellites, amateur radio, broadcasters and more. Fox frequency listings feature call letter cross reference as well as alphabetical listing by licensee name, police codes and signals. These Fox directories are $14.95 each plus $3.00 shipping. State of Alaska-**RL019-1**; State of Arizona-**RL025-1**; Buffalo, NY/ Erie, PA-**RL009-2**; Chicago, IL-**RL014-1**; Cincinnati/ Dayton, OH-**RL006-2**; Cleveland, OH-**RL017-1**; Columbus, OH-**RL003-2**; Dallas/Ft. Worth, TX-**RL013-1**; Denver/Colorado Springs, CO-**RL027-1**; Detroit, MI/ Windsor, ON-**RL008-2**; Fort Wayne, IN/Lima, OH- **RL001-1**; Hawaii/Guam-**RL015-1**; Indianapolis, IN-**RL022-1**; Kansas City, MO/ KS-**RL011-2**; Long Island, NY-**RL026-1**; Louisville/Lexington, KY-**RL007-1**; Milwaukee, WI/Waukegan, IL-**RL021-1**; Minneapolis/St. Paul, MN-**RL010-2**; Nevada/E. Central CA-**RL028-1**; Oklahoma City/ Lawton, OK-**RL005-2**; Orlando/Daytona Beach, FL-**RL012-1**; Rochester/Syracuse, NY-**RL020-1**; San Diego, CA-**RL018-1**; Tampa/St. Petersburg, FL- **RL004-2**; Toledo, OH-**RL002-3**. Regional directories which cover police, fire ambulance & rescue squads, local government, forestry, marine radio, mobile phone, aircraft and NOAA weather are available for $19.95 each. **RD001-1** covers AL, AR, FL, GA, LA, MS, NC, PR, SC, TN & VI. **RD002-1** covers IL, IN, KY, MI, OH & WI. For an area not shown above call Fox at 800-543-7892 or in Ohio 800-621-2513.

Regency® HX1500-MA

List price $369.95/**CE price $218.95**
11-Band, 55 Channel • Handheld/Portable
Search • Lockout • Priority • Bank Select
Sidelit liquid crystal display • EAROM Memory
Direct Channel Access Feature • Scan delay
Bands: 29-54, 118-136, 144-174, 406-420, 440-512 MHz.
The new handheld *Regency* HX1500 scanner is fully keyboard programmable for the ultimate in versatility. You can scan up to 55 channels at the same time including the AM aircraft band. The LCD display is even sidelit for night use. Includes belt clip, flexible antenna and earphone. Operates on 8 1.2 Volt rechargeable Ni-cad batteries (not included). Be sure to order batteries and battery charger from the accessory list in this ad.

Bearcat® 100XL-MA

List price $349.95/**CE price $178.95/SPECIAL**
9-Band, 16 Channel • Priority • Scan Delay
Search • Limit • Hold • Lockout • AC/DC
Frequency range: 30-50, 118-174, 406-512 MHz.
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.

★★★ SPECIAL SAVINGS COUPON ★★★

★★★ FREE DURACELL® Batteries Included ★★★
★★★★ Free local frequency directories ★★★★
Save even more with this special coupon. As long as your order is **prepaid by money order**, you'll get extra special pricing on items listed in this coupon. In addition, if you order a *Bearcat* 50XL or *Regency* HX1500 scanner with this coupon, you'll get a free set of *Duracell* batteries which we recommend for best performance. If you buy a *Regency* Z60 or Z45 scanner using this coupon, you'll get a free Fox frequency directory worth $14.95. This coupon must be included with your *prepaid* order. *Credit cards and quantity discounts are excluded from this offer.* Offer valid only on prepaid orders mailed directly to Communications Electronics Inc., P.O. Box 1045 - Dept. M3, Ann Arbor, Michigan 48106-1045 U.S.A. Coupon expires July 31, 1987. Coupon may not be used in conjunction with any other offer from Communications Electronics Inc. Be sure to add shipping & handling fees listed in this ad (add $3.00 for shipping free books or batteries).

RH250B-M3 *Regency* 25 W. VHF Transceiver.... $299.95
RH600B-M3 *Regency* 60 W. VHF Transceiver.... $388.95
RU150B-M3 *Regency* 15 W. UHF Transceiver.... $399.95
UC102-M3 *Regency* 1 W. VHF 2 channel trans. $119.95
HX1500-M3 *Regency* 55 channel scanner $217.95
Z60-M3 *Regency* 60 channel scanner $158.95
Z45-M3 *Regency* 45 channel scanner............ $148.95
BC100XL-M3 *Bearcat* 16 channel scanner....... $177.95
BC800XLT-M3 *Bearcat* 40 channel scanner...... $278.95
INF1-M3 *Regency* Informant scanner $249.95
BC210XW-M3 *Bearcat* 20 channel scanner...... $168.95
BC50XL-M3 *Bearcat* 10 channel scanner........ $113.95
RD55-M3 *Uniden* Radar Detector.................. $97.95

★★★ SPECIAL SAVINGS COUPON ★★★

Bearcat® 800XLT-MA

List price $499.95/**CE price $289.95/SPECIAL**
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-MA Shortwave receiver..... $179.95
RD55-MA *Uniden* Visor mount Radar Detector $98.95
***NEW!* BC 70XLT-MA** *Bearcat* 20 channel scanner... $169.95
BC 145XL-MA *Bearcat* 16 channel scanner $98.95
BC 140-MA *Bearcat* 10 channel scanner $89.95
BC 210XW-MA *Bearcat* 20 channel scanner $169.95
BC-WA-MA *Bearcat* Weather Alert™............... $38.95
PC22-MA *Uniden* remote mount CB transceiver ... $99.95
PC55-MA *Uniden* mobile mount CB transceiver ... $59.95
***NEW!* R1080-MA** *Regency* 30 channel scanner ... $118.95
***NEW!* R1090-MA** *Regency* 45 channel scanner ... $148.95
***NEW!* INF1-MA** *Regency* Informant scanner $289.95
UC102-MA *Regency* VHF 2 ch. 1 Watt transceiver... $124.95
P1405-MA *Regency* 5 amp regulated power supply ... $69.95
P1412-MA *Regency* 12 amp reg. power supply... $164.95
MA549-MA Drop-in charger for HX1200 & HX1500... $84.95
MA518-MA Wall charger for HX1500 scanner..... $14.95
MA553-MA Carrying case for HX1500 scanner.... $19.95
MA257-MA Cigarette lighter cord for HX12/1500.... $19.95
MA917-MA Ni-Cad battery pack for HX1000/1200... $34.95
SMMX7000-MA Svc. man. for MX7000 & MX5000.... $19.95
B-4-MA 1.2 V AAA Ni-Cad batteries (set of four)..... $9.95
B-8-MA 1.2 V AA Ni-Cad batteries (set of eight).... $17.95
FB-E-MA Frequency Directory for Eastern U.S.A. $14.95
FB-W-MA Frequency Directory for Western U.S.A.... $14.95
ASD-MA Air Scan Directory....................... $14.95
SRF-MA Survival Radio Frequency Directory $14.95
TSG-MA "Top Secret" Registry of U.S. Govt. Freq.... $14.95
TIC-MA Techniques for Intercepting Comm........ $14.95
RRF-MA Railroad frequency directory $14.95
EEC-MA Embassy & Espionage Communications... $14.95
CIE-MA Covert Intelligenct. Elect. Eavesdropping ... $14.95
A60-MA Magnet mount mobile scanner antenna $35.95
A70-MA Base station scanner antenna $35.95
USAMM-MA Mag mount VHF/UHF ant. w/ 12' cable ... $39.95
USAK-MA ¾" hole mount VHF/UHF ant. w/ 17' cable... $35.95
USATLM-MA Trunk lip mount VHF/UHF antenna.... $35.95
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

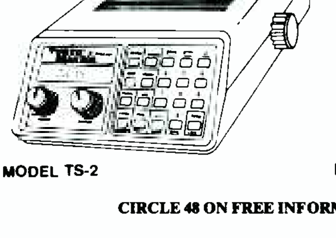
To ***get the fastest delivery from CE*** of any scanner, send or phone your order directly to our Scanner Distribution Center.™ Michigan residents please add 4% sales tax or supply your tax I.D. number. Written purchase orders are accepted from approved government agencies and most well rated firms 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. Not responsible for typographical errors.

Mail orders to: Communications Electronics,™ Box 1045, Ann Arbor, Michigan 48106 U.S.A. Add $7.00 per scanner for R.P.S./U.P.S. *ground* shipping and handling in the continental U.S.A. For Canada, Puerto Rico, Hawaii, Alaska, or APO/FPO delivery, shipping charges are three times continental U.S. rates. If you have a Discover, Visa or Master Card, you may call and place a credit card order. Order toll-free in the U.S. Dial 800-USA-SCAN. In Canada, order toll-free by calling 800-221-3475. FTCC Telex anytime, dial 825333. If you are outside the U.S. or in Michigan dial 313-973-8888. Order today.

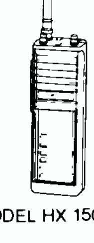
Scanner Distribution Center™ and CE logos are trademarks of Communications Electronics Inc.
‡ *Bearcat* is a registered trademark of Uniden Corporation.
† *Regency* and *Turbo Scan* are registered trademarks of Regency Electronics Inc. AD #050487-MA/M3
Copyright © 1987 Communications Electronics Inc.

For credit card orders call 1-800-USA-SCAN

Regency RH250



MODEL TS-2



MODEL HX 1500

COMMUNICATIONS ELECTRONICS INC.

Consumer Products Division
P.O. Box 1045 □ Ann Arbor, Michigan 48106-1045 U.S.A.
Call 800-USA-SCAN or outside U.S.A. 313-973-8888

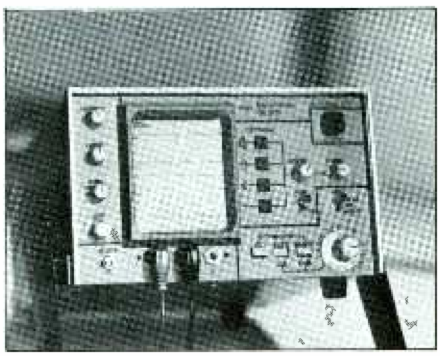
CIRCLE 48 ON FREE INFORMATION CARD

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.

Signature Analyzer

Information Devices' (Seattle, WA) Model 1502 Analogger is designed to find defective solid-state and electrical components in- and out-of-circuit in about half the time required by other instruments to do the same. The four displayed component "signatures" can be separated on the CRT screen for individual viewing, or they can be overlapped for comparison viewing. Using the Analogger, test component power dissipation is reduced to 25% of single-signature dissipation, permitting testing of devices that previously could be damaged by prolonged testing.



Quality tests for solid-state components, in or out of a circuit, can be done at test frequencies ranging from 50 Hz to 5 kHz. Controls on the front panel allow the user to select one of three test-frequency ranges. The test frequency chosen can be afc-locked to a multiple of the power-line frequency or to an external source. Continuously adjustable test frequencies allow for "ball-parking" the proper test for certain components, including reactive devices. A phase control on the front panel can be adjusted to eliminate test-lead effects that distort signatures. $1,690.

CIRCLE 15 ON FREE INFORMATION CARD

Video Titler

RCA has a pair of keyboard character generators that let the user of a video-camera/recorder setup create titles containing up to 60 characters that can be displayed on the screen at one time. Characters can be defined in four sizes from small to large. In addition, 20 sets of characters can be stored and recalled a page at a time, and 40 frequently used words can be stored in a word register. The memory system is powered by two AA cells for about a year.

Special effects can be created simply by pushing one of seven buttons. Pressing "curtain" causes the picture to slowly be covered with black from the side of the screen. A "window effect" button allows the user to frame the picture with a black border that closes in to replace the scene. A "scroll" button moves titles up and down to give the scrolling effect used in motion pictures. Time-lapse images and a clock/calendar display are other special effects that are possible to create with the new video titlers.

The Model CGA010 titler is suitable for use with most major brands of video cameras equipped with a compatible 10-pin connector, while the Model CGA020 is intended for use with RCA camcorders. $269.95 for CGA010; $249.95 for CGA020.

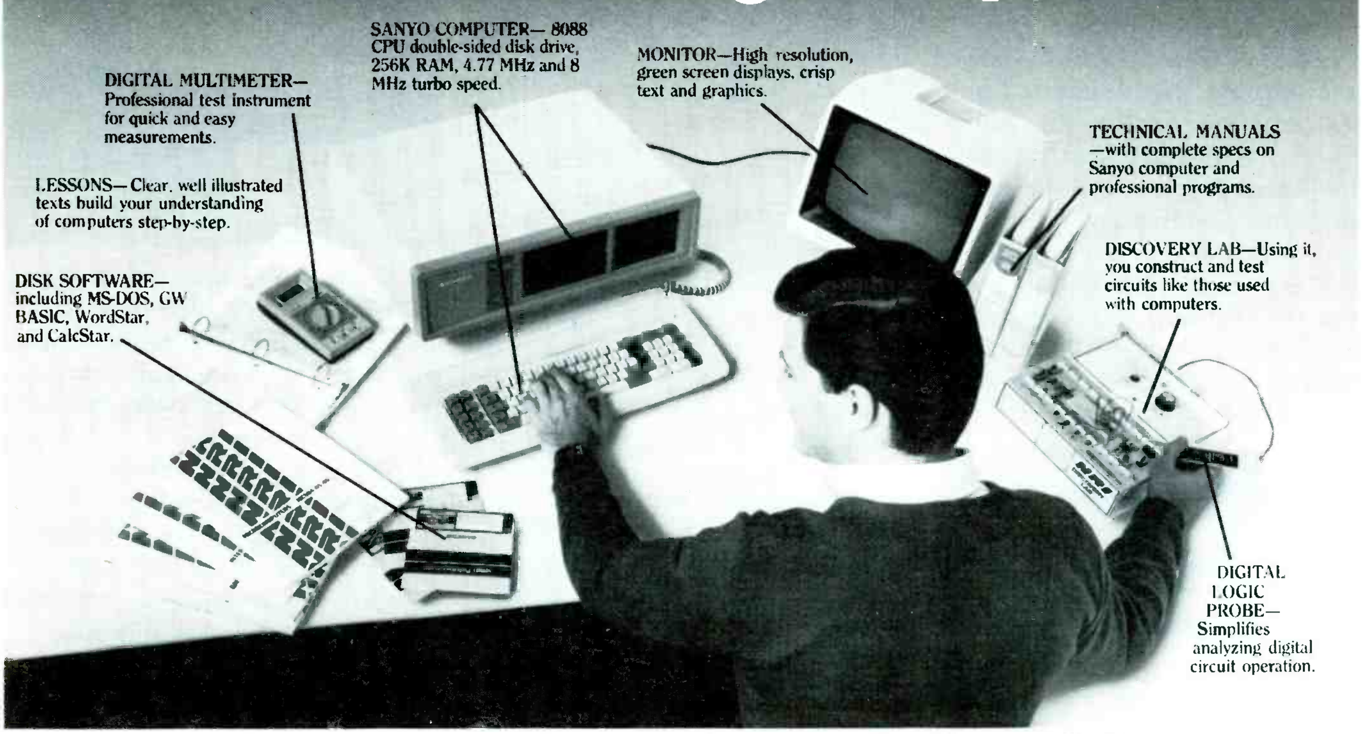
CIRCLE 16 ON FREE INFORMATION CARD

Light Adapter for Multimeters

The LUX Adaptor from Extech converts a multimeter into a light meter for use in photography, computer environments, maintenance or wherever light measurements are needed. When this accessory is plugged into a digital multimeter (or a voltage recorder) set to a 200-millivolt scale, it provides a 10-lux resolution. The plug-in photocell senses light fluctuations from 0 to 2,000 lux or foot-candles. The Lux Adaptor measures 2" in diameter and comes with a 45" coiled cord that plugs into the meter with which it is used.

CIRCLE 17 ON FREE INFORMATION CARD

Train with NRI for a high paying career servicing computers.



Get started now by building this fully IBM PC compatible computer

Now you get it all . . . training for America's fastest growing career opportunity . . . training to service all computers . . . training on the newest total computer system, the Sanyo 880. Only NRI can give you the well-rounded training you need, because only NRI gives you a complete computer system . . . computer, monitor, disk drive, software, even test instruments like a digital multimeter and logic probe to work with and keep. It all adds up to training that builds the knowledge, competence, and ability you need to succeed as a computer service specialist.

Get inside the newest, fully IBM PC compatible Sanyo Microcomputer

As an NRI student, you'll get total hands-on training as you actually build your own latest model Sanyo 880 Series computer from the keyboard up. It's fully IBM PC compatible and, best of all, it runs programs almost twice as fast as an IBM PC. As you assemble the Sanyo 880, you'll perform demonstrations and experiments that will give you a total mastery of computer operation and servicing techniques. You'll do programming in BASIC language—even run and interpret essential diagnostic software.

Understanding you get only through experience

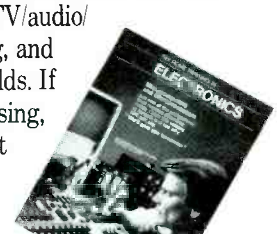
You need no previous knowledge to succeed with NRI. You start with the basics, rapidly building on the fundamentals of electronics with bite-size lessons. You perform hands-on experiments with your NRI Discovery Lab and then move on to master advanced concepts like digital logic, microprocessors, and computer memories.

Learn at home in your spare time

You train in your own home at your own convenience, backed at all times by your own NRI instructor and the entire NRI staff of educators and student service support people. They're always ready to give you guidance, follow your progress, and help you over the rough spots to keep you moving toward your goal.

100 page free catalog tells more . . . send today

Send the postage-paid reply card today for NRI's 100 page catalog that gives all the facts about computer training plus career training in robotics, data communications, TV/audio/video servicing, and many other fields. If the card is missing, write to NRI at the address below.



NRI SCHOOLS

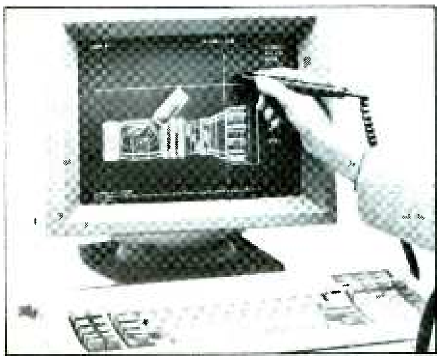
McGraw-Hill Continuing Education Center
3939 Wisconsin Avenue
Washington, DC 20016

We'll give you tomorrow

NEW PRODUCTS . . .

Mouse Interface Software & Light Pen Board

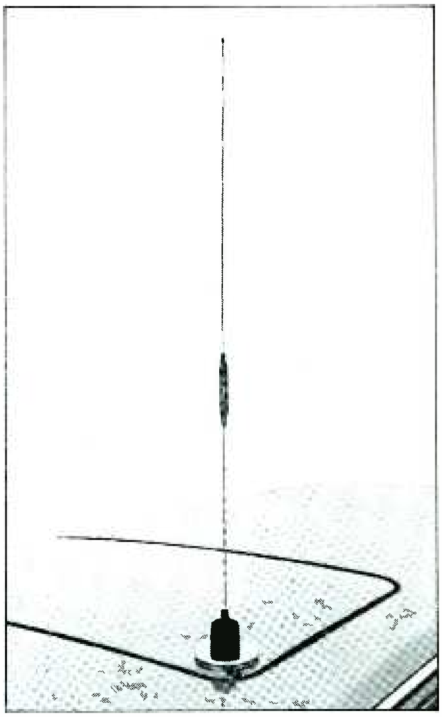
FTG Data Systems' "MouseTrap" is said to emulate Microsoft's interface software and includes a lightpen interface routine for AutoCAD® . With these dual capabilities, MouseTrap is claimed to substantially expand the amount of software accessible to the company's light pen. Most software that runs with the Microsoft Mouse is usable with the FTG Model FT-156 high-performance light pen. The software is available separately for $39.



The FTG light-pen board is available in three configurations: the PXL-350/1 ($149) is for use with a standard IBM PC or compatible; the PXL-350/2 ($179) is for use with an enhanced graphics adapter (EGA); and the PXL-350/3 is for use with the AT&T 6300/Olivetti PC. The board modifies the light pen's standard character-level interface and substitutes pixel-level resolution. It also provides hardware interrupts necessary for a light pen to work with multitasking software like Microsoft's Windows.

CIRCLE 18 ON FREE INFORMATION CARD

Magnet-Mount Mobile Antenna

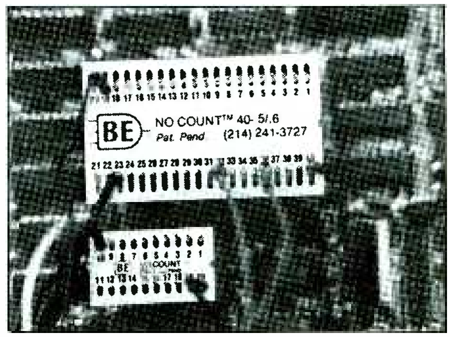


A magnet-mount mobile antenna that can be installed in seconds has been announced by Regency Electronics. The Model MA-547 antenna is specially tuned to match the frequency ranges monitored by Regency's new Informant public information radio. The antenna is said to enhance the receiver's sensitivity in all three frequency ranges (vhf-low, vhf-high and uhf) to provide long-range reception of signals from 50 miles or farther away. Though designed for temporary installation, the antenna can withstand maximum highway speeds without scratching roofs or trunk lids. Since it measures less than 30 inches in total length, the antenna usually does not have to be removed from a vehicle's roof when parking in garages with limited overhead clearance. In addition to the magnet-mount arrangement, the Informant is available as the Model MA-548 mirror-mount configuration. $49.95.

CIRCLE 19 ON FREE INFORMATION CARD

IC Tester Pin Identifiers

The No Count™ pin locator from L.J. Broder Enterprises (Dallas, TX) is a punched plastic card that slips over the pins of a DIP IC test clip and remains with the clip. Pin numbering is in the top-view format, with pin 1 located to the left of the index notch.



With the No Count card in place, when the test clip is attached to the IC, each pin is easily identified by pin number, eliminating time-consuming counting of pins and reducing counting errors.

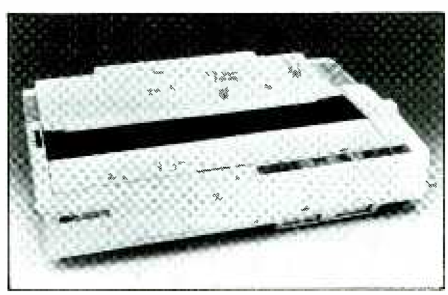
No Count is available in 14 DIP configurations for use with test clips that have from 14 to 64 pins. Prices range from $3.50 for the 14-pin version to $7.00 for the 64-pin version.

CIRCLE 20 ON FREE INFORMATION CARD

24-Wire Dot-Matrix Printer

A 24-wire, high-speed dot-matrix printer designed for heavy-duty use has been introduced by Star Micronics. The Model NB24-15 printer features a touch-pad control panel, draft printing at 180 characters per second, letter-quality printing at 60 cps and slots for two plug-in font modules. The control panel provides selection of 19 print and format functions—three font styles, four print pitches, eight form lengths, two print modes and margin settings. It also provides the ability to override standard software commands and DIP switch settings.

Standard paper-handling features include friction feed for smooth, automatic loading of single sheets and a



push tractor feed to accommodate fanfold paper and multiple forms. Additional features include micro alignment when setting forms and a 15″ carriage for data processing and spreadsheet printing.

The NB24-15 emulates the Epson LQ-1000, IBM Graphics and IBM ProPrinter printers for high-quality graphics. Diablo 630, Qume Sprint II and Toshiba P351 emulations are optional. A parallel interface is standard, and an optional serial interface is available. The printer uses the Star Micronics ribbon cartridge common to all N series 24-wire, wide-carriage printers. $1,099.

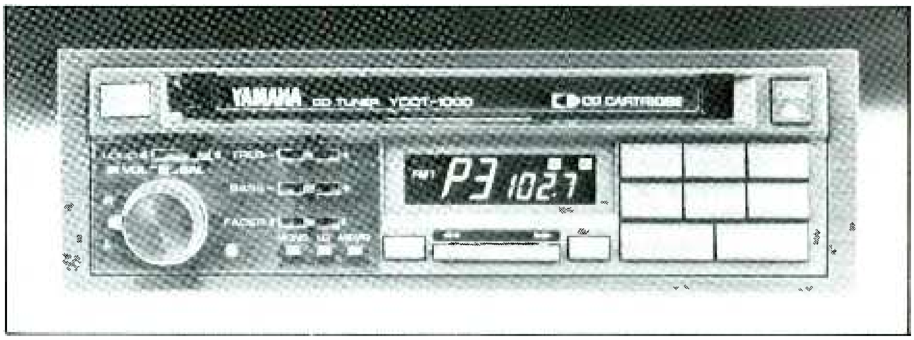
CIRCLE 21 ON FREE INFORMATION CARD

Infrared Stereo Receiver

With the Nady (Oakland, CA) Model IR-103 Personal Infrared Stereo Receiver, music lovers can use their own stereo headphones for wireless listening throughout a room. The receiver, which clips to a pocket or sits on a table or nightstand, permits listening to stereo or TV sound at distances of up to 35 feet away from the transmitter. It accommodates stereo headphones with impedances in the 8-to-100-ohm range and runs on three AAA cells.

Any number of Nady infrared receivers can be used in the room in which the transmitter is located. A slave transmitter, the Model IRT-520-S, is available for the system to extend listening range and area coverage. $99.95. A Model IHR-210 integrated headphone/receiver is also available for $59.95.

CIRCLE 22 ON FREE INFORMATION CARD



Car CD-Player/Tuner

Yamaha's new Model YCDT-1000 in-dash Compact Disc player and AM/FM-stereo tuner combination utilizes the company's protective CD cartridge system and can be installed in almost any car. The CD player has a floating suspension system that isolates it from vibrations and a shock sensor circuit that detects shocks and automatically regulates laser pickup current to assure stable and accurate tracking. Skip and search functions provide fast access to any portion of the disc being played. A disc location stop mode has been specifically designed for the car environment. When power is turned off during play, the CD player remembers its last location on the disc and will continue from that point when power is restored. Other features include: disc-in/play indicator; separate bass, treble and balance controls; and a three-beam laser pickup. Frequency response is 20 to 20k Hz ±3 dB; harmonic distortion is less than 0.05 percent; S/N ratio is 90 dB; and channel separation is 70 dB at 1 kHz.

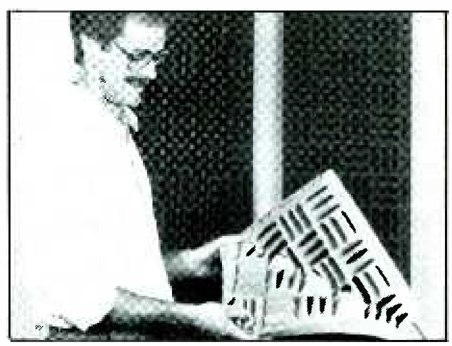
The MR II "Maximum Reception" ETR tuner has 12 FM/6 AM station presets and features: MOSFETs for lower noise and higher S/N ratio; a double balanced mixer for wider headroom and elimination of saturation by strong signals; wideband agc for extended gain and improved IM and cross-modulation characteristics; improved oscillator stability; and an i-f op amp for better limiting. Usable FM sensitivity is 1.8 microvolts, S/N is 70 dB, alternate-channel selectivity is 80 dB and capture ratio is 1.5 dB. $699 (includes five CD cartridges).

CIRCLE 23 ON FREE INFORMATION CARD

Acoustic Foam Panels

Sonex ProPhiles from Illbruck (Minneapolis, MN) are foam panels that are designed for acoustically treating a listening environment so that it more closely duplicates the environment in which recordings were made. The new panels are based on the anechoic wedge design the company uses for its professional audio applications. The difference is that ProPhiles are cut to "decorator" shape for home use.

Each panel measures 40″ × 12″ × 3″ and is available in black, brown, beige or blue. Installation of the panels is simple and requires no special



tools. ProPhiles are packaged four sheets to a carton (13.3 square feet). $89.95 per carton.

CIRCLE 24 ON FREE INFORMATION CARD

(Continued on page 80)

The EGA Wonder Board: A Low-Cost Alternative

At a time when virtually all software applications either support or demand high-resolution EGA (Enhanced Graphics Adapter) graphics, too many of us find ourselves shackled to an IBM PC, PC clone, or Compaq with a built-in monochrome monitor—leaving us with one of three choices when it comes to graphics performance quality. We can: (1) Suffer in silence with less-sharp graphics, (2) Invest in an EGA video card and compatible monitor to the tune of at least $900 or (3) Install an EGA Wonder™ for only $399.

The EGA Wonder (ATI Technologies Inc., 450 Esna Park Dr., Markham, Ontario, Canada; 416/477-8804) is a half-length video card with 256K of memory that can display EGA software on a standard monochrome monitor and on any color monitor, as well as any software on any monitor. (To operate on the internal monitor of a portable's dual-mode system, a $99 expansion module is required.)

Altogether, the EGA Wonder can duplicate five graphics modes, including Monochrome Display (MDA), Color Graphics (CGA), Enhanced Graphics (EGA), Hercules Graphics (HGC), and a proprietary 132-column screen (80-column only on portable internal monitors). In the EGA mode, the EGA Wonder can display 16 simultaneous colors (from a palette of 64) on either an EGA monitor or the less-expensive RGB monitor. When using the EGA mode with a monochrome monitor, the EGA Wonder converts the colors to 16 shades of gray. Furthermore, the EGA Wonder is able to sense the software's needs and automatically switches the display between EGA and CGA color modes or among the EGA, MDA, and Hercules monochrome modes during loading of the program.

Interlace Scanning

The secret to the EGA Wonder's success is something called interlace scanning. Interlace scanning is not a recent discovery destined to revolutionize computer displays. It has been around for a long time. In fact, your television set uses interlace scanning to paint an image on its screen, and has been doing so for more than 40 years.

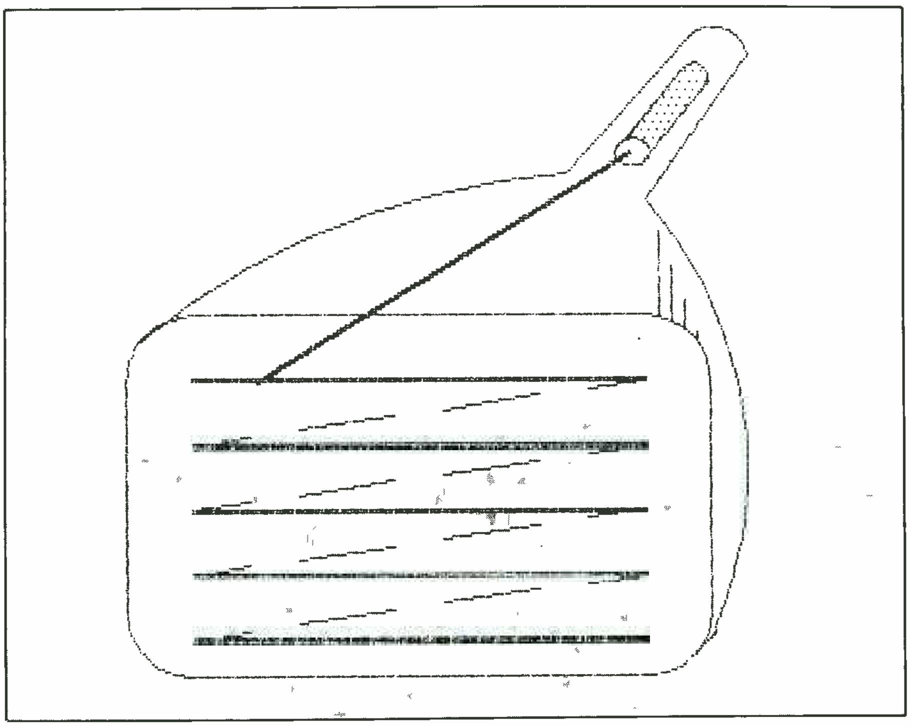
Screen images are created using a raster. A raster is a pattern of fine horizontal lines that are used to generate a mosaic-like picture. Beginning in the upper left-hand corner of the screen, a dot of light is swept across the face of the tube from left to right at a very fast rate, producing a thin line on the screen. The dot is then returned to the left side of the screen just below the starting point and another line is drawn. The process continues until the screen is filled with row after row of horizontal lines. This is one full raster, which is sometimes referred to as a frame. When the intensity of the light dot is modulated to produce dark and light patches within this lattice, an image is created.

Ordinarily, a computer monitor uses only one frame to display its information. Because of the relatively slow sweep rate used by standard monitors, however, a rather large empty space exists between scan lines that reduces the display's resolution. Increased screen resolution can be achieved only by increasing the number of scan lines on the screen. The EGA method does it by moving the dot at a faster sweep speed, cramming more lines into the same time frame.

In interlace scanning, the monitor doubles the number of raster lines by first painting one frame on the screen than going back and filling in the blank spaces between the lines on the next field in an interwoven pattern. Using this method, the amount of information displayed on the screen is increased without an increase in the scan rate, thus allowing the EGA Wonder to display EGA graphics on a standard monochrome or an RGB video monitor.

Limitations

Unfortunately, interlace scanning has its drawbacks. The most obvious is flicker. Because each field is drawn on alternate screens, the brain is forced to integrate the two into a single image. Due to the low scan rate of 30 frames per second, however, the lines appear to jump about the screen. Text and graphics alike flicker. The jitters are most noticeable when the EGA Wonder card is operating in the EGA mode using a standard RGB monitor. Monochrome monitors generally fare better because their phosphors have a longer persistence time, and the flicker is not generally evident.



Another problem encountered with the interlace scanning method is blooming on the monochrome video monitor. Blooming is a screen-sizing effect brought about by changes in the high voltage to the anode of the cathode ray tube (CRT). This very-high voltage (about 12,000 volts) is what accelerates the electron beam to produce a dot on the screen. It is derived from the sweep oscillator, which is driven by the video card. When changing screens in the interlace scanning mode, the high voltage is lowered somewhat by the slower scan rate, causing the image to start off small and expand to full screen size over a period of several seconds as the high voltage builds back up. It can be best described as the effect one perceives when blowing up a carnival balloon with printing on it.

The EGA wonder also tends to produce quite a few "ghosties" during normal operation. These ghosties are apparitions which sporadically appear on the screen and even tend to accumulate over a period of time, especially when working with Microsoft Word. They take the form of dots that often blink like a cursor. While most of the ghosties are only transitory, coming and going at will, they can be most annoying when they appear in an area where work is being done. Color streaks are also common when working in the CGA mode and are due to competition between the 8088 microprocessor chip and the video card for access to the computer's random-access memory (RAM).

Conclusion

Despite its flaws, the EGA Wonder is still an interesting deal, especially at discount prices I've seen that are as low as $299. Though it will never equal an EGA system in appearance, it does what it purports to do and does it as well as can be expected given the limitations inherent to older monitors. So if you are long on video graphics imagination and want to work with EGA color software on a monochrome monitor, but short on hardware bucks, the EGA Wonder could be just your ticket.—*TJ Byers*

CIRCLE 81 ON FREE INFORMATION CARD

Oscilloscope Measurements Guide

Part 1

How to use an oscilloscope to accurately obtain quantitative and qualitative information about a circuit's or a device's performance

By Robert Witte

The oscilloscope is undoubtedly the most versatile electronic instrument in use today. Unlike meters, which allow the user to measure only amplitude information, the oscilloscope (or "scope") allows one to view instantaneous voltage over time. This reveals the shape of a waveform, while parameters such as frequency and phase can also be measured. The oscilloscope can also be used to compare two different waveforms and measure their time and phase relationships.

This discussion of oscilloscopes and measurement techniques will be centered around the typical two-channel analog scope, which has largely eclipsed single-channel ones. Four-channel scopes are also prevalent in the marketplace and are particularly useful for measuring signals in digital systems. (Digital systems usually have multiple data and address lines on one bus that may need to be viewed simultaneously.) Four-channel scopes operate similarly to two-channel scopes, of course, with the exception of having twice as many inputs and vertical amplifiers.

For general-purpose use, analog scopes are still more economical than digital scopes (for equivalent frequency range). As analog-to-digital conversion technology improves, this will undoubtedly change. In concept, analog and digital oscilloscopes perform the same types of measurements, but with different techniques internal to the instruments.

Let's examine the working elements of an oscilloscope as a prelude to exploring how to use it for measurement purposes that range from frequency to identifying values of components.

Typical Oscilloscope

When a sine wave is displayed on an oscilloscope, the vertical axis represents voltage and the horizontal axis represents time. The oscilloscope display has a set of horizontal and vertical lines called a graticule to aid a user in estimating the value of the waveform at any particular point.

Figure 1 highlights a block diagram incorporating scope features that will be discussed. The various switches allow the scope to be configured in a way that allows a wide variety of measurement functions to be performed. Both input channels can be configured for dc or ac coupling; the electronic switch allows both alternate and chop modes for two-channel operation and the display can be set up for either time-base or X-Y operation.

The display of an oscilloscope (usually a cathode ray tube, or CRT) requires two pieces of information: the vertical position to be plotted and the horizontal position to be plotted. The vertical axis represents the waveform to be plotted, so the input of the oscilloscope is connected to an amplifier that drives the vertical position of the display. On the horizontal axis, time is plotted. Driving the horizontal position of the display is an internally generated waveform that represents time. The section of the circuitry that produces the time waveform is called the time base.

We know what the vertical signal looks like—it's just whatever the input waveform is, perhaps a sine wave or square wave. What we want the time base to do is constantly increase the horizontal position as the input voltage goes through a cycle. This results in the input waveform being swept or painted across the display at some rate, depending on the time base. The time base waveform required to do this is a constantly increasing voltage called a ramp. Since the display is usually updated repetitively, the ramp starts over when it reaches its maximum value, resulting

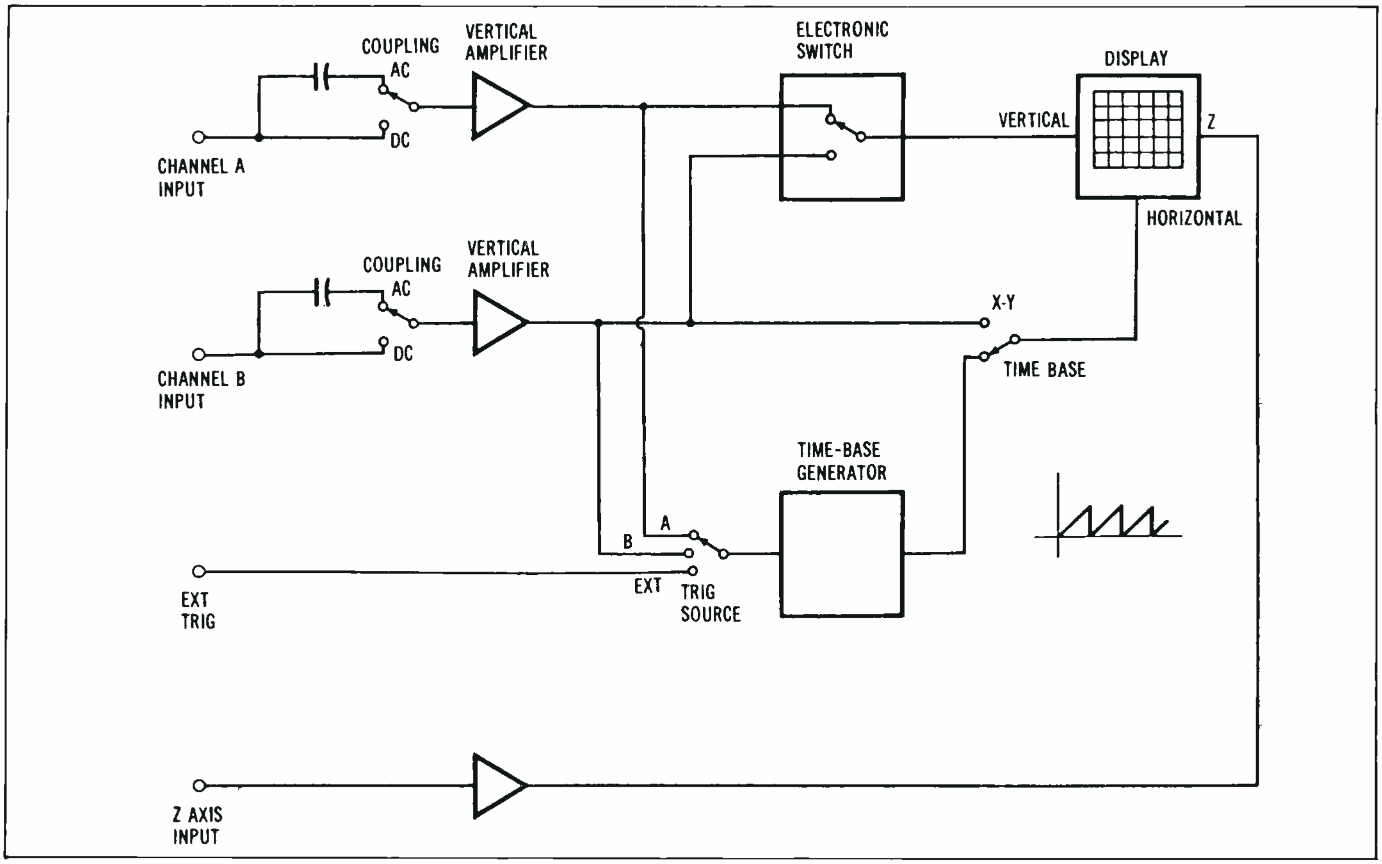


Fig. 1. Block diagram of typical two-channel oscilloscope.

in a sawtooth waveform. Each cycle of the sawtooth waveform corresponds to one sweep across the display. A small delay (called the retrace time) occurs between each ramp of the sawtooth as the horizontal position is reset to the left side of the display.

A time base alone is not sufficient to produce a usable display, however. The time base must know when to start a sweep. Without this information, the display will attempt to show the correct waveform, but with a random start time. At best, this results in an unstable waveform wandering across the display. At worst, the display is a jumbled collection of waveforms smeared together filling the entire display area (Fig. 2a). A properly triggered waveform, having a predictable and repeatable starting point, will be stationary from sweep to sweep (Fig. 2b).

The trigger point on a waveform is usually defined using both a voltage level and a slope (positive or negative). The trigger level control determines the voltage level at which the trigger will occur. The trigger slope control, in turn, determines whether the trigger will occur on rising (positive-slope) or falling (negative-slope) portions of the waveform.

When the waveform being measured is used as the trigger source, the oscilloscope is using internal trigger. Scopes that have more than one channel usually allow the user to select which of the channels is to be used. Internal trigger is used the most, but it is possible to trigger off other waveforms. An external trigger input is provided to allow the user to connect an external signal to the oscilloscope to be used for triggering purposes. This signal is usually not viewed one the scope display, but some scopes do have this capability to help the user in setting up the triggering. The line trigger selection uses the ac power-line frequency as the trigger signal (usually 60 Hz). Line trigger is useful for observing waveforms that are either directly related to the power-line frequency (including its harmonics) or have power-line related voltages superimposed on the original waveform.

The trigger can be ac coupled or dc coupled. Dc coupling presents the trigger circuit with a waveform containing both ac and dc voltages, while ac coupling removes any dc level that might be present. Ac coupling is useful when the desired trigger signal is riding on a dc voltage that must be removed. Many oscilloscopes include additional filters that can be switched into the trigger circuit to condition the trigger signal. A low-frequency reject filter, for example, removes low frequencies such as the 60-Hz line frequency (and its harmonics) that may be present in the trigger signal, causing triggering problems. A high-frequency reject filter will similarly remove high-frequency noise.

The trigger holdoff control disables the triggering circuit for a period of time after the end of the sweep. This is useful when the waveform has several places in its cycle that are the same as the trigger condition. The oscilloscope would normally trigger on all of them, but with trigger holdoff, the scope ignores all but the first one.

For a better understanding, suppose we want to display the first cycle of a pulsed sine wave. The trigger could be set to zero volt and positive slope, which will trigger off the beginning of the sine wave. Unfortunately, this trigger condition exists at the start of every one of the sine-wave periods, causing the oscilloscope to display every cycle. However, if the trigger holdoff is properly adjusted, subsequent triggers can be ignored and only the first cycle of each sine pulse will be displayed.

Triggering is probably the most troublesome part of using an oscilloscope. Most scopes provide a variety of ways to trigger on a signal so that the user can customize the triggering to a particular measurement problem. Of course, this also means that the user must understand and make decisions about what type of triggering to use.

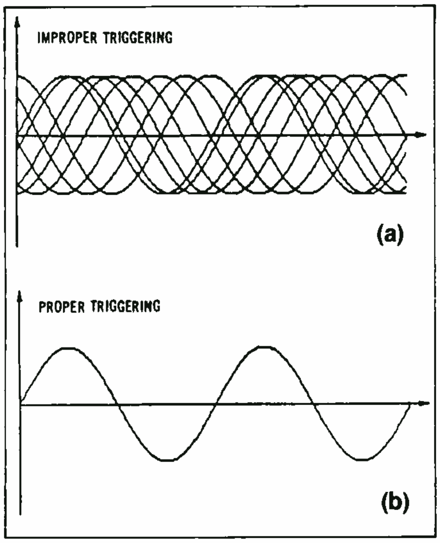


Fig. 2. Examples of oscilloscope triggering: (a) improperly triggered waveform results in unstable display; (b) properly triggered waveform has stable display.

Sweep Control

In single-sweep mode, the oscilloscope displays only one sweep and then waits until the user resets the scope for another sweep. This allows one to capture a particular one-shot, or transient event, rather than continuously updating the display with unwanted information. Although this feature is supplied on almost all oscilloscopes, it is most useful when the scope also provides a method of storing the waveform, at least temporarily, on the screen. Otherwise, the single-sweep tends to be a brilliant, but brief, flash across the display.

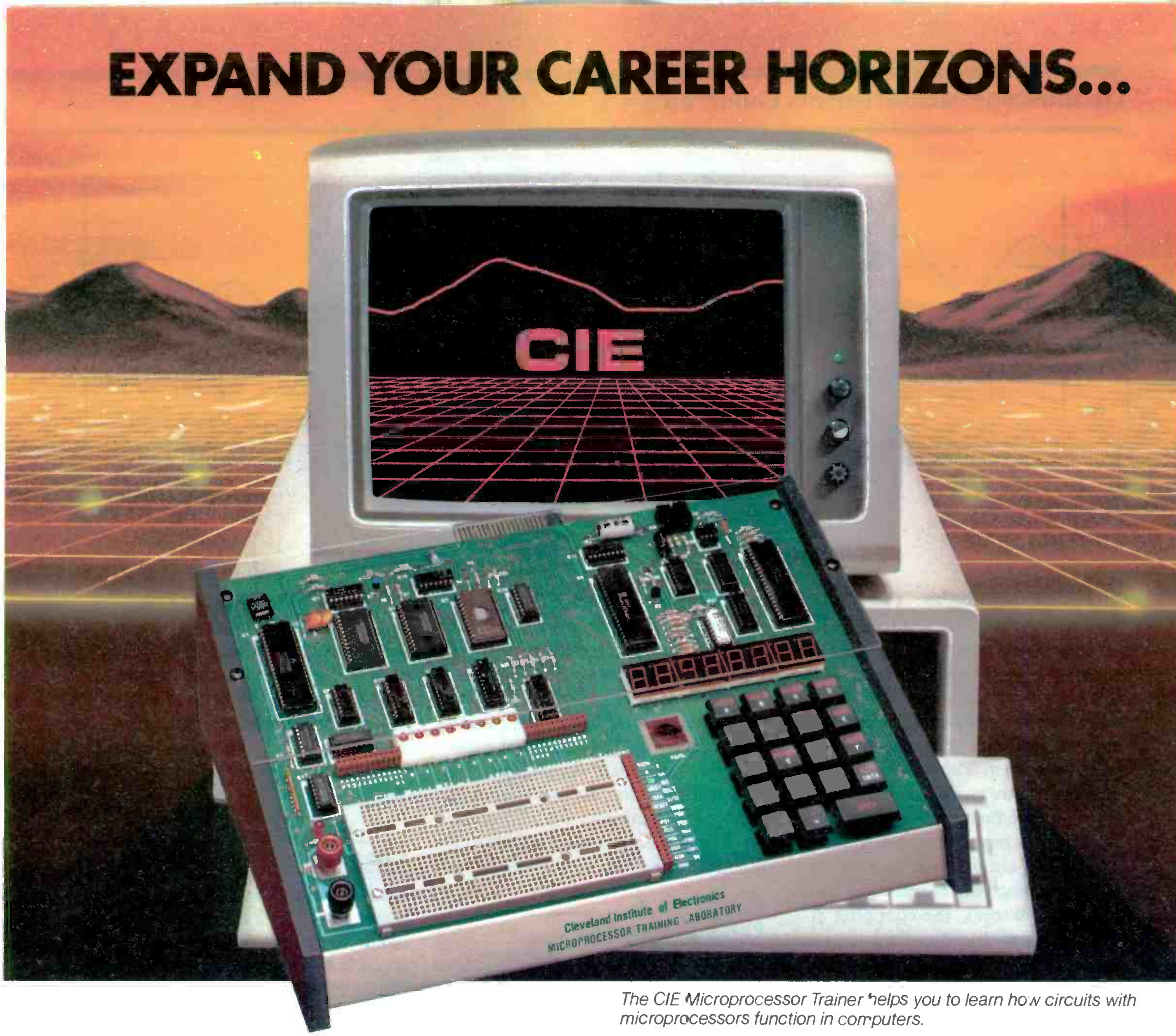
Most oscilloscopes supply two types of continuous sweeps: automatic and normal. The difference between the two is rather subtle but important. With normal sweep, the oscilloscope is not swept until a valid trigger occurs. This is fine for most ac waveforms, but it is inconvenient if the input is a dc voltage. In this case, no trigger will occur, since the dc input is constant and will not be passing through whatever trigger level happens to be selected. The result is a blank display.

Automatic sweep operates just like normal sweep except that if no trigger occurs for a period of time (like in the case of a dc input or an incorrectly adjusted trigger level), the scope generates a sweep anyway. This is convenient because it gives the user a look at the waveform, even if it isn't triggered properly. The user can then determine whether the waveform is on-screen and what action is necessary to correct triggering. In the case of a pure dc voltage, triggering is rather meaningless—the user just wants to view the constant voltage. If a trigger starts occurring at a fast rate (typically anything greater than 40 Hz), the scope triggers just as in the normal sweep mode.

Automatic sweep should be the default choice, since it will give good results on most waveforms. The exception is when the desired trigger condition occurs so infrequently (a very-low-frequency sine wave, for example) that the automatic mode will begin triggering before the appropriate time. In that case, normal sweep should be used.

Most oscilloscopes have at least two channels, both of which can be displayed at the same time. One way to do this is to have a display that can plot two waveforms simultaneously. Analog scopes that have true simultaneous dual-trace capability are sometimes called dual-beam oscilloscopes. This term is used when a CRT display has two electron beams active at the same time. Another, more cost-effective, method is to use a single display but electronically switch between two possible input signals. If this is done quickly enough, it will not be noticeable to the user nor will it affect most measurements. This consideration does not apply to digital scopes, which are not limited by the type of display, but by the analog-to-digital conversion circuitry.

There are two different ways of deciding when to throw the electronic switch. Chop mode switches between the two inputs as fast as possible while the waveforms are being



The CIE Microprocessor Trainer helps you to learn how circuits with microprocessors function in computers.

START WITH CIE.

Microprocessor Technology. Satellite Communications. Robotics. Wherever you want to go in electronics... start first with CIE.

Why CIE? Because we're the leader in teaching electronics through independent study. Consider this. We teach over 25,000 students from all over the United States and in over 70 foreign countries. And we've been doing it for over 50 years, helping thousands of men and women get started in electronics careers.

We offer flexible training to meet your needs. You can start at the beginner level or, if you already know something about electronics, you may want to start at a higher level. But wherever you start, you can go as far as you like. You can even earn your Associate in Applied Science Degree in Electronics.

Let us get you started today. Just call toll-free **1-800-321-2155** (in Ohio, 1-800-362-2105) or mail in the handy reply coupon or card below to:
Cleveland Institute of Electronics,
1776 East 17th Street, Cleveland, Ohio 44114.

CIRCLE NO. 50 ON FREE INFORMATION CARD

CIE **World Headquarters** AMO-84

Cleveland Institute of Electronics, Inc.
1776 East 17th Street • Cleveland, Ohio 44114

☐ Please send your independent study catalog.
For your convenience, CIE will try to have a representative contact you — there is no obligation.

Print Name______________________________

Address________________________ Apt.______

City__________________ State______ Zip______

Age______ Area Code/Phone No.________________

Check box for G.I. Bill bulletin on Educational Benefits
☐ Veteran ☐ Active Duty **MAIL TODAY!**

Just call toll-free **1-800-321-2155** (in Ohio, 1-800-362-2105)

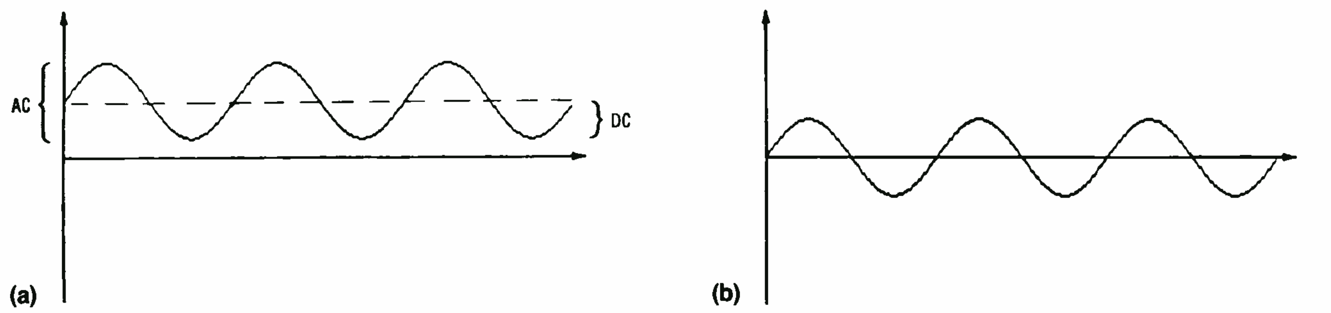


Fig. 3. Effect of dc and ac coupling: (a) dc coupling causes entire waveform to be displayed, including dc portion; (b) ac coupling removes dc portion of signal.

plotted on the display. The display trace switches back and forth ("chops") between the two waveforms during the sweep, resulting in both traces appearing on the screen. The two channels can be switched at such a high rate that the chopping cannot be seen. This works well for sweeps that are much slower than the rate at which the two channels chop. So chop is best for low-frequency signals. If chop mode is used on high-frequency waveforms (and with very fast sweeps), the chopping effect is noticeable in the display.

On the other hand, alternate mode makes a complete sweep of one waveform and then switches to the other input and takes another sweep. The first sweep displays channel A, the second channel B, the third channel A again, and so on. This works well during fast sweeps because if the update rate in the display is fast, the user perceives that both inputs are being plotted simultaneously. Therefore, alternate mode works best with high-frequency signals. If alternate mode is used on low-frequency waveforms (and with slow sweeps), however, individual sweeps of each channel become apparent and the effect of simultaneously displayed channels is lost.

One potentially misleading problem with alternate mode is that even though the two waveforms appear to be displayed simultaneously, they are really measured at two distinctly different points in time. For most measurements, this is not a problem, since the waveform repeats the same cycle every time. There are cases, however, where the user must measure both channels simultaneously. Oscilloscopes that do not have true dual-trace capability will almost always supply chop and alternating modes (for maximum flexibility).

Vertical Amplifier

Gain of the vertical amplifier will determine how large the waveform appears on the display. In an analog scope, vertical sensitivity will determine vertical amplifier gain and will be calibrated in volts/division so that the user can determine signal amplitude by counting the number of vertical divisions on the display. For example, let us assume a sine wave that has four vertical divisions peak-to-peak. If the vertical sensitivity control is set to 0.2 volt/division, the sine wave would be $4 \times 0.2 = 0.8$ volt peak-to-peak.

Oscilloscopes have a vertical amplifier for each input channel. The channels may be labeled in a variety of ways—channels A and B, channels 1 and 2, etc. In the usual time-base mode of the scope, both A and B are displayed as a function of time.

In addition to displaying channel A and/or B, many scopes provide the capability of displaying A + B or A − B. Also, one or both channels may be capable of being displayed inverted, in reverse polarity. (A − B might not be provided, but A + B with channel B inverted can achieve the same result.)

Coupling

Each input can be selectively ac or dc coupled. Figure 2 shows a waveform containing both ac and dc. If the scope is dc coupled, the waveform is displayed as in Fig. 3a. If it is ac coupled, the dc portion of the waveform is blocked and only the ac portion is displayed, as in Fig. 3b.

The previous example seems straightforward, but the issue of ac coupling may show up in other unexpected ways. Consider the pulse waveform in Fig. 4a, shown as a dc-coupled scope would display it. Thus, one might think that it would be unaffected by coupling. However, when the scope is ac coupled, the display changes! The waveform shifts down by about one-third of its original zero-to-peak value (Fig. 4b). The original waveform did have some dc present in it (remember, dc is just the average value of the waveform). Ac coupling removed the dc, leaving a waveform whose average value is zero. Notice that the waveform is not centered exactly around zero volt, since its duty cycle is 1/3. Ac coupling may also cause voltage "droop" or "sag" in the waveform (Fig. 4c) resulting from the loss of low frequencies.

Most oscilloscopes have a convenient means of grounding the input (usually a switch near the connector). This is symptomatic of one of the most confusing things in using a scope—where is zero volt on the display? The ground switch allows the user to quickly ground the input and observe the flat trace on the display, which is now at zero volt. The line can then be set anywhere on the display that is convenient, using the display's position controls. Knowing where zero is defined along with the volts/division selection determines the scale on the display. Fortunately, more-recent digital scopes have eliminated the confusion by always displaying data on-screen in a known calibrated manner.

Many scopes provide a bandwidth limit control that activates a fixed-frequency low-pass filter in the vertical amplifier. This has the effect of limiting bandwidth of the scope (typically to about 20 MHz). Since bandwidth is such a desirable characteristic, it may seem strange to intentionally limit it. An example of where this comes in handy is when there is a noticeable amount of high-frequency noise riding on the waveform. When the bandwidth limit control is switched on, the high-frequency noise is eliminated, but the original sine wave remains uncorrupted. Of course, this works only when the interfering noise is outside the bandwidth of the filter and the desired signal is inside the filter's bandwidth.

X-Y Display

Most two-channel scopes have the ability to plot the voltage of one channel on the vertical (Y) axis and the voltage of the other channel on the horizontal (X) axis. This results in a voltage-vs.-voltage display, usually called A vs. B, Y vs. X, or simply X-Y. The time-base triggering circuits are not used when operating in this manner.

This feature greatly enhances an oscilloscope's usefulness. Now the horizontal axis is no longer limited to only time. Another parameter that can be represented as a voltage can now be used as the X axis. More precisely, both vertical and horizontal axes can be used to display any two parameters represented by a voltage. For instance, if a current-sensing resistor were used to convert a current into a voltage, a current could be

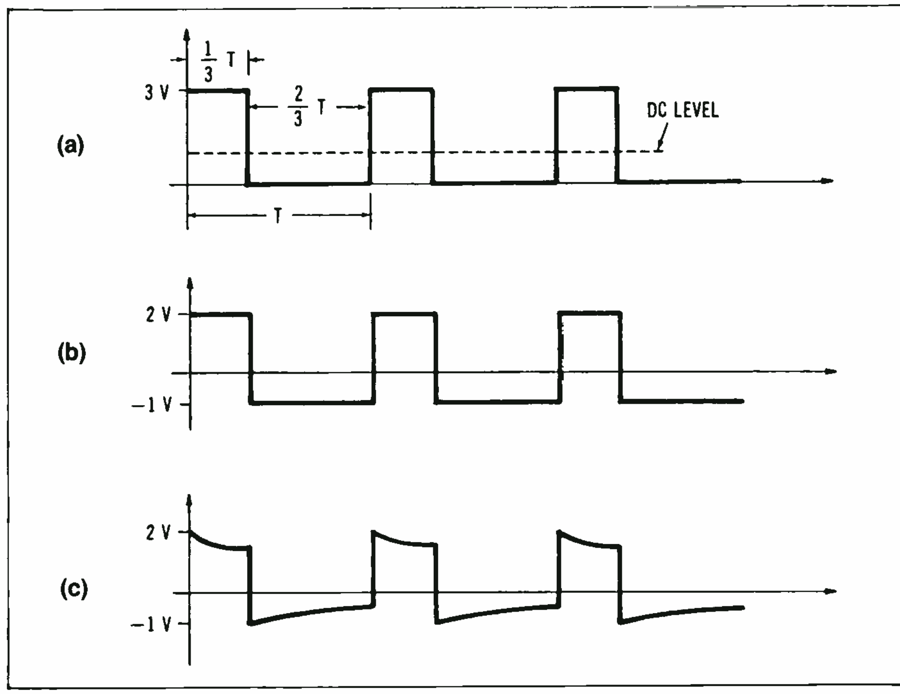


Fig. 4. Effect of ac coupling on a pulse train: (a) original waveform displayed with dc coupling; (b) pulse train with dc component removed by ac coupling; (c) ac coupling may cause voltage drop due to loss of low frequencies.

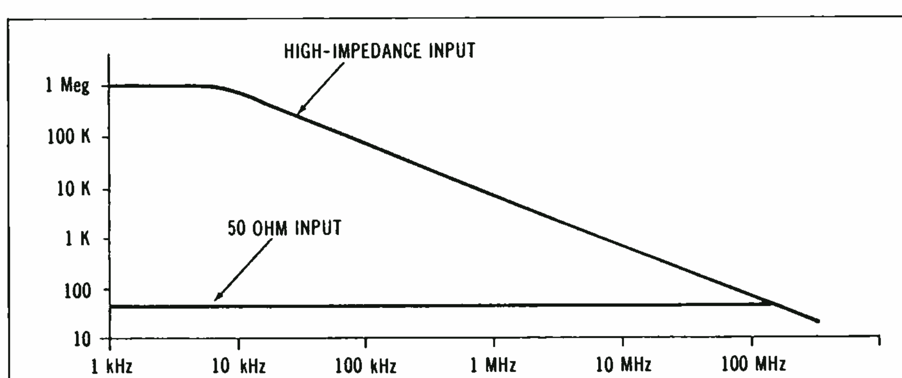


Fig. 5. Plot of magnitude of input impedance for high-impedance and 50-ohm inputs.

plotted on the vertical axis while another voltage is plotted along the horizontal axis.

Z-Axis Input

The Z-axis input (also known as the intensity-modulation input) provides a means for controlling a display's intensity while in the X-Y mode. The name "Z axis" comes from the fact that, in addition to the X-axis and Y-axis information, display intensity can be varied to provide an additional "axis" of information—the Z axis. If a positive voltage (typically several volts) is applied to the Z-axis input, the trace is blanked (has no intensity). If a negative voltage is applied to the Z-axis input, the trace has full intensity. Voltages between the two extremes produce less than full intensity (but is not blanked).

The actual voltages, and even the Z-axis input polarity, vary depending on the model of instrument. Given the proper Z-axis control signals, different sections of the trace can have different intensities. This is useful for highlighting a particular point on a display or for turning off the trace to start a plot over at a particular point (without having a trace drawn to that point).

Oscilloscope Inputs

The typical oscilloscope has a high-impedance input so that the circuit under test is not loaded significantly. The input can be modeled by a 1-megohm resistor in parallel with a capacitance. The value of the capacitance depends on the particular model of scope, but is generally in the range of 10 to 30 pF.

The magnitude of a typical input impedance is plotted in Fig. 5. At low frequencies, the capacitance acts like an open circuit and the impedance consists of only the 1-megohm resistor. At about 8 kHz, the capacitor's impedance becomes significant as it just equals the 1-megohm resistor's

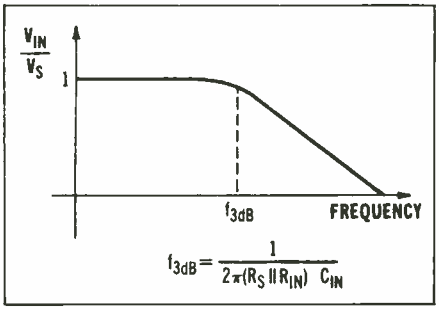


Fig. 6. Response of 1× probe rolls off at higher frequencies; 3-dB bandwidth is calculated with equation shown.

impedance. Impedance of the parallel combination continues to gradually increase for higher frequencies. Although the input impedance is very high at low frequencies, keep in mind that it will tend to load the circuit being measured as the frequency increases.

Some oscilloscopes offer a second type of input having a 50-ohm input impedance. It is often the same connector as the high-impedance input, with a switch for selecting between the two, and is frequently implemented by placing a 50-ohm resistor in parallel with the 1-megohm input. Since 1 megohm is much larger than 50 ohms, the effective parallel impedance is approximately 50 ohms.

If a scope does not have the 50-ohm input built in, an appropriate load can be placed in parallel with the high-impedance input to produce the same result. The input impedance is modeled as a single 50-ohm resistor, with the input capacitance in parallel. In a 50-ohm system, the capacitive effect is less critical, resulting in a wider-bandwidth system. Figure 5 shows that even though the 50-ohm input impedance starts out much smaller than the high-impedance input, it remains constant out to a higher frequency.

The major disadvantage of a 50-ohm input it that it is too low a load resistance for many circuits. (For these cases, very-low-capacitance active probes, which are designed to drive the 50-ohm input, are used to provide minimal circuit loading and greater overall bandwidth.) Of course, the 50-ohm input is especially convenient for systems that have an inherent 50-ohm impedance.

Most oscilloscopes have inputs that have one side directly connected to ground. This is the most practical and economical way to build the instrument. This is usually not a problem, since most measurements are made with respect to ground anyway. For some measurement situations, however, it is desirable to connect the scope input to arbitrary

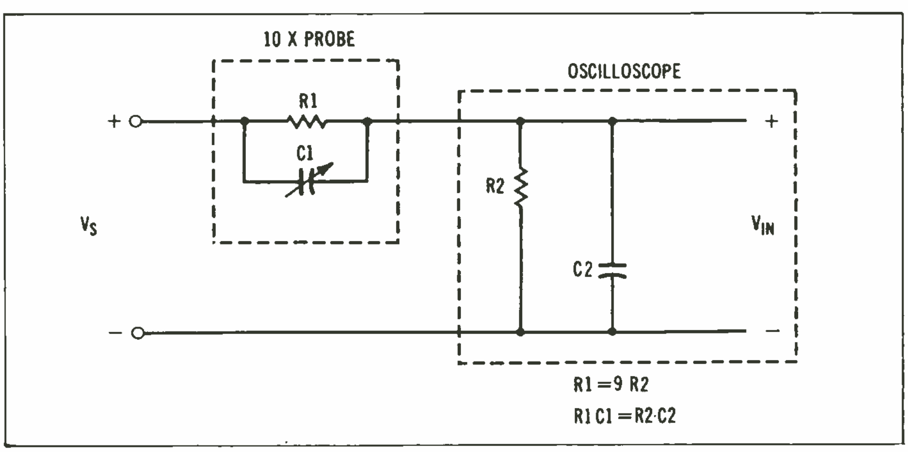


Fig. 7. A 10× probe used with high-impedance oscilloscope input. Effect of capacitors cancels when C1 is properly adjusted.

points in the circuit, including ones that are not grounded. Some scopes do have floating or differential inputs that allow both leads of the input to be connected away from ground. In this case, grounding is not a problem. A two-channel scope with the ability to display A − B (the difference between the two channels) can be used as a one-channel floating input source.

Oscilloscope Specifications

A set of typical scope specifications may appear as follows:

Bandwidth (3 dB): 40 MHz
Rise time: 8.8 ns
Input impedance: 1 megohm in parallel with 20 pF
Deflection factor: 1 mV/div to 5 V/div, ±3%; 12 steps in 1-2-5 sequence
Sweep time: 0.1 μs/div to 0.5 s/div, ±3%; 21 steps in 1-2-5 sequence

The deflection factor tells what vertical volts per division settings are available. In this example, settings between 1 mV and 5 volts per division are available in a 1-2-5 sequence (1 mV, 2 mV, 5 mV, 10 mV, 20 mV, etc.). Included with the deflection factor is a percent error (±3%) that defines the fundamental accuracy of the instrument. Similarly, the time-per-division settings on the horizontal axis are from 0.1 μs to 0.5 second per division. Again, an error specification that defines the accuracy of the time scale is included in the specs (±3%).

Digital Scopes

Conceptually, analog and digital oscilloscopes do the same thing—they display voltage waveforms. The analog scope uses traditional circuit technology to display the voltage waveform on a CRT. In contrast, a digital scope converts the original analog signal into a series of binary numbers that can be displayed or stored in memory. This means that a digital scope is inherently a storage scope because the waveform is stored in digital form. Contrast this with the analog scope, where the waveform is a short-lived voltage trace. (There are techniques for storing waveforms on an analog display, but they are generally expensive, temperamental and have finite storage time.)

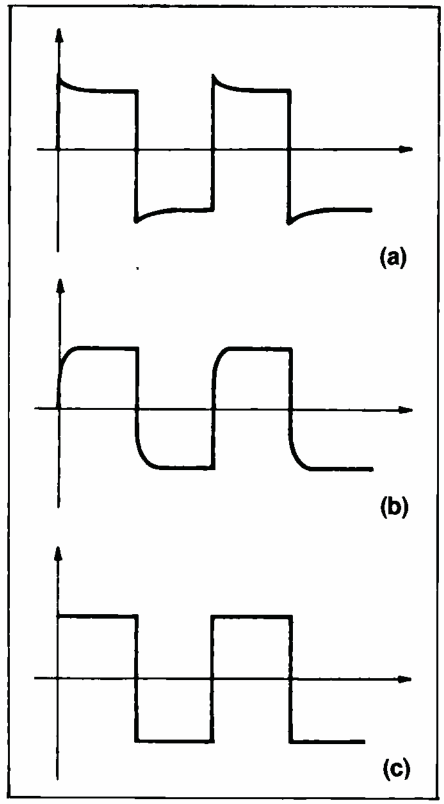


Fig. 8. Examples of 10× probe compensation: (a) undercompensated; (b) overcompensated; (c) properly compensated.

The ability to store waveforms is especially important when capturing one-time events. Without waveform storage, the waveform is plotted across the display and then abruptly disappears. With storage, the waveform remains on the screen so that the user can carefully analyze the data.

Another advantage of digital scopes is the ability to display the waveform that occurred before the trigger. This may seem impossible at first glance, but a digital scope can accomplish this by constantly storing the input signal in memory while waiting for the trigger to occur. When the trigger does activate, the waveform portion that occurred just before the trigger is already stored.

Like other digital instruments, the digital scope is well suited to applications that require transferring waveform data to a computer. Since it stores the waveform internally as digital numbers, the data is already in a form compatible with computers.

Oscilloscope Probes

The high-impedance input of an oscilloscope can be connected directly to a circuit under test using only a simple cable. It is highly recommended that any cable used should be shielded, naturally, to minimize noise pickup. For maximum performance, however, a probe matched to the input of the scope should be used.

1× probes, also known as 1:1 (one-to-one) probes, simply connect the high-impedance input of the oscilloscope to the circuit being measured. They are designed for low capacitance, minimum loss and easy connection. Otherwise, they are equivalent to using a basic cable to connect the scope.

The 1× probe and the input impedance of the oscilloscope together produce a low-pass filter. For very-low frequencies, the capacitor acts as an open circuit and has little or no effect on the measurement. For high frequencies, the capacitor's impedance becomes significant and loads down the voltage seen by the scope. If the input is a sine wave, the amplitude will tend to decrease (due to the loading effect) and the phase will be shifted. The rise and fall times of pulse inputs will be increased. Figure 6 shows this effect in the frequency domain.

10× probes (also called 10:1 probes, divider probes or attenuating probes) have a resistor and capacitor in parallel inserted into the probe. Figure 7 shows the circuit for the 10× probe connected to a high-impedance input of a scope. If $R_1C_2 = R_2C_2$, the circuit has the amazing result that the effect of both capacitors exactly cancel. In practice, this condition may not be met precisely, but it can be approximated. The capacitor is usually made adjustable and can be tweaked for near-perfect match. Under these conditions, the relationship of V_s to V_{in} is:

$$V_{in} = V_sR_2/(R_1 + R_2)$$

which should be reminiscent of the voltage-divider equation. Resistor R_2 is the input resistance of the scope's high input impedance (1 megohm) and $R_1 = 9R_2$. From the previous equation, this results in

$$V_{in} = (1/10)V_s$$

Therefore, the net result is a probe and scope input combination that has much wider bandwidth than the 1 × probe due to the effective cancellation of the two capacitors. The penalty incurred is loss of voltage. The scope now sees only one-tenth of the original voltage (hence the name 10× probe). Also, the circuit being measured sees a load impedance of $R_1 + R_2 = 10$ megohms, which is much higher than with the 1× probe. Some probes are designed to be conveniently switched between 1× and 10× operation.

This factor-of-ten loss in voltage is not a problem as long as the voltage being measured is not so small that dividing it by 10 makes it unreadable by the scope. This means that the scope's sensitivity may be a factor in deciding whether to use a 10× probe. On most oscilloscopes, the user must remember that a 10× probe is being used and must multiply the resulting measurements by a factor of 10. This is sort of a nuisance and, fortunately, some scopes include two scale markings: one valid for a 1× probe and the other valid for a 10× probe. Some new digital scopes have gone one step further and automatically adjust the reading by the correct amount when an attenuating probe is used.

Scopesmanship

An oscilloscope is a fairly complex instrument, especially when compared with a voltmeter. The large number of switches and knobs on its front panel can be intimidating to a novice user. Therefore, a few comments are in order to help the first-time user to get started.

After carefully reading the scope manufacturer's operating manual, the best way to get started with a measurement is to put the oscilloscope into a known state that will get at least something on the display screen. Some digital scopes have included a key called "Autoscale," which automatically evaluates the waveform, chooses an appropriate trigger condition, and selects reasonable horizontal and vertical scales. Pushing this button can prevent a lot of user frustration. Assuming that this feature is not available, a suggested starting point for setting up an oscilloscope measurement is listed here. (This can only be a start, as each measurement is somewhat different.)

Vertical Amplifier:
- Input coupling = dc
- Volts/div = 1 volt or (Expected Vo − p)/4

Time Base:
- Time base operation
- Time/div = 1 ms or 1/(4 × expected frequency)
- Auto sweep

Trigger:
- Internal trigger
- Trigger level = 0 volt
- Trigger slope = positive
- Trigger coupling = dc

Hopefully, a trace will appear on the display after the oscilloscope is set up and the scope settings optimized for the particular measurements. If there is no trace at all, then things like the power switch (yes, the power switch) and intensity control should be checked. Perhaps the waveform is just off-screen because it is much larger than the volts/division setting will allow on the screen? Try grounding the input—a horizontal line corresponding to zero volt should appear. Some scopes have a beam-finder button, which, when pushed, gives the user some idea where an off-screen trace is hiding.

If the trace is on-screen but is not stable, adjust the trigger controls. Try tweaking the trigger level to make the waveform stable. The slope and trigger coupling may also be helpful. If the display is stable but scaled improperly, adjust the time/division or/and volts/division knobs.

Probably the best advice for operating an oscilloscope is: carefully try something! The two approaches that do not work are: (1) just sitting in front of the instrument, staring at it, and (2) twisting every knob until all controls are guaranteed to be in the wrong positions. Instead, make an educated guess as to what control might correct the problem and try it. If it does not improve the situation, it should probably be returned to the original setting. On the other hand, try not to get the oscilloscope set up so that only a seasoned technician can straighten it out. If in doubt, revert to the suggested starting point.

In order to maximize the bandwidth of the 10× probe, it is necessary to precisely adjust the probe's capacitor to cancel the input capacitance of the scope. This is accomplished by a procedure known as compensation. To do this, the scope probe is connected to a square-wave source called a calibrator, which is built into the scope. The probe is then adjusted to make the square wave as square and flat-topped as possible. Figures 8a and 8b show the oscilloscope display during compensation with an overcompensated and undercompensated probe. Figure 8c shows the display using a properly compensated probe.

Other types of attenuating or divider probes are available, including

Typical Oscilloscope Probe Specifications			
Probe Type	**Frequency Range**	**Resistive Load**	**Capacitive Load**
1×	dc-5 MHz	1 megohm	30 pF
10×	dc-50 MHz	10 megohms	10 pF
Active	dc-500 MHz	10 megohms	2 pF

50:1 and 100:1 probes. The general principles of these probes are the same as for the 10× divider probe: voltage level and bandwidth are traded off. To obtain wider bandwidth, more loss is incurred in the probe and less voltage is supplied to the input of the scope. This may require a more-sensitive scope for low-level measurements. Some divider probes use the scope's 50-ohm input instead of the 1-megohm input.

So far, all of the probes discussed have been simple passive circuits with no active components such as transistors or integrated circuits. In instances where extremely low capacitance is required for high-frequency measurements, an active probe can be used. An active probe has a small amplifier built into it that is designed to have very little capacitance on its input. The output of the amplifier is usually matched to drive the 50-ohm input of the oscilloscope. This allows a length of 50-ohm cable to be used between the probe and scope without additional capacitive loading.

A summary of typical specifications of various types of scope probes that have been discussed is given in the table. Actual characteristics will vary according to manufacturer and model, of course.

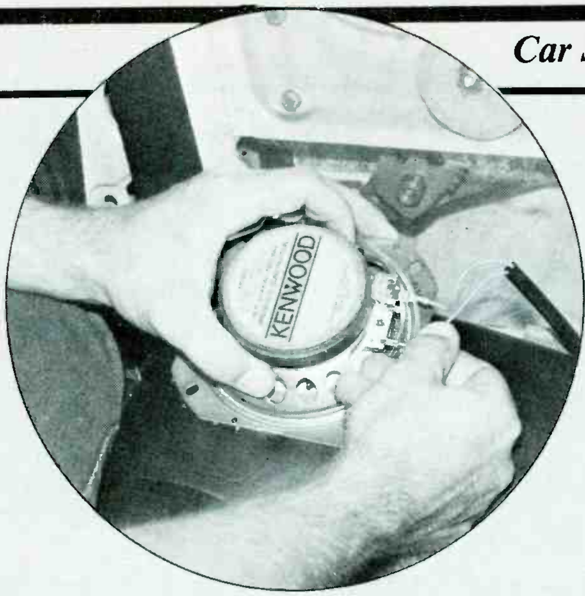
Although oscilloscopes are designed for a voltage input, they also can be used to measure current using a current probe. Such a probe has a set of "jaws" that enclose the wire through which the measured current is flowing. No electrical connection is needed. The circuit does not have to be broken or altered in any way.

Current probes generally use one of two technologies. The simplest uses the transformer principle, with one winding of the transformer being the wire being measured. Since transformers work with only ac voltages and currents, current probes of this type do not measure direct current.

The other type of current probe works on the Hall effect. This technique requires the use of an external power supply, but it measures both ac and dc.

Coming Next Month

In this installment, we have introduced you to the basic elements that make up the typical oscilloscope and discussed the differences that exist between the traditional analog and the more modern digital designs. Next month in the conclusion of this article, we will discuss in detail the various tests and measurements that can be made with the oscilloscope. **ME**



Installing Car Speakers

Car stereo sound can be greatly improved just by substituting new speakers

Probably the greatest improvement you can make on a cost/performance basis in an automobile stereo sound system is to replace the speakers that originally came with it. Better-performing ones can smooth out the sound while extending high and low frequencies.

The installation photos shown here and accompanying captions illustrate how to make these changes with as little pain as possible. If the replacement speakers are not identical with the original, which is often the case, then there is little extra work to be done in order to fit the speakers into their appropriate setting. With a bit of imagination, you will also have guidelines to adding new speakers in new locations.

Car Stereo Overview

A car stereo system might be considered akin to a home stereo component system. Separate components, such as speakers, can be added to the basic unit. To add more power than is possible with a basic radio or combination radio/cassette unit, a power amplifier can be added. If you go this route, though, be sure that your speakers have the power-handling capacity needed to avoid blowing them out.

In addition to a power amplifier booster, car sound aficionados often add an equalizer as well, which is an even more important accessory in an automobile than it is in a home. Power amps and equalizers are often combined in one package, though they are also available separately. Going the fully separate components route, speaker outputs from a car radio would go directly to an equalizer, which would output to a power amplifier, then to frequency dividers and, finally, to separate speakers.

Car radios and allied equipment draw their power from the automobile's electrical system, of course. Usually, the power cable has a quick-disconnect with a fuse that goes to the ignition switch.

As you know, there is not much space to toy with in a car. Consequently, installing speakers or a radio presents a greater mechanical challenge than they do in a home. Raw speakers are commonly used in automobiles, where the door or trunk is utilized as the enclosure. A small percentage of speakers designed for cars do come in enclosures, however. Mostly, though, they are useful only in vans where space is not at such a premium.

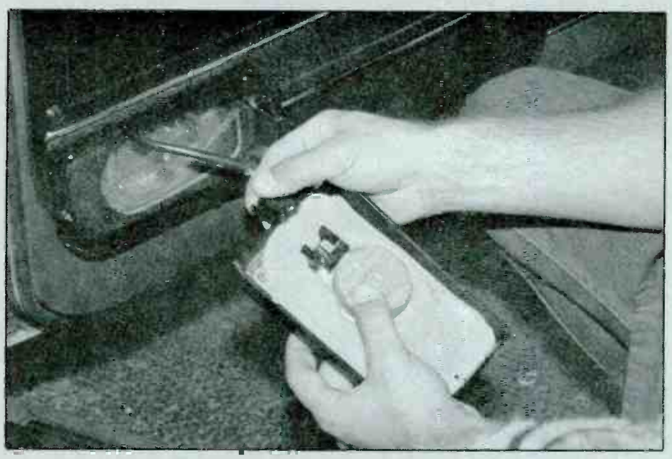
Keep in mind that the proper impedance matches for speakers to their inputs should be maintained. Front and rear speakers are usually paralleled, while speakers in each area are most often in series. Consequently two 4-ohm from speakers from a single channel would commonly be in series, totaling 8 ohms; the same goes for two rear speakers. The combined speakers, front and rear, would therefore have an impedance of 4 ohms, since each setup is in parallel with each other.

If you are adding speakers in a new locations, be sure to use stranded wire and follow color codes. To run the wiring in a new installation, you will probably have to remove door sills and locate the wiring under the edge of a car's carpeting, concealing the wiring behind side kick panels and under the dashboard. For an existing installation, where only the speakers are being substituted, the wiring is already installed, so this presents no problems.

Do not rush out and buy new speakers because you would like to upgrade the sound of your system with them. First check the original speakers and determine their dimensions. Then try to buy upgraded ones with the same size. This will save you a lot of frustrating time and effort.

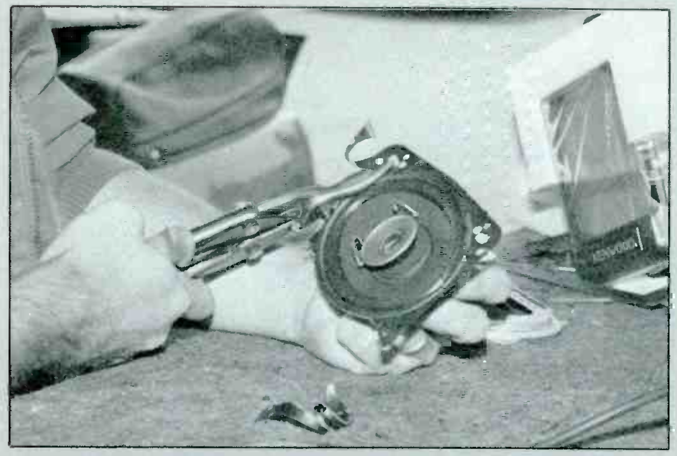
Photographs and captions by Ron Cogan

—Step-By-Step Speaker Installation—



1. Begin your car-speaker upgrading by checking the factory-installed speakers' dimensions and then try to purchase upgrade ones offering the same size.

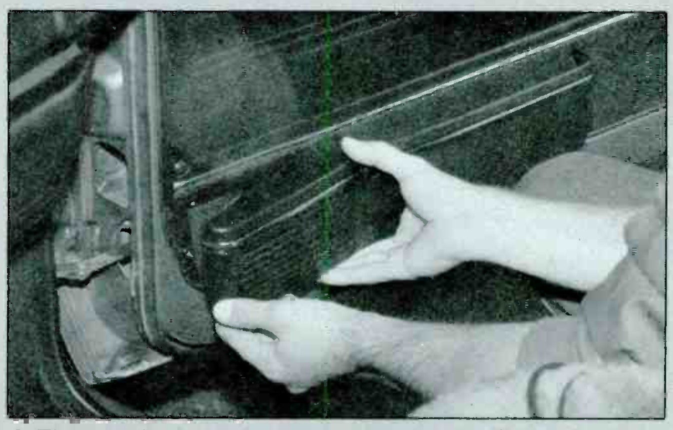
2. Even if you do purchase identically sized speakers, it is likely that their metal frames will differ slightly. This metal may have to be trimmed so the new speaker will fit properly. To do this, place old and new speaker face down as shown and scribe around the original so trim marks are visible.



3. Carefully use tin snips along the marked outline to trim a new speaker's frame to size. Trimming in this way does not affect the speaker's sound, but voids a speaker's warranty nonetheless, of course.

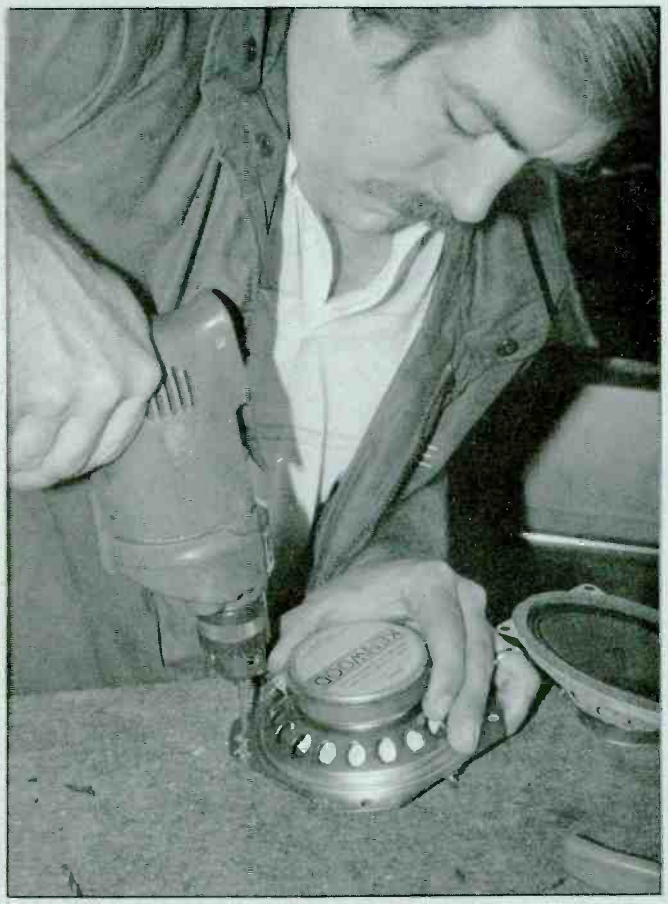
4. A trimmed speaker now fits precisely into the factory location that housed the original 4" × 6" speaker in this car. It bolts into the housing easily with the original hardware, too.

5. Often, factory quick-disconnects found in speaker wiring will not mate correctly with the new speakers. To remedy this, simply snip off the original connectors. Then crimp insulated connectors onto the stripped wire ends to join the vehicle's speaker wires to the new speakers.



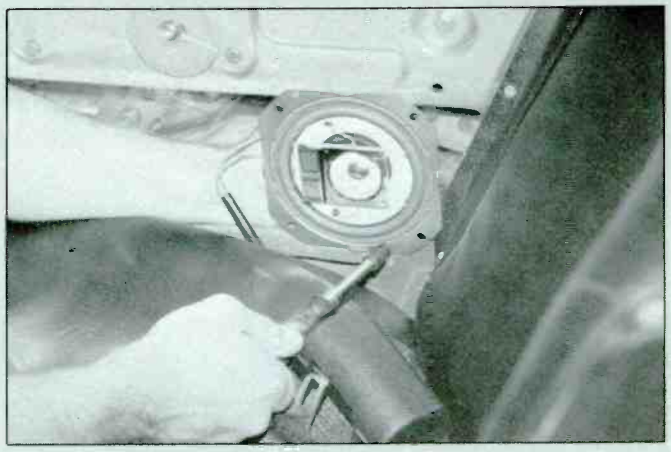
6. The speaker housing and grille are now fitted back into place on the door panel and bolted tightly down. No apparent change has been made from an aesthetic point of view, but much cleaner, extended-frequency sounds will soon emanate from behind the grille.

7. A similar procedure can be followed to update rear speakers in any car with factory speaker locations here. In this case, the window cranks had to be removed and the rear side panels snapped from position, as shown. Once all fasteners have been snapped outward and away from the interior body metal, the panel was simply moved aside to reveal the factory's speaker location. A near-invisible grille is built into the factory panel here.

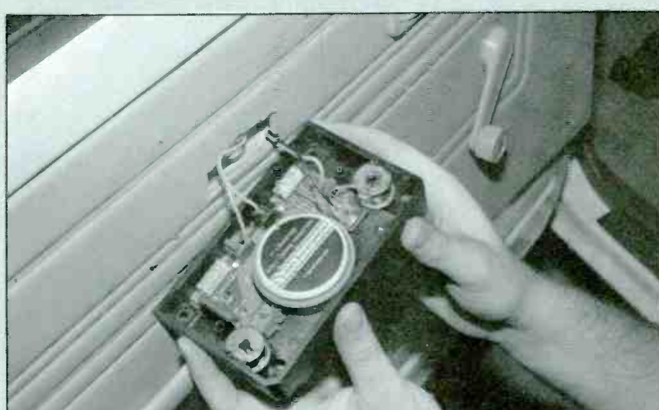


9. Following the procedure outlined earlier, trim the new speaker to size if needed. Here, a Kenwood KFC-1205 5″ round speaker did not require trimming but did require some new mounting holes to be drilled.

8. Unbolt the factory speaker and pull it from its mounting location. Again, note the type of connectors used to join the factory speaker wiring to the terminals. Reuse them if possible; otherwise, snip them off and install new crimp-on connectors.



10. Connect speaker terminals to the vehicle's speaker wires, align the speaker, and then bolt it into position. You can see why new holes were needed here. All that remains is to snap the panel back into place.

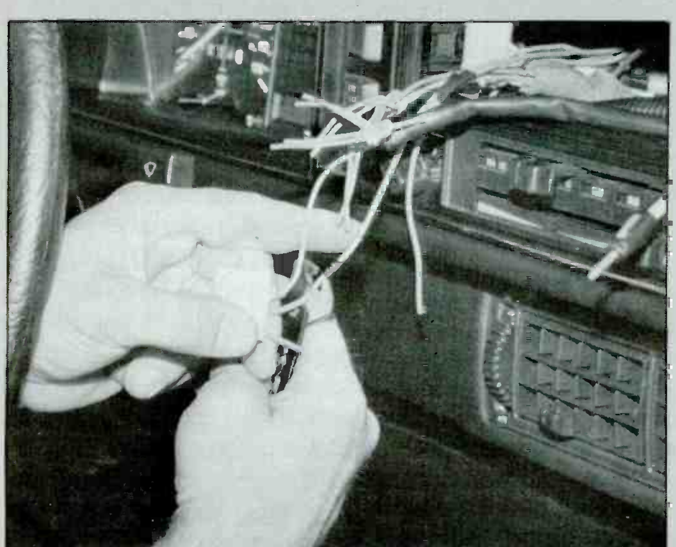


11. Surface-mount speakers, like this Kenwood tweeter, can also be used. They require only a small access hole for speaker wiring. Surface-mount speakers are simple to install because very little is involved.

12. Once the hole is cut and speaker wiring is routed and connected, the speaker is simply aligned on the panel and installed with screws. Since surface-mount speakers are bulkier than flush-mounts, they may not always be effective in small cars.

13. Installing speakers in a nonfactory location like door panels is a bit more involved but fairly easy. Begin by pulling the panel off the door and making sure there is enough clearance. Then align the template.

14. After making cut lines with the aid of the template, cut the panel to make an access hole for the speaker. Metal tabs can be installed at bolt locations to accommodate self-tapping screws if needed.



15. If speakers are installed in nonfactory locations, you will have to route new speaker wiring from here to your amplifier or deck. Use insulated connectors to make these connections.

16. In the event you want to add new speakers and additional power, you can even do it with a single component. Several autosound companies market bi-amplified speakers that boost the wattage output of a stereo system right at the speakers. For example, the Sparkomatic unit shown (Model ASK3010) offers 50 watts of output power (40 watts each woofer and 16 watts each tweeter). It is designed for rear deck mounting.

Car-Audio Installation Tape

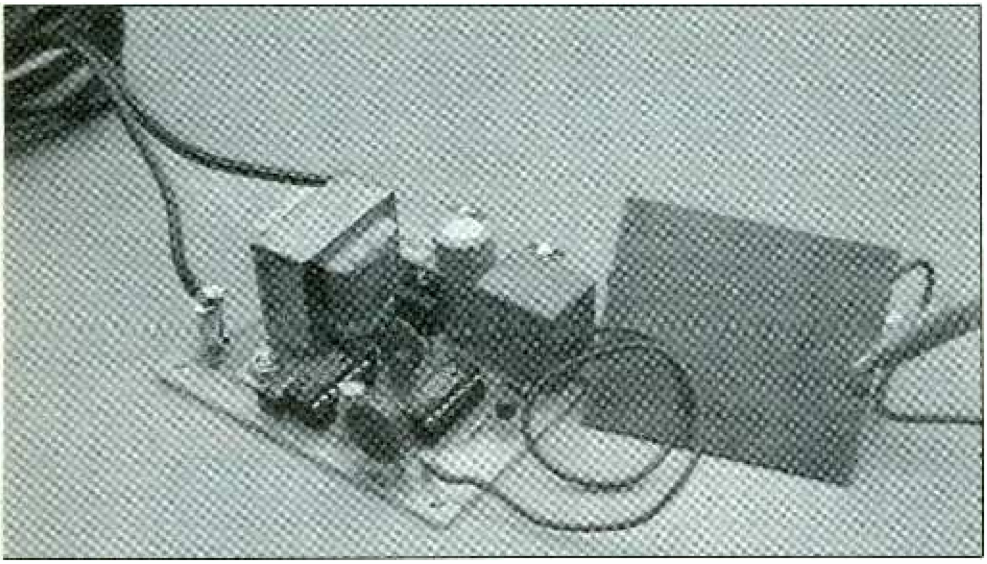
A videocassette training tape, "Basic Car Audio Installation," is available from EIA's Consumer Electronics Group. This 30-minute videotape introduces the electronics technician to car audio installation, guiding an installer in the correct layout and design of a car-stereo installation facility. It covers basic as well as specialized tools needed for the installation, and outlines the correct procedure for removing and replacing car radios from the dashboard.

Among other key topics covered in this training tape are safety in the shop; how to treat the customer's car, from pre-installation checkout to demonstrating the completed job; the technical resources available for information about specific types of vehicles, dashboard dismantling, speaker sizes and antenna locations; and types of speaker wiring found in the automobile.

For additional information on this videocassette, which is priced at $30, contact the CEG Product Services Dept., Electronic Industries Association, 2001 Eye St. N.W., Washington, DC 20006 (Tel.: 202-457-8782). ME

Versatile Touch Switch

High-speed CMOS circuitry solves unreliability problems that are common to other touch-switch circuit designs



By Paul E. Montgomery, Jr.

Touch switches aren't new, but most exhibit an unreliability problem. A truly reliable touch switch had to await the advent of high-speed CMOS (HCMOS) devices. Our versatile touch switch overcomes this problem and is simple in design and low in parts cost.

This touch switch employs a capacitance-sensitive design that conforms with the principles outlined in Don Lancaster's *CMOS Cookbook*. Power-up reset, good noise immunity and touch-plate debouncing are achieved with only two integrated circuits. Included are a sensitivity control that allows the project to accommodate different sizes of touch plates and a light-emitting diode that simplifies "tuning" the project. The relay that does the actual switching on and off of ac power has contacts rated at 5 amperes, which can easily switch on and off just about any electrical light or small appliance found in the average home.

The entire project wires on a compact circuit board that can be fitted inside the device to be controlled. Alternatively, you can build the touch switch into a separate box and equip it with an ac line cord and chassis-mounted ac receptacle for "portable" use with a variety of lamps and/or appliances at different times.

About the Circuit

Figure 1 is the complete schematic diagram of the touch switch circuit. Schmitt-trigger hex inverter *IC2* takes care of all housekeeping chores. All but one of the inverters in *IC2* are busy. On power-up, *C3* and *R3* enable *IC2A* (pinouts and internal details of the ICs used in this project are shown in Fig. 2) to deliver a brief low pulse to the pins 1 and 13 reset inputs for both sections of dual D flip-flop *IC3*. This ensures that the Q outputs at pins 5 and 9 of *IC3* are clamped low until *IC3A* stabilizes. Hence, if power is interrupted, the Q outputs will automatically come up in the low state when power is restored to the circuit. At all times, *IC3*'s not-Q outputs (shown with a bar over the Qs in Fig. 2) at pins 6 and 8 will be the opposite state of that of the Q outputs.

Configured as an astable oscillator, *IC2B* generates a series of pulses at a frequency of about 200 Hz at pin 4. This pulse train is inverted by *IC2C* and is delivered to the pin 3 clock input of *IC3A*. The wire for the touch plate is also tied into the circuit at this point. In this "clocked" mode, the logic level present at the data input is transferred to the output during the positive-going transition of the clock input pulse.

With proper adjustment of sensitivity control *R7*, the data input will receive a pulse slightly before the clock input receives the same (inverted) pulse. This is due to the delay resulting from passage through *IC2C*. As long as this condition exists, the data input pulse will be low when the clock input pulse makes the low-to-high transition and forces the Q output to be off.

Touching the touch plate adds body capacitance to the circuit. This creates an RC network with *R7* that slows the pulse train to the data input. When *R7* is properly set, an in-

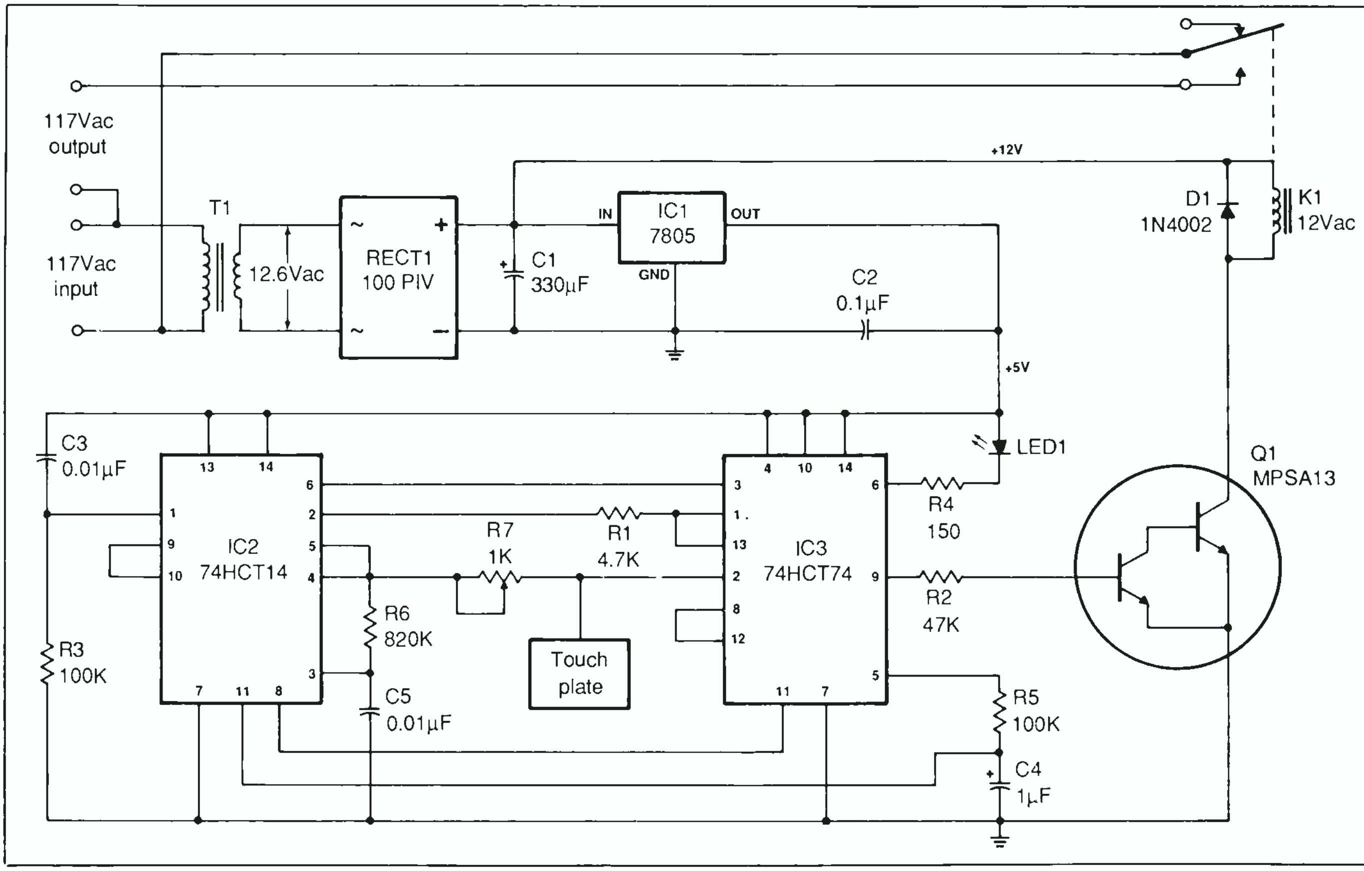


Fig. 1. Overall schematic diagram of touch switch.

put from the touch plate will slow things down enough so that the clock input pulse gets to pin 2 of *IC3*, causing the Q output to turn on. Simultaneously, the not-Q output at pin 6 of *IC3A* turns off and *LED1* lights, providing a visual indicator that aids in adjusting the setting of *R7*.

Debouncing for the input to *IC2E* at pin 11 is provided by *R5* and *C4*. The pin 10 output of *IC2E* is inverted by *IC2D* and delivered to clock input pin 11 of *IC3B*. Flip-flop *IC3B* is wired for toggle operation so that a low-to-high transition causes its Q output at pin 9 to change state. This allows high-gain Darlington transistor *Q1* to energize *K1*. Diode *D1* provides protection from transient spikes for *Q1*.

Power for the touch switch and device being controlled by the project is tapped from the same point of the 117-volt ac power line and is shown

PARTS LIST

Semiconductors

D1—1N4002 silicon rectifier diode
IC1—7805 +5-volt regulator
IC2—74HCT14 hex Schmitt buffer
IC3—74HCT74 dual D flip-flop
LED1—Red light-emitting diode
Q1—MPSA13 npn Darlington transistor
RECT1—1-ampere, 100-PIV mini-bridge rectifier

Capacitors

C1—330-µF, 25-volt radial-lead electrolytic
C2—0.1-µF disc
C3,C5—0.01-µF polyester or metal-film (5% tolerance)
C4—1-µF, 35-volt radial-lead electrolytic

Resistors (¼-watt, 5% tolerance)

R1—4,700 ohms
R2—47,000 ohms
R3,R5—100,000 ohms
R6—820,000 ohms
R7—1,000-ohm trimmer potentiometer

Miscellaneous

K1—12-volt dc relay with 5-ampere spst contacts (Digi-Key, P.O. Box 677, Thief River Falls, MN 56701; specify Cat. No. Z411ND)
T1—12-volt transformer (Mouser Electronics, 11433 Woodside Ave., Santee, CA 92071; specify Cat. No. 4PG006)
Printed-circuit board or perforated board and suitable soldering or Wire Wrap hardware (see text); sockets for IC2 and IC3; suitable enclosure (optional; see text); ac line cord and plug (optional; see text); sheet metal for touch plate; 4-40 or 6-32 machine hardware; hookup wire; solder; etc.

Note: The following items are available from Verdemont Radio, P.O. Box 329, Westcliffe, CO 81252 (Tel.: 303-783-2617): Etched and drilled pc board for $7.00 and kit of all parts but not including optional items like enclosure and line cord for $24.95, all orders postpaid. Colorado residents, please add state sales tax.

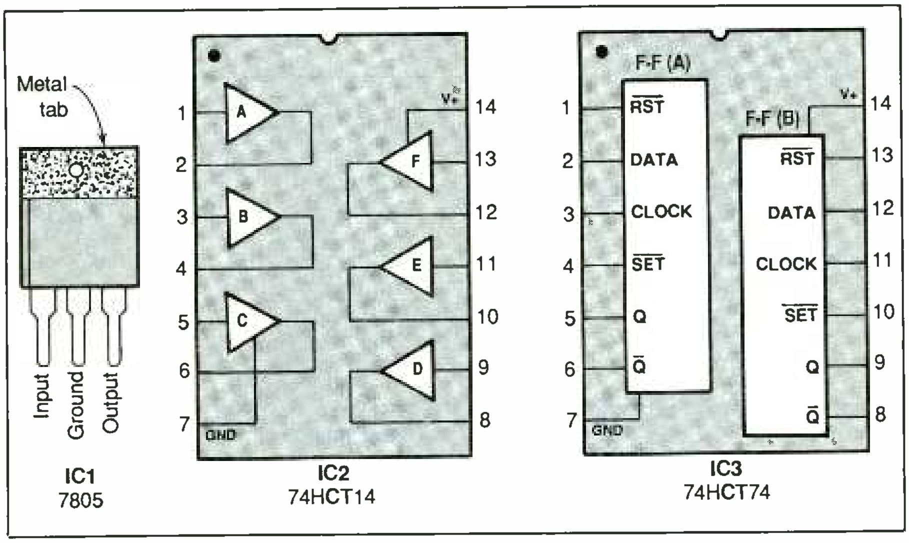


Fig. 2. Pinouts and internal details for ICs used in project.

as the 117 Vac Input in Fig. 1. This ac power is stepped down to 12 volts ac by transformer *T1* and is filtered to 12 volts dc by *C1*. The 12 volts dc is used directly to power the *K1/Q1* circuit and is further reduced to and regulated at 5 volts dc by *IC1* to power the rest of the project.

Lines in parallel with the primary of *T1* provide the circuit path from the ac line to the lamp or appliance being controlled. Note, however, that in one side of this line are the relay contacts. Alternate touches of the touch plate will close and open these contacts, causing ac power to be delivered to and removed from the device being controlled.

Construction

There is nothing critical about construction of the touch plate. You can use a printed-circuit board on which to mount the various components or substitute perforated board and suitable solder or Wire Wrap hardware. In either case, you should make the circuit board the same size and use sockets for *IC2* and *IC3*.

If you decide to use a pc board, you can etch and drill your own, using the actual-size artwork shown at the left in Fig. 3. Alternatively, you can purchase a ready-to-wire pc board from the source given in the Note at the end of the Parts List.

Wire the board exactly as shown in the diagram at the right in Fig. 3. (If you've decided to use perforated board, use the Fig. 3 layout as a rough guide to component placement on it.) Do not install *IC2* and *IC3* in their sockets until the entire circuit has been wired. Even

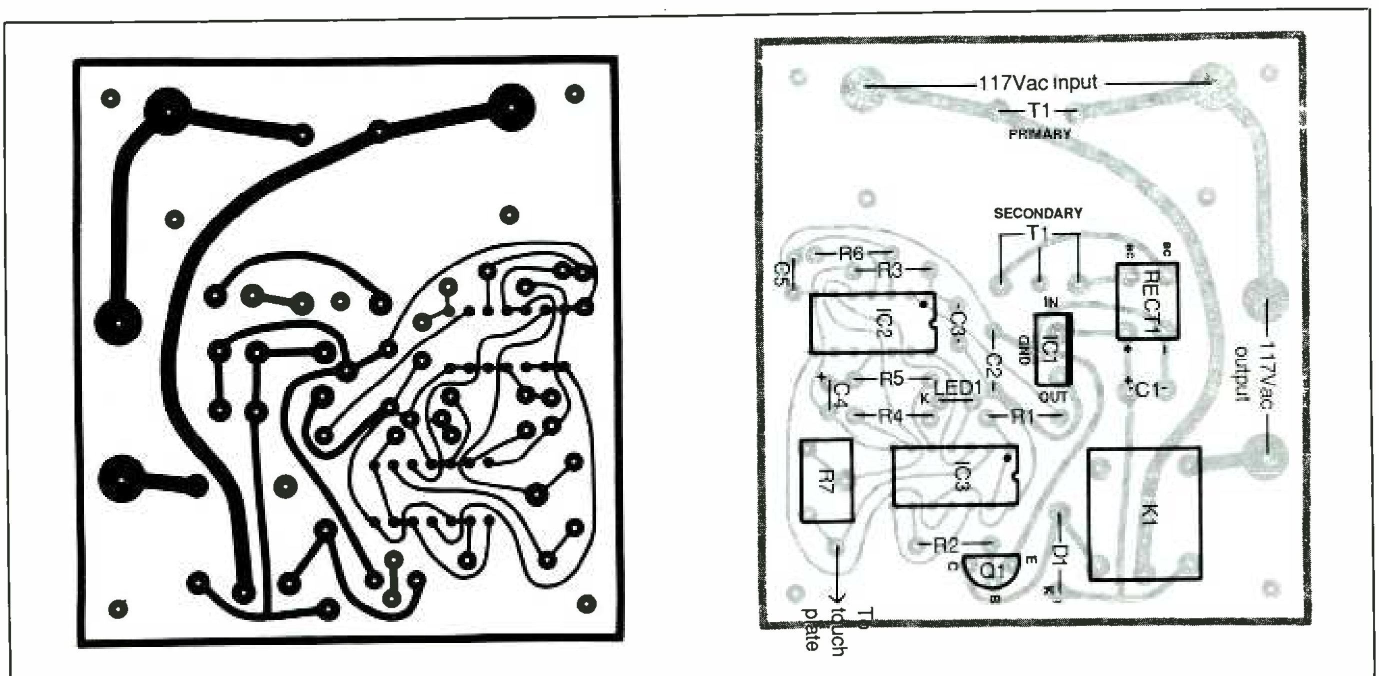


Fig. 3. Actual-size etching-and-drilling (left) and wiring (right) guides for printed-circuit board. Use the layout shown as a rough component-placement guide if you use perforated board and soldering or Wire Wrap hardware.

the fourth law of robotics
A robot shall make learning fun for man and thereby improve the quality of life for mankind.

A robot is a robot is a robot... *was* a robot. Until HERO 2000.

HERO 2000 is much more than a robot. It's a walking, talking 16-bit computer. With 64K ROM and 24K RAM expandable to more than half a megabyte. And a fully articulated arm with five axes of motion. Yours to program. Command. Modify and expand. Total system access and solderless experimenter boards provide almost limitless possibilities. Its remote RF console with ASCII keyboard gives total control. Available with three self-study courses. Backed by Heath Company, world leader in electronic kits.

Build your own HERO 2000. Or buy it assembled. Have fun learning skills that translate directly to the world of work.

HERO® 2000
the knowledge builder

Mail coupon today to receive a ***FREE*** *Heathkit Catalog featuring HERO 2000.*

Mail to: Heath Company
Dept. 079-558
Benton Harbor, Michigan 49022

Name ____________________

Address ____________________

City ____________________ State __________

Zip __________

RO-141

FREE. Send today for latest Heathkit Catalog.

Heathkit®
Heath Company

CIRCLE 2 ON FREE INFORMATION CARD

A subsidiary of Zenith Electronics Corporation.

though these two CMOS ICs are gate-protected devices, they can be damaged by the heat of soldering and static electricity resulting from careless handling.

As you install each component on the board, double check it against Fig. 1 for value and/or identification. Make sure the electrolytic capacitors, diode, LED and transistors are properly oriented before soldering any leads to the pads on the bottom of the board. Also, as you install *IC2* and *IC3* in their respective sockets, practice safe handling procedures for CMOS devices, and make sure they're properly oriented and that no pins overhang the sockets or fold under the IC cases as you push these devices home.

You can make the touch plate from any piece of metal that's 9 square inches or less in surface area. Make the wire that connects the touch plate to the circuit board no longer than 36″. Too large a touch plate or too long an interconnecting wire will make the circuit more vulnerable to false triggering.

If you've decided to build the touch switch into the lamp or appliance with which it is to be used, find a suitable location near the route taken by its ac line cord. Disconnect the device's line cord from the ac line and cut through it at a point near where the center of the touch plate board passes under it. Separate the conductors of the line cord at both cut ends for a distance of about 3″ and strip ¼″ of insulation from each. Then tightly twist together the fine wires in each conductor and lightly tin with solder.

Plug the conductors that go back to the ac line plug into the holes labeled "117 Vac Input" in the Fig. 3 wiring guide and solder them into place. Do the same for the conductors that go to the lamp or appliance and the holes labeled "117 Vac Output." Then mount the circuit board in the selected location, using ½″ spacers and 4-40 or 6-32 × ¾″ machine screws, nuts and lockwashers. Use at least 1″ spacers and appropriate-length machine screws if you used Wire Wrap hardware to wire the circuit.

If you plan on using the touch switch in a "portable" mode with different lamps and/or appliances at different times, mount the circuit inside a plastic enclosure that can accommodate both it and a chassismountable ac receptacle. Wire this receptacle to the points on the board labeled "117 Vac Output" and a separate ac line cord with plug to the points labeled "117 Vac Input."

If you wish, you can use a metal enclosure or a plastic box with a metal top panel. However, make absolutely certain that you don't allow any portion of the circuit, including the metal touch plate and its interconnect wire, to touch the metal.

Setup and Use

Only one thing must be done to get the touch plate circuit up and running: set sensitivity control *R7* for positive and reliable on/off operation. To do this, the circuit must be plugged into an ac outlet. (*Warning:* Various points in the circuit are at 117 volts ac line potential when the project is plugged in and can present a hazard. Avoid touching the 117 Vac Inputs and Outputs and relay contacts or their circuit-board traces.)

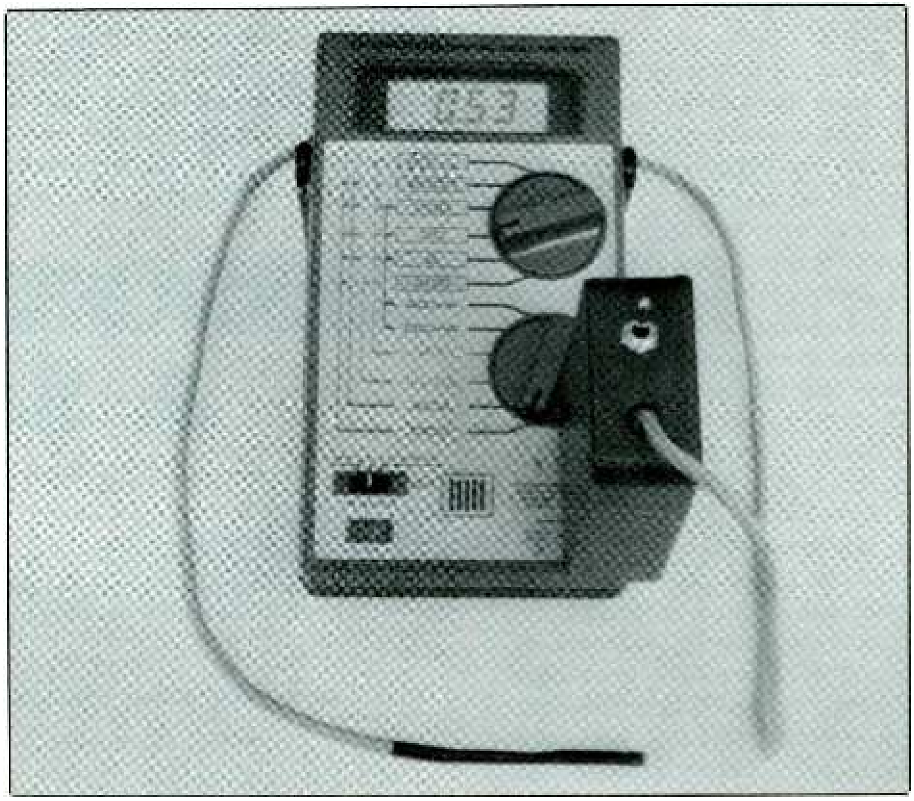
Plug the line cord into an ac outlet and touch tour finger to the touch plate. Adjust *R7* until *LED1* turns on. When you remove your finger from the touch plate, the LED should extinguish. If it doesn't, repeat the adjustment procedure as often as necessary until you obtain the proper results. When the circuit is operating properly, successive touches of the touch plate should turn on, off, on, etc. the lamp or appliance being controlled.

The relay specified for *K1* in the Parts List has contacts that can accommodate loads of up to 300 watts at 117 volts ac. This should be sufficient for most small consumer appliances. However, if you wish to use this project to switch heavier loads, you should use an optical isolator and a high-power triac in place of the relay, or use the specified relay to drive another heavy-duty relay whose contacts are rated for the amount of power the device will draw.

A Temperature Probe For Your Multimeter

Depending on sensor IC chosen, this low-cost probe provides highly accurate measurement of temperature in either °F or °C

By Jan Axelson



Over the years, a number of circuits for temperature probes that can be used with multimeters have appeared in print. However, low-cost ones usually provide low accuracy, and highly accurate ones were usually quite expensive to build. The temperature probe described here combines high accuracy with low cost.

It can measure temperature to within a fraction of a degree and can be built to give temperature readings in either degrees fahrenheit or degrees celsius so that you can build the version that best suits the needs of your usual temperature measuring applications. In fact, the temperature probe is low enough in cost that you might want to build both versions inside the same case and incorporate a switching arrangement for choosing between measurements in degrees fahrenheit and degrees celsius, as conditions require.

About the Circuit

National Semiconductor's LM34 and LM35 precision temperature-sensing integrated circuits are what make it possible for you to build the temperature probe for a very low cost. Both contain all the circuitry needed to sense temperatures and scale the output for direct reading on a digital multimeter set to a low dc volts range. Identical except for how they scale the output voltage, the LM34 and LM35 are calibrated for outputs in degrees fahrenheit and celsius, respectively. Actually, the LM34 and LM35 make up an entire family of temperature sensors. The versions most commonly available are those in the "CZ" series. These are medium-range, standard-accuracy devices in plastic TO-42 transistor-type cases.

A couple of features make the LM34 and LM35 particularly easy with which to work. Firstly, their responses are linear. Like other integrated-circuit temperature sensors, the LM34 and LM35 contain a constant-current source and a diode junction. Operation is based on the principle that when a constant for-

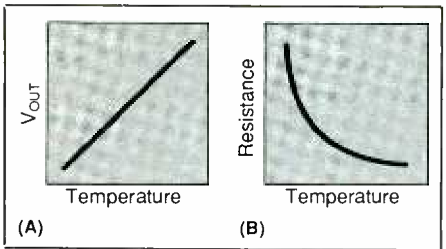


Fig. 1. Constant 10-mV/degree output from LM34 and LM35 (A) is easy to predict and interpret compared to nonlinear response of thermistor (B).

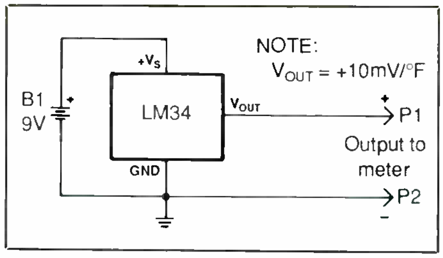


Fig. 2. This simple probe circuit measures temperatures over a range of from 5 to 230 degrees fahrenheit.

ward current flows through a diode, the voltage across the diode junction varies linearly with temperature.

Outputs from the LM34 and LM35 are a constant 10 millivolts per degree. To make a reading, all you do is multiply the displayed voltage by 100 to obtain the measured temperature. An output of 0 volt means the temperature is 0 degree; 0.32 volt means 32 degrees; 1.00 volt means 100 volts, and so on.

By contrast, the response of thermistors (temperature-dependent resistors) that are often used as temperature sensors is notoriously nonlinear. Figure 1 illustrates the response of the LM34/35 (A) with reference to that of the typical low-cost temperature-dependent resistor (B).

The second feature that makes the LM34 and LM35 so attractive is that both devices come precalibrated, the first for degrees fahrenheit and the second for degrees celsius. You don't have to calibrate the response of each device and then translate the output from the Kelvin scale, as you must with other sensor ICs.

Accuracy is where the LM34 and LM35 shine. Typical CZ series error is rated at ±0.8 °F (±0.4°C) at room temperature and only twice that figure at their maximum and minimum limits. Of course, when you use these sensor ICs in a temperature probe, you must take into account the basic error of your meter as well. However, if you have a garden-variety digital multimeter that has a rated accuracy of ±0.5% of reading, meter error is less than 0.4 °F at room temperature.

All in all, your temperature readings with this probe should be within one or two degrees of actual room temperature. This should be close enough accuracy for the great majority of measuring applications.

About the Circuit

Shown in Fig. 2 is a very simple circuit that can be used to measure temperatures that range from a low of about 5 degrees to a high of 230 degrees fahrenheit. Note that the IC sensor has three terminals that are labeled $+V_s$, V_{out} and GND (ground or common). As shown, to use the IC as a temperature probe, all you need do is connect to it a power supply or battery that delivers between +5 and +20 volts from the $+V_s$ to GND terminals in the polarity indicated and measure the output voltage between V_{out} and GND. At this point, V_{out} in volts (or millivolts) multiplied by 100 gives you the measured temperature.

Figure 3 shows the full-range circuit that maintains the 230-degree high end of the range but allows the temperature probe to give readings down to 0 degree fahrenheit and below. This circuit is only a little more complex than that shown in Fig. 2. As before, the positive side of the battery goes to $+V_s$. This time, however, the GND terminal of the sensor IC is raised by about 1 volt above ground by placing a pair of silicon diodes in series between the GND terminal of *IC1* and the negative side of *B1*. This enables *IC1* to measure tem-

PARTS LIST

B1—9-volt battery
D1,D2—1N914 or similar small-signal silicon diode
IC1—LM34CZ or LM35CZ precision temperature sensor (National); see text (Available from Digi-Key Corp., P.O. Box 677, Thief River Falls, MN 56701)
P1,P2—Chassis-mount banana jack (Radio Shack Cat. No. 274-721 or similar)
R1—18,000-ohm, ¼-watt, 10% tolerance resistor
S1—Spst toggle or slide switch
Misc.—Suitable enclosure (Radio Shack Cat. No. 270-220 or similar—see text); perforated board; 9-volt battery snap connector; mounting clip for 9-volt battery (optional—see text); three-conductor cable; heat-shrinkable tubing (see text); machine hardware; hookup wire; solder; etc.

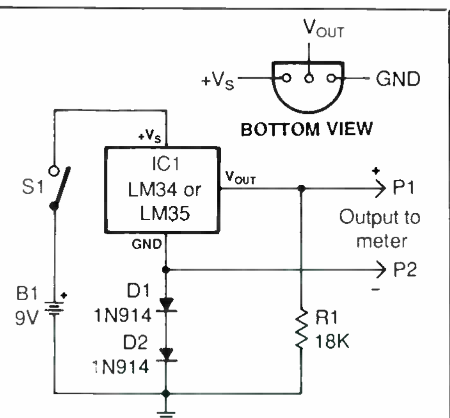


Fig. 3. With this full-range circuit arrangement, the probe can measure temperatures down to 0 degree and below.

peratures below 0 degree by allowing V_{out} to go more negative than the GND terminal of the sensor IC. Also note that V_{out} now connects to the negative side of *B1* through an 18,000-ohm resistor.

In both circuits, the only component that is critical is the sensor IC itself. You can use this temperature probe with virtually any digital multimeter. Even a budget analog multimeter will do, although you can expect your readings to be less precise.

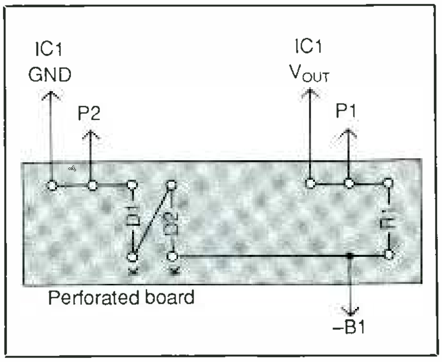


Fig. 4. Wiring guide for temperature probe's tiny circuit board.

Construction

As can be seen in Fig. 3, the full-range version of the temperature probe contains very few components. Start construction by preparing the wiring needed for the project. First, remove 2″ of outer insulation from a 36″ length of three-conductor cable. Strip ¼″ of insulation from all conductors on both ends of the cable. Tightly twist together the fine wires in each conductor and lightly tin with solder. Then strip ¼″ of insulation from two 2″ lengths of hookup wire.

Next, referring to the lead photo, drill holes in one end of the plastic case in which the project's circuitry will be housed for mounting banana plugs *P1* and *P2*. Note that these plugs are used to plug the temperature probe directly into the digital multimeter with which the project will be used. Therefore, space these holes so that when the banana plugs are mounted they directly line up with the input jacks on the multimeter. This done, drill the holes for mounting the switch and battery clip and for entry of the probe cable in the opposite end of the plastic box. Also, if you wish, you can use an optional battery clip for *B1*. In this event, drill a hole in the floor of the box to accommodate its mounting hardware.

Connect and solder one end of each of the two prepared hookup wires to the banana jacks. Mount the jacks in the holes you drilled for them. Feed one end of the three-conductor cable into the box through its hole. Then tie a knot about 4″ from the end inside the box to prevent the cable from pulling loose as you use the probe.

Cut a piece of perforated board to an appropriate size. If you are using the Radio Shack box specified in the Parts List, note that there are molded plastic guides inside it for holding one or more small circuit boards in place. Simply trim the perforated board to the same depth as the inside of the box and make it wide enough to fit inside the guides.

Mount the diodes and resistors on the board, as illustrated in Fig. 4. Be sure to properly orient the diodes and wire the circuit as shown. Then connect and solder the + and − banana jacks, the black battery snap connector wire and two wires from the three-conductor cable into the appropriate points in the circuit, again as shown. Since the sensor IC has not been wired into the circuit yet, you can use any two of the three conductors in the cable for the V_{out} and GND wires at the circuit board. Connect and solder the red battery connector wire and the remaining cable wire to the appropriate lugs on the switch and then mount the switch in its hole.

Slip a 1¼″ length of small-diameter heat-shrinkable tubing over each of the three conductors at the free end of the probe cable, and form a small hook at the end of each conductor. Trim the leads of the sensor IC to ¾″ and form a small hook at the end of each. Crimp and solder

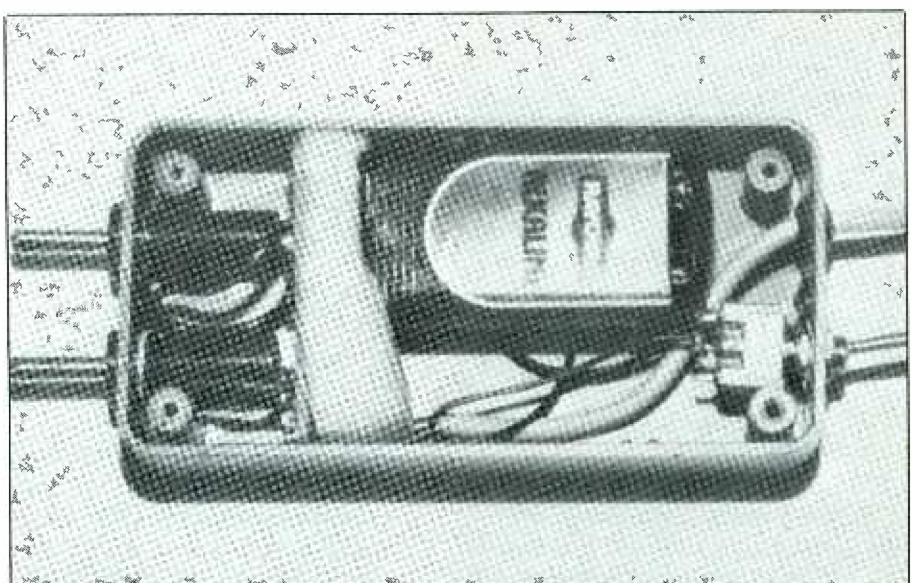


Fig. 5. Interior view of assembled project. Note how circuit board fits into and is held in place by molded guide rails on both sides. Battery is held in place with foam plastic or optional battery clip.

the IC leads to their respective cable conductors, referring to Fig. 3 to determine which conductor goes to which lead.

Push the heat-shrinkable tubing over the soldered connections and bring it flush with the bottom of the sensor IC's case. Shrink the tubing into place. Then slip a 5" to 6" length of larger-diameter heat-shrinkable tubing over the probe end of the cable and position it so that it covers all three connections and just overlaps only the bottom of the IC. Shrink it solidly into place so that it protects the leads of the sensor IC and keeps the end of the probe rigid.

Double-check all your wiring against Fig. 3. Then slide the circuit-board assembly into the case between its guides. Snap the battery into its connector and slip it into its mounting clip or gently wedge it in place with a piece of foam plastic, as illustrated in Fig. 5.

Checkout and Use

Plug the temperature probe into your multimeter and set the latter to read dc volts on a low enough range that will provide easy reading of potentials up to about 5 volts. Turn on both the multimeter and the temperature probe. The meter should now display a number that when multiplied by 100 is the ambient room temperature. If you obtain a reasonable reading and the ambient temperature is well below your body temperature, wrap your hand around the sensor IC and note that the number displayed by the meter increments. Remove your hand, and the number should decrement. If you obtain these results, the temperature probe is operating properly.

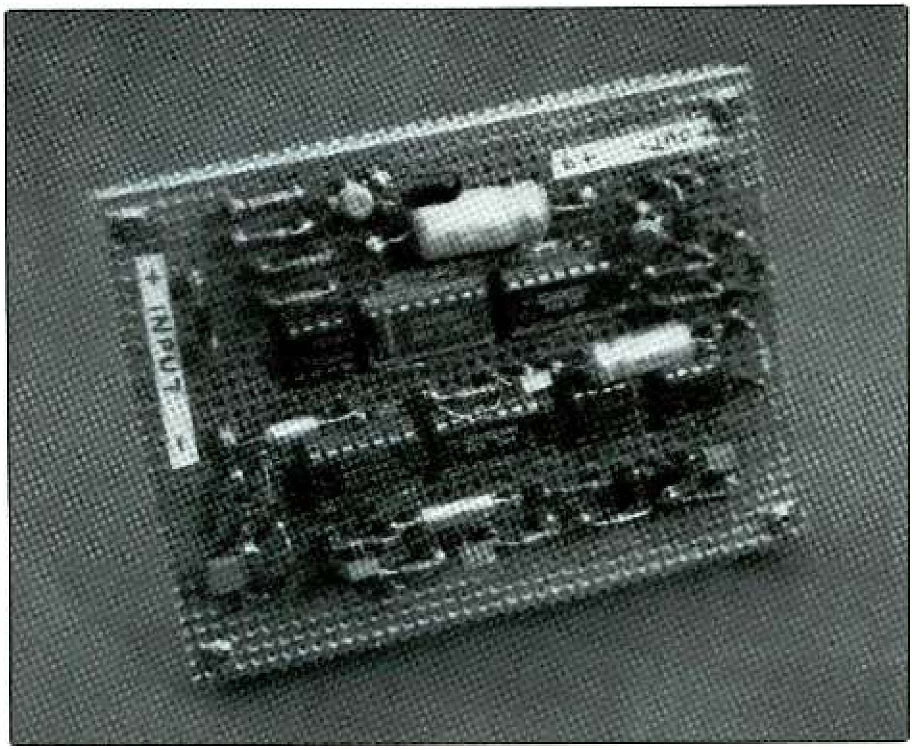
If you note any deviation from proper operation, power down both the temperature probe and your multimeter. Open the project's case and carefully inspect all wiring. Use an ohmmeter to verify that all connections are solid.

To measure the temperature of liquids, place the sensor IC end of the probe inside a tube that is sealed at one end and immerse the tube in the liquid. Do *not* allow the liquid itself to come into contact with the probe's leads. Because it is a good thermal conductor, a copper tube is best for measuring the temperature of liquids, though other types of metal tubes will do almost as well. Though you can use a glass or plastic tube, neither is as good a thermal conductor, which means it will take longer for the temperature to stabilize. **ME**

A 10-Minute Call Monitor

Installing this accessory between your telephones and the incoming line automatically limits calls to 10 minutes in duration

By Anthony J. Caristi



Is your home telephone constantly tied up by long-winded conversations so that you frequently can't make or receive calls? If so, our 10-Minute Call Monitor will put a stop to this. This nifty little device can be installed between any telephone instrument and its wall connector or between the point where the telephone line enters your home and the line that connects to all phones. It automatically limits the duration of any given call, whether incoming or outgoing, to 10 minutes, after which it automatically and abruptly disconnects the instrument from the telephone network.

So as not to appear the total tyrant, the Monitor has a light-emitting diode that comes on and a circuit that places a 2-kHz on the telephone line to visually warn users that they have 60 seconds to conclude their conversation before automatic disconnection.

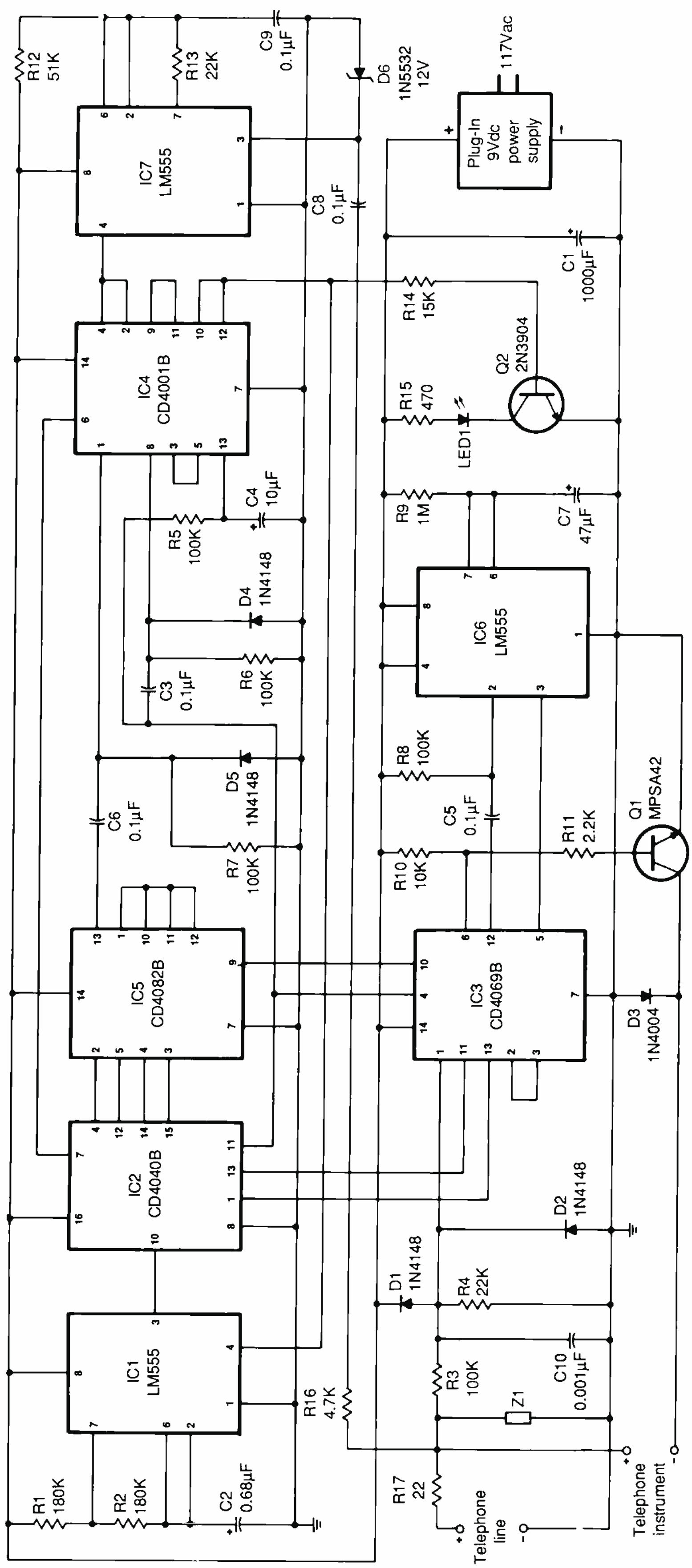
Following auto-disconnect, the Monitor puts the telephone instrument(s) on a 60-second hold during which time outgoing calls can't be made but incoming calls will get through in the normal manner. For conversations that *must* go over the 10-minute timed period, there's even a provision that lets you override the timer function. Of course, you'll want to reserve knowledge of this feature for yourself and select users who don't abuse the calling privilege.

The 10-Minute Call Monitor hardwires into the telephone-line circuit and is live at all times as long as power is continuously applied to it. This power is provided by an external 9-volt wall transformer that plugs into a convenient ac outlet. Depending on the current-delivery capability of the transformer used with the project and the utility rate in your locality, cost of operation should average about $1.00 per year.

Use of the project in no way interferes with normal use of your telephone, other than as noted for the auto-disconnect and time-out period during which outgoing calls can't be made. A new timing cycle is initiated every time the telephone is used, whether for an incoming or an outgoing call.

About the Circuit

Referring to Fig. 1, the timing circuit of the 10-Minute Call Monitor is built around 555 timer *IC1* and 12-stage binary divider *IC2*. Output frequency from *IC1*, which is operated in its astable mode, is approximately



PARTS LIST

Semiconductors

D1,D2,D4,D5—1N4148 or similar silicon switching diode

D3—1N4004 or similar 400 PIV silicon rectifier

D6—1N5532 or similar 12-volt zener diode

IC1,IC6,IC7—LM555 timer

IC2—CD4040B 12-stage counter/divider

IC3—CD4069B hex inverter

IC4—CD4001B quad 2-input NOR gate

IC5—CD4082 dual 4-input AND gate

LED1—Panel-mount or molded plastic package 2-volt, 200-mA red light-emitting diode

Q1—MPS A42 or equivalent high-voltage npn transistor

Q2—2N3904 or similar npn transistor

Capacitors

C1—1,000-µF, 15-volt electrolytic

C2—0.68-µF, 25-volt ceramic

C3,C5,C6,C8—0.1µF, 25-volt ceramic

C4—10-µF, 15-volt electrolytic

C7—47-µF, 15-volt electrolytic

C9—0.01-µF ceramic

C10—0.001-µF ceramic

Resistors (¼-watt, 10% tolerance)

R1,R2—180,000 ohms

R3,R5 thru R8—100,000 ohms

R4,R13—22,000 ohms

R9—1 megohm

R10—10,000 ohms

R11—2,200 ohms

R12—51,000 ohms, 5% tolerance

R14—15,000 ohms

R15—470 ohms

R16—4,700 ohms

R17—22 ohms

Miscellaneous

Z1—Transient suppressor (Radio Shack Cat. No. 276-570 or similar)

9-volt dc, 100-mA plug-in power supply (Radio Shack Cat. No. 273-1651 or similar); printed-circuit board or perforated board and suitable solder or Wire Wrap hardware; sockets for all ICs; telephone cables (2); suitable plastic enclosure; small-diameter heat-shrinkable tubing; wire; solder, etc.

Note: The following items are available from A. Caristi, 69 White Pond Rd., Waldwick, NJ 07463: pc board for $8.95; CD4040B for $3.50; CD4069 for $3.00; CD-4082 for $3.00; and MPS A42 transistor for $2.00. Add $1.00 P&H. New Jersey residents, please add state sales tax.

Fig. 1. Complete schematic diagram of 10-Minute Call Monitor.

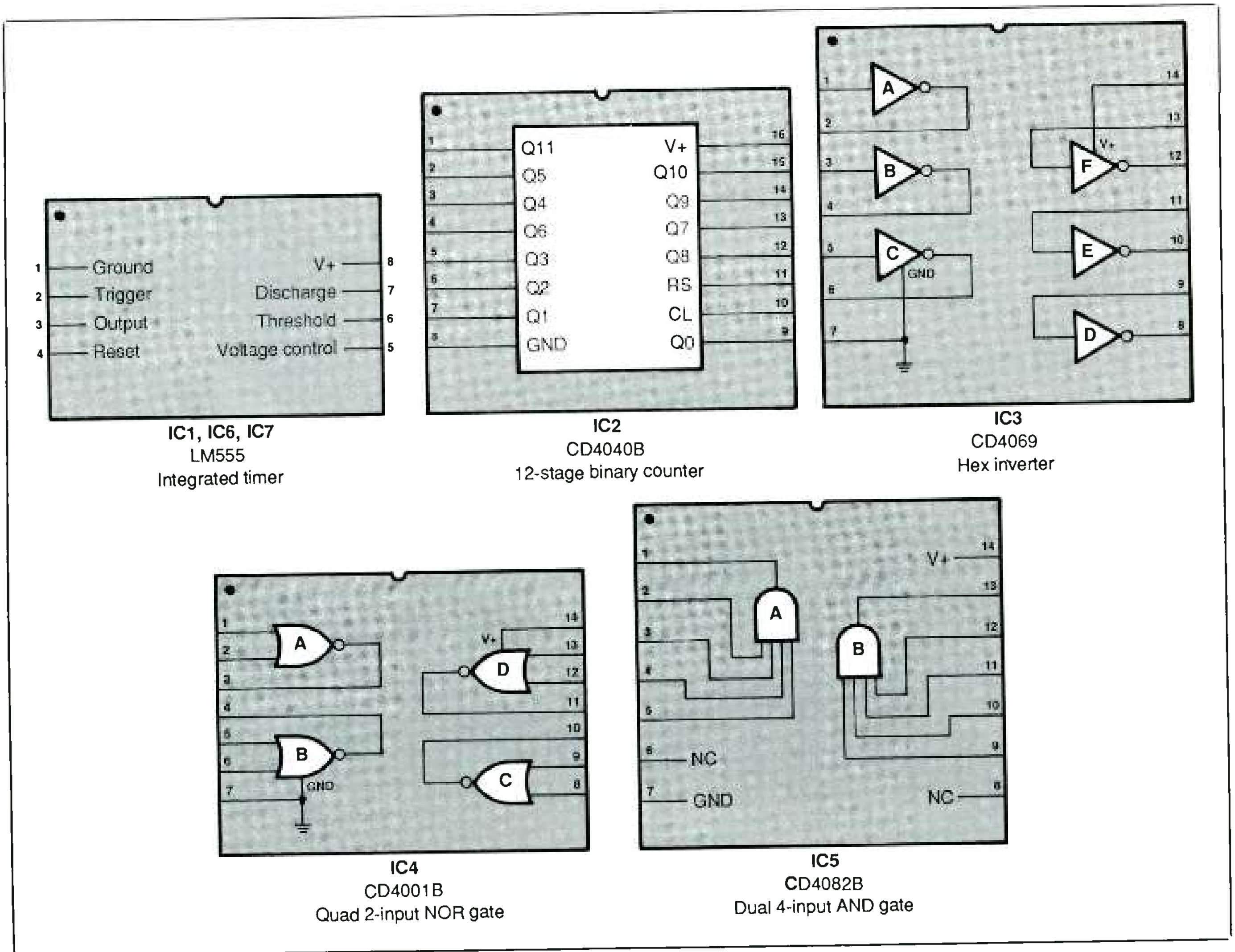


Fig. 2. Pinouts and internal details of ICs used in this project.

3.4 Hz, as determined by the values of *C2, R1* and *R2*.

To ensure that *IC1* always starts from a count of 0 when a telephone conversation begins, this stage is held in reset at all times when the telephone is on-hook. This is accomplished by sensing the voltage across the telephone line by *R3, R4, IC3A* and *IC3B*, which is normally about 48 volts with the phone on-hook and 6 volts when the phone is in use. The logic level fed to *IC2*'s pin 11 master reset forces the counter to 0 when the phone isn't being used. As soon as the handset is lifted off the hook, however, *IC2* begins counting at the 3.4-Hz rate.

About 9 minutes after the count begins, the *IC5A/IC5B* decoder circuit generates a logic 1 at pin 13 of *IC5B*. This sets pin 4 of latch circuit *IC4A* and *IC4B* to a logic 1 and allows *IC7* to oscillate at about 2 kHz. About 0.5 second later, pin 7 of *IC2* goes to logic 1 and resets the latch circuit and disables the oscillator. In this manner, a short burst of the 2-kHz tone is impressed on the telephone line as a warning that the call will be terminated in about 60 seconds.

Monostable multivibrator *IC6*'s output at pin 3 remains at logic 0 at all times except when the circuit is triggered by a negative-going pulse at pin 2. The logic output of *IC6* is inverted by *IC3C* so that forward bias is applied to *Q1* to allow this transistor to conduct. Hence, when the circuit is in its normal quiescent state, *Q1* is in full saturation and its collector is at about 0 volt. This is the negative return to the telephone instrument under control and permits normal operation.

When *IC2* is clocked at 3.4 Hz by *IC1*, the final divider stage output at

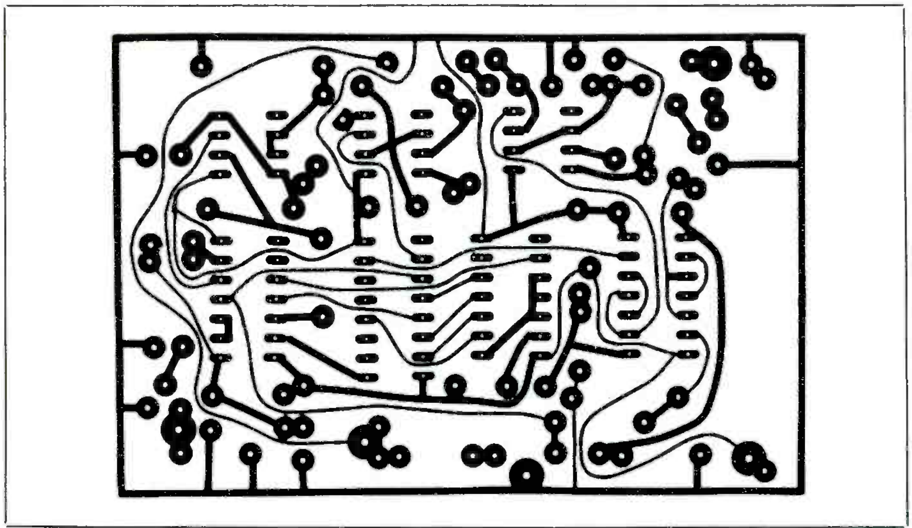


Fig. 3. Actual-size etching-and-drilling guide for printed-circuit board.

pin 1 goes to logic 1 ten minutes after the count is started by lifting the telephone instrument's handset off the hook. The positive-going output pulse from *IC2* is inverted by *IC3F*. This applies a trigger pulse to *IC6*, which then "one-shots."

The time constant of *IC6* is about 60 seconds, as determined by the values of *R9* and *C7*. Pin 3 of *IC6* remains at logic 1 during this time. As a result, *Q1* is held in cutoff and disconnects the negative side of telephone instrument from circuit common. This cuts off the telephone call and disables the instrument for about 60 seconds. At the end of *IC6*'s timing cycle, the circuit returns to its quiescent state and the telephone instrument is restored to service.

To provide a defeat function that permits a call longer than 10 minutes in duration, the *IC4C/IC4D* latch circuit is included. When the telephone is on-hook, pin 13 of *IC4D* is held at logic 1, which forces the output at pin 10 of *IC4C* to logic 1. This turns on *IC1* so that it outputs the 3.4-Hz clock signal at pin 3. At the same time, *Q2* is forward biased and *LED1* is on.

When the handset is lifted off the hook to place or answer a call, the voltage at pin 13 of *IC4D* decays to 0, but the output at pin 10 of *IC4C* remains as it was and *IC1* continues to run. Now, if the telephone hook switch is momentarily pressed and released, the resulting positive-going pulse at pin 4 of *IC3B* is fed to pin 8 of *IC4C*. This resets the *IC4C/IC4D* latch circuit, which deprives pin 4 of *IC1* of its logic-1 state, disabling the timer and stopping generation of the clock pulses. When this occurs, *LED1* will turn off and the timing cycle is suspended.

When the telephone handset is placed back on-hook, the *IC4C/IC4D* latch circuit is restored to its normal state by the positive voltage applied to pin 13 of *IC4D*. The LED turns on, indicating the the Monitor is ready once again to initiate a new timing cycle when the next call begins.

The circuit made up of *R14, R15, Q2* and *LED1* is optional. (Even if you omit it, the 2-kHz warning tone will still be heard). It's included here to provide visual indication of the status of the *IC4C/IC4D* latch circuit. When on, *LED1* tells you that the Monitor is armed and ready to limit any call to a maximum of 10 minutes. Disabling the timing circuit turns off *LED1*.

Construction

Though you could wire the 10-Minute Call Monitor on perforated board with suitable soldering or Wire Wrap hardware, it's much more convenient to use a printed-circuit board. You can fabricate your own board with the aid of the actual-size etching-and-drilling guide artwork shown in Fig. 3. Alternatively, you can purchase a ready-to-wire board from the source given in the Note at the end of the Parts List.

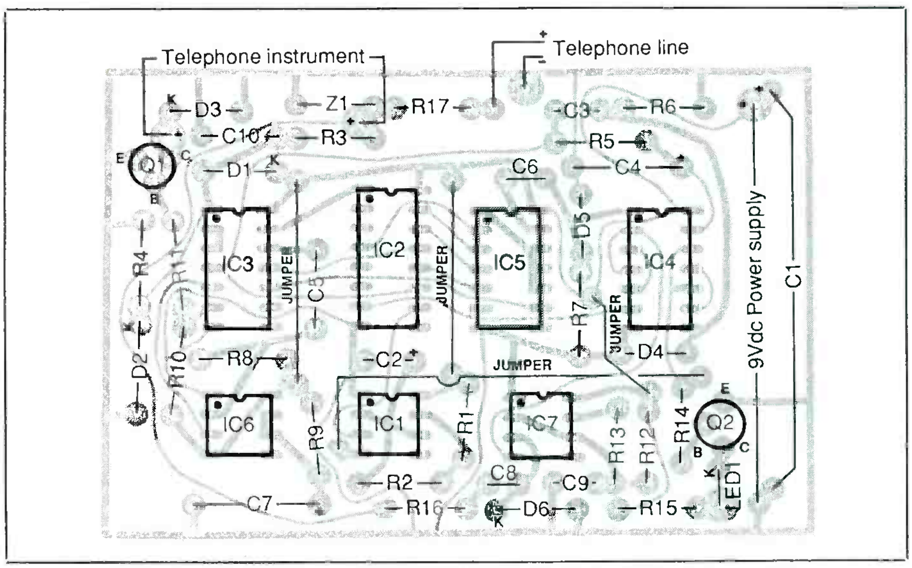


Fig. 4. Component placlement/orientation and wiring guide.

With the exception of the plug-in wall transformer that powers the circuit, all components mount on the pc board, as shown in Fig. 4. Install and solder into place on the board the various components exactly as shown in Fig. 4. (If you decide to use point-to-point wiring on perforated board, use Fig. 4 as a guide to component placement.)

Use sockets for the ICs and install the sockets, but don't install the ICs in the sockets until after you've checked out your installation and wiring. Make sure you properly orient the electrolytic capacitors, diodes and transistors before soldering their leads to the board. Also, keep in mind that it's very important that you use the specified transistor (or its electrical equivalent) for *Q1*. Because it must stand up to the 90-volt, 20-Hz ring signal that appears on the telephone line when an incoming call is signaled, *Q1 must* be a high-voltage transistor.

Note also that you must install four jumper wires in the locations on the board identified with a "J." It's best to use insulated solid hookup wire for the jumpers to obviate any possibility of short circuits. Save installation of *LED1* for last (assuming you've decided to use the visual warning indicator option). This LED will normally be mounted on one of the panels of the enclosure in which you'll house the Monitor, where it will be readily seen. You can use either a panel-mount type of LED or a discrete molded plastic-cased LED.

Select a plastic enclosure that's large enough to accommodate the circuit-board assembly but is otherwise compact to allow it to be mounted unobtrusively near the phone you wish to monitor. (Don't use a metal project box, unless you completely line it with an insulating material. Otherwise, you run the risk of creating a short circuit.) Drill separate entry holes for the cables from the telephone line and telephone instrument through the walls at opposite ends of the box, and another hole anywhere else for the cable from the plug-in power supply. Determine which surface of the enclosure will be most visible when the project is mounted in its final location near the phone it's to control and drill a fourth hole for the LED. Size this hole according to the type of LED you're using. If you've decided to use the standard LED with a molded plastic lens, size its hole to provide a snug—but not force—fit.

Cut off and discard the modular plug from one end of a 6-foot or longer telephone cord. Do the same for the cord coming from the telephone instrument with which the project is to be used. If there's a connector at the end of the plug-in power supply's cable, cut it off and discard it. Pass the cut-off ends of all three cables separately through the holes you drilled for them in the plastic enclosure. Tie a strain-relieving knot in each cable inside the enclosure, leaving sufficient length in all three cases for easy connection to the circuit board plus some slack.

Remove about 1" of outer insulation from all three cables and separate the exposed conductors. Trim ¼" of insulation from each conductor. Twist together the fine wires in

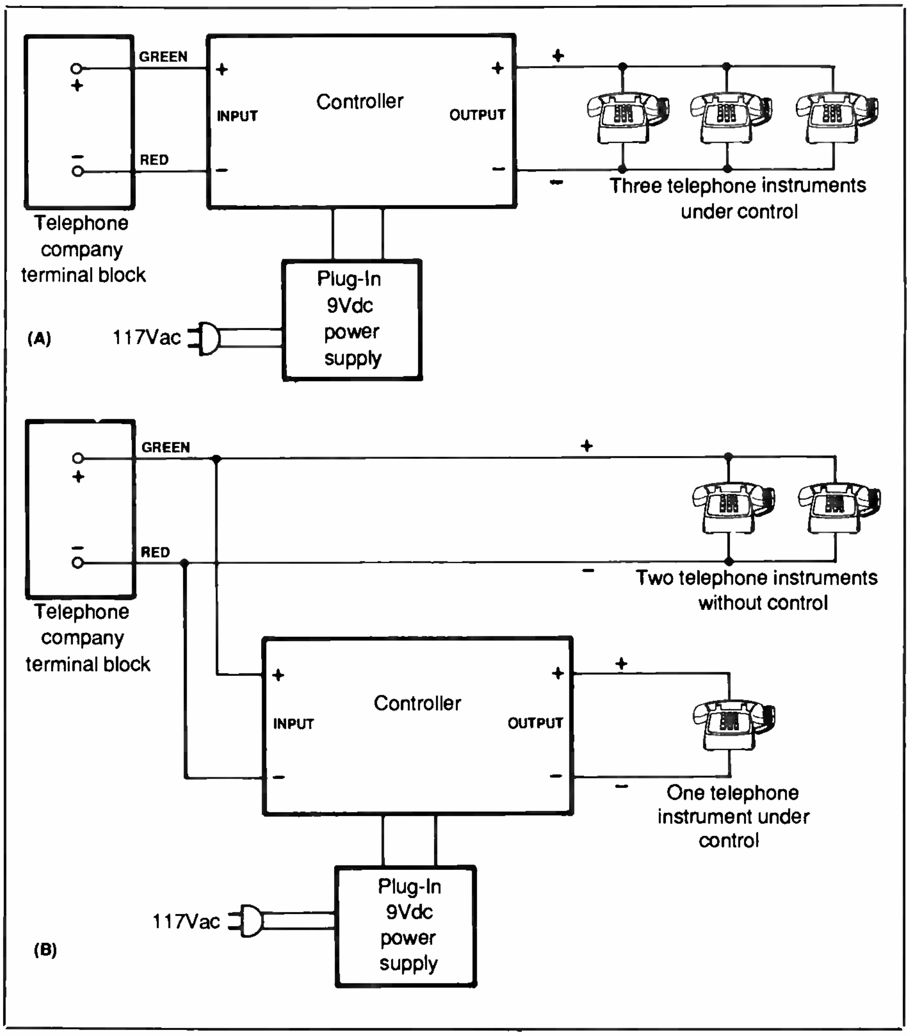


Fig. 5. Installation details showing all telephone extensions (A) and one instrument (B) under 10-minute call control.

each conductor and sparingly tin with solder.

As mentioned earlier, the 10-Minute Call Monitor is designed to be hard-wired into your telephone line, between the terminal block to which the telephone company's incoming line enters your premises and the telephone(s) you wish to have the project control. Figure 5 illustrates two possible methods of installation. In Fig. 5(A), the Monitor is installed so that all telephone instruments on that line or run are subjected to the 10-minute call limitation. Figure 5(B) shows the hookup arrangement when you want the project to control only one instrument. When you wire the project as shown in Fig. 5(B), only the one phone will be controlled by the Monitor; all others will operate with no time restriction.

Regardless of which installation option you choose, it's imperative that you observe proper telephone line and Monitor polarity. In many telephone systems, the green wire is positive and the red negative. However, to be certain, check the polarity of your particular telephone line with a dc voltmeter that's capable of measuring at least 50 volts. Follow the circuit polarity as indicated in Fig. 5. Should you inadvertently install the project in the wrong polarity, your phone won't work at all.

Once you know the polarity of the telephone line, refer back to Fig. 4 and connect and solder the three cables to the appropriate points on the pc board.

Mount *LED1* in its hole and determine the lead lengths needed to reach the *LED1* holes in the circuit board. Solder insulated hookup wires of the needed length to the LED's leads, preferably using red insulation for the anode lead and black insulation for the cathode lead. Slip a length of small-diameter heat-shrinkable tubing over one LED lead, making it long enough to cover the entire exposed lead and overlap the soldered connection by about ½". Push it all the way up to the bottom of the LED's case and shrink it into place. Now the two leads of the LED can't short together. If you're using a standard panel-mount LED with long insulated wire leads, you need only cut them to length, trim away about ¼" of insulation and solder them into the appropriate holes on the board.

Plug the power supply into a convenient ac outlet. Then use a dc voltmeter to check the voltages in the circuit before installing the ICs in their respective sockets. Connect the meter's negative or common probe to circuit ground for the following measurements, all of which should read about +9 volts. Touch the positive probe of the meter to the + side of *C1* and pin 8 of *IC1*, *IC5* and *IC7*, pin 4 of *IC5*, pin 16 of *IC2* and pin 14 of *IC3, IC4* and *IC5*.

If all voltages check out, unplug the power supply from the ac socket and wait a few seconds. Install the ICs in their respective sockets, referring back to Fig. 4 for locations and orientations. Make sure as you plug each IC in that no pins fold under the device's body or overhang the socket before pushing it home.

Since the 10-Minute Call Monitor is powered by a 9-volt plug-in supply that itself must be plugged into an ac outlet, mount the project so that it's within reach of both an ac outlet and the telephone-line wall box.

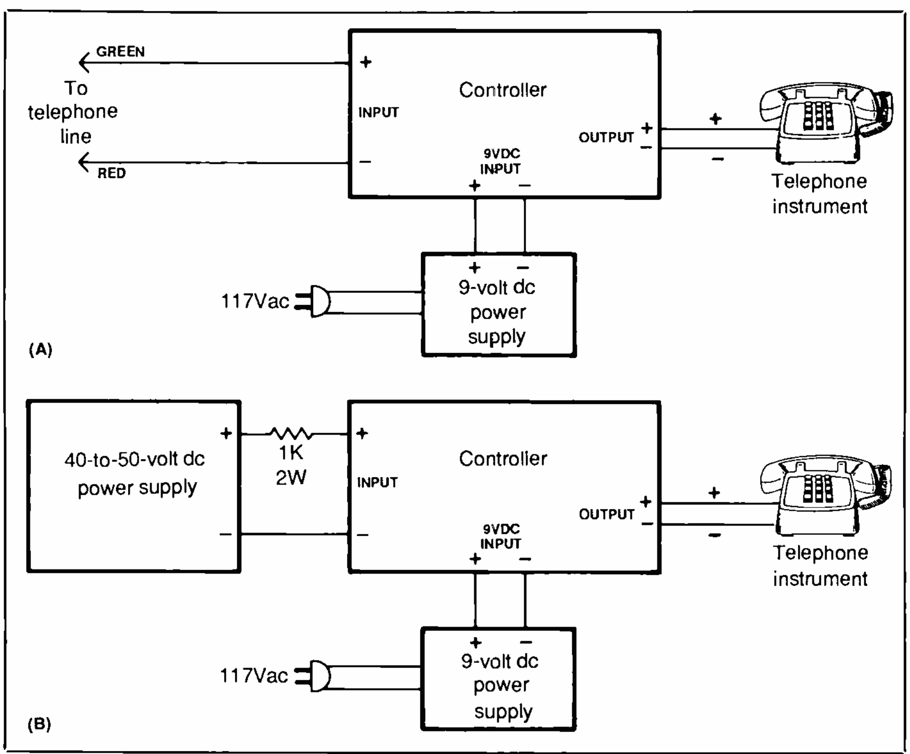


Fig. 6. Test setup using the telephone line (A) and a dc power supply to simulate telephone line (B).

Checkout and Use

Before actually installing the 10-Minute Call Monitor, you should check it out to be sure it's operating as it should. The checkout procedure can be performed with the aid of any telephone instrument and the telephone line. Alternatively, you can substitute for the telephone line a 40- or 50-volt dc power source and a 1,000-ohm, 2-watt resistor.

Refer to Fig. 6 for details on the

hookup using either the telephone line or a dc power supply for the power source to conduct the tests. In either case, you'll have to power the 10-Minute Call Monitor with the plug-in 9-volt power supply.

Since the logic levels present in this Monitor accessory change state at a very low rate, you can check them with an ordinary dc voltmeter that has an input impedance of at least 1 megohm or an oscilloscope. Logic 0 is 0 volt, while logic 1 is about +9 volts. Just keep in mind that all voltages must be referenced to circuit ground.

Connect the Monitor between your telephone instrument and the telephone line as illustrated in the appropriate drawing in Fig. 6. Be sure to observe proper polarity throughout. Plug the project's power supply into an ac outlet and measure the voltage across *C1*. This should be between 8 and 10 volts, with the polarity as indicated in Fig. 1.

Check the hookswitch logic levels at pin 4 of *IC3*. With the telephone on-hook, you should obtain a reading of about 9 volts, which indicates a logic 1. Taking the handset off the hook, the measured voltage should drop to near 0, indicating a logic 0. If you don't obtain these indications, check the potential on both ends of *R7*. You should read 40 to 50 volts on-hook and 6 to 8 volts off-hook.

When the circuit is energized, the LED should light regardless of whether the phone is on- or off-hook, since the *IC4C/IC4D* latch is preset by the positive voltage fed to pin 13. Check latch operation by lifting the telephone handset off-hook, waiting at least 5 seconds and then momentarily pressing and releasing the hookswitch with your finger. The LED should extinguish, indicating that the timing function has been disabled. Placing the handset back on-hook should cause the LED to light.

If the latch circuit doesn't work as it should, carefully check the wiring of *IC4C, IC4D, Q2* and the associated components.

Operation of *IC1* and *IC2* can be verified by lifting the handset off the hook and checking the pin 3 output of *IC1* for oscillations of about 3.4 Hz. This is most easily done with an oscilloscope or analog dc voltmeter. Check the *IC2* circuit for proper operation by following the frequency division of its outputs starting with pin 9 and working downward, as shown in Fig. 1. Each succeeding output should have a signal whose frequency is half that of the preceding output.

Final checkout is done as follows: With the 10-Minute Call Monitor connected to a telephone line as shown in Fig. 6(A) and power applied to the circuit from the power supply, lift the handset. You should hear a dialtone and the LED should be on. Now dial a friend and hold a conversation for at least 9 minutes, at which time you (and the person with whom you're talking) should hear a "beep." About 60 seconds later, the line should suddenly go dead and any effort to dial out should have no effect. Continue to hold the handset to your ear for at least 60 seconds longer, at which time the dialtone should just as suddenly be restored.

If you fail to hear the warning tone at the end of 9 minutes or your call isn't cut off after 10 minutes on the line, you might want to troubleshoot the circuit using a timing circuit that clocks out timing pulses at 10 times normal speed. This will considerably reduce the time required to check out the circuit, causing time-out to occur in just one minute. You can easily accomplish this by temporarily changing the value of *C2* to 0.068 microfarad. The warning tone should then occur at about 55 seconds into the cycle and be just 50 milliseconds in duration.

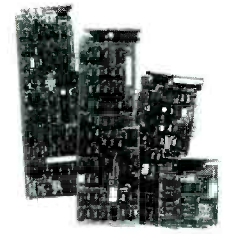
Be sure to do the following when disabling the timer so that your conversation isn't accidentally cut off. When making an outgoing call, you must disable the timer *before* you dial the number. To do this, lift the handset, and after waiting at least 5 seconds, momentarily press and release the hookswitch with your finger. When the dialtone returns, make your call.

To disable the timer on an incoming call, you can momentarily operate the hookswitch any time after the first 5 seconds following handset pickup and before the circuit has timed out. If you forget to do this and hear the warning tone, you still have about 60 seconds to disable the timer and avoid being cut off.

After installing your 10-Minute Call Monitor, be sure to inform everyone that you did so and tell them what it does. You don't want anyone to be unpleasantly surprised as the line suddenly goes dead in the middle of his or her conversation. ME

COMPUTER PARTS GALORE

IBM COMPATIBLE WIRED CARDS



HEXPACK **$79.95**
A workalike copy of the famous AST sixpack with all it's features 384K, RAM, clock, Cal Serial, Parallel, now only $79.95.

COLOR GRAPHICS **$59.95**
A copy of the ever popular PERSYST card 100% IBM compatible, with RGB, + composite color & monochrome outputs.

MONO GRAPHICS **$69.95**
The Hercules clone with par printer.

MULTI IO **$84.95**
The MULTI I/O has it all! Disc control, clock, cal, game, serial, parallel. Total I/O.. $84.95.

FARADAY DRIVE **$29.95**
FARADAY, the card that runs 1-4 drives in internal daisy chain fashion.

KRAM **$159.95**
An exact clone of the famous JRAM card. We did our own software and schematics. Very good for RAM, disc, etc.

SOFTWARE & BOOK **$19.95**
DISKETTE, book & schematic.

PRINTER **$24.95**
The std parallel printer card.

GAME **$24.95**
The std 2 port game I/O card.

RS232 **$34.95**
The dual port RS-232 card for COM-1 & 2 one of our best cards.

CLOCK **$34.95**
Clock/calendar card.

RS232 + CLOCK **$44.95**
A nice card with 2 RS232 ports and a clock/calendar on board.

384K **$59.95**
A close grid of 64K RAM to upgrade an older PC or early clone.

576K **$64.95**
A small card with 2 rows of 256K RAM and 1 row of 64K to upgrade 64K PC's.

I/O + 2 **$64.95**
The I/O + II is a very effective card for saving slots. Clock, cal, serial, parallel, game I/O in 1.

1.2M/360K DRIVE CARD **$89.95**
360K/1.2M XT/AT Dual drive card. A clever card for the XT or AT, it will run 1.2M or 360K drives, mixed or two identical ones. Very good for up/down transfer of data from AT/XT, archives, hard drive fast back-up etc. Really flies with the program called FASTBACK.

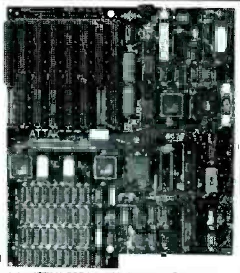
EPROM PROGRAMMER
A clever card that plugs into your IBM and lets you program any EPROM up to 512K under software control. Full screen edit/add/delete features, will program all types, 5v, 12v, 21v, 24v, a really full feature unit for the price. Comes in two styles: the EW901 does 1 at a time, the EW904 does 4 EPROMS at a time.
EW901..$119.95 EW904..$199.95

IBM COMP PC BOARDS

All the bare PCB come complete with a parts list and placement diagram. All the PCB are pretested on a bed of nails for open/short faults. We do not have schematics except where noted. All PROMS and EPROMS are available, as is certain non-copyright software, as noted.

HEXPACK	$19.95
COLOR GRAPHICS	$19.95
384K	$14.95
576K	$14.95
RS232	$9.95
KRAM	$24.95
KRAM SOFTWARE & BOOK	$19.95
PROTOTYPE XT	$24.95
MEMORY PROTOTYPE XT	$24.95
PROTOTYPE AT	$24.95
EXTENDER XT	$19.95
EXTENDER AT	$29.95
PRINTER	$9.95
GAME	$9.95
MONO GRAPHICS	$19.95
FARADAY DRIVE CARD	$12.95
PROM	$9.95
CLOCK	$9.95
RS232+ CLOCK	$12.95
I/O + 2	$14.95

NEW ATTAK 286 1A $495.00



- 8, 10, 12 MHZ CAPABLE
- ON BOARD BATTERY
- STD AT SHAPE & SIZE
- STD AT PERIPHERAL
- RUNS ALL BIOS SETS
- 8 INTERFACE (6-2) SLOTS
- 1 MEGABYTE RAM SPACE
- CMOS CLOCK/CALENDAR
- 80287 SOCKET ON BOARD

At last the new model 1A of the ATTAK-286 board is in stock. This has all the latest features for easy operation at up to 12 Mhz with the 12 Mhz IC set. It uses the LSI chip set from CHIPS & TECHNOLOGY that you have heard tell about. It is of 4 layer construction for noise free high speed operation and is exhaustively pretested on a GENERAL RADIO bed of nails computerized matrix tester. It is the same size as the real AT and has space for up to 1 Meg of RAM. Wired boards are equipped with the latest PHOENIX BIOS. We sell the boards in these formats

(A) 8 Mhz Wired 100% tested, with book, BIOS OK RAM.	$495.00
10 Mhz board wired and 100% tested	$595.00
(B) Bare tested PCB with parts list & placement	$99.95
(C) Detailed manual, with CHIPS & TECH data, schematics and many useful hints and kinks	$29.95
(D) PHOENIX BIOS, for bare PCB buyers, latest version	$59.95
(E) Keyboard BIOS from PHOENIX for bare PCB	$29.95
(I) CHIPS & TECHNOLOGY 5 Chip set, 8 Mhz	$99.95
(K) 80286 CPU, 8 Mhz	$89.95

We have many other parts in stock, ask.

AZTEC 200W POWER SUPPLY FOR AT $129.95

We sell the AZTEC power supplies because they are very good. Less than 0.1% fail in service, and the overvoltage protection is so good that they never fry boards. Just try some of the real cheapos... ask a friend who had a system fry at 18V on the 5V line, hard drives and all. They are FCC/CSA and UL approved. They put out a true 200W with + 5V at 21A, + 12V at 8A, -5V-12V at 0.3A. And they will last forever, being AZTEC

HARD DRIVE CABINET $59.95

This is a very nice case for your hard drive, it has space for 2½ height drives with cover-up bezel for one only. The back is cut for fuse holder, AC plug, switch, connector panel and 3½" AC or DC fan.

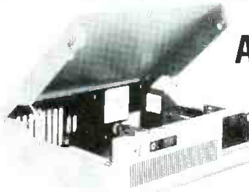
We also have some switching power supplies for one or two drives. The 40 Watt unit has 5V-4A and 12V-1.5A and the 60 watt one is 5V-7A and 12V-2.5A.

Switching Power Supplies
40 Watt $39.95
60 Watt $59.95

KEYTRONICS RT-101 XT-AT KEYBOARD 100% REAL

ONLY **$99.95**

We were able to get a few more RT-101 from an OEM who was overstocked with them, but only a few so act fast. The finalshipment will arrive about one week after you see this ad so act fast to get in the queue.



AT CASE $129.95

NEW TYPE FLIP TOP

This nice new case allows you to build an AT compatible and to easily get at the innards. Gone are the days when you get to slide about 80 pounds of scraping iron on and off just to see what you own!

PANASONIC

5.25" and 3.5" for DOS 3.2 from PANASONIC. The old standby from Panasonic, the JU455-A5 (SA455 SHUG). A highly reliable, quiet unit. DSDD, for XTs.................. **$99.95**
The new AT style for 1.2 M with DSQD format, the JU475 made for the AT. Very fast, quiet and reliable.................. **$139.95**
The new 3.5" 80 track DSDD drive for 720K data storage, made for the new smaller units, runs under DOS 3.2, JU393.................. **$99.95**

SCOPE PROBES

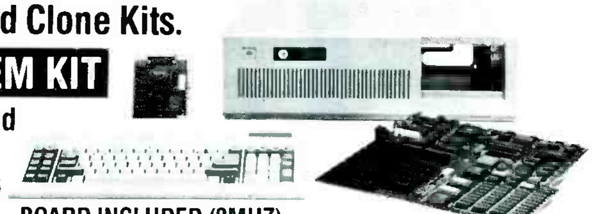
We have sold 100's of these great scope probes to hobbyists all over the USA. A well made probe with 1X, 10X and Ref Sw. With up to 10 Meg I/P Imp, useable to 100 Mhz, low capacity, short rise time, and 600V AC + capable for.......... **$29.95**

Easy to Build Clone Kits.

AT SYSTEM KIT

All Wired and Pretested

$999.95



BOARD INCLUDED (8MHZ)

All you need to build up a really nice AT compatible system with our FLIP-TOP case • AZTEC 200 Watt power supply • ATTAK-286 Motherboard fully tested with 512K of DRAM • Dual 360/1.2 floppy controller • 1.2M PANASONIC drive • a 5160 AT/XT compatible keyboard • PHOENIX BIOS • PHOENIX keyboard BIOS • all the small hardware to let you quickly (1 Hr.) assemble your own AT system. We know they are good because our own employees are buying them for use at home.

COMPLETE 8MHZ XT TURBO KIT

This kit consists of the following wired parts.
- Flip-top case, heavy gauge steel
- 150 Watt power supply, true 150W
- 5160 AT/XT autoswitch keyboard
- 8Mhz Turbo with 640K DRAM
- Drive card & cable
- 2 PANASONIC DSDD drives
- Video card, color/mono
- Clock/cal/ser/par ports
- 10 free diskettes with feeware
- Assembly manual
- Speaker

ALL WIRED AND PRETESTED

$599.00

BARE BONES 8MHZ TURBO KIT

This is a minimum system kit, having just the basics, you add to it from our cards or any good cards etc. Allows maximum freedom of choice.
- Flip-top case, heavy gauge steel
- 150 Watt power supply (true 150W)
- 8 Mhz 640K TURBO with 256K on it
- speaker
- Assembly manual

$249.00

XT TURBO KITS

Yes we make up the kits from stocks of wired and tested boards so you know all will be well when it is assembled. As you know we have been in the bare PCB business for years, and we know good and bad boards when we see them. We insist on the best quality of pre-tested boards, stuffed with good new IC's and then thoroughly tested and burned in. You may see stuff cheaper then ours but it won't be better. After all what good is it to save a few bucks and then have 100's of hours of aggravation? Better to pay a small amount more (after all quality control time is cheap in Taiwan) and have 1000's of hours of satisfaction. The kits go together easily in about an hour.

640K 2 OR 4 LAYER XT MOTHERBOARD

4 LAYER 10 MHZ TURBO
This is a champion of a board, made with the latest of 4 layer PCB fabrication techniques. It is rock-solid and has perfect hard-switch (a toggle switch chooses speed) modes to choose from. It will also use two BIOSes, DIP switch selectable for when you want to select certain BIOSes for particular applications. A high quality board at a realistic price. **$159.95**

4 Layer 8 Mhz TURBO, as above but single BIOS, Hard/soft Sw **$149.95**

2 Layer 8 Mhz TURBO **$129.95**

BARE PCB FOR II + , IIe

We still have a few of the BARE PCB's for the II + and the IIe in stock. We are clearing them out so the price is good, but some items may be gone forever, good luck.

GROUP 1, 3 FOR **$12.00**
DISC, 16K, 80 Column, 80 Col + Softswitch, RS-232, Z-80, Communications, Sprite graphics, 13/16 Sector Disc.

GROUP 2, 2 FOR **$13.00**
Super Serial, IIe Ext Ram/128K SSM Modem, Grippler, Time II, APPLACARO Z-80 + RAM, 9 Voice music, RGB, SAM.

GROUP 3, 2 FOR **$16.00**
Thunder clock, EPROM, Large PROTO-small PROTO, 256K Applacard addon.

All BARE PCB come with parts list and where they plug in.

BIG BLUE SEED

APPLE SEED I, APPLE SEED II

The famous SEED manuals contain the essentials of assembling all manner of APPLE and IBM clone motherboards & plug in cards. Organized into 3 main areas for economy.
(A) BIG BLUE SEED Over 75 IBM XT motherboards and cards listed with all parts and placement for easy work on the bare PCB. Tells where to get the various bare PCBs, Has XT, AT, Turbo, etc., constantly updated **$17.95**
(B) APPLE SEED 1 For the many II+ and IIe clone motherboards. With lots of data on each one...... **$9.95**
(C) APPLE SEED II For plug ins for the APPLE II+ and IIe. 85 cards listed with all parts, placements, hints, etc. For easy building...... **$14.95**
Buy 2 or more and save 10%, all cards listed are for sale from us.

MEMORY MAGIC RAM CARD **$139.95**

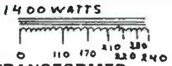
This clever little card has copied the Lotus/Intel RAM format for expanded memory specs (EMS) and is far, far cheaper, but just as good. Comes ready to stuff with 64K or 256K DRAMS, and will accept 2MB of 256K, or 512K of 64K DRAM. Comes with driver disk for RAM disk or spooler.

ASCII KEYBOARD

A great ASCII keyboard for general use, made with a 5V micro it only needs +5 to run. Has word processing layout with a large return key and 20 keys for special macro use under software control. Cost AES DATA over $100. MICRO-SWITCH HALL type keyswitches for external use. With schematic and pinout...... **$19.95**

ISOLATION TRANSFORMER

This is a high quality full AC isolation transformer for those who wish to run 110 Volt items on 220 Volts and vice-versa. Good for 240 Watts at 50/60 Hz. Ideal for: COMPUTERS, SCOPES, PRINTERS, MONITORS and many, many more items using 240 Watts or less. With full user details...... **$19.95**



AUTOTRANSFORMER

Another very good item for running 110 volt items on 220 or vice versa. This autotransformer has 1400 Watts capacity, about 12-13 Amps at 110 or 6-7 Amps at 220. Does not isolate the 110 from the 220 or vice versa, so it must be used with a proper through grounded 3 wire circuit for safety. Full data given. Tapped at 110, 170, 210, 220, 230, 240, versatile Eh.
1400 Watts **$29.95**

IBM COMPATIBLE KEYBOARDS

BEST QUALITY AS LOW AS **$54.95**

As you know the keyboard is one of the two mechanical items in your system, all else is solid state and runs forever. We have looked high and low for good Taiwan keyboards, and found them!! BTC, one of the world's finest keyboard makers, has them. We tested them thoroughly first, and then we bought. We found them to be of excellent quality, 100% IBM/Keytronics compatible and only a little more costly than the real cheapies

5150 The std 84 key type for XT, with large return key...... **$54.95**
5160 The new XT/AT autoswitch type that knows what it is plugged into. Has LED status panel, large return key, and a very nice feel...... **$64.95**
5161 The enhanced AT/XT autoswitch with 12 function keys, LED status panel, numeric pad, large return key...... **$88.95**

CASE STAND $39.95

How nice it is to be able to stand your computer on its side to save space. This stand will adapt to all the XT and AT clones and real thing on the market. It is a solid heavy steel plate so that your unit will not fall over easily as the center of gravity is kept nice and low. We are able to sell this nice unit at a far lower price than other units of inferior design

SWIVEL BASE

How nice it is to be able to turn the monitor from right to left and up and down on an easy-to-use swivelling stand that adds only 2" in height to the overall system. A very handy accessory, an ideal gift.
SMALL 12" **$11.95** LARGE 14" **$12.95**

POWER SUPPLIES

NCR BURROUGHS NORTHERN TELECOM

The ever famous NCR switching power supply for their defunct IBM clone, 5V at 7A, 12VA3A -5-12 at 1A. Another very nice unit. It will run a clone and is a very high quality unit...... **$34.95**
The NORTHERN TELECOM power supply is running out at last. We have only 300 of these great beauties left (out of the 3000 we had). It gives 5V at 4A, 12, -5, -12V at 1A each. A real deal at only...... **$19.95**
What a deal, we bought a whole lot of these BURROUGHS switching power supplies for real cheap. They give 5V at 6 Amp, & 12V at 3 Amp. A very good unit for external tape, or hard drive, or ext floppy. We are able to sell these for only **$24.95**

UNINTERRUPTIBLE POWER SUPPLY

1. High efficiency	85%
2. Sinewave (avoid modified square wave)	Sinewave
3. Internal no-spill battery	Yes
4. External battery terminals	Yes
5. Audible power loss warning	Yes
6. Fast transfer time, under 5 Ms	Yes
7. Multiple output sockets	2
8. % of line transients filtered	100%

2 great new uninterruptible power supplies from SENDON. Each is rated to run a system of the rated wattage for 10-20 minutes to let you back-up files etc. in case power fails. A real time saver in rural areas where power can be intermittent in bad weather. The UPS-250W can also be used as a 150 Watt continuous 120 volt AC supply when run from an external 12V battery. This extends the rating of the internal GEL-CEL for as long as you can keep hooking up car batteries (or in a boat or car as long as you wish). In this case the rating is 150W on a continuous basis. The UPS-400W has a 24 volt internal GEL-CEL and can be run on 24V DC power as well, but at 250W continuously.

UPS-250W $239.95 UPS-400W $379.95

COMPUTER PARTS GALORE INC.
56 HARVESTER AVE.
BATAVIA, NY 14020 USA
1-716-343-6133
IN CANADA 1-800-387-1385

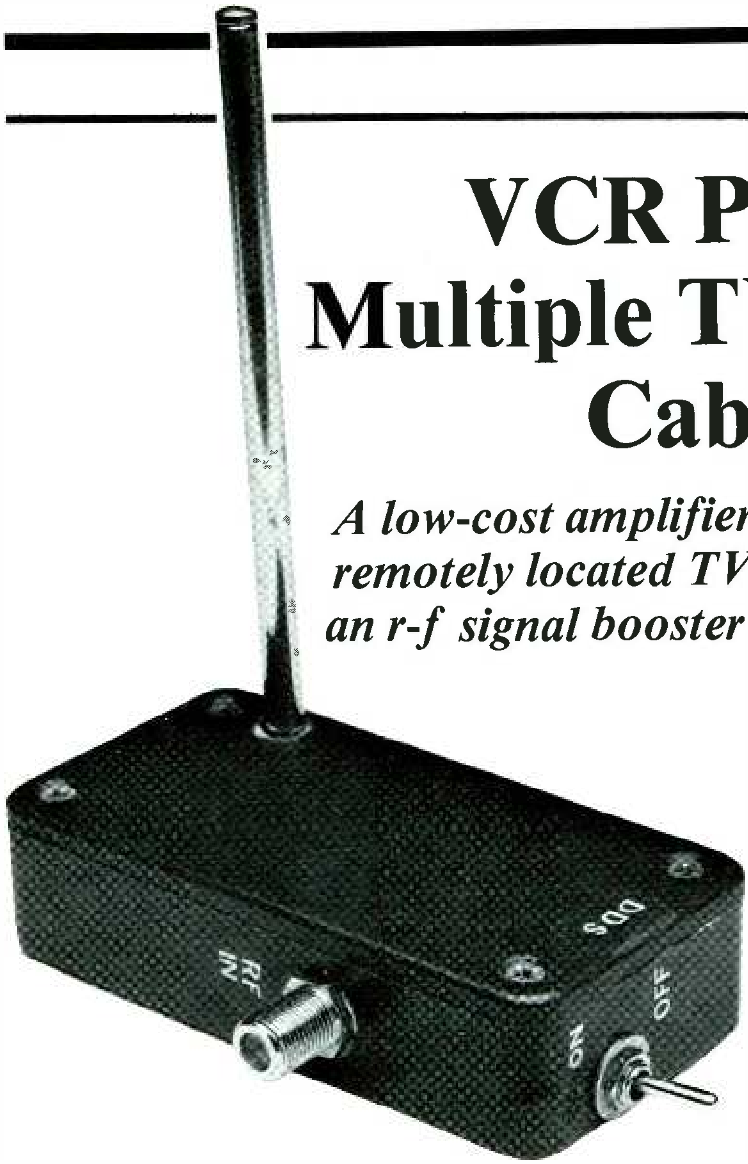
CALL TOLL FREE 1-800-431-9008

VISA MasterCard AMERICAN EXPRESS

TERMS AND CONDITIONS: MINIMUM ORDER $10.00. FOR ORDERS LESS THAN $60.00, PLEASE ADD $5.00 FOR PACKING AND FREIGHT. OVER $60.00, PLEASE ADD 5% FOR PACKING AND FREIGHT. HEAVY ITEMS MAY NEED EXTRA FREIGHT. ALL ORDERS SENT BY UPS GROUND UNLESS ANOTHER WAY IS REQUESTED. IN THAT CASE ANY EXTRA FEE WE MUST PAY IS CHARGED. UPS RED, BLUE ARE AVAILABLE. C.O.D. BY US MAIL OR UPS. PLEASE ADD $3.50 C.O.D. FEE TO THE ABOVE. WE ACCEPT VISA, MASTERCARD, AMERICAN EXPRESS, CERTIFIED CHECK, MONEY ORDER, SCHOOL, COLLEGE, UNIVERSITY, OR STATE AND FEDERAL INSTITUTION PURCHASE ORDERS. PERSONAL CHECKS NEED 14 DAYS TO CLEAR. ALL GOODS SHIPPED AS SOON AS POSSIBLE. ALL ITEMS SUBJECT TO PRIOR SALE. PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE.

VCR Playback on Multiple TV Sets Without Cable Wires

A low-cost amplifier distributes VCR signals to remotely located TV receivers through use of an r-f signal booster



By Desi Stelling

More than 40 percent of U.S. households have at least one videocassette recorder as of year-end 1986, according to E.I.A. estimates. It's higher now. Most of these homes include more than one TV receiver, opening the door to the possibility of playing video tapes on a few TV sets at the same time while using only one VCR.

There are a few ways to do this. For example, you could employ a passive signal splitter with the proper impedances. This method divides the VCR's output signal strength, though. Consequently, there may not be enough strength to satisfactorily drive a remotely located TV set if it's too far away due to line losses. Alternatively, you could use a video distribution amplifier system, though it's quite costly. Both approaches require one to string wires to remote TV sets, of course, which is enough to deter most people from adding this convenience feature.

This project overcomes the drawbacks exhibited by the foregoing approaches. It supplies the proper impedance with enough signal amplification to drive a bevy of remotely located TV sets. Equally important, it can be used without running any wires around the house! At the same time, total parts cost is modest.

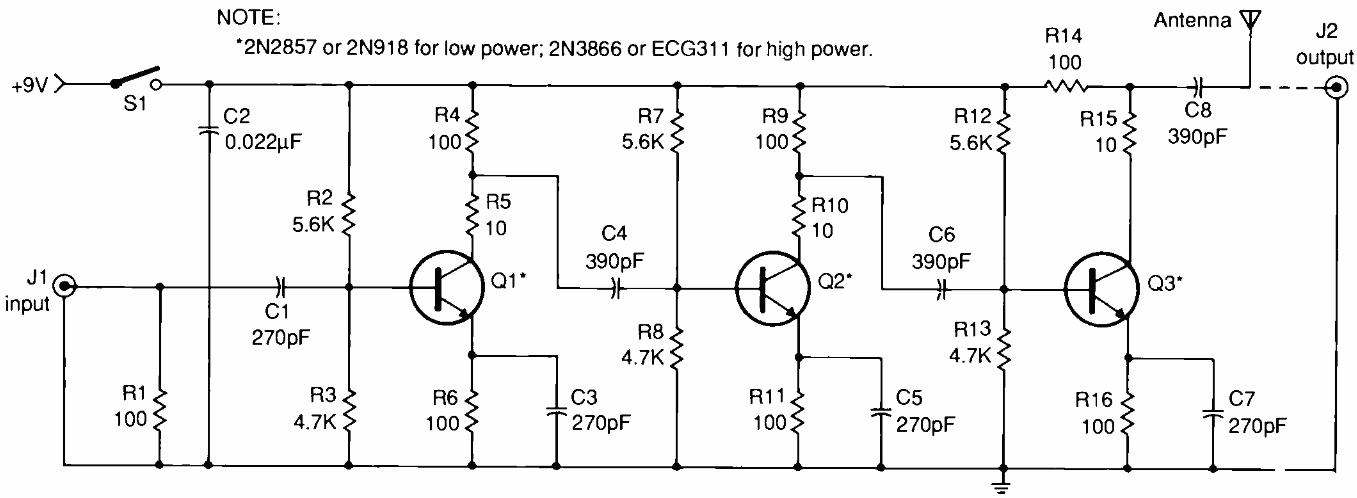
Basically, the project boosts the output signal from a VCR to a level sufficient to deliver high-quality video and audio to as many as four separate TV sets in a cable/splitter distribution system. The booster's bandwidth is purposely limited to the 60-to-75-MHz range, which covers TV channels 3 and 4, where VCRs are designed to operate.

You can build either of two versions of the booster. A $25 low-power version is intended to feed a splitter/cable arrangement. For less than $3 more, a "high-power" version can provide a wireless signal from a whip antenna that can feed a number of TV sets within a 50-foot or so range, eliminating the need for splitters and distribution cables.

About the Circuit

VCRs, as well as video games, home personal computers and video-disc players used with a standard TV receiver connect to the set's vhf antenna terminals. Their signals are received by setting the TV channel selector to channel 3 or 4, the choice of which depends on which of the two has no commercial signal being broadcast in the viewing area. A switch is generally provided on the video equipment for user channel selection.

To obtain a high-quality picture and sound, the amplitude of the video machine's output signal should be about 5 millivolts. Picture



PARTS LIST

Semiconductors
Q1,Q2,Q3—2N3866 or ECG311 transistor for high power or 2N2857 or 2N918 transistor for low power—see text

Capacitors
C1,C3,C5,C7—270-pF disc
C2—0.022-μF disc
C4,C6,C8—390-pF Mylar

Resistors (¼-watt, 5% tolerance)
R1,R4,R6,R9,R11,R14,R16—100 ohms
R2,R7,R12—5,600 ohms
R3,R8,R13—4,700 ohms
R5,R10,R15—10 ohms

Miscellaneous
J1,J2—Panel-mount F-61 female coaxial connector
S1—Miniature spst toggle switch
Printed-circuit board (see text); 4″ × 3″ × 1″ enclosure, preferably metal (see text); 9-bolt battery, snap connector and mounting clip (optional); telescoping antenna; fiber washers (see text); small rubber grommet; grounding lugs (see text); lettering kit or tape labeler; ½″ metal spacers; 4-40 × ¾″ or 1″ machine screws, nuts and lockwashers; hookup wire; solder; etc.

Note: Available from DDS Systems, P.O. Box 5715, Glendale, AZ 85312: Pc board only, $4.50; Complete kit of parts for high-power version, $27.50; Complete kit of parts for low-power version, $24.95. (kits of parts exclude enclosure and battery.) Add $2.50 for P&H for kit orders. Arizona residents, please add 6% sales tax.

Fig. 1. Full schematic diagram of booster.

frequencies are at 61.25 MHz for channel 3 and 67.25 MHz for channel 4. In either case, the sound carrier's frequency is 4.5 MHz above the picture carrier frequency.

To drive a second TV receiver that's located in another room or on another floor from your VCR, a signal splitter of the proper impedance and a long cable are usually required. This combination creates a problem. If you use a two-output splitter, the amplitude of the signal that reaches each of the two TV receivers will be halved. (It will actually be less than this, due to the splitter's normal losses.) So if you start with a 5-mV signal and split it to feed two TV sets, each set will receive only about 2.5 mV or less of signal. This may not be enough to assure high-quality reception with both sets sitting side by side and coupled to the splitter with very short cables.

The length of the cable run to the remote TV receiver complicates matters. If the run to the remote set is 50 feet or more from the splitter, line losses in the cable will attenuate the signal even more, possibly to the point where the signal reaching the remote set may not even be usable. To compensate, you might have to install an r-f amplifier at the splitter's output that feeds the signal to the remote set. A 15-dB-gain amplifier would usually boost the signal to a level sufficient for good reception.

Our r-f booster provides about 24 dB of gain at 75 ohms. Hence, it lets you use splitters to feed high-quality video and audio to as many as four TV receivers from a single VCR, video game, etc.

Note in Fig. 1 that the basic booster circuit consists of a three-stage amplifier with ac interstage coupling. This circuit has no inductors, which eliminates the tedium of having to wind coils. Also absent are trimmer capacitors, so no critical tuning adjustments are required. Component layout in this project provides sufficient bandpass filtering to assure good frequency stability and oscillation immunity.

Proper impedance match for the r-f outputs of most consumer video equipment is provided by *R1*. Resistors *R2* and *R3* provide bias to give

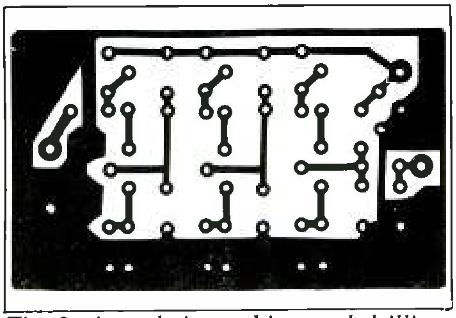


Fig. 2. Actual-size etching-and-drilling guide for printed-circuit board.

the booster maximum gain with the chosen value of emitter resistor *R6*. Capacitor *C3* provides a low ac impedance for the emitter circuit to optimize gain in each stage. Resistors *R4* and *R5* provide the emitter-to-collector current needed to drive the *Q2* and *Q3* stages, respectively, and to protect the collector-to-emitter junctions of the transistors. The *Q2* and *Q3* second and third stages are the same as the *Q1* first stage.

Capacitor *C8* couples the output to the load, which can be a splitter to drive two or more TV sets or an antenna (not both simultaneously) to drive any number of sets within the booster's range. To guard against unwanted oscillation, wiring for the power supply and output circuit must be kept as short as possible.

An F-type female connector that can be adapted to a BNC or standard phono jack is used for *J1*. This type of connector is fairly common in consumer video products and is used in this project to make it easy for you to use the r-f booster in virtually any home installation.

Power for the r-f booster can be just about any 9-volt dc source. If you wish, you can use a commonly available 9-volt dc plug-in wall supply like those used to power calculators and other small consumer appliances, though additional filtering may be needed to minimize ac-line noise. Since the circuit draws only about 20 mA, it can also be powered for a long time by a 9-volt battery (listed as an option in the Parts List).

Construction

This project is easy to build if you use a printed-circuit board, which you can fabricate yourself with the aid of the actual-size etching-and-drilling guide shown in Fig. 2. Alternatively, you can purchase a ready-to-wire board from the source given in the Note at the end of the Parts List. If you fabricate your own pc board, drill mounting holes for it in the lower-left and both right corners, with the board viewed as in Fig. 2.

Start board wiring with the resistors, followed by the capacitors, and finishing with the transistors, as shown in the Fig. 3 wiring diagram. As you mount each component in its respective location, be sure to push it as close as possible to the top of the board. Also, before soldering any of the leads to the board's pads, make certain that all transistor leads go into the appropriate holes.

You can mount the circuit-board assembly in any size enclosure that's large enough to accommodate it and the 9-volt battery that powers the booster and has room for INPUT and OUTPUT jacks *J1* and *J2* (and the antenna if you build the high-power version of the project) on its panels without interfering with the rest of the circuit. Though a plastic enclosure can be used to house the booster, it's best to use a metal type for good shielding.

Drill the hole for and mount *J1*. If you're using a metal enclosure, place a toothed lockwasher between the jack and box panel to assure a solid ground to the chassis. If you use a plastic enclosure instead, make sure to place a ring-type solder lug between the jack and the box panel. Fully tighten the nut on the jack if you're using a metal box, but make the nut only finger tight of you're using a plastic box. Position the circuit-board assembly inside the box so that the wire that will connect the inner-conductor lug of the jack to the input side of *C1* will be no more than 1″ in length. Mark the locations of the circuit board's mounting holes on the floor of the box. Then drill appropriate-size holes at the marked locations. Temporarily mount the board in place with ½″ metal spacers and 4-40 × ¾″ or 1″ machine hardware.

Since the wire from the output side of *C8* to the antenna and/or OUTPUT jack *J2* should also be as short as possible, carefully mark the location of the antenna's and/or the jack's mounting holes to assure a short wire run (1″ or shorter).

You can mount the antenna directly on the circuit board with a lockwasher between its screw head and the pad labeled OUTPUT in Fig. 3. Alternatively, you can mount it to the floor of the enclosure as near as possible to the OUTPUT pad on the

(Continued on page 92)

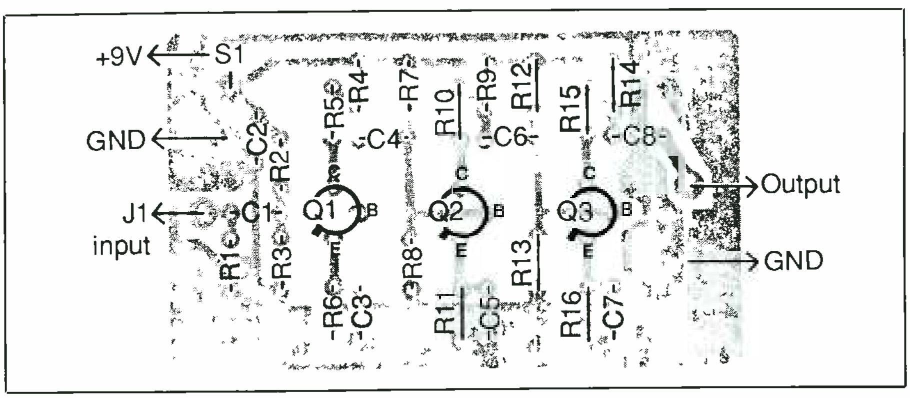


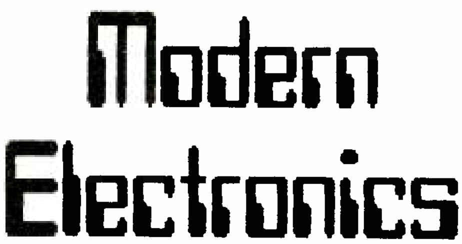
Fig. 3. Wiring guide for printed-circuit board.

Create Project Decals With Your Computer

By Rich Vettel

Any project looks only as good as the case in which it's housed, no matter how sophisticated and complex it may be. Finishing touches spell the difference between a professional-looking project and one that looks like it was used as an afterthought. Here's how to make great-looking decals that will really dress up your pride and joy . . . easily and for less than $1 each.

Start by generating the original artwork. For the sample shown, I used an IBM PC computer, an Okidata 192 dot-matrix printer and "Print-Master" software. Print-Master is one of several programs available that allow you to print many different character styles with a garden-variety dot-matrix printer.



After you print out the words (and any graphics you decide to use) you want to appear on the front panel of your project on plain white paper, have a transparency made at a photocopy shop. Most copy shops do this for less than $1. Also, many copiers have the ability to enlarge and reduce the final artwork. If you need more enlargement or reduction than can be obtained in a single pass, simply have made copies of successive copies until you have the size you want. A good copier will generate finished transparencies that are darker than the original you supply.

Next, apply a thin, even coat of clear spray cement like Scotch brand Spray Mount to the project case's front panel where the decal is to go. (Spray cement is available from most stationery and art-supply stores.) It's a good idea to place the panel inside a large box before spraying on the cement. Otherwise, you're liable to get the cement all over your workbench and anything else in the vicinity.

Holes for screws, control and switch shafts, panel lamps, etc. can be punched in the artwork transparency with a leather punch. These punches come in various sizes to suit different needs. If larger-size holes or square or rectangular cutouts must be made in the transparency, it's best to make these after the artwork has been mounted on the panel.

With the lettering side facing up, place the decal transparency on top of the cement-coated project panel. Position it as accurately as possible. The cement will immediately adhere to the artwork but will still allow you to reposition the decal as necessary.

With the artwork accurately positioned, place the plate on which it's mounted, transparency side down, on a piece of thick cardboard. Using a sharp utility or X-acto knife or a single-edge razor blade, trim the transparency material from around the edges of the panel. If you have any large square or rectangular cutouts, trim away the transparency material inside them at this time. Turn over the panel and place a piece of clean paper over it. Burnish the decal firmly down onto the panel. If there are any large holes or slots still to be cut in the decal, do this now.

This completes the finishing touches that will give your projects a professional appearance. You'll find that the decal not only gives your projects that factory-made appearance but also protects their front panels from scratches. **ME**

Recycling An Old Video Monitor

Here's how you can inexpensively adapt a TRS-80 Model I video display monitor to use with a newer computer

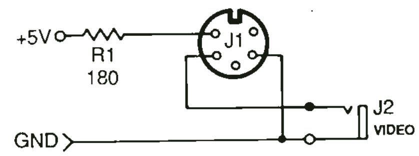
By Steven Kelnhofer

Many personal computers designed for home use include an r-f modulator for connection to an existing TV receiver. Sure this is convenient and saves you the cost of a video monitor. But text quality and graphics generated by your computer are seriously degraded when you view them on a low-resolution TV receiver that is prone to interference.

A video monitor, which eliminates the r-f stage entirely, is desirable for this purpose, of course. There are some good, low-cost monochrome ones on the market. For only a very few dollars, though, and very little work, you can recycle a good black-and-white video monitor that might even be gathering dust: an old TRS-80 Model I computer monitor. If you have one, as so many people still do, here's how you can modify it to work with just about any of the present crop of home computers. All you need are an adapter cable and a source of 5 volts dc. Should you decide to use it later with a Model I computer, you can do so simply by unplugging the adapter cable and plugging in the old TRS-80 cable.

What You Must Do

A TRS-80 Model I computer's video display monitor requires 5 volts dc to power an isolation circuit inside the monitor. It obtains this 5 volts from the keyboard/computer assembly inside the computer with which it is used. Any interface between this monitor and a computer other than the Model I must supply this dc power and couple the composite-video signal into the monitor.



PARTS LIST

J1—5-pin chassis-mount DIN connector (Radio Shack Cat. No. 274-005 or equivalent)
J2—Shielded phono jack (Radio Shack Cat. No. 274-346 or similar)
R1—180-ohm, ½-watt, 5% tolerance resistor
Misc.—Suitable enclosure (see text); 5-volt power supply (see text); machine hardware; hookup wire; solder; etc.

Monitor interface circuit shows rear view of 5-pin DIN connector.

Only 30 milliamperes of current is required by the monitor's isolation circuit. Hence, the required 5 volts can be tapped from the power supply within the computer with which you plan to use the monitor. You can also use an external 5-volt dc power supply to power the isolation circuit. In fact, I decided to use a separate modular 5-volt power supply for my prototype. You can do the same. Alternatively, you can build any of the various 5-volt supplies that have appeared in print, or even a battery supply with a zener to keep things as simple as possible.

The interface system required to adapt a Model I's video monitor to other computers is shown in the schematic diagram. Keep in mind that the pin arrangement for the 5-pin DIN connector is a rear view.

Our interface ties the ground line of the composite-video signal to the 5-volt supply's common (ground) side. It also connects circuit ground, +5 volts and "hot" signal input lines to the video monitor.

Construction and Use

Construction of the interface is straightforward and requires no special assembly skills to perform. You start by selecting a suitable box in which to build it. This can be a small plastic box on one wall of which you mount DIN connector *J1* and shielded prone jack *J2*. If you've decided to use an external modular dc power supply, mount a suitable jack for it on another wall. With this arrangement, the box you use can be very small. On the other hand, if you've decided to use a home-built power supply, select a metal box that is large enough to accommodate it as well and mount the jacks as far as possible from it as you can. Also, make sure to line the entry hole for the line cord with a small rubber grommet and tie a knot in the cord inside the box to serve as a strain relief.

To use the interface box, plug the DIN connector from the TRS-80 monitor into *J1* and the phono plug that carries the video output from the computer into *J2*. Then power up your system and begin computing.

This simple adapter arrangement can be very useful to you if none of your applications require a color monitor. With it, you get a few more miles out of your old TRS-80 Model I monitor. And not having made any permanent modifications to the monitor, you can still return it to service with an old Model I computer. ME

Experimenting With Infrared Detectors

By Forrest M. Mims III

Sensors capable of detecting infrared radiation have many applications in science and technology. For example, infrared sensors can remotely monitor the temperature of distant objects, detect air pollution, sense the presence of a human being and pinpoint hotspots concealed by a blanket of smoke. Arrays of infrared sensors are used in thermal imaging systems that find many applications in medicine, astronomy, physics and warfare.

In this column, I will describe in detail two specific kinds of infrared detectors. I will also show you how to use these detectors in simple, effective circuits that can remotely detect such infrared sources as a flame, a hot soldering iron, a running automobile engine, a hot coal and even a human being.

Detector Sensitivity

Any detector's lower sensitivity limit is determined by the sum of the internal noise level of the detector itself and the noise contributed by external components (such as load resistors) and circuits (such as amplifiers). Unless special signal processing techniques are used, when the noise level equals or exceeds the signal level, the signal cannot be detected with any reliability.

Minimum detectable signal power is called the "noise equivalent power," or NEP. The NEP of a specific detector is the noise level divided by the detector's responsivity. It's important to note that NEP is dependent on the wavelength and frequency of the signal as well as the detector's temperature and bandwidth. Smaller values of NEP give best detector performance. However, it's difficult to compare the NEP of different detectors of varying sizes. For this reason, infrared systems designers compare different detectors by means of a figure of merit parameter called "D-star," or simply D*.

A detector's D* is the square root of its area divided by its NEP. Generally, a detector with a high D* is more sensitive than a detector with a lower D*. The D* for a specific detector must be specified in terms of wavelength, frequency, noise bandwidth and temperature. For additional information about D*, see any good reference book on infrared or optoelectronics. Manufacturers of detectors sometimes include explanations of D* in their product literature. See, for example, "Introduction of Pyroelectric Detectors" (ELTECdata #100, *Eltec Instruments, Inc.*).

Lead-Sulfide Detectors

Lead sulfide (PbS) is a semiconducting compound that has an electrical resistance that is altered by the presence of both visible and infrared radiation. Thin films of polycrystalline PbS are used to make photoresistive sensors whose operation, if not sensitivity, is similar to that of the venerable cadmium-sulfide photoresistor.

Peak sensitivity of PbS occurs at a wavelength of around 2.5 microns. This coincides with the peak infrared emission of a blackbody having a temperature of around 1,200 degrees Kelvin (927 degrees Celsius or 1,700 degrees Fahrenheit). Every blackbody having a temperature above absolute zero emits a broad spectrum of radiation, and PbS is sensitive to radiation slightly beyond 3 microns. Therefore, a PbS detector can detect the radiation from blackbodies having a temperature that is considerably cooler than 1,200 degrees Kelvin. For example, a hot soldering iron and a hot water pipe can easily be detected by a PbS detector.

Though PbS detectors will work well at room temperature, they work even better when cooled. Therefore, they are often cooled with liquid nitrogen, dry ice or thermoelectric solid-state heat pumps. An important consideration when using cooled detectors is prevention of frost accumulation on the detector and its window. For this reason, the windows of cooled detector assemblies sometimes in-

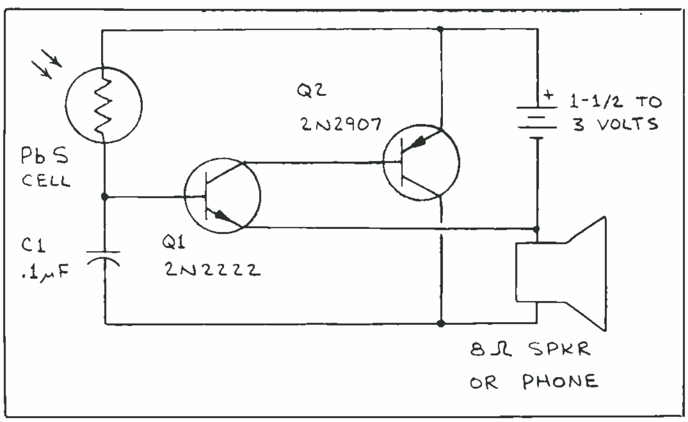


Fig. 1. An infrared-sensitive tone generator.

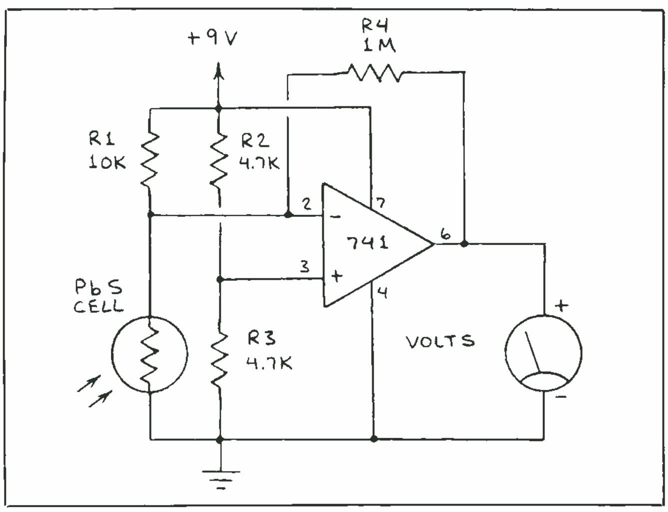


Fig. 2. A simple infrared radiometer.

corporate a low-power heater. The space between the window and detector is often evacuated or filled with dry nitrogen.

Infrared-sensing circuits that use PbS detectors are very easy to design and build. Unfortunately, PbS devices are not as readily available as detectors that respond to visible light. One major manufacturer of PbS detectors is *Infrared Industries.* Prices for its PbS detectors range from around $20 to $50.

PbS Detector Circuits

Figure 1 is the schematic diagram of a circuit for a simple infrared-sensitive tone generator. In this circuit, the frequency increases with the intensity of the infrared energy striking the circuit's lead-sulfide detector.

This circuit can easily be assembled in half the battery compartment of a small flashlight. Using the flashlight's built-in reflector will allow the detector to collect considerably more infrared energy than if it were used alone. The result is a considerable increase in circuit sensitivity. The PbS detector is mounted between the filament posts of the flashlight's lamp.

Caution: Use care when breaking and removing the lamp's glass envelope. One safe way to do this is to wrap the glass bulb in several layers of tissue and then crush it with gentle pressure from pliers. Be careful to avoid crushing or otherwise distorting the lamp's metal base.

A circuit similar to the one shown in Fig. 1 that I installed in a small pocket flashlight in 1973 still works today. It easily detects almost anything having a temperature near or above that of boiling water. For example, very discernible tone shifts are produced when the unit is pointed at a hot soldering iron, a warm stove, a running car engine, a bed of hot coals and even a hot water pipe.

A PbS detector can be used in a radiometer that provides a visual readout or relative infrared intensity. Figure 2 is one such circuit. In operation, the voltage appearing across the divider formed by *R1* and the PbS detector is amplified by a 741 op amp. The amplified voltage is indicated by means of a voltmeter.

Fig. 3. A typical Eltec IR detector.

For best results, the detector should be installed at the focus of a reflector, perhaps a flashlight reflector as described above. A thin sheet of polyethylene plastic is relatively transmissive to the infrared wavelengths emitted by the human body and can be used as a protective window over the reflector. *Edmund Scientific* is an excellent source for various kinds of parabolic reflectors.

Because the input of the circuit is a voltage divider network and because of the op amp's offset current, the meter will indicate a small output voltage even when the PbS detector is blocked. Therefore, you may want to experiment with variations on the basic Fig. 2 circuit to obtain optimum results.

Better op amps have a smaller offset current. And, depending on the specifications of the PbS detector, it might be possible to eliminate the voltage divider input by connecting the circuit as a transimpedance amplifier. In this mode, the detector is connected between the amplifier's input and a supply voltage. For additional information about transimpedance amplifiers, see any good book on op amps. A very simple explanation is given in my *Engineer's Mini-Notebook: Op Amp IC Circuits* (1985), a Siliconcepts™ book available from Radio Shack.

Pyroelectric Detectors

Certain plastic films, ceramics and unsymmetrical crystals (such as lithium tantalate) exhibit the "pyroelectric" effect. A thin wafer or film of pyroelectric material coated on both faces with conductive electrodes functions well as an infrared detector. Since pyroelectric materials are electrical insulators, the resultant assembly is essentially electrically equivalent to a capacitor.

Pyroelectric material exhibits an internal electric field that is collected by the electrodes. When infrared radiation strikes the pyroelectric material, the charge on the electrodes is almost instantly altered. The change in charge is detected by a circuit connected across the detector.

A typical lithium-tantalate pyroelectric detector has a capacitance of almost 30 picofarads. Monitoring the charge on a capacitor this small requires a high-input-impedance amplifier. Therefore, most lithium-tantalate detectors are packaged together with a FET and high-value load resistor that together provide necessary impedance conversion.

Typical lithium-tantalate detectors have a smaller D* than PbS detectors. According to at least one major manufacturer of lithium-tantalate detectors, this difference may not be significant in all applications. That's because operation of a lithium-tantalate detector is dependent on the on the area of the device, not the square root of the area.

Pyroelectric detectors can respond more rapidly than can most other kinds of infrared detectors. A lithium-tantalate detector, for example, may have a response time of nanoseconds when a small load resistor is used.

Unlike most other kinds of infrared detectors, pyroelectric detectors respond only to changes in the intensity of infrared radiation they receive. As will soon be clear, this can be advantageous when

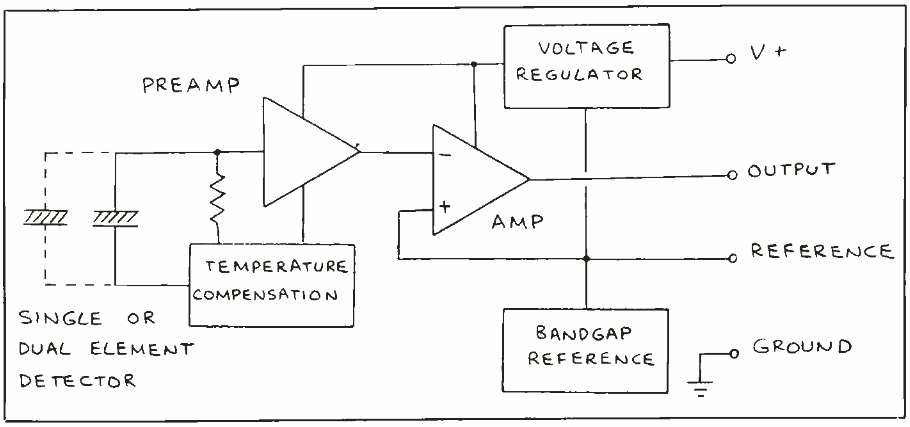


Fig. 4. Block diagram of internal circuitry of a typical Eltec IR indicator.

the infrared energy being detected is modulated or emitted by a moving source. For other applications, however, a mechanical chopping wheel must be placed before the detector to provide a fluctuating source of infrared energy. Otherwise, the detector might produce only a single transient when first exposed to the infrared, then quickly settle down and produce no signal, even though it continues to receive a steady IR signal.

Lithium-tantalate detectors are available for around $25 apiece from several manufacturers. Many such detectors are actually dual detectors designed specifically to detect moving infrared "targets," such as human beings. A family of both single and dual detectors is the 440 series "IR-EYE"™ integrated IR lithium-tantalate detector series made by Eltec Instruments, Inc.

Figure 3 shows a typical Eltec lithium-tantalate detector, and Fig. 4 is a block diagram of the internal circuitry in a typical Eltec detector. Both the detector and its circuitry are housed in a TO-5 can that has a square aperture fitted with an infrared-transmissive window.

Since pyroelectric detectors also possess piezoelectric properties, Eltec mounts its detector chips on an array of flexible electrodes that function as shock absorbers. This reduces false signals and detector noise that might result from vibration and movement.

Amperex Electronics Corp. also makes a family of pyroelectric ceramic detectors, including the miniature low-profile, dual-element KRX10. These detectors are made from doped lead zirconate titanate, a rugged material that is unaffected by water. Like the Eltec detectors, the Amperex devices include low-noise impedance-matching circuitry.

Spectral sensitivity of pyroelectric detectors ranges from 0.0001 (soft X-rays) to 1,000 micrometers. Therefore, various window materials are often used to selectively filter out unwanted wavelengths to enhance a detector's performance at specific wavelengths. For example, Eltec's HP7(-3) window is a coated high-pass material that effectively blocks most of the radiation from the sun and incandescent lamps while transmitting the spectral band near 10 micrometers emitted by a human being. Figure 5 shows the overall transmission of this material and the region over which transmission exceeds 70 percent.

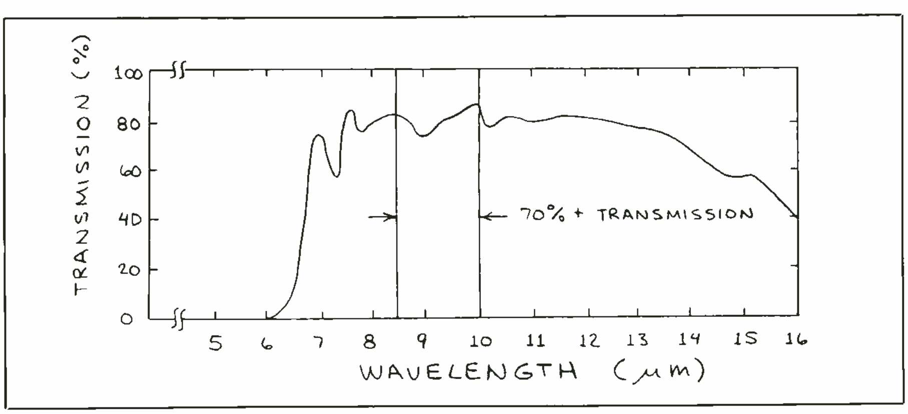


Fig. 5. Transmission characteristics of Eltec's -3 window.

Pyroelectric Detector Circuits

Figure 6 is the schematic diagram of a simple amplifier circuit that can indicate the presence of a burst or fluctuating source of infrared radiation. The detector is a single-element pyroelectric device, such as Eltec's 441M1-3. When the circuit is connected to a voltmeter, a constant output of about 7.7 volts will be indicated. If you place your hand a few inches from the detector and then move it away, the meter's pointer will swing to around 2.5 volts, pause a moment and then return to its previous state. The meter should indicate the presence of your hand out to a distance of a foot or more. Detection range can be increased considerably with an infrared-transmissive lens or a parabolic reflector.

An LED can also serve as an output indicator. The LED will normally remain off, even when you place your hand a few inches from the detector. When you move your hand away, the LED will switch on, glow for a second or so and then switch off. Unless you use a high-input-impedance multimeter (set to indicate voltage), it's best to use either the LED or the voltmeter.

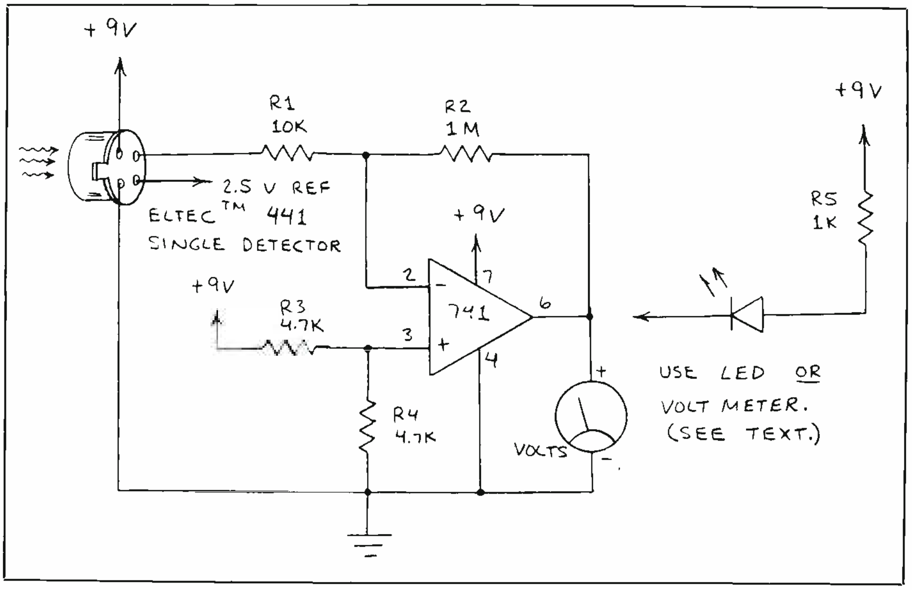


Fig. 6. A simple pyroelectric IR indicator.

Incidentally, this circuit will not function as described when power is initially applied to it. A minute or so after power-up, though, the detector will stabilize and the circuit will work properly.

Figure 7 is the schematic diagram of a simple adjustable-threshold infrared detection circuit. In this circuit, a 741 or other op amp is connected as a comparator whose switching voltage or threshold

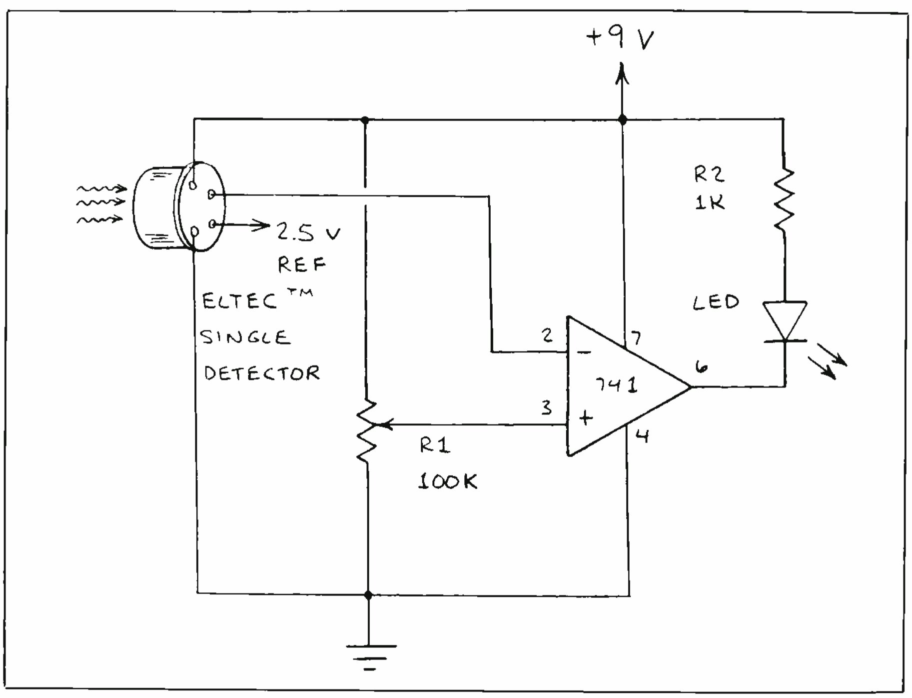


Fig. 7. An adjustable-threshold pyroelectric IR detector.

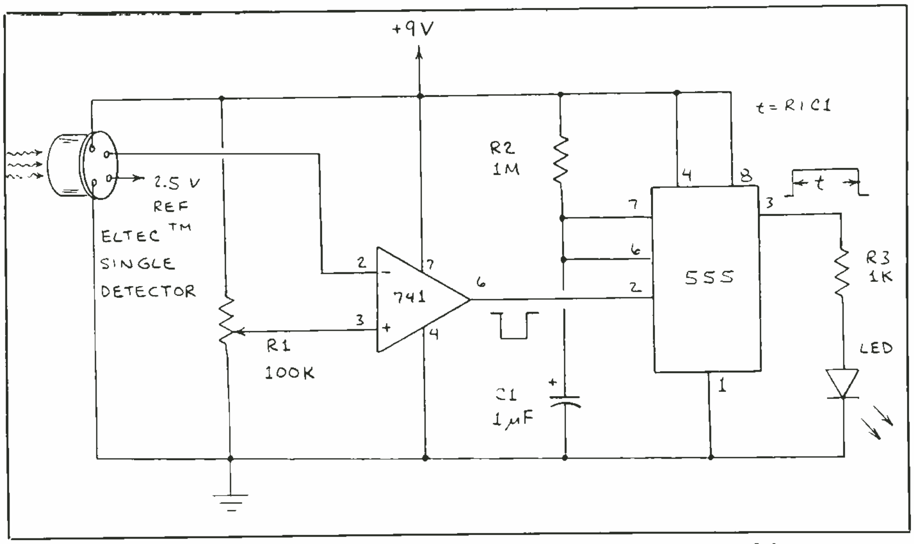


Fig. 8. Adjustable-threshold pyroelectric detector with output delay.

is controlled by potentiometer *R1*. In operation, after applying power and allowing the detector to stabilize, *R1* is adjusted until the LED just switches off. When your hand or another warm object is placed within a few feet of the detector, the LED will remain off. When your hand is moved out of the detector's field of view, the LED will switch on and remain glowing for several seconds.

In some infrared detection applications, it is necessary for the output of the detection circuit to remain actuated for a a fixed time interval. For example, an IR detection circuit for an automatic door opener must remain actuated long enough for a motor to fully open the door.

The Fig. 6 circuit may be adequate for some such applications, since the output remains active for a few seconds after the infrared source is removed. For applications that require a longer time delay. the output of the Fig. 7 circuit can be connected to a 555 monostable multivibrator, as shown in Fig. 8.

The 555 circuit in Fig. 8 provides a delay of several seconds. Increasing the value of *C1* or *R1* increases the timing interval. Actual delay in seconds corresponds approximately to the product of *R1* and *C1*. For more details about 555 monostable circuits, see the 555 specifications in a databook or my *Engineer's Mini-Notebook: 555 Timer IC Circuits* (1984), a Siliconcepts book available from Radio Shack.

Dual Pyroelectric Detector Circuits

The single-detector circuits described above are all capable of detecting such moving infrared-emitting targets as people, pets, livestock, automobiles and other warm objects. However, they are sub-

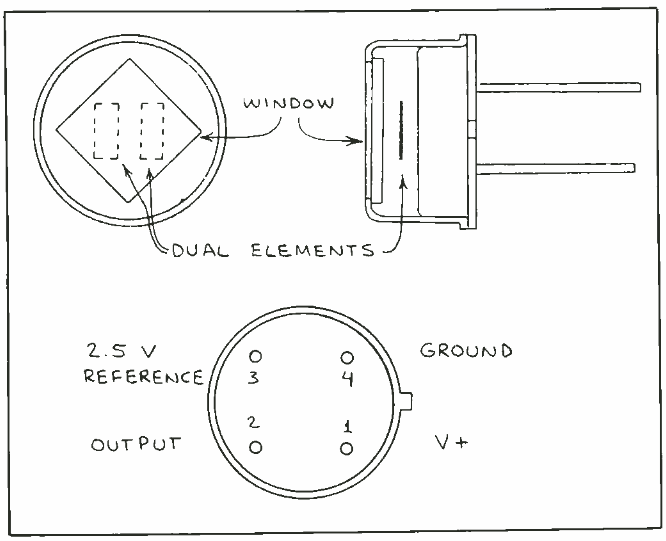


Fig. 9. Package details of Eltec's dual pyroelectric IR detector.

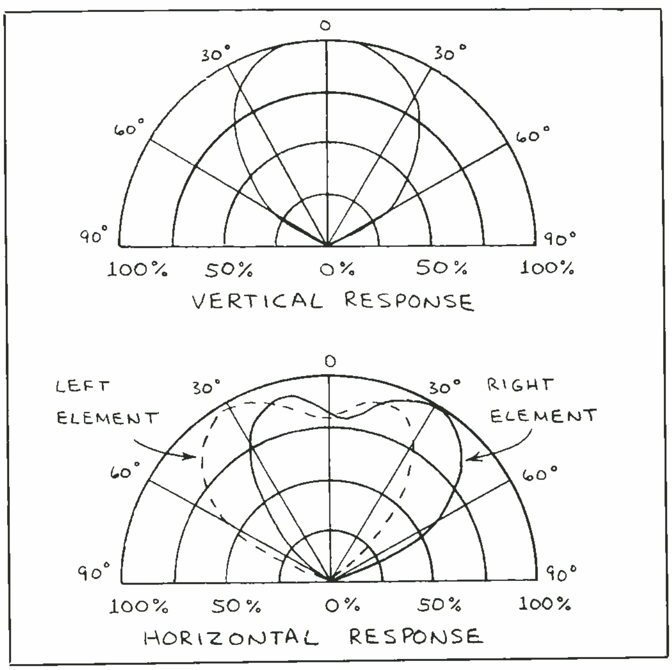


Fig. 10. Field of view of Eltec's dual pyroelectric IR detector.

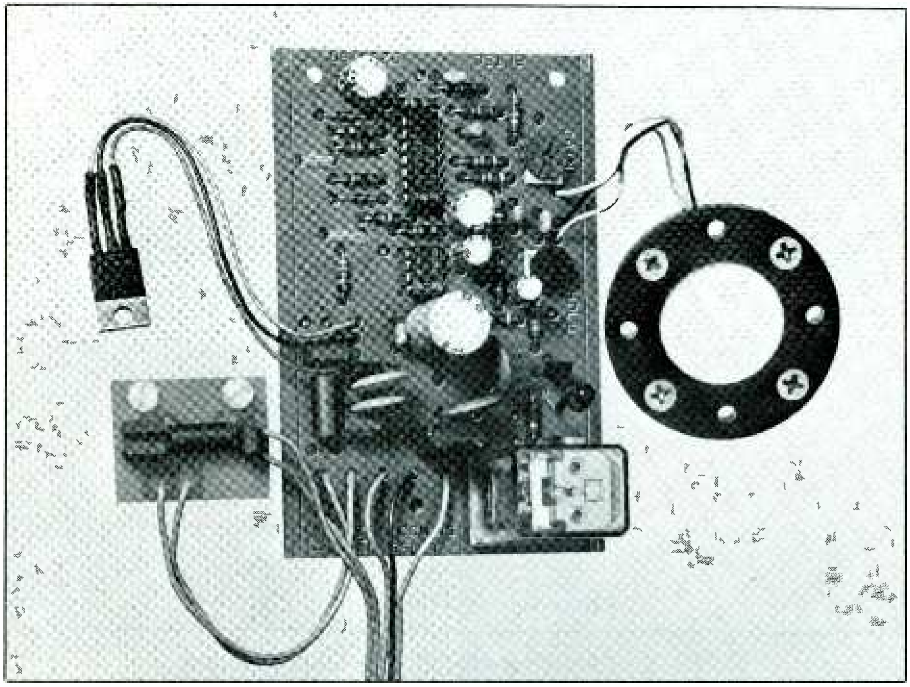


Fig. 11. Eltec's "IR-Eye" passive IR sensing system.

ject to false triggering due to random noise. False alarms can be greatly reduced by using a dual detector.

A dual detector consists of two pyroelectric detectors mounted close together on a common substrate. Generally, the detectors are connected in reverse series or reverse parallel. Therefore, no output signal occurs when infrared radiation equally irradiates both detectors. If one detector receives slightly more infrared energy, however, an output signal is generated.

Figure 9 is an outline view of a typical Eltec dual-element lithium-tantalate infrared detector. Figure 10 illustrates the field of view of this kind of detector. Note that the vertical response of the two detectors is identical, while the horizontal response differs.

Even though the horizontal response differs, for most practical movement detection applications it is necessary to focus the received infrared signal onto the detectors with a lens or reflector. The lens or reflector collects far more radiation than the unassisted detectors do, thereby significantly increasing detection range. Moreover, without a lens or reflector both detector chips will receive approximately the same amount of infrared energy.

Generally, a lens or reflector will sharply focus the infrared energy from a moving infrared source (the target) onto only one detector at a time. Therefore, a person walking through the field of view of a dual detector equipped with a lens will cause two distinct pulses to appear on either side of a null. The first pulse occurs when the image of the person irradiates the first detector. The null occurs when the person moves into the field of view of both detectors, thereby canceling the output from each. The second pulse occurs when the person moves into the field of view of the second detector.

Though each of the pyroelectric detector circuits described above specifies a single-element detector, each can be used with a dual-element detector. Indeed, infrared motion detectors can be designed around a single-element detector. For best results, however, a dual-element detector and a collection lens or reflector are required.

You can easily design and assemble your own infrared motion detector, or you can purchase a preassembled circuit like Eltec's Model 822/826B/4192-3 IR-Eye Passive Infrared Sensing System shown in Fig. 11. This system, which costs $85, uses a dual lithium-tantalate detector installed in a molded nylon detector head that is fitted with an IR-transmissive fresnel lens. When an infrared source is detected, a relay is actuated. The system can be powered by a 9-volt battery or 24 volts ac. Both sensitivity and delay time of the system can be adjusted as needed.

Figure 12 is an exploded view of the detector head (the large circular object in Fig. 11). When the hollow square reflector is installed, the system has a relatively broad field of view (approximately 60 de-

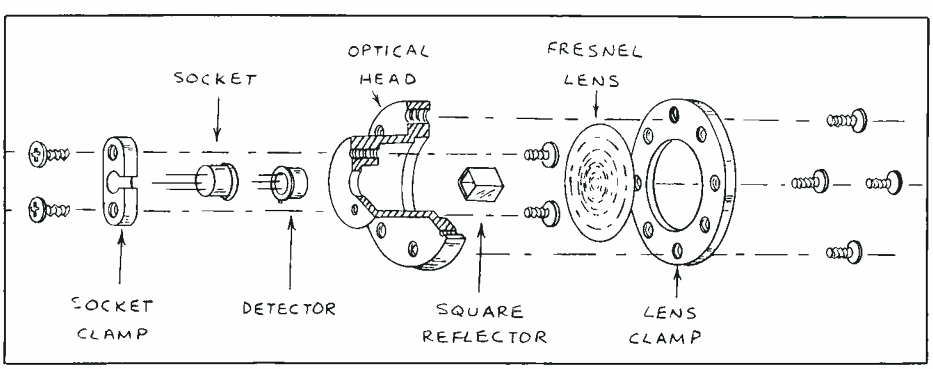


Fig. 12. Exploded view showing internal details of Eltec's "IR-Eye" optical head.

NAMES AND ADDRESSES

Amperex Electronic Corp.
George Washington Hwy.
Smithfield, RI 02917

Edmund Scientific Co.
101 E. Gloucester Pike
Barrington, NJ 08007

Eltec Instruments, Inc.
P.O. Box 9610
Central Business Park
Daytona Beach, FL 32020

Infrared Industries, Inc.
12151 Research Pkwy.
Orlando, FL 32826

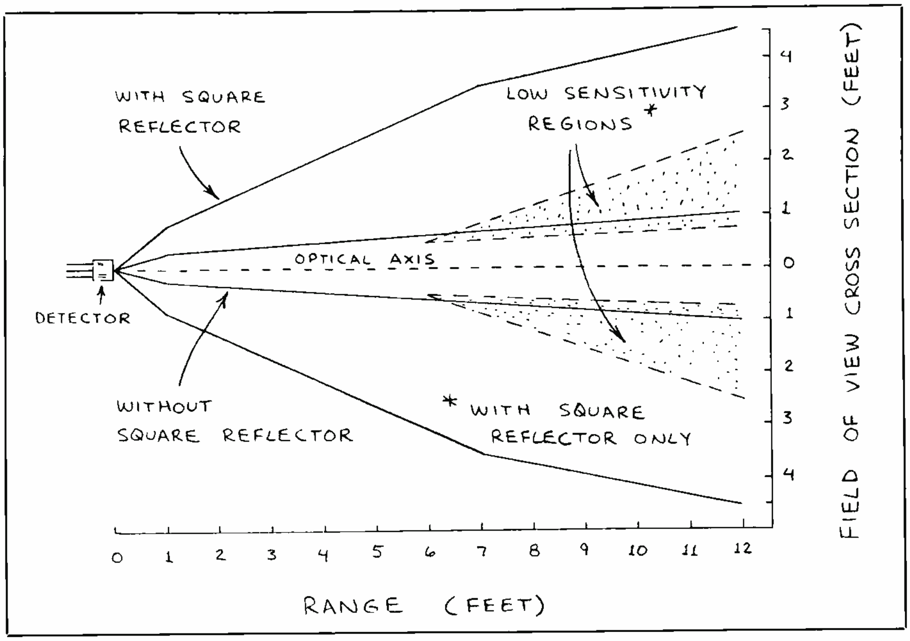


Fig. 13. Field of view of "IR-Eye" optical head.

grees) that is divided into alternating active and inactive regions. This increases the contrast of moving infrared targets, thereby enhancing system reliability. With the hollow square reflector installed, the system will detect a human being at a range of up to about 15 feet.

When the hollow square reflector is removed, the field of view of the detector head is reduced to around 6 degrees. This permits a human being to be detected out to a range of approximately 50 feet or more. Figure 3 shows the field of view for both operating modes.

If the detector in the IR-Eye system is replaced by a single-element unit, the system can be used to detect flames. Detectors with different window materials can also be used to enable infrared targets at specific temperatures to be more readily detected.

A particularly interesting aspect of the IR-Eye detector head is its plastic fresnel lens. Most glasses and plastics are not very transmissive of infrared wavelengths in the vicinity of 10 microns, which is the peak emission of the human body. Those materials that are highly transmissive at infrared wavelengths are generally expensive or water-soluble. A suitable compromise is to make a thin fresnel lens from a reasonably transmissive, inexpensive plastic. If made into a conventional positive lens, the plastic would be so thick it would absorb much of the radiation it collected. A fresnel lens is so thin that the losses are tolerable. Incidentally, keep in mind that thin polyethylene can be used as a window material for infrared detector systems.

Going Further

Lead-sulfide detectors are as easy to use as the common cadmium-sulfide photocell. Pyroelectric detectors, however, are trickier to use. Literature about pyroelectric detectors supplied by Eltec, Amperex and other manufacturers will greatly enhance your understanding of this important class of infrared sensors. But hands-on experience is more important to understanding the advantages and limitations of both lead-sulfide photoresistive detectors and pyroelectric detectors. Therefore, I hope you will obtain some detectors and try some of the circuits presented here. **ME**

Bookmark—Data-Protection Software

By Art Salsberg

Bookmark™ from Intellisoft International is a memory-resident $70 program for IBM PC/XT/AT computers and true compatibles that protects software data in an unusual manner.

It copies what's in the system memory and video RAM regularly and automatically, creating hidden files on a reserved area of a hard disk. Doing this continually at selected intervals (the default is 1,000 keystrokes or two minutes, whichever comes first, or the user can select another stroke number of time) ensures that data will be preserved—up to the last save—in the event electric power is lost or some other problem occurs that causes data to be lost. One can also manually shut down the computer and still retain data.

In addition, Bookmark can automatically return you to precisely where you left off upon powering down when you start up again. This is done by answering Y in response to the opening question on whether you wish to resume.

Settings can be changed whenever you wish to do so at the C prompt. Furthermore, an alphanumeric password can be chosen to prevent an individual's work from being used by unauthorized people. Another feature of Bookmark is an Extended Key Buffer option that can store up to 127 characters instead of the default 15 characters.

In-Use Comments

It's easy to install Bookmark, which is copy protected and requires de-installation if you want to load it onto another hard disk. An on/off hot-key of your choice enables you to toggle Bookmark within a program so that it can be enabled or disabled.

Whenever an automatic save takes place, a screen display advises you. This isn't necessary, though, because you cannot continue to type until the save period is over. This happens fast enough, but as impatient computer users know, it's really never fast enough. To avoid interrupting my thought trends while typing, I found that I had to extend the default period to at least five minutes or 3,000 keystrokes. This protects my data to a lesser extent, but that's the tradeoff.

Be prepared to use up lots of disk space with this program, which only takes 6K of memory-resident RAM, because it "snapshots" in 256K to 640K chunks when it saves. There's usually plenty of room for this for most hard-disk users, but not always, especially if you have only a 10-megabyte one loaded with all your programs and data files.

Bookmark gives you the option of a double backup, too, which consists of alternate writing to one of two backup files from automatically saved ones. Each backup file takes the same hard-disk space as in your system's RAM and up to 256K of video RAM. Therefore, you'd really need at least a 20-Mb hard drive to use this extra-protection device. The extra protection comes in because some data could still be lost if a power outage occurs in the middle of a Bookmark save.

Perhaps the sorest point in using Bookmark is that it doesn't work well with all memory-resident programs. You might have to play around with the order of loading them in order to get Bookmark working flawlessly. Otherwise, you might find yourself with a frozen keyboard. Should this happen and you have to re-boot, you won't lose all your data, of course, just the newest data entered since the last Bookmark save.

Bookmark works with all manner of video boards, monochrome or color. It does not, however, support more than 640K of memory.

This is a nice, useful program, I concluded. But not for me at this time because I found myself unable to save a file during a few sessions and don't want to bother at this time to juggle memory-resident programs around or eliminate a Keybuf.Sys driver that Intellisoft's manual suggests could cause problems. Its cost is low enough and what it does automatically is important enough, however, for prospective users to invest in the program. ME

BOOKS

Technipubs/Prentice-Hall 1987 Electronics Source Book Series Edited by Harry Helms: CMOS Devices (soft cover; 560 pages; $39.95), Linear IC Devices (soft cover; 592 pages; $39.95), Microprocessors (soft cover; 576 pages; $39.95) and Operational Amplifiers (soft cover; 816 pages; $41.95).

This 8½" × 11" set of books provide technical information on a selected variety of IC devices. Provided information includes manufacturers' electrical and mechanical specifications and applications notes. Each volume has four separate indexes—by manufacturer, device number, device description and application—with the first being the "master" index. Contents are arranged alphabetically by manufacturer name and numerically within each manufacturer "chapter."

CMOS Devices includes data on arithmetic logic units, buffer/line drivers, data selectors, filters, flip-flops, latches, logic gates, modems, multiplexers and demultiplexers, multivibrators, PLLs, shift registers, switches, timers and miscellaneous devices. In all 92 CMOS devices from seven major manufacturers are represented.

Linear IC Devices includes data on amplifiers, companders, comparators, converters, function generators, modems, oscillators, PLLs, sample/hold devices, timers, voltage references and a variety of specialized devices. This volume contains complete technical information on 78 devices from 10 manufacturers.

Microprocessors covers the latest and most widely used 8-, 8/16-, 16-, 16/32- and 32-bit microprocessors available from four major manufacturers. It includes one page of brief preliminary data on Intel's 80386 and much more complete details on Motorola's 68020 32-bit high-performance processors that are currently being used in the most powerful personal computers and workstations.

Operational Amplifiers covers a miscellany of devices, such as active filters, amplifiers, automotive circuits, converters, logic circuits, multivibrators, oscillators, preamplifiers and miscellaneous devices. The last category includes such items as high/low limit devices, a Ni-Cd battery charger, air-flow and infrared detectors and more. This volume contains data and details on 154 devices from 11 major manufacturers.

Material contained in this series is not claimed to be complete in each category. Specific device types covered represent only those most commonly used in current electronic products and those products that will appear in the near future. In this light, this is a "must-have" reference library for anyone involved in product and system design, maintenance and troubleshooting.

Forrest Mims' Circuit Scrapbook II by Forrest M. Mims, III. (Howard W. Sams & Co. Soft cover. 255 pages. $19.95.)

This large-format (8½" × 11") book contains dozens of circuits that should keep any experimenter or hobbyist busy for a long time at his workbench. All are from the workbench of the master experimenter who writes our monthly "Electronics Notebook" column, and all have appeared in print in this and other magazines. Some are fully developed projects, others are add-ons or add-ins for existing equipment. Not a few are simple test instruments, and still others are just for having fun and games playing. All have been built by the author before being written up.

Each circuit is fully described in a manner that is easy to read and understand by even a novice experimenter. A "Going Further" section that concludes each discussion is a nice touch. Here is where applications are discussed, as are additional references, where applicable.

The "projects" presented are grouped according to category, such as analog or digital circuits, optoelectronic devices, lightwave communications, etc. The first chapter reintroduces the reader to the ubiquitous transistor, while the last chapter provides a nice wrap-up on circuit assembly tips.

Except in unusual cases, the circuits in this book can be built from readily available components. Radio Shack part numbers are given for most components. However, where specialized items are required source references are given, and the appendix at the back of the book lists company addresses for both unusual parts and further reading.

All in all, this is a well-written—and more to the point, enjoyable—book for experimenters of all levels. Every reader will find at least one circuit from among the dozens offered to build and use.

Inside the IBM PC AT by TJ Byers (Micro Text/McGraw-Hill. Soft cover. 309 pages. $19.95.)

If you use or hope to buy an IBM PC AT, this book can help you make greater use of this personal computer's power. It stresses practical applications. Hence, it is meant to be used as you sit at the keyboard and to serve as a reference manual to which can refer whenever you have a question or are in doubt about anything related to the machine, its DOS software and options. Material that deals with the various parts of the computer's hardware and its options is meant to be read and absorbed to guide you in setup procedures and installing various options.

Starting with an introductory overview of the hardware and software that make up an AT computer system, the book describes the two configurations that are available and talks about first impressions, computer security, the new disk drives that were introduced with this powerhouse computer and, especially, the 80286 microprocessor that gives the computer its tremendous power. Peripherals and networking are also discussed in this section. Initial system setup, a chapter in itself, then discusses available AT options, installation and initialization. Each succeeding chapter deals on an individual basis with a specific topic. Among these topics are: DOS 3.0, BASIC 3.0, the XENIX multiuser/multitasking operating system, the new keyboard in its many guises, the special disk drives that were introduced with the PC AT, video and graphics, interfacing and various other aspects of the system. Each chapter quickly familiarizes you with the topic under discussion.

The book is written in a manner that neither talks down to the newcomer nor up to the expert computer user. Though the text is not devoid of technical detail, only enough of this is given to inform and/or clarify specific points. All in all, then, this is a very worthwhile book for the IBM PC AT user to have alongside the computer's other documentation.

Build Your Own Satellite Dish Antenna by Gordon L. Williams. (Power Gain Systems, P.O. Box 2955, West Monroe, LA 71291. Soft cover. 44 pages. $12.00.)
In this book are complete fabrication details for putting together a 10-foot parabolic satellite TV antenna. Through words, drawings and photos, the book details the machining of the various members that make up the dish antenna from square one, starting with raw aluminum stock. It tells what tools are needed to fabricate and assemble the elements. Machining operations take up more than half of the book's pages. Everything is done step by step in numbered sequence.

Chapter 1, titled "Getting Started," lists the types of tools needed for fabrication and assembly. These are mostly common home woodworking and handyman items that most people already have, though a pop riveter and 6-ft straight edge and perhaps a large scribing compass may have to be bought or borrowed. For materials that are not commonly available from local stores, the author recommends sources.

Step-by-step instructions are provided for building a 10-foot parabolic dish antenna suitable for satellite TV reception. However, information is provided for fabricating 20- and 30-foot dishes for receiving other satellite services. In sum, this is an excellent book for anyone who is willing to devote the considerable time and money to building a satellite antenna.

NEW LITERATURE

Crystals Catalog. A new catalog from Jan Crystals gives general information on frequency-control quartz crystals for CB, amateur radio, scanning monitors, microprocessor and business radio. Listed and fully described are the entire line of crystals available from the company, including current prices. For a copy of Catalog No. 30, write to: Jan Crystals,

(Continued on page 86)

HARDWARE HACKER

Superconductivity breakthroughs; modem eliminators; sync stripping circuits; small hardware sources; new tech literature

By Don Lancaster

Uh, let us start with a correction to that Apple IIGS disk drive adapter circuit that we looked at in April 1987. Instead of making no connection to the 3.5″ ENABLE line, ground pin 4 of the DB-19 connector by jumpering it to pin 3 of the same connector. Sorry about that. This lets the 3.5″ drive boot properly if there is nothing in either of the 5.25″ drives.

One problem remains, though: flaky protection schemes used on some early Apple disks may take too long to start booting and thus may get bypassed. The only solutions to this are to (1) boot the problem disks on an old disk card in slot 6 only, or (2) remove the inane protection from a backup copy of the disk.

It's really interesting to watch the computer people dropping virtually all copy protection as being conclusively proven to be both unworkable and counterproductive, while at the same time watching others who are trying to force highly elaborate, quality-degrading, easily-bypassed, and totally useless "hardware locks" onto the new digital audio tape systems. Dumb.

I recently looked into the economics of self-publishing, and the opportunities I found here are astonishing. Did you know you can self-publish a technical book for a production cost of around $6 each for as few as *20* copies? And that your copies can be on the way to reviewers a mere seventy minutes after the final author manuscript is received?

The power of the press lies in owning one. A laser printer and *Postscript*-speaking one, of course.

Let me know if you want to hear more on this. I definitely want to get some self-help networking going. The time is long past due.

But for now, let's warm up to a very cold topic . . . .

What is superconductivity?

The past few weeks have seen some interesting breakthroughs in the field of superconductivity. The field dates back a dozen or more years, to when scientists and engineers at IBM and other laboratories discovered that two remarkable things happen when certain materials, most notably lead and niobium, are cooled to extremely low temperatures.

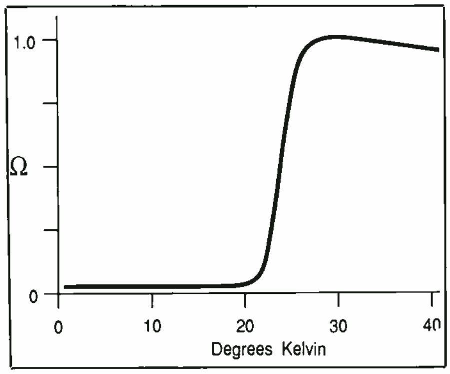


Fig. 1. Resistance curve for an older superconductor.

The first effect is that all electrical resistance drops magically to zero below a critical transition temperature. This is where the term "superconductivity" comes from. The second effect is that any and all internal magnetic fields also drop to zero. This is called the Meissner effect. For a true superconductor, both zero resistance and zero internal magnetic field are needed.

Until recently, these transition temperatures have been extremely low. In fact, the only way you could get them was by using liquid helium, a very expensive and rather inefficient way to cool things.

Superconductor critical temperatures are usually measured in degrees Kelvin. Zero degree K is in fact absolute zero; 273 degrees K is the usual melting point of ice; and 373 degrees K is the usual boiling point of water.

Figure 1 shows a resistance-versus-temperature curve for an older superconductor. Until very recently, superconductivity took place only in a few materials and then only at the frigid temperatures of 23 degrees K or lower.

As you might imagine, cooling costs have put a damper on uses for supercon-

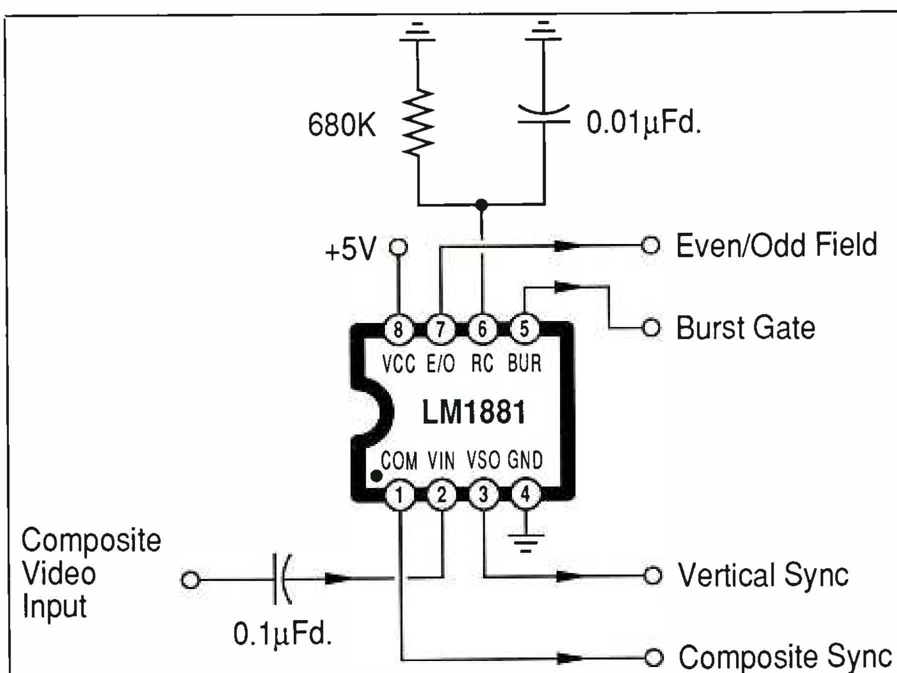


Fig. 2. A simple video sync stripper circuit.

ductors. To date, superconductivity is used for all the large magnets used in particle physics, where no other method is known that can create the intense magnetic fields required.

There is also a brand new oscilloscope out that makes used of superconductivity to achieve a 5-picosecond risetime. No, that's not a misprint. Five picosenconds! The time it takes light to travel the thickness of a quarter.

If you are going to worry about a little thing like a tank of liquid helium, you really don't need a 5-picosecond risetime scope. And if you have to ask how much this jewel costs, you can't afford it.

No, it's not in the Heath catalog—at least not yet. But let's dream a little. What if we had a room-temperature superconducting material that was cheap, ductile, strong, and easy to process? Nearly all electrical and electronic applications would be profoundly and permanently affected.

For instance, the 33 percent power loss involved in any long-distance electrical transmission could be eliminated. Levitated magnetic trains would be practical, as would much more efficient electric autos with far greater ranges. The expenses of elementary particle research would drop dramatically. In the computer area, the superconducting devices known as Josephsen junctions could be used as logic gates that are ridiculously faster, smaller, cooler, and more efficient than any logic we have today. And test equipment would never be the same; nor would be medical diagnostics.

Until several weeks ago, there seemed to be a 23-degree K barrier to superconducting materials, plus a bunch of theory that said that higher-temperature superconductors were impossible. Both have just been shattered. Hundreds of researchers in dozens of laboratories around the world have reported superconductors above 100 degrees K, and hints of superconductivity as high as 240 degrees K. The Russians even claim 250 degrees K. At -9 degrees Fahrenheit, that equals a typical January evening in Minneapolis, Minnesota.

Actually, the highest verified superconductivity transition temperatures are still in the 100-degree K range.

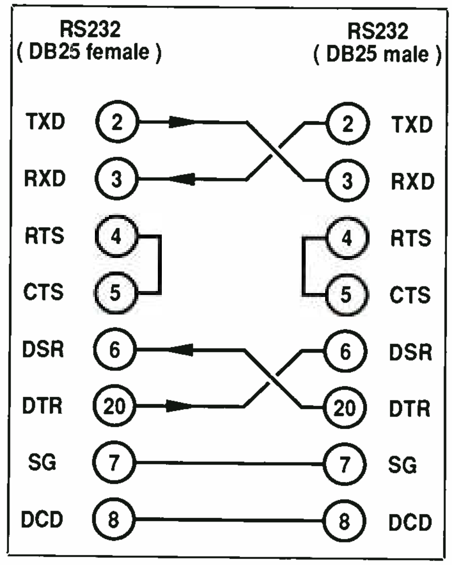


Fig. 3. A typical circuit for a modem eliminator.

These higher observations still remain unproved anomalies. But the chances are overwhelming that higher-temperature materials will be discovered and refined.

The new materials are simple. They are just ceramics made from copper oxides laced with rare-earth elements such as yttrium. Methods of forming them into thin films and other useful forms have already been described.

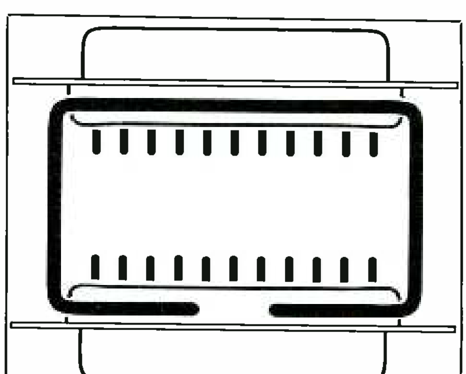


Fig. 4. Two wire loops hold modem eliminator together.

So, what's in this for a hacker? Liquid-helium cooling is beyond the means of all but the most gonzo super hacker. Liquid-nitrogen cooling, as needed by the 100-degree K materials, is within the bounds of what one or two dedicated individuals could handle on their own in a sophisticated home lab.

By way of comparison, liquid helium costs about the same as fine brandy, while liquid nitrogen costs about the same as draft beer.

With a 240-degree K superconductor, you're talking dry ice in a picnic basket on your kitchen table. And you now have a whole new ball game in which anyone has a chance to play.

Even with no lab of your own, superconductivity is a sure-fire winner for your school report or research topic.

Needless to say, the editors here at *Modern Electronics* will pay very well for the first superconducting hacker construction project that can be done on a kitchen table using reasonably available materials.

Where can I find tiny hardware?

Obvious places to look are your local hobby store, jeweler's supply houses and in model railroading magazines. One source of miniature taps, screws and nuts is J.I. Morris. The largest screw size they stock is 2-56, and they go down to 0000-160. These are available in both brass and stainless steel. Typical pricing is in the range of $10 per gross.

Show me a sync separator circuit.

The *National* LM1881 is a low-cost, easy-to-use sync stripper circuit you might find handy to use for converting composite computer video for use with split-sync monitors.

Figure 2 shows the simple circuit. You power this 8-pin mini-DIP from the usual + 5-volt supply and capacitor couple the input video as shown. Outputs include composite sync, vertical sync, burst and even/odd field.

While there is no horizontal sync output as such, the burst output can often be fattened a tad and used instead. The even/odd output will work on only "true" NTSC color video.

The NTSC color subcarrier can be regenerated by using the composite video and the burst gate as inputs to a chroma circuit or chip.

Let me know what additional uses you can come up with for this interesting integrated circuit.

What is a modem eliminator?

There are two different types of serial RS-232 data communications. When your computer is talking with a modem, all of the data lines and all of the handshaking likes are connected "straight through." On the other hand, when your computer is talking with another computer or to an intelligent printer, the data and handshaking outputs must be crossed so that output from one machine forms the input to the other.

Thus, in general, there are also two different types of serial data cables. Straight-through cables are used for modems, while crossed cables are used to talk to a printer or another computer.

Now, if you are talking from computer to computer through a pair of modems over the telephone line, you would use straight-through cables at both ends. But if you are sending your serial data directly from one computer to another without using a "real" modem, then you will need a single crossed cable.

We can call a straight-through cable a *modem* cable and a crossed cable a *printer* cable. More technically, the modem setup is called a DCE protocol, while the printer setup is called a DTE protocol.

The DTE stands for "data terminal equipment," while the DCE stands for "data communications equipment."

Many computer systems will offer other ways of crossing or not crossing cable pins. For instance, on the Apple IIe Super Serial Card, there is a small plug-in black box that goes arrow-down for printer use and arrow-up for modem use.

On the Apple IIGS, the control panel will select either "printer" or "modem" operation for either port. Much of the Macintosh software also gives you an option to cross or uncross your cables with software.

Newer serial communications standards, such as RS-422 and RS-423, also need ways of crossing cable lines, again crossing for computers and/or printers, and not crossing for modems.

A modem eliminator can be any connector lash-up that will either cross the wires on an uncrossed cable or will uncross those wires on a crossed cable. This is very handy if you are trying to use the "wrong" cable sometime, or you aren't sure what type of cable you have.

Figure 3 shows one possible RS-232 modem eliminator that seems to work well in both Apple and IBM environments. You can easily build this one from connectors picked up at *Radio Shack*, with total parts cost of under $6.

Pins 1 (safety ground), 7 (signal ground), and 8 (data carrier detect) go straight through. Pins 2 (transmitted data) and 3 (received data) are crossed. Pins 6 (data set ready) and 20 (data terminal ready) are separately crossed.

Pins 4 (ready to send) and 5 (clear to send) can be handled in several different ways, depending on your needs. These two pins are only rarely needed at all. If both ends of your application know what these signals are and how to use them, you should cross 4 to 5 and 5 to 4.

It is also possible to locally jumper pins 4 and 5 at both ends of your modem eliminator. I've done it this way, since this particular connection is very handy in getting from an IBM clone's COM1 port over to an Apple Laserwriter.

One hint on construction: if you do the obvious and use screws to hold the two back-to-back connectors, the screw heads will get in the way and cause hassles. Instead, take a foot of bare #12 wire (strip a scrap of house wiring) and bend it into a pair of rectangular loops as shown in Fig. 4.Then solder one loop to each side of each connector. Use a larger soldering gun or iron, and be sure to use a good grade of electronic solder flux.

NAMES AND NUMBERS

Advanced Linear Devices
1030 W. Maude Ave., B501
Sunnyvale, CA 94086
(408)720-8737

Allied Electronics
401 E. 8th St.
Ft. Worth, TX 76102
(800)433-5700

Harris Semiconductor
2401 Palm Bay Rd.
Palm Bay, FL 32905

J.I. Morris Co.
394 Elm St.
Southbridge, MA 01550
(617)764-4394

National Semiconductor
2900 Kifer Rd.
Santa Clara, CA 95052
(408)721-5000

Precision Monolithics
1500 Space Park Dr.
Santa Clara, CA 95052
408727-9222

PostScript BBS
2504 Sycamore St., Bay City, TX 77414
(409)244-4075

Relay Specialties
17 Raritan Rd.
Oakland, NJ 07436
(800)526-5376

Standard Microsystems
35 Marcus Blvd.
Hauppauge, NY 11788
(526)273-3100

Toshiba America
2692 Dow Ave.
Tustin, CA 92680
(714)832-6300

Note that a modem eliminator will not automatically correct your serial communication problems. All it can do is cross or uncross cables. Beyond that, you have to make sure that both ends are speaking the identical baud rate, number of data bits, number of stop bits, parity and handshaking.

Much more information on data communications appears in my *Micro Cook-*

books. I also have available a free RS-232 handout and breaker box plans that you can request.

What's new?

There are lots of goodies this month. *Allied Electronics* has a brand new fat and free catalog. At one time, Allied was *the* best place to go for first-line electronic components. Unfortunately, they went steadily downhill for far too many years due to stiff surcharges over and above the list price for small-quantity orders, for greatly limiting selections, and through general mismanagement.

Thankfully, Allied seems to have gotten over most of its worst hangups, and the company once again merits consideration as a good and reasonable source of supply for hardware hackers.

Relay Specialties has an interesting free catalog that lists pretty near any relay from just about any source. There are no bargains here, just a very wide selection of first-rate products at the usual list prices. Be sure to ask for a complete price list with your catalog request.

Precision Monolithics has a new 1987 data book on linear and data-conversion integrated circuits. Their ap notes tend to be built into their data sheets, but there is a complete subject index. This is a great source of linear circuits and ideas.

Standard Microsystems also has a new data book out on dedicated integrated circuits used for data communications, video display systems, keyboard encoders, and such.

Harris Semiconductor has a new products guidebook on their digital and linear integrated circuits. They do tend to be a bit pricey at times. And *Toshiba* has released a new MOS Memory data book with lots of good info in it on RAM, ROM, and EPROM products.

Advanced Linear Devices now has a micro-power 555-style timer that will run on as little as 1 volt of supply power. This one looks like a great hacker toy.

Turning to my own stuff, currently hot products include my *Postscript Show and Tell* for laser printing with most any computer. I now also have a pair of new mailers for you that include lots of free and hard-to-find information. Just write or call per the Need Help? box. **ME**

NEED HELP?

Phone or write your **Hardware Hacker** questions directly to:

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

Find Your Fortune, Plan a Page, Fix a Disk

By Eric Grevstad

It's been a good fight and I thought it was too close to call for the first rounds, but it looks like the Macintosh has won—not in the sense that Apple's flagship has replaced the PC standard as a superior machine for most applications, but in the sense that ease of use, friendly graphics instead of typed commands, and standard user interfaces and programmers' toolkits are taking over. Even the three-paragraph, no-specifications story in my hometown paper pointed out that the new IBM Personal System/2 machines can be used with a mouse; the next version of Microsoft Windows gives up even the token design difference of tiled windows in favor of Mac-style overlapping ones.

I like ease of use as much as the next guy and I hate to sound like those diehards who say they'll never give up on CP/M or the PC*jr*, but one thing worries me about the long-range trend: What's going to happen to all the quirky computer products?

I recently went to the West Coast Computer Faire in San Francisco (Hardware Hacker Don Lancaster was the best of the keynote speakers). A company named New Riders Publishing gave the press free copies of a ridiculous little program called Cookies ($5.95 plus $1.50 shipping); it randomly reads lines from the supplied or your own ASCII text file so that, placed in your AUTOEXEC.BAT file, it gives you a fortune cookie message each time you start your computer. It's absurd; I don't know why I haven't uninstalled it yet.

Cookies is a silly example, but I remain fond of programs that don't necessarily appeal to the Mac generation—software that, if not hard to use, still requires a bit of memorization or reading the manual; software that lets you twiddle around and do neat things in exchange for typing a few keystrokes. This month's examples are a limited but likable desktop publishing program, and a rather pricey but deluxe update to a popular disk utility software package.

PC Papers Lifestyle

The Newsletter of Computing Chic

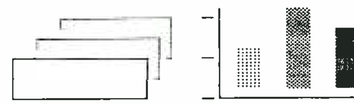
Volume 3, Number 7 — July 1987

Cinema Trends

HOLLYWOOD -- Personal computers have often appeared as props in movies such as WarGames, but Tinsel Town never expected the box-office success caused when Microsoft, inspired by sales of tutorial VCR cassettes, gave Paramount the go-ahead for MS-DOS: The Motion Picture. The high-tech adventure, starring Meryl Streep as the A> prompt, has already spawned two sequels, Charles Bronson's CHKDSK and Clint Eastwood's I Fought the DOS and the DOS Won.

Teenage horror buffs are flocking to IBM's Personal System 2: The Terror Continues, though other studios have flopped with such scare films as A Nightmare at ComputerLand and Sector the 13th, Track 4. Computer romances have not fared particularly well, either, judging from the Alan Alda/Kim Basinger bomb Software Compatible. Roger Moore's first role since retiring as James Bond, The 80386 Affair, received mixed reviews for its elegant looks and fast pace but incomplete status as a silent film, though producers say the soundtrack will be ready in two years.

PC Business Report



SEATTLE -- "A blast from the past" is how one Microsoft Corp. watcher describes a developers' test version of the long-awaited 386 operating system. According to secret sources, the new MS-DOS is a dead ringer for ProDOS, the Apple II operating system.

▶Details: Page 2

In This Issue

WordStar 4: Return of the Living Dead

Remove Ugly FAT From Your Hard Disk

50 New Commodore & Amiga Jokes

Follow Today's Fashions With the MODE Command

Vanna White's Best 1-2-3 Macros

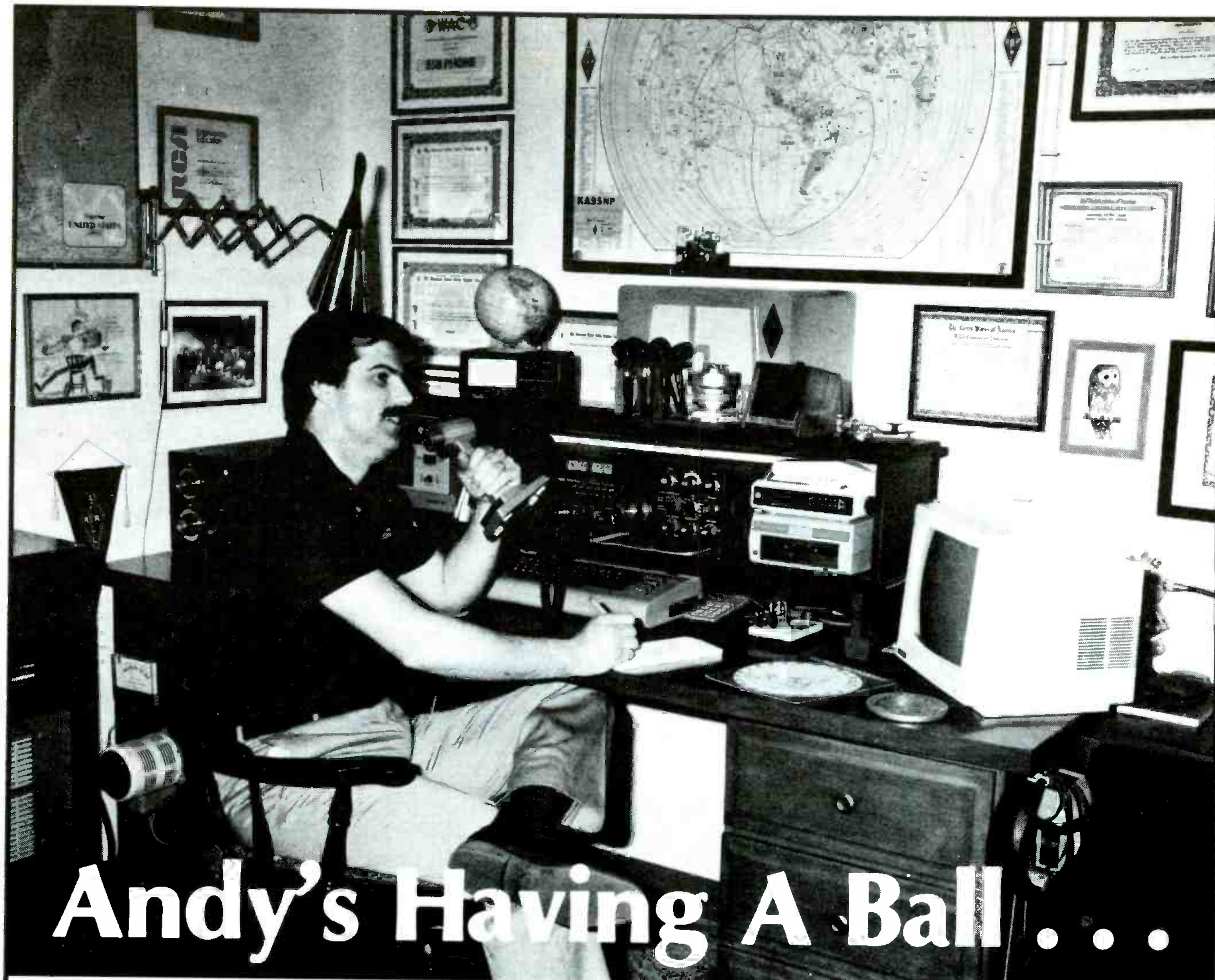
Look, Ma, no graphics: PAGEr brings desktop publishing under $50.

One Page at a Time

Everyone knows about desktop publishing: You need a program like PageMaker ($695) or Ventura Publisher ($895), a high-speed 286 or 386 system with a megabyte of memory, a hard disk, an Enhanced Graphics Adapter, a color monitor, and a Fine Arts degree. If someone offered you a program that restricted documents to one page, that supported few printers, and that contained no typestyles, graphics, or clip art, you'd laugh. But what if it needed only 256K and a floppy disk, worked with monochrome adapters and monitors, and cost just a mere $49.95?

This bizarre bargain is called PAGEr, from Plummer Research. It's a free-form page layout tool that lets you place text and single or double lines or boxes anywhere on an 8.5-by-11-inch (80 columns by 66 lines) page, then print them on an IBM Proprinter- or Epson-compatible dot-matrix or HP LaserJet. There are no fonts except normal, underlined, bold, double-width, and double-height text (the last two unavailable on LaserJets), and no graphics except the shapes, card suits, Greek letters, and smileyfaces of the PC's alternate character set. You can use these for composing makeshift diagrams or bar charts.

But for (very) modest newsletters or simple forms or invoices—the disk includes sample and tutorial files—PAGEr is surprisingly powerful and great fun to play with. The F10 key pops up a moving-bar menu of easily learned function-key commands; if you can't memorize them, you can leave a cheat-sheet menu on screen or press F1 for a help screen



and you can too!

Andy is a Ham Radio operator and he's having the time of his life talking to new and old friends in this country and around the world.

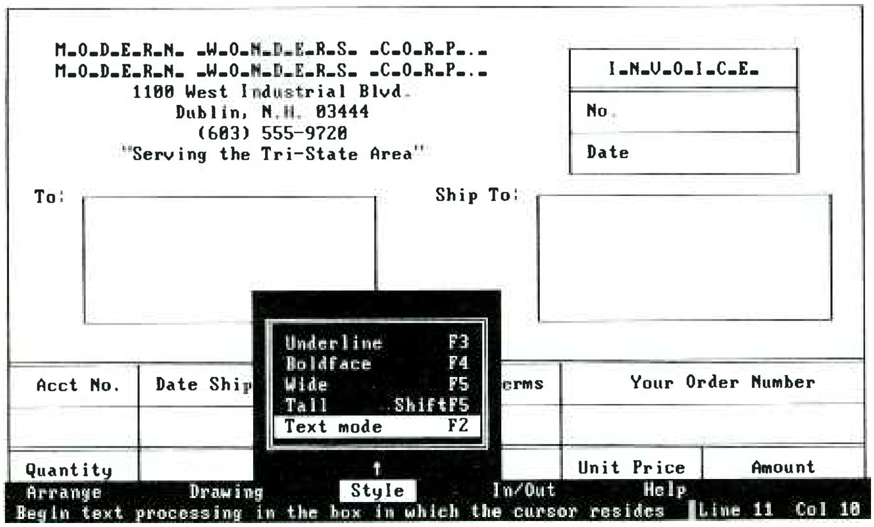
You can do it too! Join Andy as he communicates with the world. Enjoy the many unique and exclusive amateur bands . . . the millions of frequencies that Hams are allowed to use. Choose the frequency and time of day that are just right to talk to anywhere you wish. Only Amateur Radio operators get this kind of freedom of choice. And if it's friends you're looking to meet and talk with, Amateur Radio is the hobby for you. The world is waiting for you.

If you'd like to be part of the fun . . . if you'd like to feel the excitement . . . we can help you. We've got all the information you'll need to get your Ham license. Let us help you join more than a million other Hams around the world and here at home. Who are we? We're the American Radio Relay League, a non-profit representative organization of Amateur Radio operators.

For information on becoming a Ham operator
circle number 110 on the reader service card or write to:

AMERICAN RADIO RELAY LEAGUE Dept CQ, 225 Main Street
Newington, Conn. 06111.

This space donated by this publication in cooperation with the American Radio Relay League.

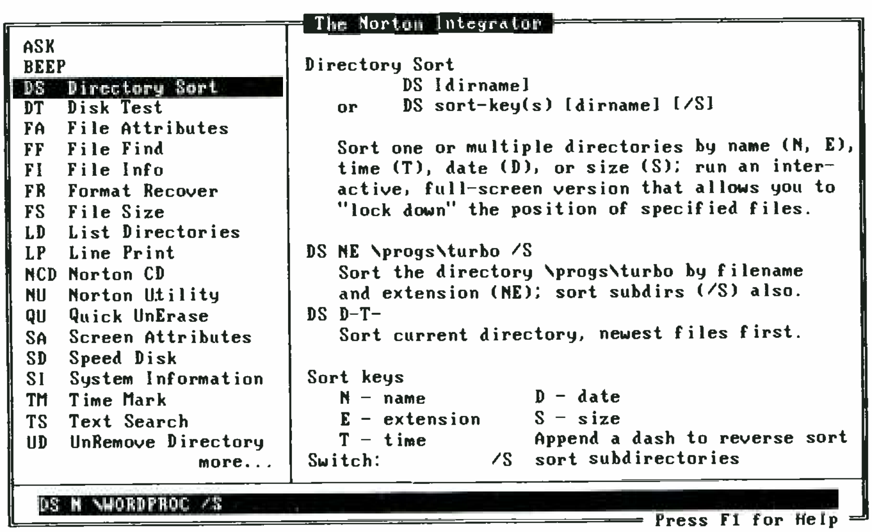


PAGEr shows its pop-up menu (and the spacers that indicate double-wide or -high text).

(actually, one 66-line help page). Drawing a line or box is easy, as is marking an area to center, move, cut, copy, or paste. An undo command minimizes mistakes. Since PAGEr isn't a graphics program, it's the fastest in its class at scrolling or moving around the page.

You can put text into as many columns as you want, drawn as boxes or borders (which you can erase after text is in place). The F2 key toggles between a whole-page overwrite mode and "text processing mode," which offers word wrap and left, right, or full justification within boxes (padding lines with extra spaces, occasionally ugly in slim columns). There are no text editing commands except for backspace and delete, but PAGEr takes care of that—put the cursor in a box and load an ASCII file created with your word processor. It'll be rearranged inside the new borders; if the file's too big to fit, loading will pause at the end of the box or column while you move to another.

That's a neat feature, but PAGEr has others; for its price, it's remarkably well-crafted, prompted, and foolproof. The "draw a line" command asks if you'd rather overwrite or skip intervening text such as a title; the erase command lets you remove an area or just the box around it. You must type a filename for the load or save commands, but one keystroke displays a directory. PAGEr makes homely dot-matrix printouts, but it lets you design them very nicely. It's a $50 program that's made me wish I had an Epson-compatible laser printer.



New from Norton: More power and a friendly menu.

Fireman, Save My Files

The Norton Utilities need no introduction; Peter Norton's package of DOS aids for finding, inspecting, and modifying disk files—and, most famously, UnErasing deleted ones—has saved users' bacon for years. Lately, however, rival utilities have broken Norton's market monopoly. The maestro has responded with two updates, Norton Utilities 4.0 ($99.95) and Advanced Edition ($150). I just got the latter, and my hard drive and I are ready for anything.

My first impression is that the Utilities have gained weight, growing from compact .COM to more sophisticated but bulky .EXE files. BEEP, which used to be a 16-byte program for audio alert at the end of a batch file, now takes 5,324 bytes and plays multiple tones or songs. Some Utilities take up disk space to replace DOS commands that take none—FI (File Info) is a 14K version of DIR, NCD (Norton Change Directory) a 19K equivalent to the directory commands MD, RD, and CD.

But, of course, the Norton programs do much more than their DOS ancestors. FI lets you attach a 65-character description to each item in a directory; NCD lets you choose or create directories anywhere on a visual diagram, or jump from any directory to another by typing its first few letters instead of pathnames and backslashes. You can search for a text phrase not only in existing but in erased files, or create batch files that pause for interactive keyboard input. If you want to examine or tinker with files, the main NU program is to DEBUG what Micro-

Names and Addresses

New Riders Publishing
31125 Via Colinas #902
Westlake Village, CA 01362
818-991-5392

Plummer Research
1345 Greenwood Ave.
Palo Alto, CA 94301
415-324-8160

Peter Norton Computing
2210 Wilshire Blvd.
Santa Monica, CA 90403

soft Word is to EDLIN for word processing.

Also, the new Utilities are much easier to use than the old. Experts can still juggle functions with command-line syntax, but novices (or those who use Norton only in emergencies) will apreciate the extra on-line help and the "Norton Integrator" that lets you run any Utility from a menu with help window. The main program has changed from a maze of pushing function keys to a smoothly prompted job of typing commands' first letters. Even complex UnErase functions almost run themselves, helped by a first-class, entertaining tutorial.

The Advanced Edition lets hard-disk hackers get into serious (and possibly dangerous) fiddling with directory contents and the partition and file allocation tables, but I endorse it for two other features. One, Speed Disk, rearranges your Winchester with directories up-front and contiguous, unfragmented files, much like Soft Logic Solutions' Disk Optimizer ("Software Focus," April 1987, p. 81).

The other, Format Recover, is phenomenal: If you've regularly run its update-date-file routine (and avoid a few versions of AT&T or Compaq DOS), it can undo the devastation caused if you accidentally reformat your hard disk. I gave it the acid test, and let me tell you, I was scared—I didn't realize what it'd be like, or that I'd actually shake and sweat when I saw "10,584,064 bytes free . . . Directory of C: , File not found." I grabbed Format Recover, crossed by fingers, and got it all back—every file, all 17 directories, each more lovely than the last. I'm a Norton groupie for life.

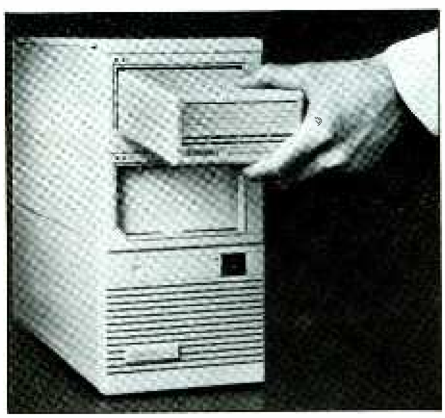
The Advanced Edition's $150 price seems a little steep; hackers and devotees of the "old" Norton will be tempted by the Mace Utilities (Paul Mace Software), which have more cryptic commands than the new Norton menus but which include undelete, unformat, unfragment, and a disk cache for $99. Still, if you can find a mail-order or discount dealer and want the most famous name in DOS supplements, Norton's definitely not resting on his laurels. **ME**

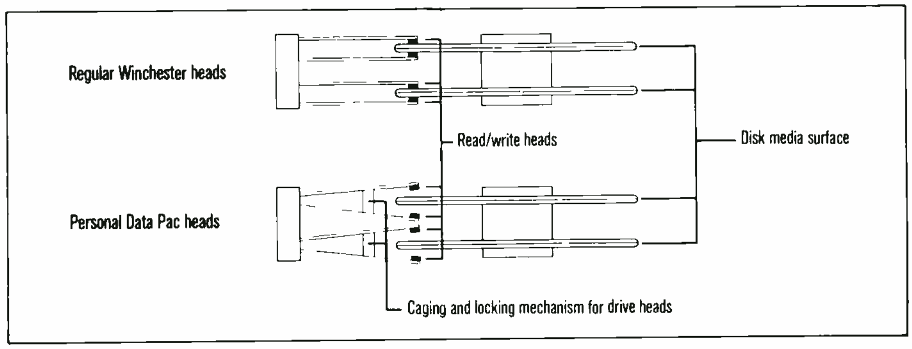
NEW PRODUCTS... *(from page 13)*

Computing to Go

Called "A computing environment to go," Tandon's new portable hard-disk drive technology represents a revolutionary step forward in transportable personal computing. Its new Personal Data Pacs (PDPs) are designed for use with IBM PC and compatible computers, as well as Tandon's own PAC 286 AT-compatible computer that was specifically developed to accommodate the hard-disk drives. PDPs pack 30 megabytes of storage capacity into compact, ruggedized modules that can be transported from one computer to another. Two PDP drives run in Tandon's Ad-PAC 2 subsystem that attaches by shielded cable to a personal computer. What makes this arrangement unique is its unusually rugged removable media.

Each Personal Data Pac weighs just 2.5 lbs., measures only 7″ × 4.75″ × 2.5″ and contains a 30-Mbyte capacity 3.5″ shock-mounted hard-disk drive in a plastic case. (The PDP resembles a standard external hard drive.) Unlike other removable hard-disk drives, PDPs are said to be built to withstand the rigors of transport. The Pac can be dropped, shaken and jolted without harming the media or drive mechanism. According to Tandon, even when the impact is severe enough to damage the outer plastic casing of the Pac, stored data is usually recoverable.





PDP drives feature a proprietary head-locking mechanism that secures the heads safely above the media when the Pac is not in use. Hence, there is no need to "park" the heads as must be done with other hard-disk systems. Access-time specifications are: average, 40 ms; track-to-track, 18 ms.

Personal Data Pacs can be used in Tandon's own PAC 286 computer as well as with any IBM PC or compatible computer equipped with the Ad PAC 2 subsystem, which also contains two slots called Data Racs. Upon inserting a PDP, an automatic VCR-like mechanism engages and fully draws it into the Data Rac slot, where it remains securely in place until ejected by the user or application. This is one level of ensuring data security. Another is a unique serial number that is encoded on the media at the Tandon plant. Application programs can read this number, but the controller itself thwarts any attempt to erase or alter it.

Application programs and sensitive data bases, for example, can be "married" to a single Data Pac, preventing them from being run or accessed from any other location. Large companies can also use the serial numbers to track individuals who have received copies of an application.

Performance-increasing features include: RLL (run length limited) technology that packs data 50% more densely on the disk than do conventional encoding methods; data caching through a 128K RAM buffer on the disk controller; and a disk directory on the mid-disk tracks that reduces average time required to seek directory information. About $400 per PDP; about $500 for Ad-PAC 2 subsystem.

Tandon's PAC 286 computer supports up to two of the 30-Mbyte Personal Data Pacs. Built around the 80286 microprocessor, the computer comes with 1 Mbyte of RAM and serial and parallel ports on its motherboard. The computer's footprint is 40% smaller than that of the IBM PC/AT and can be used either in a horizontal or vertical position.

The computer features Tandon's Memory Management System. At the lowest level, the system emulates the Lotus/Intel/Microsoft expanded memory specification (EMS) for support of a full megabyte of memory. It also allows standard applications to access all additional memory installed in the system, provided the appropriate software driver is available.

PAC 286 accommodates memory expansion cards to provide up to 4 Mbytes of additional RAM without using any of the standard expansion slots built into the system. Other features include: battery-backed clock; AT-enhanced 101-key keyboard; and socket for an 80287 math coprocessor. Microsoft Windows is included. Available options consist of a 12″ monochrome video monitor with Hercules-compatible graphics card and a 14″ EGA monitor with an EGA graphics card. About $3,000.

CIRCLE 25 ON FREE INFORMATION CARD

Universal Remote Controller

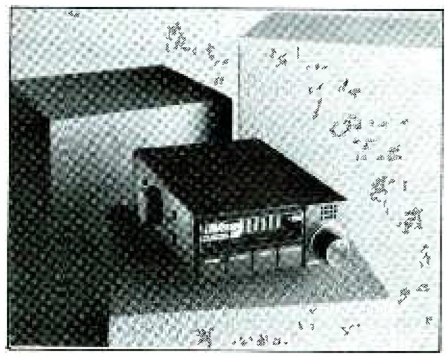
A user-programmable infrared remote controller for TV receivers, VCRs, cable boxes and just about any other device that can be controlled by infrared commands has been introduced by Onkyo, the Model RC-AV1 "Unifier." Any infrared remote-control commands from any manufacturer can be fed into the Unifier, which then learns the control codes from the other unit. More than 100 different functions can be stored in the Unifier's memory.

Supplied with control codes for Onkyo products already preprogrammed in, the Unifier can be easily reprogrammed. The key to this product's versatility is an on-board microprocessor that electronically stores and then later, on command, transmits the other remote's function codes. Three main modes are available: audio, video and auxiliary. The audio mode allows remote control of amplifier/tuner/receiver, cassette deck, CD player and turntable. The video mode works with TV receiver, cable TV box and videocassette recorder. The auxiliary mode handles any infrared-controlled home product and a variety of other components, including laser-disc players, equalizers, audio/video processors and home-security systems. $119.95.

CIRCLE 26 ON FREE INFORMATION CARD

Radar Detector

AutoPower and AutoMute are said to help make the new Vixen III the most convenient superheterodyne radar detector ever made by Fox Marketing. AutoPower eliminates the need to turn on and off the detector when entering and leaving your



vehicle. In most vehicles, the cigarette lighter is always powered—even when the ignition is off. If Vixen III is plugged into the cigarette lighter, the detector automatically turns itself on and off when the ignition is turned on and off. AutoMute eliminates a constant audible alarm during the time the detector is receiving a radar signal. When activated, AutoMute sounds an alarm for 5 seconds and then silences until another radar source is detected.

It features both a Varactor-tuned microwave cavity (VTC) and Fox's proprietary analog microchip for improved sensitivity and reduced false alarms. The VTC false-alarm rejection system is claimed to result in more precise interpretation of radar signals. Other features include a six-LED signal-strength meter and a city/highway switch. Included with the detector are a molded carrying case and brackets for dashtop/visor mounting.

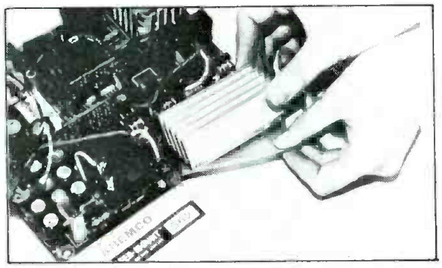
CIRCLE 27 ON FREE INFORMATION CARD

NEW PRODUCTS . . .

Heat-Sink to Printed-Circuit Board Adhesive

Wafer-Mount™ 562 is a dry film adhesive from Aremco Products (Ossining, NY) that provides a convenient method of bonding heat sinks to printed-circuit boards. It can be used to replace high-melting-point adhesives, hot-melt adhesives and double-backed tape. The film adhesive is claimed to provide a good mechanical bond while at the same time providing high thermal conductivity and electrical insulation. Its melting point is a low 200 degrees Fahrenheit, so it can be used to attach a heat sink without disturbing any components on the circuit board.

Offered in sheet form, Wafer-Mount is easy to apply. To use, you simply cut it to size. It is also easy to remove if the board requires repair. This is done by reheating it to 200 degrees and sliding the heat sink off the board. Any residue left behind can be removed with a toluene bath. \$50 for twenty 10″ × 8″ × 0.003″ sheets.



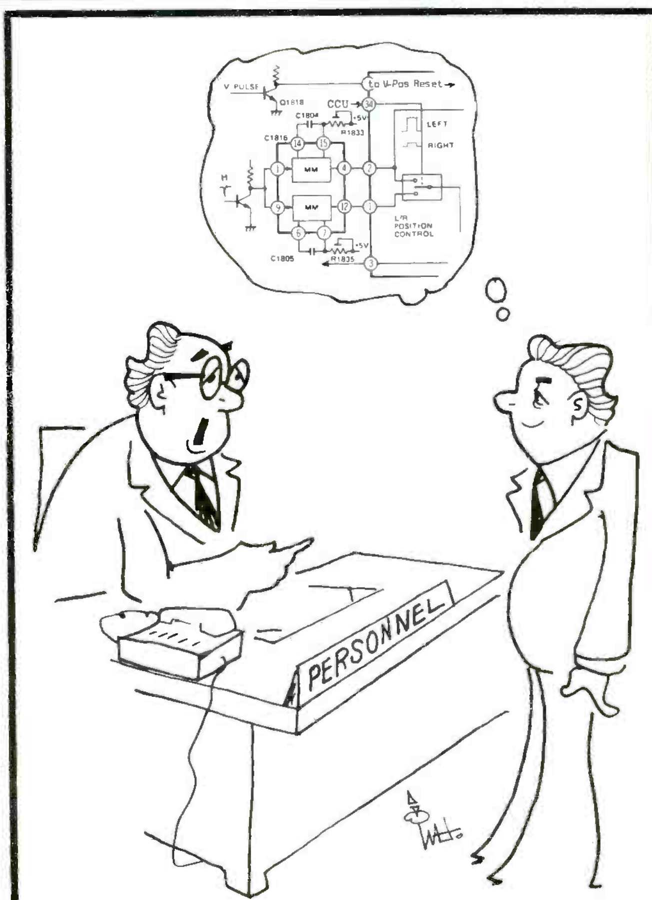
CIRCLE 28 ON FREE INFORMATION CARD

Dual Switchable T.I. Filter

A dual switchable filter that combines 60- and 80-MHz terrestrial interference notch filters in a single compact housing has been developed by Pico Products (Liverpool, NY). The DSF is said to provide effective suppression of mild to moderate T.I. on transponders where such interference is present. It can also be switched off when viewing satellite transponders where no T.I. is present.

The DSF's 60- and 80-MHz notch filters feature Pico's new "wide-notch" technology. The U-shaped notch overcomes minor errors in the downconversion process and accounts for slight shifts in the receiver's final i-f by keeping the 3-dB bandwidth at its existing width and increasing the 30-dB bandwidth from 50 kHz to 500 kHz. This is claimed to result in more efficient suppression of interfering carriers without additional loss of satellite video and audio signals.

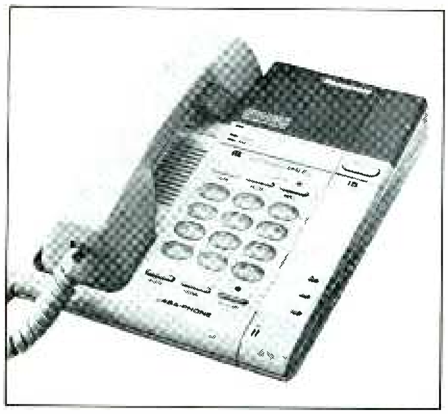
CIRCLE 29 ON FREE INFORMATION CARD



"I LIKE THE WAY YOU THINK,MR. ARLISS,YOU'RE HIRED."

Telephone/Answering Machines

Panasonic uses the latest in microchip technology in two compact integrated telephone instrument/answering machines. The new units use a memory chip instead of a separate



magnetic tape for outgoing messages, coupling it to a single microcassette incoming-message tape. As a result, size was dramatically reduced. The memory chip provides up to 16 seconds for an outgoing message. Panasonic's Auto Logic™ control system makes the units easy to use. For example, to listen to a message, pressing a playback/pause button causes the answering system to automatically switch to the playback mode. The tape rewinds and plays back messages that have been recorded. It then resets to receive additional calls. Both units feature tone remote control that eliminates the need to carry a beeper. Each system also has user-selectable security codes for the remote function.

The KX-T2622 features: Message Transfer that automatically dials a preprogrammed number after an incoming call has been recorded; Answer-Back Speakerphone for hands-free conversation; one-touch dialer that holds up to 16 30-digit numbers; 14-function access with the tone remote system; 15 times auto-redial; and 100 security codes. $199.95.

The KX-T2620 features: 12-station, 30-digit speed dialer with three emergency call buttons; one-touch redial that accommodates up to 30 digits; and 11-function tone remote access. $159.95.

CIRCLE 31 ON FREE INFORMATION CARD

Signaling Device for Homes

An easy-to-install exterior signaling device for homeowners who want an effective way to alert emergency and delivery vehicles, visitors and children to their residential location is available from Alert Devices (Hinsdale, IL). The "Alert Switch" consists of a wall-mounted interior light switch that contains an electronic circuit that can turn on and off an exterior porch or front-door light. When on, the light flashes and is similar to the lights used by many hotels to "hail" taxi cabs for their guests. To install the Alert Switch, one simply replaces the conventional switch that controls porch or front-door lights with the device. The Alert Switch measures 4″ high × 2″ deep × 1¾″ wide. $9.95 to $14.95.

CIRCLE 32 ON FREE INFORMATION CARD

CIRCLE 33 ON FREE INFORMATION CARD

CIRCLE 35 ON FREE INFORMATION CARD

NEW LITERATURE *(from page 69)*

2400 Crystal Dr., P.O. Box 06017, Ft. Myers, FL 33906.

Test Instruments Catalog. A new complete product line catalog from Sencore lists and describes the latest in test instruments for video, audio, component analysis, waveform analysis, IEEE instrumentation and a complete line of instrument accessories. Full specifications are given for all products, along with application information for each instrument, including nine new instruments designed to speed the technician's work. For a copy, write to: Sencore Electronics, 3200 Sencore Dr., Dept. ME, Sioux Falls, SD 57107.

Technical Supplies Catalog. Contact East's new Spring/Summer Catalog contains listings for thousands of products for engineers, technicians and hobbyists involved in assembling, installing, testing and repairing all types of electrical and electronic equipment. Featured are such test instruments as DMMs, oscilloscopes, counters, power-line monitors, disk-drive testers, etc.; hand tools like screwdrivers, pliers, wrenches, crimpers and more; soldering supplies; static-control products; and Contact East's exclusive line of tool kits. All products are described in detail, including specifications, full-color photos and prices. For Free a copy, write to: Contact East, P.O. Box 786, Dept. ME, North Andover, MA 01845.

Interface Products Databook. A new comprehensive National Semiconductor databook describes the company's interface product line, including drivers and receivers, bus transceivers, display controllers, and memory and microprocessor support. The databook contains product data sheets and application notes detailing more than 200 devices. It is organized by product category and includes an alphabetic/numeric index. To obtain a copy of the Interface databook, send $9.00 to C.M.C. Publications, 565 Sinclair Frontage Rd., Milpitas, CA 95035-5470.

Communications Accessories Catalog. A catalog of communications accessory mounts of various types is available from IIX Equipment. It lists strap and multiple-antenna mounts, standoff brackets and ginpole kits, adapters and ladder masts for radio towers, and various mobile-radio mounting systems. For a free copy, write to: IIX Equipment Ltd., P.O. Box 9, Oaklawn, IL 60454.

Science and Technical Books Sourcebook. The "Book of Books" from Omega Press describes and gives ordering information for English-language textbooks from the 14 leading science and technology publishers. This one-stop source lets engineering and scientific professionals locate all the significant books available in any subject area. Listed are more than 10,000 book titles (plus scientific software and complete descriptions and prices) in 16 subject categories that include all engineering disciplines, the sciences, mathematics and computer science. For a free copy, write on company letterhead (and include business card) to: Bob Wiseman, Book of Books, Inc., P.O. box 2349, Stamford, CT 06906.

TI Filter Catalog. A new 32-page catalog/"textbook" from Microwave Filter describes symptoms and helps the reader to select filters to cure terrestrial interference in more than 500 satellite TV receivers. The publication is illustrated with diagrams for standard and block-down-conversion receivers that show where interference can affect the system and the choice of filters (an extensive listing of filters is provided) to solve the problem. Descriptions of TVRO installations are included. Also described is a line of SMATV cable system distribution filters and uplink/downlink bandpass filters for commercial and military bands. For a copy of Catalog No. MTV/87, write to: Linda Decoursey, Microwave Filter Co., Inc., 6743 Kinne St., E. Syracuse, NY 13057.

Filter-Synthesis/Analysis Software Literature. DGS Associates is offering literature that describes new highly professional, fully flexible CAD software specifically written for filter designers. The literature describes S/FILSYN™ for PC users, an interactive program consisting of separate modules and a number of utilities. Data sheets describe S/FILSYN and available filter types that work in conjunction with the program, including: low-pass, high-pass, linear-phase, bandpass and band-reject. The seven data sheets included in the literature include descriptions of all of the new software and the S/FILSYN program, plus a current price list. For a copy, write to: Dr. George Szentirmai, DGS Associates, 1352 Sarita Way, Santa Clara, CA 95051.

LETTERS . . . *(from page 5)*

64-pin microprocessors in the VCR. After a lot of head scratching, I decided to try a new processor, which I received by calling the replacement-parts division. That solved the problem.

My experience makes me look forward to the day when home appliances will routinely contain a port for computerized troubleshooting. By making available a connection for a computer and supplying a diagnostic disk and help software, in addition to the service manual, service technology will at last be brought up to the level of sophistication utilized by home appliances.

Dan Becker
Chapel Hill, NC

A Southpaw's Computer

• As a "lefty" in a "righty" world, I was ecstatic to see on page 82 of April 1987's Modern Electronics a Commodore PC clone for us people.

The left-hand return key will take a while to get used to—but as a percentage of the population that uses 30 percent of total brain capacity (as opposed to 10 percent), this should be no problem. But don't you think that reversing the Commodore logo was going a bit too far?

Joel C. Kerr
Vernon, CT

We thought that it's about time that someone addressed the needs of our country's left-handed minority. This view was supported by our film house's erroneous flopping of the picture.—Ed.

Parts Listings

• I have been picking up *Modern Electronics* at the supermarket for the past year and know that it is way past time to have this outstanding magazine delivered to the house. Enclosed is my check for a two-years subscription. As a technician/student/enthusiast, I find all the articles both interesting and informative, keep up the good work.

I do have a question: On many projects where a parts list is given, if the project is in a back issue, how many months from that issue would it be safe to assume that the parts supplier might still have the parts listed (mainly, in cases where a dealer or company is listed for a specific circuit board). Also, when a specific part, like the TIL-311 LED hex display (Texas Instruments; available from Jameco) listed in the "EPROM Programmer," Feb/Mar '87, why isn't the price of that part at time of publication also listed, as are the circuit boards. In most articles you do give the address of the dealer, but unless one has a multitude of catalogs, how does one know how much green stuff to send when ordering the parts?

Carlo H. De Shouten
El Paso, TX

Thanks for the subscription check and your kind comments. It's safe to assume that a circuit board offered for sale will be available for at least three months. Prices of specific parts are generally not listed because they vary so much from dealer to dealer, while a circuit-board supplier is a single source offering a unique product. Unless a kit of parts is noted, the pc-board seller doesn't usually offer the parts.—Ed

MODERN ELECTRONICS MART

Classified Commercial Rates: 90¢ per word, 15-word minimum ($13.50) prepaid. (Word count includes name and address, ZIP code and abbreviation each count as one word; P.O. Box number and telephone number count as two words each.) Indicate free category heading. A special heading is available for a $6 surcharge. *First word only is set boldface caps* at no charge. Add 20% for additional boldface words.
Mart Display Rates: 1" × 1 col., $120; 2" × 1 col., $230; 3" × 1 col., $330. Prepayment discount 5% for 6 issues; 10% for 12 issues prepaid at once.
(All advertisers with PO Box addresses must supply permanent address and telephone number. Copy is subject to publisher approval.)
Mailing Information: Copy must be received by the publisher by the 20th of the third month preceding the cover date. Send Advertising material with check or money order to: Modern Electronics, Classified Department, 76 N. Broadway, Hicksville, NY 11801.

VIDEO

STRANGE Stuff. Plans, kits, items. Build Satellite Dish $69. Descramblers, bugs, adult toys. Informational photo package $3. Refundable. Dirijo Corporation, Box 212-M, Lowell, NC 28098.

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.

CABLE TV CONVERTERS. Scientific Atlanta, Jerrold, Oak, Zenith, Hamlin. Many others. "New" **VIDEO HOPPER** "The Copy Killer". Visa, M/C & Amex Accepted. Toll Free **1-800-826-7623**. B&B Inc., 10517 Upton Circle, Bloomington, MN 55431.

CABLE DECODERS AND CONVERTERS. Get your free catalog today! Viewstar 2501 $129.00, Starcom-3 $139.95, N-12 Decoder replacement $100.00, Tri-Bi Decoder $100.00, Star Base $99.00, HAMLIN-JERROLD-OAK-SCIENTIFIC ATLANTA. OUR CATALOG WILL HELP YOU DETERMINE THE EQUIPMENT YOU NEED. OR CALL (402) 331-4957 GUARANTEED 90 DAYS. (M.D.) MOVIE DOCTOR ELECTRONICS, 5078 SO. 108TH #115, OMAHA, NE 68106.

PROJECTION TV . . . Convert your TV to project 7 Foot picture . . . Results comparable to $2,500 projectors . . . Total cost less than $30.00 . . . **PLANS AND 8" LENS** $21.95 . . . Illustrated information **FREE**. Macrocoma-MK, Washington Crossing, Pennsylvania 18977. Credit card orders 24 HRS. (215) 736-3979.

59 DEGREE BRAND NAME LNA's! LNB's! Ku-Band LNB's! Discount pricing! Catalog $1.00 (Refundable): LNA-MEI, 201 E. Southern, Suite 100, Tempe, AZ 85282.

ELECTRONICS

VOICE DISGUISERS! FM Bugs! SWL Active Antenna! Receivers! More! Catalog $1.00 (Refundable): XANDI ELECTRONICS, Box 25647, "K", Tempe, AZ 85282.

INTEL, RCA, NATIONAL, OKI, SGS, and more. Factory prime and surplus parts catalog. **LYNBAR** Industries, 205 Main, Box 822, St. Joseph, MI 49085-0822.

TUBES: 59¢. Year Guarantee. Free Catalog. Tube Tester $8.95. CORNELL, 4213-17 University, San Diego, CA 92105.

LINEAR PARTS—Transistors: MRF454 $15, MRF455 $12, MRF477 $11, MRF492 $16.75, MRF421 $22.50, SRF2072 $13, SRF3662 $25, 3800 $18.75, 2SC2290 $19.75, 2SC2879 $25. **Tubes:** 6KD6 $10.50, 6LQ6 $9.75, 6LF6 $9.75, 8950 $16.75. Best Prices on Palomar Road Noise Mics, Ranger AR3300. New 16 page Catalog listing radio/amplifier tricks—Channel Modification, PLL-Sliders, Peaking for Range, Hard-to-Find Linear Parts—Mail $1.00 to: **RFPC**, Box 700, San Marcos, CA 92069. For Same Day Parts Shipment, Call (619) 744-0728.

DIGITAL ELECTRONICS INTRODUCTORY COURSE! Covers Theory and Design. Includes Trainer Kit! $19.95 HIET Electronics, 2626 Babcock #1707, San Antonio, Texas 78229.

COMPUTERS

DISK Utility Program for all PC's using DOS featuring: copy functions, display specifications, disk surface analysis, sector display and modification, data repair, disk performance measurements, and much more. $40ppd. CGT Associates, Box 695, Concord, MA 01742. (617) 371-3130.

"FREE Price List: We sell video game cartridges for: Atari, 2600, 5200, Coleco, Intellivision, Nintendo. Software Atari XL/XE, Adam. Villa Villa, Box 17085, Milwaukee, WI 53217. Modems call (414) 265-5149 24 hrs, 300/1200 baud. Distributors feel free to contact us, if you have games to sell."

TI-99/4A Software/Hardware bargains. Hard to find items. Huge selection. Fast Service. Free Catalog. TYNAMIC, Box 690, Hicksville, NY 11801.

COMMUNICATIONS

PROPAGANDA TAPES! Authentic, rare recordings of WW-II German and Japanese shortwave broadcasts by "Tokyo Rose", "Axis Sally", others. Cassette $9.95. D-W Research, 4548 Auburn Blvd., #231-F, Sacramento, CA 95841.

POLICE, Fire Scanning Radios. Bearcat Regency Fanon. Harvey Park Radio, Box 19224ME, Denver, CO 80219.

INVENTORS

INVENTORS! Have idea for product or invention, don't know what to do? Call AIM we present ideas to manufacturers - Toll Free 1-800-225-5800.

DIGI-KEY CORPORATION

1-800-344-4539

AK, Puerto Rico — 218-681-6674 Telex — 62827914 FAX — 218-681-3380 TWX — 9103508982 DIGI KEY CORP

NATIONAL SEMICONDUCTOR • PANASONIC • ... OK MACHINE • EWC, INC. • INTERSIL • AD... EAC, INC. • J. W. MILLER • AAVID ENGINEE... E. F. JOHNSON • ATLANTIC SEMICONDUC... ...DIODES • DIAMOND TOOL • UNGAR • ...ES • CW INDUSTRIES • AMDEK • G.E. ...NGAR • YAGEO • J. W. MILLER • LUXO ...GC CHEMICALS • ARIES • PLESSEY

NEW! **256K (262,144 x 1) DRAM 150NS $5.70/1; $39.95/9**

Factory Firsts

INTEGRATED CIRCUITS

7400 TTL — 74LS00 TTL — 74HC00 CMOS — 74S00 TTL — 74C00 CMOS

INTEGRATED CIRCUITS

4000 CMOS — Linear — Memory — Micro — A/D & D/A — Interface — Signetics

4116 200 nsec 16,384x1 D Ram

NEC Memory Chips

NEC Microprocessor Chips

T I I.C. SOCKETS

SOLDER TAIL DIP SOCKETS

- Single beam
- Low profile
- YOUR CHOICE: TIN OR GOLD

TIN PLATED SOLDER TAIL — GOLD INLAY SOLDER TAIL

WIRE WRAP DIP SOCKETS

- Standard profile
- Universal mounting and packaging capabilities
- Contacts accommodate .015" through .021" rec. or round dual-in-line leads
- Wire wrap posts held to true position of .015" providing a true position of .025" on boards for efficient automatic wire wrapping
- YOUR CHOICE: TIN OR GOLD
- TEXAS INSTRUMENTS QUALITY

TIN PLATED WIRE WRAP — GOLD INLAY WIRE WRAP

Silicon Transistors

1 AMP SILICON RECTIFIERS

3 AMP SILICON RECTIFIERS

5% Carbon Film Resistors

Available in 1/8, 1/4 & 1/2 Watt

1/8 Watt Carbon Film Assortments — 1/4 Watt Carbon Film Assortments — 1/2 Watt Carbon Film Assortments

1% Metal Film Fixed Resistors

Available in 1/4 Watt

1/4 Watt Metal Film Assortments

5% Metal Oxide Film Resistors

Available in 1 & 2 Watt

1 Watt Resistor Assortments — 2 Watt Resistor Assortments — 5 Watt Resistor Assortments — 10 Watt Resistor Assortment

5% Wirewound Rec. Resistors

Available in 5 & 10 Watt

DISC CAPACITORS

NPO NPO NPO NPO NPO NPO NPO NPO

For Complete Specs on Physical Size and Electrical Characteristics, consult your FREE DIGI-KEY Catalog

ASSORTMENT OF 10 POPULAR VALUES PANASONIC QUALITY — 310 DISC CAPACITORS — CAT. NO. DH-KIT ONLY $24.95

PANASONIC LS SERIES

Miniature Aluminum Electrolytic Capacitors

150 CAPACITORS — ASSORTMENT OF 15 POPULAR CAPACITORS — Cat. No. P6200-Kit ONLY $39.95

TANTALUM CAPACITORS

ASSORTMENT OF 15 POPULAR VALUES — PANASONIC QUALITY — CAT. NO. F-KIT $54.95

Metallized Polyester Capacitors

ASSORTMENT of 15 POPULAR VALUES — CAT. NO. E-KIT $54.95

PANASONIC V-SERIES

Stacked Metallized Film Capacitors

The Digi-Key volume discount and service charges are simple to apply. Most items sold by Digi-Key may be combined for a volume discount. Items that are not discountable are identified by the suffix ND following the part number. After writing your order, total all of the discountable items and apply the appropriate discount. To this subtotal, add the non-discountable items. Then add the service charge. We pay all shipping and insurance to addresses in the U.S.A., Canada and Mexico when check or money order accompanies order. Digi-Key only ships orders within the continental U.S., Alaska, Hawaii, Canada and Mexico.

WHEN ORDERING BY PHONE, CALL 1-800-344-4539 (AK, call 218-681-6674). BY MAIL SEND YOUR ORDER TO: DIGI-KEY, P.O. Box 677, Thief River Falls, MN 56701.

You may pay by check, money order, Master Charge, VISA or C.O.D. **DIGI-KEY GUARANTEE:** Any parts or products purchased from Digi-Key that prove to be defective will be replaced or refunded if returned within 90 days from receipt with a copy of your invoice. ***"PRICES SUBJECT TO CHANGE WITHOUT NOTICE."***

SERVICE CHARGES		VOLUME DISCOUNT	
$ 0.00-$ 9.99	Add $2.00	$ 0.00-$ 99.99	NET
$ 10.00-$25.00	Add $0.75	$ 100.00-$249.99	Less 10%
$ 25.00-$49.99	Add $0.50	$ 250.00-$499.99	Less 15%
$ 50.00-$99.99	Add $0.25	$ 500.00-$999.99	Less 20%
$1000 & Up	No Charge	$1000 & Up	Less 25%

CIRCLE 3 ON FREE INFORMATION CARD

SPEAKER CATALOG

1001 bargains in electronics. Save up to 50% call toll free 1-800-346-2433 for ordering only. Order by VISA/MC/AMX. No COD's. Missouri, Alaska, Hawaii call 1-816-842-5092, or write McGee Radio, 1901 McGee St., K.C., MO 64108. Postage for catalog $1.00.

Free Product Information

Readers can obtain free information on products advertised by certain companies, as well as for some editorially mentioned products. Simply circle the appropriate number printed below an advertisement onto the Modern Electronics "Free Information Service" card bound into this issue. After filling in your name and address, just mail the postpaid card. Your request will be forwarded directly to the advertiser with a mailing label prepared by our reader-service department to ensure speedy response.

INVENTORS

INVENTORS! Can you profit from your idea? Call AMERICAN INVENTORS CORPORATION for free information. Over a decade of service, 1-800-338-5656. In Massachusetts or Canada call (413) 568-3753.

HACKERS

Pay TV and Satellite Descrambling. Now 120 pages. Theory and working schematics for 13 cable and 7 satellite systems. Includes Bypasses, detection methods. $14.95. 6 Ed., 20 page Supplement Only $8.95. *Experiments With Videocipher*. Turn-ons and cloning methods $12.95. *MDS/MMDS Handbook*. For Hackers $9.95. *Cable TV*. Two-Way, security, system design. $12.95. *Build Satellite Systems Under $600* $12.95. Any 3/$26. Summer catalog $1. Shojiki Electronics Corp., 1327P Niagara St., Niagara Falls, N.Y., 14303. COD's 716-284-2163.

MISCELLANEOUS

DISCOVER Apex® Power Screwdriving Bits, Accessories. Sensational fit, Remarkable toughness, Amazing durability. Free bargain catalog. Write today! Don Shockey, 5841 Longford Road, Dayton, Ohio 45424-2940.

LEARN MORSE CODE IN 1 HOUR. Amazing mnemonics. Supereasy! Moneyback guarantee. $5. Bahr, 2549-Q3 Temple, Palmbay, FL 32905.

BASIC COMPUTERS, 10 lesson correspondence course, $39.50. Certificate. Details free. AMERICAN TECHNICAL INSTITUTE, Box 201, Cedar Mountain, NC 28718.

ASIAN LADIES want correspondence for friendship, marriage, SUNSHINE INTERNATIONAL, Dept. TW, Box 260, North Hollywood, CA 91603.

Order Form
Please print in block letters.

MODERN ELECTRONICS 76 North Broadway, Hicksville, NY 11801

Name ______
Street ______
City ______
State ______ Zip ______

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20

Order Back Issues of MODERN ELECTRONICS

THE MAGAZINE FOR ELECTRONICS & COMPUTER ENTHUSIASTS

BACK ISSUE ORDER FORM

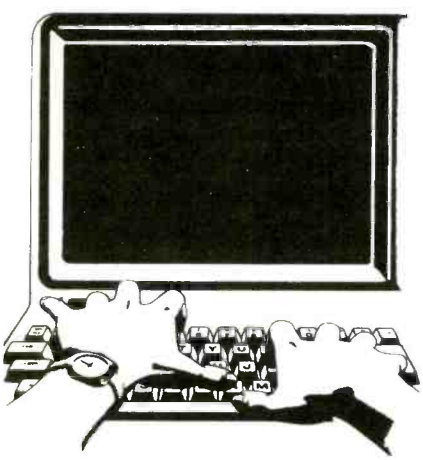
Please send me the following issues of *Modern Electronics* @ $2.50 each:

Month(s) & Year(s): ______

Number ordered @ $2.50 each: ______ Total Payment Enclosed: ______
(Check or M.O. only.)

NAME: ______
COMPANY (Optional): ______
STREET ADDRESS: ______
CITY: ______ STATE: ______ ZIP: ______

ADVERTISERS' INDEX



Free Product Information

Readers can obtain free information on products advertised by the above companies, as well as for some editorially mentioned products. Simply circle the appropriate number printed below an advertisement onto the Modern Electronics "Free Information Service" card bound into this issue. After filling in your name and address, just mail the postpaid card. Your request will be forwarded directly to the advertiser with a mailing label prepared by our reader-service department to ensure speedy response.

SUBSCRIBE NOW & SAVE!! – Twelve Issues $17.97

* *

2 CENTS PLAIN

* *

That's about all it costs subscribers for each page of editorial matter in ***MODERN ELECTRONICS . . .*** every month. No charge for informative advertisers' messages. Or for free information requested on our bound-in postpaid Free Information Service card.

A bargain? You bet! ***MODERN ELECTRONICS*** is a veritable one-stop source of "hard" information for enthusiasts whose interests spread across the entire spectrum of electronics and computers for work and play. The latest technical information and news written by a galaxy of authoritative writers—Forrest Mims on "Experimenting," Don Lancaster on "Hardware Hacking," Stan Prentiss on "Video," Len Feldman on "Audio," Glenn Hauser on "Communications," and Eric Grevstad on "Personal Computers," to name a few authors who share their specialized experiences with readers every month.

This neat package keeps everyone abreast of the important developments in electronics and computers. From new devices and circuits to useful construction projects to evaluations of the latest products. Both "how to do" and "how it works" information increases your technical competence every page of the way. Two cents a shot. And hands-on product evaluations make you a wiser buyer, whether it's on a test instrument or a video recorder. So whether you're a service technician, an engineer, a budding one in a technical career path, or an active electronics enthusiast, ***MODERN ELECTRONICS*** will serve you well. Subscribe and be sure to get every information-packed issue delivered to you every month. It's important reading you can't afford to miss!

Just fill out the coupon and mail with your check, money order or credit-card information (Visa or MasterCard) to enter your subscription. Do it today to ensure earliest delivery!

MODERN ELECTRONICS
76 North Broadway, Hicksville, NY 11801

Please send me Modern Electronics for ☐ 3 Years ☐ 2 Years ☐ 1 Year

Name ______________________

Street ______________________

City ______________________

State ______________ Zip __________

Charge My Order To: Payment Enclosed $ __________

☐ **MasterCard**

☐ **VISA**

3 Years (36 issues) .... $48.00 ☐
2 Years (24 issues) .... $33.00 ☐
1 Year (12 issues) .... $17.97 ☐

Account Number

☐-☐-☐-☐

board, but where it won't interfere with the board or battery.

If you plan on mounting the antenna off the board in a metal enclosure, size the mounting hole to accept a shoulder fiber washer on one side and a flat fiber washer on the other side of the wall to insulate the antenna from the metal of the enclosure. When you actually mount the antenna in place, sandwich a small solder lug between the inside fiber washer and the bottom of the antenna to provide a means for connecting a wire from the OUTPUT pad on the board to the antenna. With a plastic box, there's no need to insulate the antenna, but you do still require the solder lug.

If you plan on using an output jack (*J2*) with the antenna, either tack-solder a 1" or shorter insulated hookup wire to the trace near the OUTPUT pad or place a small solder lug between the screw head and lockwasher that secure the antenna to the board. Drill the hole for and mount *J2* as you did for *J1*, using a lockwasher or solder-lug ring according to whether the enclosure is metal or plastic. Again, solidly tighten the nut if you're using a metal enclosure but make it only finger-tight if you're using a plastic box.

Carefully determine where to drill the exit hole for the antenna on the other side of the enclosure. Drill the hole. If you're using a metal enclosure, make the hole large enough to allow you to fit a small rubber grommet that's just large enough to allow passage of the base (largest-diameter) section of the antenna to provide insulation. If you're using a plastic enclosure, there's no need to insulate the antenna from it.

Cut to length the insulated hookup wires needed to connect the jacks, power switch and antenna into the circuit. With a metal enclosure, you need a total of four wires if you're not planning on using the antenna, five if you are. You need connect circuit-board ground only to chassis ground via the GND near the OUTPUT pad (see Fig. 3). If you're using a plastic box, you need separate ground wires for each jack.

Strip ¼" of insulation from both ends of all wires. If you're using stranded hookup wire, twist together the fine wires at both ends of each and lightly tin with solder. Do the same for the the wires for the battery's snap connector.

Remove the circuit-board assembly from the box. Plug in and solder into place the wires for the jacks, switch, antenna and negative side of the battery connector (identified by black insulation). For plastic boxes only, remove the jacks and connect and solder the appropriate wires from the board's GND pads to their grounding lugs. Do the same for the small lug that goes to the antenna, and a No. 4 solder lug to the GND wire near the OUTPUT pad on the board if you're using a metal box.

Drill the holes for the power switch and battery clip. If you're using a metal enclosure, place a No. 4 lockwasher between the circuit board and metal spacer and between the spacer and enclosure wall at the mounting hole drilled near *R1* and *R14*. Similarly, place a lockwasher between the spacer and enclosure wall and the No. 4 solder lug attached to the GND wire near the OUTPUT pad between the board and spacer near *C7*.

Connect and solder the free ends of the wires to the center-conductor lugs of the INPUT and OUTPUT jacks and the switch, and mount the antenna in place. (Sandwich the small solder lug attached to the OUTPUT wire between the antenna and the fiber washer.) If you're using a plastic box, mount *J1* and *J2* in their respective holes, placing the grounding-lug rings between the panel and mounting nuts.

Then connect and solder the free ends of the wires coming from the INPUT and OUTPUT pads to the center lugs of *J1* and *J2*, respectively. Solder the free end of the *S1* wire to one lug of the power switch. Mount the antenna, sandwiching the small lug attached to the OUTPUT wire between the antenna and box. Regardless of which type of box you're using, solder the free end of the red wire coming from the battery snap connector to the other lug of the switch.

Snap the battery into its connector and plug it into its mounting clip. The project is now ready to be used. When you're finished assembling the project, label the INPUT and OUTPUT jacks with a dry-transfer lettering kit or a tape labeler.

If you put together the high-power wireless version, do keep in mind that there's a possibility that some r-f interference could impair reception in other communications equipment. However, the r-f signal booster's limited range reduces this possibility. **ME**

10 MHz IBM® XT Compatible Computer System Sale

Complete System for Only

$599.00

COMPUTER DIRECT

22292 N. Pepper Road, Barrington, Ill. 60010

" The Computer Experts "

Call (312) 382-5050 or 382-5244 for

Free Catalogs of Over 1000 Programs & Accesories

Best Service • Best Price • 1000 Programs • 500 Accessories • 15 Day Free Trial

10 MHz Super Turbo IBM® XT Compatible Computer System

BEST GUARANTEE

FREE CATALOGS

Twice the speed* at just a fraction of the cost!

* Computes over two times faster than the IBM® XT

Look at all you get for only $599.00

Run 1000's of IBM® software programs available.

15 Day Free Trial

90 Day Replacement Policy

Double 90 Day Policy On Computer

This computer system is sold as a complete unit. NO SUBSTITUTIONS are allowed.

The complete system	List Price	Sale Price
10 MHz Super Turbo XT Computer	$1295.00	$499.00
* 512K Memory	$99.95	No extra cost
* Single floppy disk drive	$129.95	No extra cost
* Parallel printer port	$59.95	No extra cost
* Serial printer port	$59.95	No extra cost
* Mouse/joystick port	$59.95	No extra cost
* RGB color graphics port	$99.95	No extra cost
* Hercules compatible monochrome port	$79.95	No extra cost
MS DOS 3.2 & GW Basic	$199.00	$99.00
12" Hi-Res 35 MHz Green Screen Monitor (TTL & EGA compatible)	$249.00	$99.00
Monitor interface cable	$24.95	$19.95
Big Blue Printer	$199.00	$39.95
RS 232 IBM to Big Blue cable	$19.95	$9.95
2 rolls of paper	$19.95	$5.95
Word First • Word Processor	$99.00	$39.95
Data First • Data Base	$99.00	$39.95
Calc First • Spreadsheet	$99.00	$39.95
Total price when bought separately	$2893.85	$892.45

* Built-in the Super Turbo XT

Home & Business

This IBM® XT compatible is perfect for your home and/or business uses. It makes life easier in more ways than you can imagine. Use the system for personal letters, form letters, address storage, listing valuables, figuring finances, school reports, business reports, calculations, business projections...the list can go on and on. With the addition of some of the thousands of software programs available for IBM® you can increase the capabilities of your system even further. A terrific home improvement, business enhancer, entertainment center & educational aid!

Save over $275.00 off sale prices!

Complete System only $599

IBM® is the trademark of International Business Machines Inc.

VISA · MASTERCARD · C.O.D. **Shipping, Handling & Insurance Charges and Information** VISA · MASTERCARD · C.O.D.

Add $35.00 for shipping, handling and insurance. Illinois residents please add 6½ % sales tax. Add $70.00 for CANADA, PUERTO RICO, HAWAII, ALASKA and APO-FPO. All orders must be in U.S. dollars. WE DO NOT EXPORT TO OTHER COUNTRIES EXCEPT CANADA & PUERTO RICO. Enclose Cashier Check, Money Order or Personal Check. Allow 14 days for delivery. 2 to 7 days for phone orders. 1 day express mail. Prices & Availability subject to change without notice. Please call for C.O.D. charges.

CALL COMPUTER DIRECT AT

(312) 382-5050 or 382-5244

8am - 8pm CST Weekdays / 9am - 12 noon Saturdays

MasterCard VISA

CIRCLE 47 ON FREE INFORMATION CARD