48783

Radio-Electronics® Combined with Electronics NOW

NOVEMBER 1992

Build this
SUPER STROBE TRIGGER
and capture fantastic stop-action photos with almost any camera!

Build a
UNIVERSAL REMOTE CONTROL
for your next project!

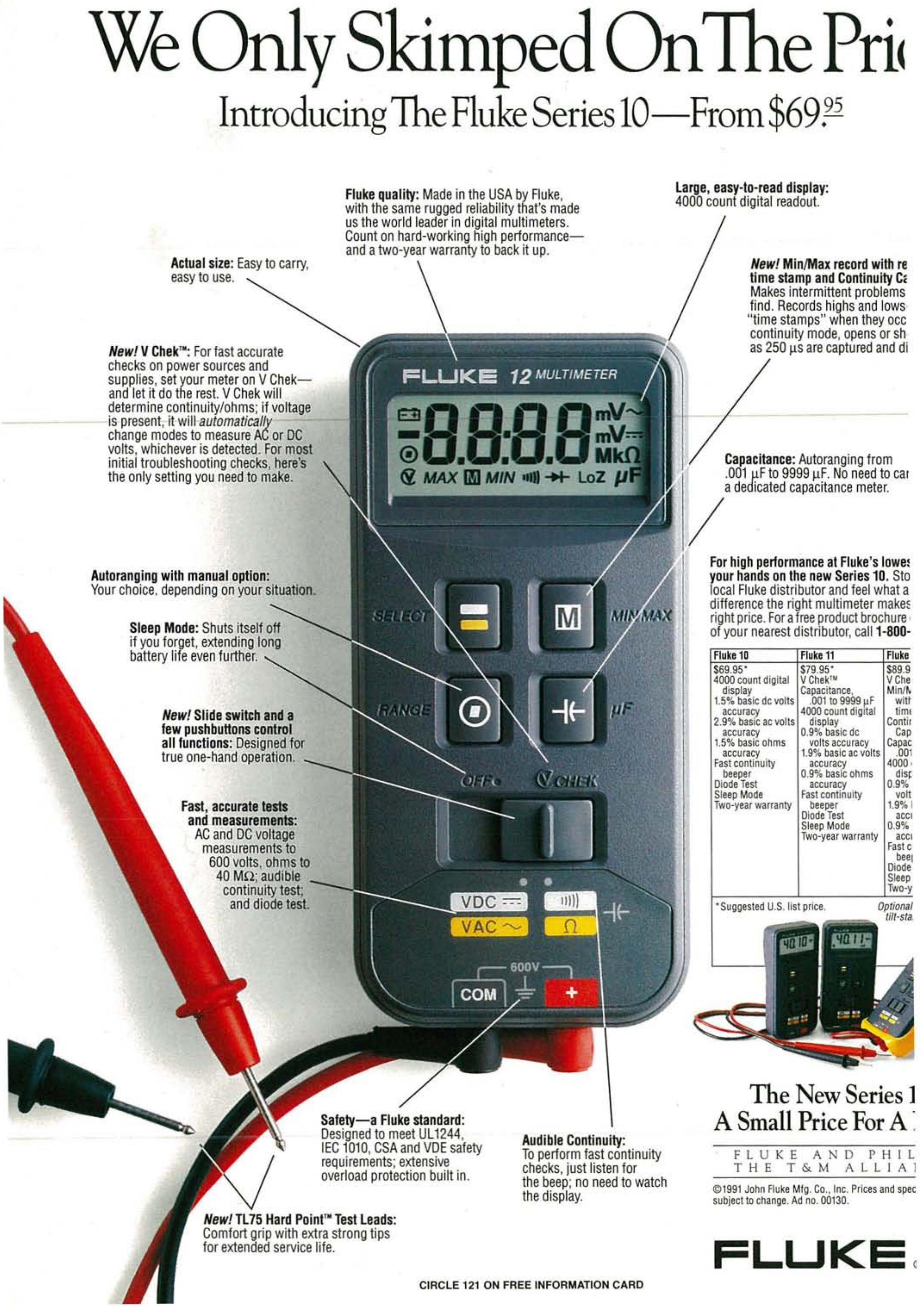
Design and build
HI-FI AUDIO AMPS
at hard-to-beat prices

How to use the
555 TIMER IC
in practical circuits

$3.50 U.S.
$3.95 CAN

A GERNSBACK PUBLICATION

XXXXXXXX CAR-RT SORT XX CR03
750456HRR5165MD93 11 64
NOV 93
RA
[redacted]


We Only Skimped On The Pri
Introducing The Fluke Series 10—From $69.95
Fluke quality: Made in the USA by Fluke, with the same rugged reliability that's made us the world leader in digital multimeters. Count on hard-working high performance—and a two-year warranty to back it up.
Large, easy-to-read display: 4000 count digital readout.
Actual size: Easy to carry, easy to use.
New! Min/Max record with re time stamp and Continuity Ca Makes intermittent problems find. Records highs and lows "time stamps" when they occ continuity mode, opens or sh as 250 µs are captured and di
New! V Chek™: For fast accurate checks on power sources and supplies, set your meter on V Chek—and let it do the rest. V Chek will determine continuity/ohms; if voltage is present, it will automatically change modes to measure AC or DC volts, whichever is detected. For most initial troubleshooting checks, here's the only setting you need to make.
FLUKE 12 MULTIMETER
Capacitance: Autoranging from .001 µF to 9999 µF. No need to car a dedicated capacitance meter.
For high performance at Fluke's lowes your hands on the new Series 10. Sto local Fluke distributor and feel what a difference the right multimeter makes right price. For a free product brochure of your nearest distributor, call 1-800-
Autoranging with manual option: Your choice, depending on your situation.
Sleep Mode: Shuts itself off if you forget, extending long battery life even further.
New! Slide switch and a few pushbuttons control all functions: Designed for true one-hand operation.
Fast, accurate tests and measurements: AC and DC voltage measurements to 600 volts, ohms to 40 MΩ; audible continuity test; and diode test.
SELECT
MIN MAX
RANGE
µF
OFF
V CHEK
VDC
VAC
Ω
600V
COM
+

Fluke 10	Fluke 11	Fluke
$69.95* 4000 count digital display 1.5% basic dc volts accuracy 2.9% basic ac volts accuracy 1.5% basic ohms accuracy Fast continuity beeper Diode Test Sleep Mode Two-year warranty	$79.95* V Chek™ Capacitance, .001 to 9999 µF 4000 count digital display 0.9% basic dc volts accuracy 1.9% basic ac volts accuracy 0.9% basic ohms accuracy Fast continuity beeper Diode Test Sleep Mode Two-year warranty	$89.9 V Che Min/M with time Contir Cap Capac .001 4000 disp 0.9% volt 1.9% accu 0.9% accu Fast c beep Diode Sleep Two-y

*Suggested U.S. list price.
Optional tilt-sta
The New Series 1 A Small Price For A
FLUKE AND PHIL
THE T&M ALLIA
©1991 John Fluke Mfg. Co., Inc. Prices and spec subject to change. Ad no. 00130.
FLUKE
Safety—a Fluke standard: Designed to meet UL1244, IEC 1010, CSA and VDE safety requirements; extensive overload protection built in.
Audible Continuity: To perform fast continuity checks, just listen for the beep; no need to watch the display.
New! TL75 Hard Point™ Test Leads: Comfort grip with extra strong tips for extended service life.
CIRCLE 121 ON FREE INFORMATION CARD

November 1992

Electronics NOW®

Vol. 63 No. 11

BUILD THIS

TECHNOLOGY


Add a convenient hold feature to any phone!

TELEPHONE HOLD BUTTON

PAGE 45


BUILD A
POWER CONTROLLER
FOR AUTOMOTIVE ACCESSORIES

Add that custom touch to your automotive accessories with our power-controller module.

PAGE 57

DEPARTMENTS

AND MORE

ON THE COVER

Point-and-shoot is fine for snapshots, but truly interesting photographs require some planning and some extra equipment. For instance, if you want to capture split-second action, such as a drop of milk splashing into a glass, you'll need either very fast shutter speeds or a good strobe light. Our Freeze Frame Super Strobe Trigger uses interchangeable sensors, so that anything that flashes, pops, snaps, or reflects or blocks light can be used to trigger your camera's flash or free-standing photographic lights. The inexpensive, easy-to-build Freeze Frame lets you capture stop-action shots for scientific purposes, or just because they're fascinating to look at. For all the details, turn to page 31.

COMING NEXT MONTH

THE DECEMBER ISSUE GOES ON SALE NOVEMBER 3.

BUILD A HIGH-TECH CHRISTMAS ORNAMENT
You'll be sure to want our best-ever ornament hanging on your tree!

COMPUTER MONITORS
A look at the history, technology, and future of computer monitors.

MODEM/FAX PROTECTOR
Protect your telephone equipment from electrical transients on the phone line.

THE 555 TIMER
Still more uses for this versatile IC.

As a service to readers, ELECTRONICS NOW publishes available plans or information relating to newsworthy products, techniques and scientific and technological developments. Because of possible variances in the quality and condition of materials and workmanship used by readers, ELECTRONICS NOW disclaims any responsibility for the safe and proper functioning of reader-built projects based upon or from plans or information published in this magazine.

Since some of the equipment and circuitry described in ELECTRONICS NOW may relate to or be covered by U.S. patents, ELECTRONICS NOW disclaims any liability for the infringement of such patents by the making, using, or selling of any such equipment or circuitry, and suggests that anyone interested in such projects consult a patent attorney.

ELECTRONICS NOW, (ISSN 0033-7862) November 1992. Published monthly by Gernsback Publications, Inc., 500-B Bi-County Boulevard, Farmingdale, NY 11735. Second-Class Postage paid at Farmingdale, NY and additional mailing offices. Second-Class mail registration No. R125166280, authorized at Toronto, Canada. One-year subscription rate U.S.A. and possessions $19.97, Canada $27.79 (includes G.S.T. Canadian Goods and Services Tax Registration No. R125166280), all other countries $28.97. All subscription orders payable in U.S.A. funds only, via international postal money order or check drawn on a U.S.A. bank. Single copies $2.95. © 1992 by Gernsback Publications, Inc. All rights reserved. Printed in U.S.A.

POSTMASTER: Please send address changes to ELECTRONICS NOW, Subscription Dept., Box 55115, Boulder, CO 80321-5115.

A stamped self-addressed envelope must accompany all submitted manuscripts and/or artwork or photographs if their return is desired should they be rejected. We disclaim any responsibility for the loss or damage of manuscripts and/or artwork or photographs while in our possession or otherwise.

Electronic NOV

Hugo Gernsback (1884-1967) founde

Larry Steckler, EHF, CET, editor-in-chief and publisher

EDITORIAL DEPARTMENT
Brian C. Fenton, editor
Marc Spiwak, associate editor
Neil Sclater, associate editor
Teri Scaduto, assistant editor
Jeffrey K. Holtzman computer editor
Robert Grossblatt, circuits editor
Larry Klein, audio editor
David Lachenbruch contributing editor
Don Lancaster contributing editor
Kathy Terenzi, editorial assistant

ART DEPARTMENT
Andre Duzant, art director
Injae Lee, illustrator
Russell C. Truelson, illustrator

PRODUCTION DEPARTMENT
Ruby M. Yee, production director
Karen S. Brown advertising production
Marcella Amoroso production assistant
Lisa Rachowitz editorial production

CIRCULATION DEPARTMENT
Jacqueline P. Cheeseboro circulation director
Wendy Alanko circulation analyst
Theresa Lombardo circulation assistant
Michele Torrillo reprint bookstore

Typography by Mates Graphics
Cover photo by Diversified Photo Services. Inset photos by Trey Simon

Electronics Now is indexed *Applied Science & Technology Ind* and *Readers Guide to Periodical Lit ature, Academic Abstracts*, a *Magazine Article Summaries.*
Microfilm & Microfiche editions available. Contact circulation depa ment for details.

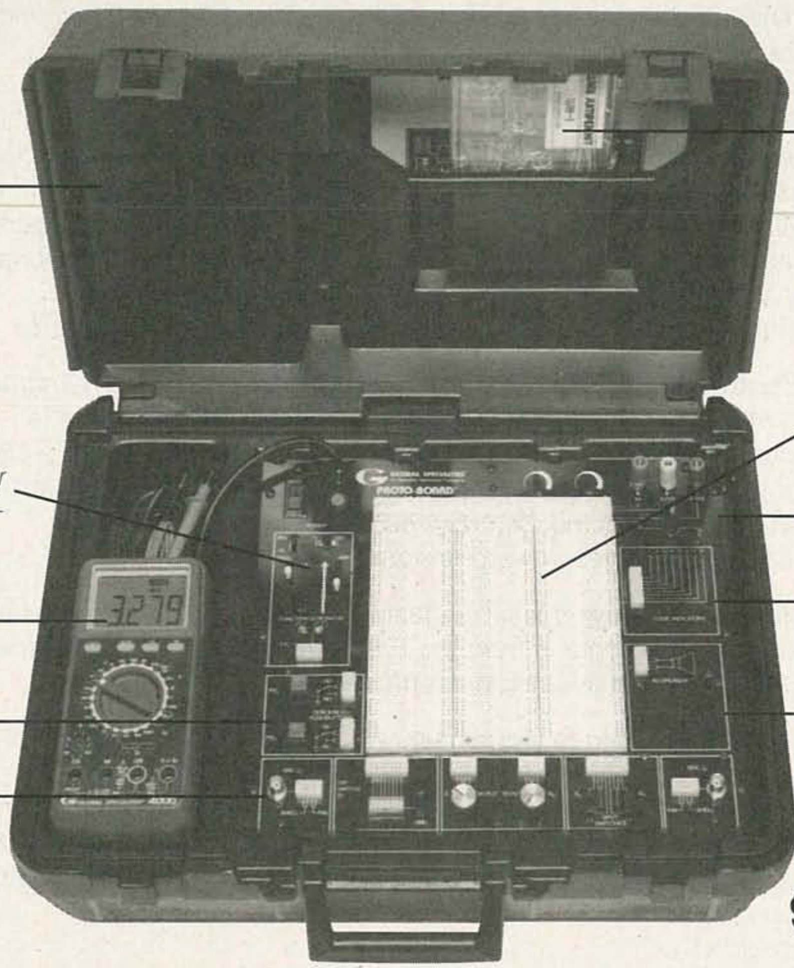
Advertising Sales Offices list on page 102.
Electronics Now Executive and Administrative Offices
1-516-293-3000.
Subscriber Customer Service:
1-800-288-0652.
Order Entry for New Subscribers:
1-800-999-7139.

Audit Bureau of Circulations
Member

HOME-WORK

For Electronics

MADE IN U.S.A.



Just $349.9

Here's PB-503-C. It has every feature that our famous PB-503 offers, but we added one more, portability. Work on your projects at the office or school, take it home at night... it's for the engineer or student who wish to take their lab with them. **Instrumentation**, including a function generator with continuously variable sine, square, triangle wave forms and TTL pulses. **Breadboards** with 8 logic probe circuits. And a **Triple Power Supply** with fixed 5VDC, plus two var outputs (+5 to +15VDC). Throw-in 8 TTL comp LED indicators, switches, pulsers, potentiome audio experimentation speaker... plus a life guarantee on all breadboarding sockets! And, bec it's portable you will always have everything you right in front of you! PB-503-C, one super test s for under $350! Order yours today!!

FOR MORE INFORMATION
CALL 1-800-572-1028

GLOBAL SPECIALTIES®

Global Specialties®, 70 Fulton Terrace, New Haven, CT 065
Tele: 203•624•3103/Fax: 203•468•0060 - ©1990, Interplex Electroni
All Global Specialties® breadboarding products are made in the U.S.
Proto-Board is a registered trademark of Global Specialties® **A03**

CIRCLE 182 ON FREE INFORMATION CARD

EDITORIAL

IT'S NOW OR NEVER

Now. This moment, this instant—it lives but a microsecond. Then it moves on and changes and becomes something new and different and better.

That's exactly what our magazine—our magazine, yours and mine—is doing. I grew up on *Radio-Craft* and *Radio-Electronics*. You've probably grown up on *Radio-Electronics*. The next generation of electronics professionals may not even remember *Radio-Electronics*, but they will know **Electronics Now**. For this new, yet old, publication will be their introduction to electronics. It will be their primer, their teacher, their guide, their companion. It will travel with them through their career just as *Radio-Electronics* has through yours. As long as there are electronics professionals, as long as there are people who follow the wonderful ever-changing world of electronics, **Electronics Now** will be there.

Electronics Now is not a new magazine, it is simply a refinement of what has always been. It's an evolution to something better, something wiser, something stronger. A magazine more closely matched to electronics today. Carefully designed, tailored and directed by selected experts who can point you, our reader, through our pages, toward tomorrow.

Electronics Now is *your* magazine. It is the culmination of almost 100 years of progress from the *Electrical Experimenter* to *Radio-Electronics* and finally **Electronics Now.**

If our founder, Hugo Gernsback, were here today, he'd probably note that we should have acted sooner. Perhaps he would have been right. But no matter what, we know we are correct in taking you and us on this new adventure. Join us as we go. Revel in the excitement of today and the adventure of tomorrow. Tell us what you like, what you hate, what we should do, and what we shouldn't.

Write our editors, contact our bulletin board, send me your ideas, comments, and criticisms. Help us make **Electronics Now** exactly the kind of magazine you know it should be. And never forget we may now bear the name **Electronics Now**, but at heart we are *Radio-Electronics, Radio Craft, Shortwave Craft, Television*, and the *Electrical Experimenter*.

Larry Steckler

Larry Steckler, EHF/CET
Editor-in-Chief and Publisher

WHAT'S NEWS

A review of the latest happenings in electronics.

20 thousandth Associate Technician certified

Garry D. Streeter of Tacoma, WA has become the 20 thousandths Associate Technician certified by the International Society of Certified Electronics Technicians (ISCET). Mr. Streeter scored 96% on the ISCET examination given on June 10th at Bates Technical College in Tacoma.

An employee of Spectroscopy Specialties, Inc., a company that manufactures laboratory equipment for atomic research, Mr. Streeter is 26 years old. He served in the U.S. Navy for six years as a fire control technician.

The Associate Exam, which has now become the standard for judging the competence of electronics technicians by industry, commerce, and the U.S. Government, covers basic electronics theory and practice. Subject matter includes mathematics, physics, electronic fundamentals, semiconductors, circuit theory, troubleshooting, and network analysis. Journeyman CET options are available in the specialized sectors of audio, communications, computers, consumer electronics, industrial, video, medical, and radar.

Information on ISCET Associate and Journeyman CET exams is can be obtained from ISCET, 2708 West Berry Street, Fort Worth, TX 79109 (817-921-9101).

FCC approves video transmission by phone

Telephone-operating companies applauded but cable TV companies were miffed by the June 17th decision of the FCC to grant the telco's the right to transmit TV programs and video services over phone lines. The decision lifted previous restrictions that had kept the phone companies from competing with the cable TV industry.

The FCC ruling also set the ground rules for the operation of a class of wireless communication devices—pocket phones, wireless facsimile machines, handheld computers, and advanced pagers. It also decided that HDTV will share the UHF spectrum with conventional television. The ruling is intended to spur competition between telephone and cable companies.

The ruling by the Government is expected to encourage local telephone companies to accelerate the upgrade of their systems with new equipment to handle video services. According to FCC chairman Albert Sikes, the initiatives could produce billions of investment dollars and thousands of new jobs in the next year. It was recognized however, that it may take years before the phone companies master the technology needed to provide video programming over phone lines cost effectively.

That delay is attributed to both technical and political reasons. Although video compression technologies are now available, complete fiberoptic networks are seen as a necessary—and expensive–requirement. It is estimated that replacing the nation's existing copper wiring with fiberoptic cabling could cost more than $100 billion. Also impeding the phone companies entry in the cable TV arena is a federal law that prohibits them from owning cable programming equipment. The FCC ruling, however, allows a telephone company to own up to 5% of a cable company.

Centel commercializes dual-mode cellular phones

Centel Cellular Company ,Chicago, IL, became the first U.S. cellular carrier to offer dual-mode cellular phones incorporating Motorola's Narrow-Band Advanced Mobile Phone Service (NAMPS). Centel demonstrated its NAMPS capability recently in a successful trial in Las Vegas, NV. NAMPS is a digitally enhanced analog tech nology that is said to triple the ca pacity of existing analog systems. I is expected to smooth a service company's transition to a digital cel lular network.

The NAMPS digital enhance ments associated will allow Cente to offer its customers digital mes saging services including alpha numeric paging and voice mai notification. It can also provide mobile reported interference (MRI which reduces the incidence of stat ic interference and lost phone call: by allowing a phone experiencin interference to request a hand-off t a clear channel automatically.

NAMPS' ability to allow frequen cies to be cleared for other wireles: applications will ease the transitio to all-digital systems. The dual mode mobile and portable phone: look and feel the same as standar analog units, but they can operat on either analog or digital cellula systems.

Blue-light laser promises higher CD data density

The blue-light solid-state lase could be a commercial reality in th near future. Both 3M and Sony hav demonstrated their devices tha could triple the amount of music c data be stored on CD's by the en of the decade.

The blue-light laser is expected t replace the red-light emitting laser now widely used in CD players. Blu light has a shorter wavelength tha red, so it can be focused on a smal er spot. That gives it the ability t store much more data in a smalle area and boost disk capacity.

Last year 3M demonstrated laser based on doped zinc selenid that emits in the blue-green 490 t 530-nanometer range. The activ layer of zinc cadmium selenide surrounded by zinc selenide. Sor Corp. showed off its true blue-emi ting laser last July.

VIDEO NEWS

What's new in the fast-changing video industry.

DAVID LACHENBRUCH

• Photo CD arrives. With the fanfare of a national advertising campaign, Eastman Kodak has launched the newest video medium, Photo CD—combining the high resolution of film photography with the convenience of electronic display. Photo processors from coast to coast are now equipped with the work stations to transfer negatives and slides in digital form to compact discs that can be played through any TV set, regardless of standards—including future high-definition sets. The transfer of 20 negatives to a digital disc costs about $20, including the disc, and additional pictures can be added to the disc at a later time, up to a total of 100 per disc.

Kodak-brand Photo CD players (which also can play audio CD's) sell for about $379 to $499, depending on features, with a carousel changer due in time for the Christmas season. The players are being made in Belgium by Philips, but Kodak says that it plans to license other manufacturers to make players as well.

Philips CD-I players are also capable of playing Photo CD's, and an increasing number of computers will be equipped to display the digital photos. Photo CD players can play some specially recorded multimedia picture-and-sound discs (including the audio-visual instruction manual for the Photo CD player). A remote control for the higher priced Photo CD player permits the viewer to zoom in on any part of the picture and to crop the photo electronically. Kodak will introduce thermal transfer equipment to make high-quality color prints and enlargements from Photo CD's. Kodak also promises to add equipment to put soundtracks and captions on the digital photo discs.

• New interactive system. The two largest American-owned consumer-electronic companies at our press time were scheduled to introduce a new CD-ROM-based system designed for attachment to home TV's that is competitive—and incompatible—with Philips' CD-I. Hardware for the new Video Information System (VIS) will be made by Tandy Corporation in Fort Worth, Texas, for sale by Radio Shack stores under Tandy's Memorex brand name and it will be offered by other dealers under the Zenith brand.

VIS differs from CD-I in that it can accommodate much of the existing CD-ROM software (designed for MPC and Macintosh standards) with only slight modifications, providing VIS with a large, virtually ready-made library. The companies have worked with Microsoft to achieve that semi-compatibility. VIS will come with a large library of entertainment, educational, and information software, and will be priced competitively with the CD-I player (which now carries a suggested list price of $699). According to its developers, VIS is designed so that eventually it will accommodate such add-ons as a modem and a keyboard. They see "VIS" as an overall product identification standard—like "VHS"—and they are inviting other manufacturers to join them with their own players.

• U.K.'s massive recall. Prospective applicants for a new commercial television network in the U.K. have been asked to outline their plans to retune, modify, or exchange virtually every VCR, video game, and home satellite receiver in the U.K. As a result of that intimidating prospect, only one applicant remained at the deadline for filing.

The dilemma resulted from what one journal called a "classic booboo" by the Independent TV Commission, which assigned UHF channels for the new nationwide network close enough to interfere with those used for connecting attachments to home TV-set antenna terminals. The ITC decreed that the winning applicant must modify any and all such devices to prevent interference. The winner, a consortiu led by Thames TV, says that it v unleash an army of 2000 techi cians, who will literally go to door-t door to do the modifications, at cost of about $135 million, althou some skeptics think that the fir price tag will be much higher.

• Widescreen TV sets. Despi controversies over national HDT systems, there is a worldwic movement toward widescreen T sets that will work with prese transmissions. TV sets with a 16 aspect ratio are now being sold Europe by the top three manufa turers there (Philips, Thomson, a Nokia) and by almost all manufa turers in Japan. The introduction the U.S. of those sets was immine as this was being written.

In Japan, Sharp introduced tl lowest priced widescreen set date (with a tube measuring : inches in viewable diagonal) for tl equivalent of about $2000. Th company was the first to announ a changeover to widescreen for large-tube receivers, with the 2 inch (4:3 ratio) in its product lin Sharp officials are forecasting tl sale of 300,000 widescreen sets the Japanese market by all ma ufacturers in the present fiscal ye (ending in March 1993), rising 800,000 in the following year.

In the U.S., both Thomson (RC GE) and Philips (Magnavox, S vania, Philips) are beginning to ir port widescreen tubes from the European factories. Thomson is ir porting 34-inch tubes and Philips importing 34- and 26-inch version Both companies reportedly plan introduce larger sets here in pr ection versions, and say that if tl new picture proportions catch with buyers they'll build the wi tubes domestically. Neither comp ny had announced a specific price press time, but at their introducti the wider sets are expected to co considerably more than comparab sized conventional models. **R**

Take Any 3 PROFESSIONAL BOOKS for only $9.95

when you join the ELECTRONICS ENGINEERS' BOOK CLUB

Values to $155.40

9255-XXX $105.00
Counts as 3

10016 $39.95

003957-XX $49.95
Counts as 2

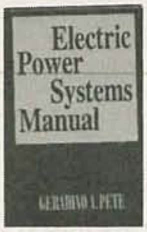
9244P $18.95
Softcover

9290-XX $36.00
Counts as 2

071231 $57.95

020975-XXX $104.5
Counts as 3

3147-XX $38.95
Counts as 2



049530 $44.95

050806-XX $54.95
Counts as 2

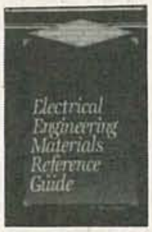
3138-XX $60.00
Counts as 2

053570-XX $64.95
Counts as 2

013933-XX $69.50
Counts as 2

9458 $29.95

028735-XX $89.50
Counts as 2



004196 $47.95

044847 $39.95

2962P $17.95
Softcover

3212-XX $39.95
Counts as 2

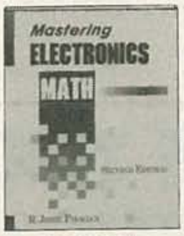
025354 $29.95

3540 $26.95

585247-XX $31.95
Counts as 2

3365P $24.95
Softcover

3991 $39.95



3589 $27.95

2672 $49.50

As a member of the Electronics Engineers' Book Club℠ . . .

. . . you'll enjoy receiving Club bulletins every 3-4 weeks containing exciting offers on the latest books in the field at savings of up to 50% off of regular publishers' prices. If you want the Main Selection do nothing and it will be shipped automatically. If you want another book, or no book at all, simply return the reply form to us by the date specified. You'll have at least 10 days to decide. And you'll be eligible for *FREE* books through our *NEW* Bonus Book Program. Your only obligation is to purchase 3 more books during the next 2 years, after which you may cancel your membership at any time.

All books are hardcover unless otherwise noted. Publishers' prices shown. ©1992 EEBC
A shipping/handling charge and sales tax will be added to all orders.

If coupon is missing, write to:
Electronics Engineers' Book Club, Blue Ridge Summit, PA 17294-0860

ELECTRONICS ENGINEERS' BOOK CLUB
Blue Ridge Summit, PA 17294-0860

YES! Please send me the books listed below for just $9.95, plus shipping/handling & tax. Enroll me as a member of the **Electronics Engineers' Book Club** according to the terms outlined in this ad. If not satisfied, I may return the books within ten days and have my membership cancelled. A shipping/handling charge & tax will be added to all orders.

If you select a book that counts as 2 choices, write the book number in one box and XX in the next. If you select a Counts as 3 choice, write the book number in one box and XXX in the next 2 boxes.

Name ______________________

Address ______________________

City/State ______________________

Zip ____________ Phone ______________________

Valid for new members only, subject to acceptance by EEBC. Canada *must* remit in U.S. funds. Applicants outside the U.S. and Canada will receive special ordering instructions. RPIF1192

GET THE LATEST ADVANCES IN ELECTRONICS

WITH A SUBSCRIPTION TO

Electronics NOW

Radio Electronics® Combined with

ENJOY THE WORLD OF ELECTRONICS EACH MONTH!

Subscribe to the best electronics magazine—the one that brings you the latest high-tech construction projects, feature articles on new technology, practical troubleshooting techniques, circuit design fundamentals, and much more.

Electronics Now looks to the future and shows you what new video, audio and computer products are on the horizon. What's more you'll find helpful, monthly departments such as Video News, Equipment Reports, Hardware Hacker, Audio Update, Drawing Board, Computer Connections, New Products, and more. All designed to give you instruction, tips, and fun.

Electronics Now gives you exciting articles like:

- Buyer's Guide to Digital Oscilloscopes
- Build A Scanner Converter
- Single-Chip Voice Recorder
- Build A MIDI Interface for your PC
- Troubleshoot Microprocessor Circuits
- Build A High-Power Amplifier for your Car
- Add Music On Hold to your Phone
- All About Binaural Recording
- VGA-to-NTSC Converter

FOR FASTER SERVICE CALL TODAY

1-800-999-7139

DON'T DELAY SUBSCRIBE TODAY!

Just fill out the order card in this magazine and mail it in today.

5RE

Graduate as a Fully Trained Electronics Professional!

If you want to learn about electronics, and earn a good income with that knowledge, then CIE is the best educational value you can receive.

CIE's reputation as the world leader in home study electronics is based solely on the success of our graduates. And we've earned our reputation with an unconditional commitment to provide our students with the very best electronics training.

Just ask any of the 150,000-plus graduates of the Cleveland Institute of Electronics who are working in high-paying positions with aerospace, computer, medical, automotive and communications firms throughout the world.

They'll tell you success didn't come easy...but it did come...thanks to their CIE training. And today, a career in electronics offers more rewards than ever before.

CIE'S COMMITTED TO BEING THE BEST...IN ONE AREA...ELECTRONICS.

CIE isn't another be-everything-to-everyone school. CIE teaches only one subject and we believe we're the best at what we do. Also, CIE is accredited by the National Home Study Council. And with more than 1,000 graduates each year, we're the largest home study school specializing exclusively in electronics. CIE has been training career-minded students like yourself for nearly sixty years and we're the best at our subject....ELECTRONICS...BECAUSE IT'S THE ONLY SUBJECT WE TEACH!

CIE PROVIDES A LEARNING METHOD SO GOOD IT'S PATENTED.

CIE's AUTO-PROGRAMMED® lessons are a proven learning method for building valuable electronics career skills. Each lesson is designed to take you step-by-step and principle-by-principal. And while all of CIE lessons are designed for independent study, CIE's instructors are personally available to assist you with just a toll free call. The result is practical training... the kind of experience you can put to work in today's marketplace.

LEARN BY DOING..WITH STATE-OF-THE-ART EQUIPMENT AND TRAINING.

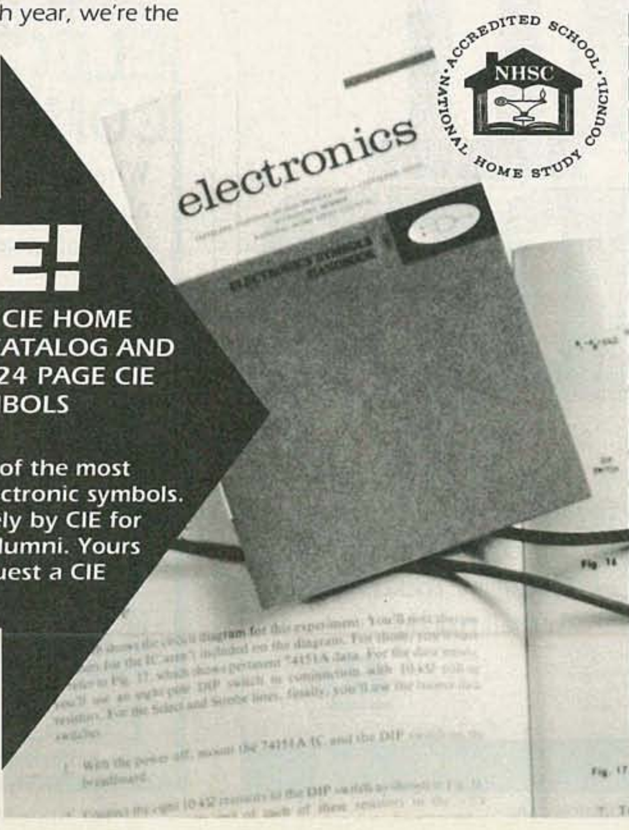
CIE pioneered the first Electronics Laboratory Course and the first Microprocessor Course. Today, no other home study school can match CIE's state-of-the-art equipment and training. And all your laboratory equipment, books and lessons are included in your tuition. It's all yours to use while you study and for on-the-job after you graduate.

PERSONALIZED TRAINING....TO MATCH YOUR BACKGROUND.

While some of our students have a working knowledge of electronics others are just starting out. That's why CIE has developed twelve career courses and an A.A.S. Degree program to choose from. So, even if you're not sure which electronics career is best for you, CIE can get you started with core lessons applicable to all areas in electronics. And every CIE Course earns credit towards the completion of your Associate in Applied Science Degree. So you can work toward your degree in stages or as fast as you wish. In fact, CIE is the only school that actually rewards you for fast study, which can save you money.

SEND FOR YOUR CIE COURSE CATALOG AND WE'LL SEND YOU A FREE 24-PAGE CIE ELECTRONIC SYMBOLS HANDBOOK.

ACCREDITED SCHOOL NHSC NATIONAL HOME STUDY COUNCIL



FREE!

SEND FOR YOUR CIE HOME STUDY COURSE CATALOG AND RECEIVE A FREE 24 PAGE CIE ELECTRONIC SYMBOLS HANDBOOK!

Includes hundreds of the most frequently used electronic symbols. Published exclusively by CIE for our students and alumni. Yours free when you request a CIE Course Catalog.

YES! I want to get started. Send me my CIE course catalog including details about the Associate Degree Program. (For your convenience, CIE will have a representative contact you - there is no obligation.)

AE44

Please print clearly

Name ____________________

Address ____________________

City ____________ State ______

Zip ____________ Age ______

Phone No. (____) ____________

Check box for G.I. Bill Benefits

☐ Veteran ☐ Active Duty

CIE 1776 East 17th Street Cleveland, Ohio 44114

A School of Thousands.
A Class of One. Since 1934.

Write to Q & A, Electronics Now, 500-B Bi-County Blvd., Farmingdale, NY 11735

ALL LOCKED UP

I've been having intermittent problems with my computer where the whole system locks up to the point where even a warm boot from the keyboard won't get it started again. After a lot of trouble, I discovered that one of the IC's on the motherboard is bad. Just about the only good thing about this is that it's a simple gate. The bad news is that it's soldered directly to the board. Do you know of any method for getting it off the board without damaging anything?—B. Sherif, Engale, NY

I've never found an *absolutely* safe way to desolder an IC. There's always some risk of damaging a PC board when removing a part, and the amount of damage is usually proportional to your desoldering skills and the number of pins on the part being removed. Consider whether the whole operation is worth the time and trouble it's going to take before starting.

If you're determined to do the repair, I'll tell you that the amount of success you're going to have will depend on the type of motherboard. If you have a simple double-sided board, what you do is fairly easy, but if your board is a multilayer one, the job is somewhat harder.

The easiest—and crudest—way I know to get an IC off the board
cut off the pins close to the bo
the chip and solder the new
right onto the old pin stubs. An
method is to use a "solder suc
that will remove solder after
iron has melted it—but you ha
act quickly. The easiest non-pr
sional method for chip removal
use desoldering braid. (Profes
als might use an electric "s
sucker," which can be quite ex
sive.) Desoldering braid is bas
just braided copper wire th
pressed onto the solder joint
the tip of a hot iron. When the s
melts, it is "wicked" up by the b
After the solder is removed fro
of the pins, wiggle each pin

SMALL WONDER

Small size to fit your pocket. Small price to fit your pocketbook. Large functionality to fit your work. The Pocket Series. A small wonder.

from $39.95

BI™

CIRCLE 177 ON FREE INFORMATION CARD

40,08

ELECTRON
COMPONENT

Whether you order 1 part
all 40,083...MOUSER stoc
and...*can ship today!!*

CALL...
(800) 992-99
for you
FREE
CATAL

2401 Hwy 28
Mansfield, TX 76

MOUSER
ELECTRONICS
Sales & Stocking Locations Nationw

CIRCLE 117 ON FREE INFORMATION C

and forth with long-nosed pliers before pulling the dip off the board.

Whatever method you decide to use, try to practice removing parts from a junk PC board to gain a little experience before attempting the job on a more valuable board.

LOTS OF SWITCHING

I have a problem that revolves around the need to switch 12 bundles of wire, with each bundle containing 24 wires that carry a variety of both AC and DC signals ranging from 1 to 3 amps. I initially used a Stackpole rotary switch driven by a computer-controlled motor to position the switch as commanded by input position logic. Everything worked well for a while, but the Stackpole switch would misalign every few hours or so. My specialty is software and I could use a little help with the hardware. Any suggestions?—D. Price, Coronado, CA

You really haven't given me the details needed to give you a complete answer, but there's certainly enough here to be able to point you in the right direction. And while your solution is feasible, you're having a problem simply because you haven't thought the problem through logically.

The easiest way for you to understand what's going wrong is to imagine that you are rotating the shafts by hand. If that were the case, you'd know when you reached the right position because you'd be doing something such as aligning marks on a dial. Well, now you have to do the same thing electronically.

What's missing in your system is some form of feedback from the switch that tells the controlling hardware exactly what the position of the switch is. The feedback mechanism can be something as simple as a potentiometer positioned on the shaft so that it reports a voltage back to the controller.

Another way to go about this is to use a stepper motor—the kind of motor used in a disk drive to position the head at a particular track on the disk. This might be the best way to go because stepper motor controllers designed for use in PC-compatible computers are readily available.

DIGITAL TACHOMETER TROUBLE

I'm building a digital tachometer for my car, and I'm having problems getting reliable readings. The counting circuit is OK, but the engine is a diesel, and I need a way to pick off an electrical signal. I've put a disk with holes around the circumference of the alternator and I am using an optical pickup and emitted infrared to read the holes. Do you know of a simple circuit that will amplify the pulses from the receiver so they can be read reliably by the counting circuit? I'm using CMOS logic.—J. Hewit, Florida, NY

I'm not sure what kind of car

Cable TV

Article Parts

We stock the exact Parts & PC Board for an article published in Radio Electronics Magazine on building a Snooper Stopper.

Snooper Stopper Kit...........$19.95
Includes all the original Parts & Etched, Drilled Silk-Screened PC Board.

Snooper Stopper................$39.00
This is an assembled and tested fixed frequency 106.5Mhz. Snooper Stopper for most Jerrold systems.

Protect yourself from descrambler detection and stop the Bullet with one of our Snooper Stoppers.

Macrovision..now you see it, now you don't.
Macrovision Kit...................$29.00
Includes all the original Parts & Etched, Drill Silk-Screened PC Board. Originally Published in Radio Electronics Magazine.

Call Toll Free 1-800-886-8699

Visa, MasterCard or COD

Northeast Electronics, Inc.
PO Box 3310
N. Attleboro, Ma. 02761

CIRCLE 179 ON FREE INFORMATION CARD

NO WONDER

Because it's from Beckman Industrial. The new Pocket Series from the people who have proven you don't have to pay a fortune for a top quality meter.

Call (800) 854-2708, (800) 227-9781 in CA.

Beckman Industrial™
An Affiliate of Emerson Electric Co.
Beckman Industrial Corporation. San Diego, CA 92123-1898.

CIRCLE 177 ON FREE INFORMATION CARD

For your Heart's sake get *PULSE STICK II*

Your very own sophisticated pocket health monitor, PULSE STICK II, checks your pulse rate quickly and accurately anywhere. Regular monitoring of your pulse rate during exercise will enable you to plan an exercise regimen suitable for your stage of fitness. pulse stick II provides an early warning that you may be exceeding your own capabilities.

PULSE STICK II photoelectrically measures the changes in the pulsed intensity of infrared radiation emitted by superficial blood vessels below the skin of the thumb. The time intervals between pulses are automatically measured and analogued by the microprocessor based circuitry and displayed in a liquid-crystal display (LCD).

Before attempting any exercise program, consult your doctor. Ask for guidance regarding the recommended safe pulse ranges for your exercise program. Follow your doctor's instructions carefully.

Only $39.95

Uses three AA dry cells supplied with PULSE STICK II

Ideal for running, walking and aerobic training programs!

PSII-2

☐ **YES!** Please send me _____ PULSE STICK II at $39.95 each. Price includes shipping and handling charges.

Total amount of order $__________

☐ Check or Money Order enclosed. Make check payable to **CLAGGK Inc. PULSE STICK II Offer**

Charge my ☐ Visa ☐ MasterCard

Account No.____________________

Exp. Date_____ / _____

Credit Card Signature____________________

Print Name____________________

Address____________________

City__________ State ____Zip______

No telephone orders or C.O.D. Signature required on credit card orders. All prices include postage and handling. Payments in U.S.A. funds only. New York residents must include local applicable sales taxes. No foreign orders.

Mail orders to CLAGGK Inc. Pulse Stick II Offer, P.O. Box 4099, Farmingdale, NY 11735.

Telephone orders to 1-516-293-3751.

FAX orders to 1-516-293-3115.

you're talking about so I can
gest a better way to get the
from the engine. Optical s
okay but it seems like a bad
for an engine compartment
there's always an oil mist anc
grunge that can interfere w
operation of the pickup. Ma
pickups or a Hall-effect s
would seem like a better way

If you have solved the probl
dirt and alignment, I'm sur
you're having a problem wi
level of the pickup output.
easy one for you to solve if
using CMOS.

The circuit shown in Fig.
simple amplifier that will wo
with just about any phototrar
The layout isn't at all critical, a
can put the whole thing (mir
phototransistor, of course) ir
sealed plastic box anywhere
car. The 741 is a readily availa

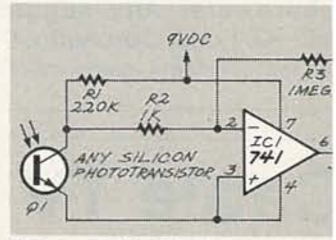


FIG. 1—THIS SIMPLE AMPLIFI work well with just about any ph sistor. The 741, although designe erate with a split supply, will wor single-sided supply as well.

amp that was designed to o
with a split supply. But since
only dealing with ons and offs
work well with a single-ended
supply.

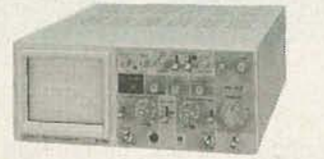
I've shown the input voltag
volts, but if you've got regula
volts available for the CMOS
ry, that will do just as well. I s
that you look at the 741 outp
scope and make sure the puls
well-shaped and low in
CMOS is noise tolerant, bu
are limits. If you see lots of gl
run the 741 output through a C
gate before sending it to y
chometer. If you have some
gates available, you can use
them. If you're going to add
use a Schmitt trigger suc
4093 NAND gate or a 4584 i
The inherent hysteresis in a S
trigger will to clean up messy
and odd circuit line noise.

48 HOUR SHIPPING

ELENCO & HITACHI & B+K PRODUCTS AT DISCOUNT PRICES

TO ORDER CALL TOLL FREE 1-800-292-7711 1-800-445-3201 (Can

ELENCO OSCILLOSCOPES



S-1325 25MHz $349
Dual Trace Oscilloscope

S-1340 40MHz $495
Dual Trace Oscilloscope

S-1360 60MHz
Dual Trace, Delayed Sweep

$775
- Automatic beam finder
- Built-in component tester
- 1mV sensitivity
- Dual time base

B+K OSCILLOSCOPES

2120 - 20MHz Dual Trace	$395
2125 - 20MHz Delayed Sweep	$539
1541B - 40MHz Dual Trace	$749
2160 - 60MHz Dual Trace, Delayed Sweep, Dual Time Base	$949
2190 - 100MHz Three Trace Dual Time Base, Delayed Sweep	$1,395
2522 - 20MHz / 10MS/s Storage	$869
1442 - 20MHz Portable	$1,229
1443 - 40MHz Battery / AC operated with Cursor & Readouts	$1,439

1.0GHz PORTABLE SPECTRUM ANALYZER

Model 2610 $2,595.95

- AC/DC operation (battery included)
- 70dB dynamic range
- Resolution bandwidth of 10kHz
- 50Ω and 75Ω input impedance (switch selectable)
- Fixed bandwidth setting for viewing TV signals
- Field calibratible with internally generated 100MHz, 80dB signal

Hitachi Compact Series Scopes

V-212 - 20MHz Dual Trace	$409
V-525 - 50MHz, Cursors	$975
V-523 - 50MHz, Delayed Sweep	$949
V-522 - 50MHz, DC Offset	$849
V-422 - 40MHz, DC Offset	$749
V-222 - 20MHz, DC Offset	$625
V-660 - 60MHz, Dual Trace	$1,095
V-665A - 60MHz,DT, w/cursor	$1,325
V-1060 - 100MHz, Dual Trace	$1,375
V-1065A - 100MHz, DT, w/cursor	$1,649
V-1085 - 100MHz, QT, w/cursor	$1,995
V-1100A - 100MHz, Quad Trace	$2,195
V-1150 - 150MHz, Quad Trace	$2,695

Hitachi RSO Series

RSO's feature; roll mode, averaging, save memory, smoothing, interpolation, pretriggering, cursor measurements.

VC-6023 - 20MHz, 20MS/s	$1,650
VC-6024 - 50MHz, 20MS/s	$1,950
VC-6025A - 50MHz, 20MS/s	$2,350
VC-6045A - 100MHz, 40MS/s	Call
VC-6145 - 100MHz, 100MS/s	Call

Digital Capacitance Meter
CM-1550B
$58.95

9 Ranges
.1pf-20,000ufd
.5% basic accy.
Zero control w/ Case
Big 1" Display

Digital LCR Meter
LC-1801
$125

Measures:
Coils 1uH-200H
Caps .1pf-200uf
Res .01-20M
Big 1" Display

Multimeter with Capacitance & Transistor Tester
$55 CM-1500B

Reads Volts, Ohms Current, Capacitors, Transistors and Diodes / with case

FLUKE MULTIMETERS

(All Models Available Call)

Scopemeters		70 Series	
Model 93	$1,095.00	Model 70II	$65.00
Model 95	$1,395.00	Model 77II	$145.00
Model 97	$1,695.00	Model 79II	$169.00
10 Series		**80 Series**	
Model 10	$62.95	Model 87	$289.00
Model 12	$79.95		

Quad Power Supply XP-580
$69.95

2-20V @ 2A
12V @ 1A
5V @ 3A
-5V @ .5A

Fully regulated and short circuit protected

Triple Power Supply XP-620
Assembled $75
Kit $50

2 to 15V @ 1A,
-2 to -15V @ 1A
(or 4 to 30V @ 1A)
and 5V @ 3A

All the desired features for doing experiments. Features short circuit protection, all supplies

AM/FM Transistor Radio Kit with Training Course

Model AM/FM 108
$27.95

14 Transistors ♦ 5 Diodes
Makes a great school project

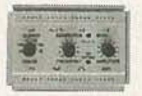
True RMS 4 1/2 Digit Multimeter
M-700T
$135

.05% DC Accuracy
.1% Resistance
with Freq. Counter
Data Hold

Sweep/Function Generator with Freq. Counter
$259
Elenco Model GF-8026

Sine, Square, Triangle, Pulse, Ramp
.2 to 2MHz, Freq Counter .1-10MHz
Internal Linear & Logic Sweep

Function Generator Blox
#9600
$28.95



Provides sine, triangle, square wave from 1Hz to 1MHz
AM or FM capability

Kit $26.95

XK-500 Digital / Analog Trainer

A complete mini-lab for building, testing, prototyping analog and digital circuits

Elenco's Digital/Analog Trainer is specially designed for school projects, with 5 built-in power supplies. Includes a function generator with continously variable, sine, triangular, square wave forms. All power supplies are regulated and protected against shorts.

Power Supplies
- Variable Power Supply
- +1.25 to 20VDC @ .5 Amp (+1.25 to 15VDC @ 1 Amp)
- -1.25 to -20VDC @ .5 Amp (-1.25 to -15VDC @ 1 Amp)
- +12VDC @ 1 Amp
- -12VDC @ 1 Amp
- +5VDC @ 1 Amp
- 30VAC Center tapped @ 15VAC at 1 Amp

Analog - Section
- Function Generator Sine, Triangular, Square wave forms
- Frequency adjustable in five ranges from 1 to 100KHz
- Fine frequency adjust
- Amplitude adjust
- DC offset
- Modulation FM-AM

Digital - Section
- Eight data swiches
- Two no bounce logic switches
- 8 LED readouts TTL buffered
- Clock frequency 1 to 100KHz
- Clock amplitude 5VPP square wave

Breadboards
- 2 breadboards, each contain: 840 tie points (total 1,680)

$159.95 Assembled

$129.95 Kit

Learn to Build and Program Computers with this Kit

Includes: All Parts, Assembly and Lesson Manual

Model MM-8000
$129.00

Starting from scratch you build a complete system. Our Micro-Master trainer teaches you to write into RAMs, ROMs and run a 8085 microprocessor, which uses similar machine language as IBM PC.

Elenco Wide Band Signal Generators

SG-9000 $129
RF Freq 100K-450MHz AM Modulation of 1KHz Variable RF output
SG-9500 w/ Digital Display & 150 MHz built-in Counter $249

WE WILL NOT BE UNDERSOLD
UPS SHIPPING: 48 STATES 5%
IL RES 7.5% TAX ($3 min $10 max)
PROBES INCL ALL SCOPES & METERS

C&S SALES INC.
1245 ROSEWOOD, DEERFIELD, IL 60015
FAX. 708-520-0085 • (708) 541-0710

VISA MasterCard

15 DAY MONEY BACK GUARANTEE
FULL FACTORY WARRANTY
WRITE FOR FREE CATALOG
PRICES SUBJECT TO CHANGE

CIRCLE 109 ON FREE INFORMATION CARD

LETTERS

Write to Letters, Electronics Now, 500-B Bi-County Blvd., Farmingdale, NY 11735

AUDIO BUYING TIPS

I have enjoyed Larry Klein's *Audio Update* column very much over the years. He provides a breath of fresh air in a field often fogged by the strong odor of addled logic. Larry's coverage of the 1991 AES Convention was also enlighteninging because he drew attention to the significant psychophysical research concerning what we really can or cannot hear.

I'd like to add a few buying tips for consumers from my article "Can You Trust Your Ears?" *AES Preprint 3177.* Because humans have such a strong tendency to hear sounds that might never have occurred, audio equipment customers should be aware that even the best receivers, preamplifiers, CD players and amplifiers cannot be reliably evaluated under controlled conditions. (I am assuming that this equipment is being operated at its specified power limit and all cabling meets the manufacturers' requirements.)

Second, it is practically impossible to conduct a fair listening evaluation even in a studio-equipped retail store with all components matched and compensated. Finally, you are not stupid if you don't understand everything the salesman tells you. When you are tempted to buy a product but still unsure of yourself, wait until the next day to make a decision. There's a good chance that you'll decide you don't need whatever it was that was being pitched. *Caveat emptor.*

TOM NOUSAINE
Cary, IL

NETWORKING CORRECTION

As a long-time reader of **Radio-Electronics** and a data-communications professional, I was pleased to read the first part of Gary McClellan's series entitled "From Not Working to Networking."in your August issue. Unfortunately, the section entitled "Connecting networks" positions bridges, routers, and repeaters in the incorrect layers of the ISO/OSI model.

It is generally accepted in LAN networking that a repeater operates at layer one, a bridge operates at layer two, and a router operates at layer three of the ISO/OSI model.

I trust that statement clarifies Mr. McClellan's information, and I look forward to reading the remainder of the articles in his series.

SHELDON H. DEAN, CET
Calgary, Alberta, Canada

THE BOTTOM LINE

As panelists in a seminar entitled "Strategies to Guard Against Productivity Loss" during PC Expo on June 25, we were astonished to find that of the thousands of industry professionals at the show, only one decided that a session on productivity enhancement was important enough to attend.

The show's management found the topic compelling enough to sponsor the seminar, and experts on the subject were ready to talk. But it seems that the individuals in the industry—vendors, customers, and managers of corporate computing resources—did not find it important enough to learn more about the link between technology and productivity.

Members of the industry do seem to find glitz, power, and speed interesting. They seem to fixate on the question: "Can we make it bigger, faster, or better than our competitors?" The name of the game seems to be "hardware for the sake of hardware" and "software for the sake of software."

We forget that senior management, which controls the purse strings, cares about return on investment, productivity and profit. They don't care about chip speed or power. Who in our industry is thinking about vital productivity issues such as education, training, and support? Is anyone thinking a the need to re-engineer produc take advantage of developing nology? Is management afra find out if there really is a po return on investment in com technology?

Until the computer industry s to takes stock of where it has and where it is going—partic the relationship between com technology and the bottom li the promise of technology wi happen. We should be conce with how the technology change the workplace, improve porate competitiveness, and us to meet our national econ goals.

None of this is glamorous Making technology deliver o promise is tough, tedious wo certainly does not offer the f playing with the latest and gre graphics user interface. But where to find productivit creases. Productivity is the res sibility of people, not just mach It seems that those attendin Expo were looking for some other than strategies to pre losses in productivity.

KAREN KARTEN
Karten Associates
PETER DE JAGER
de Jager & Co.
DAVE WHITTLE
IBM
SUSAN RASKIN
Rastec
RALPH E. GANGER
Sterling Resources

I'd like to respond to the lett Stephen Schleick, "Seeing Light,"(June **Radio-El tronics.**) In my opinion, as a t nically trained person Mr. Sc should have been better able t derstand the point made by "rocket scientist" friend. Schleik's anger at his friend is warranted, but he is correct in he said about the average power usage of a light bulb.

However Mr. Schleik missed by a mile the point being made by his friend. The problem is not average power consumed by the bulb, but the power surges that damage the bulb and cause its premature failure—the reason why we are always purchasing new bulbs.

The three reasons for filament lamp failure are operating time, frequency of turn-on, and supply voltage. A standard commercial bulb can be expected to fail after it has operated at its rated voltage for about 750 hours. (This is an average life for household incandescent bulbs). The lamp manufacturer is in business to sell lamps at a profit. If bulbs last ten years, replacement sales will be low.

The more frequently the bulb is turned on and off, the shorter its life. The 750 hour-life is an average determined from specified test procedures. Consumers usually don't get that kind of life from lamps for the same reason they don't get the gas mileage shown on new car stickers. People don't use light bulbs or cars the same way they are tested!

When I lived in an apartment in New York City, I never turned off certain lights because the electric bill was included in my rent. I just turned down the light, with a dimmer. The pont is, I never replaced light bulbs in the eight years I lived there.

When I bought a house and had to pay the electric bill, I turned off all my lights at night. I had to replace my eight-year-old bulbs in a few days. Coincidence? Maybe, but I don't think so. In my own house we had to replace bulbs every few months. We operated the bulbs at full brightness only in the evenings and on weekends.

Which is cheaper, a $1.00 bulb that lasts eight years with a dimmer (10 cents a year without being turned off) or replacing bulbs costing a buck two to three times a year?

I measured the idle current of a lamp with a dimmer having a 4.3-ohm resistor in series. The voltage across the lamp was 8 millivolts. With Ohm's Law, $0.008/4.3 = 0.00186$ amperes or 1.86 milliamperes. I multiplied 120 volts $\times$ 1.86 milliamperes to get 223 milliwatts (from the line). Then 223 milliwatts $\times$ 8760 hours/year equals 1953 watt-hours. This is a 1.953 kWh power consumption with a dimmer.

For practical purposes 1.953 equals 2 kWh at 5 cents (average U.S. power cost) per kWh for a cost of 10 cents. (In New York City with power costing three times the U.S. average, the result is 30 cents.) I ignored the time the bulb was at full brightness because I assumed that time and cost would be the same in both cases. And I haven't included the lost time and trouble of buying new bulbs and spares.

Based on the standard of 120 volts rms in the U.S., a good rule of thumb is that a 10% voltage increase shortens bulb life by half, but a 10% decrease doubles bulb life.

Are there ways to get around this? First, don't buy standard long-life or guaranteed bulbs; all you get is one designed for 130 volts, usually poorly made.

Consider traffic-light bulbs. They are made for long life and reliability.

The tungsten filament must be longer and thicker to obtain the same level of illumination but have a longer life. That makes the bulb more expensive to manufacture. Higher price means fewer will be sold which, in turn, forces up the retail price even further. Most people buy the cheapest bulbs they can find because they don't remember how long its predecessor lasted!

PAUL CHRISTIE
Bayside, NY

DISTORTION STOPPER

The distortion problem presented under the heading "Pocket-Stereo Amp" in *Ask R-E* (**Radio-Electronics**, August 1992) might not be caused by the LM386 circuit; it could be caused by insufficient load on the source amplifier from the pocket stereo—particularly if the output amplifier is made from discrete components. The key to my conclusion was the report of distortion at all listening levels.

I recommend loading the pocket stereo with a 20- to 50-ohm resistor, as shown in Fig. 1.

JIM HATHAWAY II
North Highlands, CA

CIRCLE 192 ON FREE INFORMATION CARD

Learn to troubleshoot an service today's computer systems as you build a 386sx/20 MHz mini tower computer!

Train the NRI way—and learn to service today's computers as you build your own 386sx computer system, now with 1 meg RAM, 40 meg IDE hard drive, and exciting new diagnostic hardware and software!

Jobs for computer service technicians will almost double in the next 10 years according to Department of Labor statistics, making computer service one of the top growth fields in the nation.

Now you can cash in on this exciting opportunity—either as a full-time industry technician or in a money-making computer service business of your own—once you've mastered electronics and computers the NRI way.

NRI's practical combination of "reason-why" theory and hands-on building skills starts you with the fundamentals of electronics, then guides you through more sophisticated circuitry all the way up to the latest advances in computer technology.

Train with and keep a powerful 386sx/20 MHz computer system plus popular Microsoft® Works software!

Only NRI gives you hands-on training with the finest example of state-of-the-art technology: the powerful new West Coast 386sx/20 MHz mini tower computer. As you assemble this 1 meg RAM, 32-bit CPU computer from the keyboard up, you actually see for yourself how each section of your computer works.

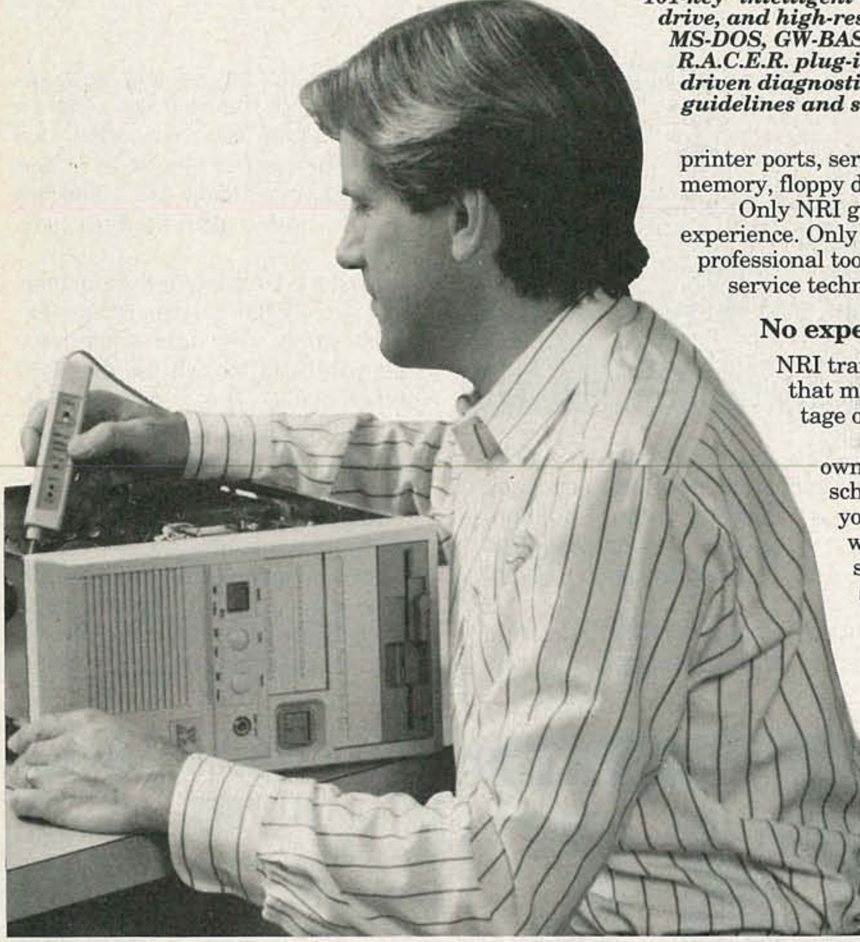
You assemble and test your computer's "intelligent" keyboard, install the power supply and 1.2 meg, high-density floppy disk drive, then interface the high-resolution monitor.

Your hands-on training continues as you install a powerful new 40 meg IDE hard disk drive—now included in your course to dramatically increase the data storage capacity of your computer while giving you lightning-quick data access.

Plus you now go on to work with today's most popular integrated software package, Microsoft Wor learning to use its word processing, spreadsheet, da base, and communications utilities for your own per and professional applications. But that's not all.

Only NRI you hands training u the remar R.A.C.E.R. in diagno card and QuickTec diagnosti software f Ultra-X— profession state-of-th diagnosti that make computer troublesh fast and a rate.

Your NRI computer training includes all this: • NRI's unique Discovery Lab® for circuit design and testing • Hand-held digital multimeter with "talk-you-through" instructions on audio cassette • Digi logic probe that lets you visually examine computer circuits • The new West Coast 386sx/20 MHz computer system, featuring a high-speed 80386sx CPU, 1 meg RA 101-key "intelligent" keyboard, 1.2 meg high-density floppy drive, and high-resolution monitor • 40 meg IDE hard drive MS-DOS, GW-BASIC, and Microsoft Works software • R.A.C.E.R. plug-in diagnostic card and QuickTech menu-driven diagnostic software • Reference manuals with guidelines and schematics



printer ports, serial communications ports, video display memory, floppy drives, and hard disk drives.

Only NRI gives you such confidence-building, real-wor experience. Only NRI gives you both the knowledge and the professional tools to succeed as today's in-demand comput service technician.

No experience needed ... NRI builds it in

NRI training gives you practical, hands-on experie that makes you uniquely prepared to take advantage of today's opportunities in computer service You learn at your own convenience in you own home. No classroom pressures, no night school, no need to quit your present job until you're ready to make your move. NRI starts with the basics, building on that foundation step by step until you have the knowledge a skills you need for success.

And all throughout your training you got the full support of your personal NRI instructor and the entire NRI technical staff, always ready to answer your questi and help you achieve your training goals.

FREE catalog tells more. Send toda

Send today for NRI's big, free catalog tha describes every aspect of NRI's innovativ computer training, as well as hands-on training in other growing high-tech career fields.

If the coupon is missing, write to: NRI School of Electronics, McGraw-Hill Continuing Education Center, 4401 Connecticut Aven NW, Washington, DC 20008.

NOW! Training now includes Ultra-X diagnostic hardware and software for quick, accurate troubleshooting!

Now you train with and keep the latest in diagnostic hardware and software: the extraordinary R.A.C.E.R. plug-in diagnostic card and QuickTech diagnostic software, both from Ultra-X. Using these state-of-the-art tools, you learn to quickly identify and service virtually any computer problem on XT, AT 80286/80386, and compatible machines.

You discover how to use the R.A.C.E.R. diagnostic card to identify individual defective RAM chips, locate interfacing problems, and pinpoint defective support chips. Plus you learn to use your QuickTech diagnostic software to test the system RAM and such peripheral adapters as parallel

IBM is a registered trademark of International Business Machines Corp. R.A.C.E.R QuickTech are registered trademarks of Ultra-X, Inc.

SEND TODAY FOR FREE CATALOG

NRI Schools McGraw-Hill Continuing Education Center 4401 Connecticut Avenue, NW Washington, DC 20008

For career courses approved under GI Bill
☐ check for details.

☑ **Check one FREE catalog only**

- ☐ **MICROCOMPUTER SERVICING**
- ☐ TV/Video/Audio Servicing
- ☐ Telecommunications
- ☐ Industrial Electronics
- ☐ Security Electronics
- ☐ Electronic Music Technology
- ☐ Basic Electronics
- ☐ Automotive Servicing
- ☐ Computer Programming
- ☐ Programming in C++ with Wind
- ☐ Desktop Publishing
- ☐ Word Processing Home Business
- ☐ Home Inspection
- ☐ Building Construction
- ☐ Bookkeeping & Accounting

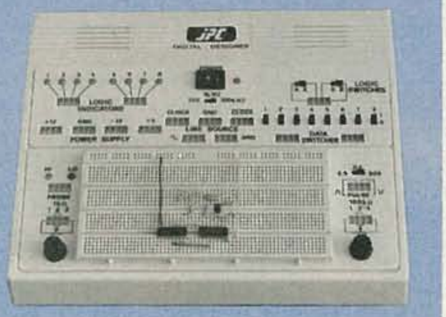
Name (please print) Age

Address

City/State/Zip Accredited Member, National Home Study Council 3-112

JPC International TD107 Digital Designer

Breadboarding circuits is the only way to learn electronics design!



CIRCLE 10 ON FREE INFORMATION CARD

From the mail that we receive at Electronics Now, we know that many of our readers enjoy our concentration—in both feature articles and columns—on circuit theory and design. In this issue, for example, we present almost two dozen circuits based on the 555 timer in a feature article, and a simple video scrambler circuit in our "Drawing Board" column. And, of course, our construction projects provide new circuits every issue.

Although it's possible to learn a great deal by studying the circuits and their accompanying descr tions, it's not the best way. Ther just no better way to increase yc understanding of electronics th "getting your hands dirty" buildi circuits and experimenting w them.

Having an adequately equipp lab is essential to electronics e perimenting. The right equipme lets you build circuits more eas and efficiently. That's important b cause the easier it is to build c cuits, the more you will experime and, thus, the more you will lea

Such thoughts kept crossing c minds as we examined the *TD1* Digital Designer from JPC Intern tional (P.O. Box 55, Agoura Hi CA 91301). The *TD107* makes easy to build circuits and chan

SIMPLE

The RMS225 was built around simplicity. Instead of a barrage of buttons to push, you simply scroll through a menu of special functions. Minimums, maximums and automatic reading hold are simple functions with Beckman Industrial's RMS225. It's simply the best meter for the money.

BI™

CIRCLE 176 ON FREE INFORMATION CARD

SUPER 12 HOUR RECORDE

CALL TOLL FREE

Modified Panasonic Slimline, 6 hrs per side
120 TDK tape furnished.
AC/DC Operation.
Quality Playback.
Digital Counter.
Durable Lightweight Plastic.

$119.(

PHONE RECORDING ADAPTE

Starts & Stops Recorder Automatically When Hand Set is Used. Solid State!
FCC Approved

$28.5

VOX VOICE ACTIVATED CONTR

Solidstate Adjustable Sensitivity. Voices & Sounds Activate Recorder
Adjustable Sensitivity
Provisions for Remote Mike

$28.5

* Add for ship. & handling. Phone Adapter & $2.00 each, Recorders $5.00 each. Colo. Res tax. Mail Order, VISA, M/C, COD's OK. Money E Guar. Qty Disc. available. Dealer inquiries inv Free data on other products.

AMC SALES INC. 193 Vaquero Dr.
Boulder, CO. 80303
Phones (303) 499-5405 1-800-926-24
FAX (303) 494-4924
Mon-Fri 8-5 MTN. TIME

CIRCLE 108 ON FREE INFORMATION CARD

their configurations, and examine how they operate. The designer, which is housed in a sturdy cream-colored plastic case that measures about 10¾ × 8¾ × 2 inches, features a large solderless breadboard on its front panel. The breadboard provides a total of 1380 tie points, which can accommodate up to sixteen 14-pin DIP's. Because the *TD107* offers built-in power supplies, pulse generators, clock generators, and more, it's possible to build circuits that are quite complex.

Eight LED logic indicators are located at the top left side of the designer's sloping front panel. A logic probe, which indicates high, low, and pulsing logic levels is also available. Two momentary logic switches let you manually generate pulses. Pulses of 0.5 Hz and 500 Hz can be obtained from front panel terminals in either high-to-low or low-to-high transitions.

Clock signals are also provided by the designer. Complementary clock signals with frequencies of 1 Hz, 1 kHz and 100 kHz can be switch-selected. A line frequency (60 Hz) clock is also available. Eight slide switches provide switchable high or low data lines that can serve as inputs.

Two potentiometers, 1K and 100K units, are conveniently located at the bottom of the panel. Among other things, they can be used to adjust the levels of the +5 and ±12 volt power supplies.

Having such building blocks as power supplies, pulse generators, and clock generators around the breadboard means that you can concentrate on accomplishing a task without worrying about basic, mundane circuitry. That makes the TD107 designer ideal for formal laboratory courses because it lets students use their class time more efficiently. The designer would also be appropriate for home use by any electronics hobbyist or enthusiast. For those users who need to build large circuits, the designer can be expanded with additional breadboard space that can hold up to eight additional 14-pin DIP's.

The *TD107* digital designer carries a suggested retail price of $159.95, which is competitive for this type of device. JPC also offers an analog designer, the TA102, which is priced at $149.95. The analog designer provides the user with variable regulated power supplies, a center-tapped 30-volt AC supply, sine-, square-, and triangle-wave generators instead of the digital pulse and clock generators, and logic indicators. **R-E**

Be an FCC LICENSED ELECTRONIC TECHNICIAN!

No costly school. No commuting to class. The Original Home-Study course prepares you for the "FCC Commercial Radiotelephone License." This valuable license is your professional "ticket" to thousands of exciting jobs in Communications, Radio-TV, Microwave, Maritime, Radar, Avionics and more...even start your own business! You don't need a college degree to qualify, but you do need an FCC License.

No Need to Quit Your Job or Go To School
This proven course is easy, fast and low cost! GUARANTEED PASS—You get your FCC License or money refunded. **Send for FREE facts now. MAIL COUPON TODAY!**

COMMAND PRODUCTIONS
FCC LICENSE TRAINING, Dept. 90
P.O. Box 2824, San Francisco, CA 94126
Please rush FREE details immediately!

NAME ____________
ADDRESS ____________
CITY ________ STATE ____ ZIP ____

TRUTH

If your meter doesn't have True RMS, it's lying to you. Those nasty nonsinusoidal and noisy sinusoidal wave forms fool even the best "averaging" meters. The problem was, True RMS used to be expensive. Good news. The RMS225 is half the price of similar meters.

Call (800) 854-2708, (800) 227-9781 in CA.

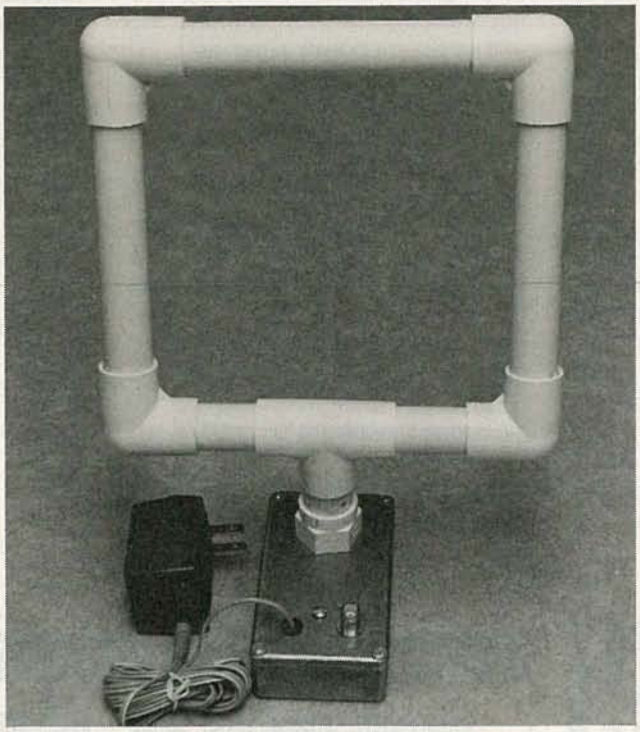
Beckman Industrial™
An Affiliate of Emerson Electric Co.
Beckman Industrial Corporation. San Diego, CA 92123-1898.

CIRCLE 176 ON FREE INFORMATION CARD

NEW PRODUCTS

Use the Free Information Card for more details on these products.

AM BROADCAST LOOP ANTENNA. The *BCL-1* receiving antenna from *Electron Processing*, a compact 8 × 8-inch square unshielded loop, is said to receive AM broadcast stations while rejecting excessive noise. A 30-dB preamplifier assures strong signals, and interference is reduced or eliminated by the loop's directional characteristics. Noise reduction permits the reception of stations that otherwise could not be received. With a reception range of 530 to 2000 kHz, the antenna is powered by line 120-volt AC. It is equipped with a jumper cable to connect the receiver and a selection of connectors is available.

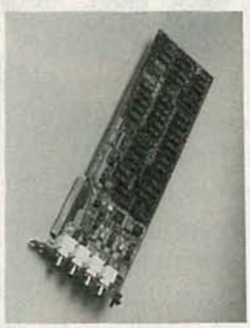


CIRCLE 16 ON FREE INFORMATION CARD

The price of the *BCL-1* AM loop antenna is $125 plus $5 for shipping and handling.—**Electron Processing, Inc.**, P.O. Box 68, Cedar, MI 49621; Phone: 616-228-7020.

DATA-ACQUISITION CARD. *Gage's CompuScope LITE-64K* data-acquisition card provides 40-MHz sampling with 64K of memory. According to the company, its card permits personal computers to match the performance of stand-alone digital oscilloscopes.

The card, in an IBM PC/XT/AT format, performs 40-msps digitization on one channel or simultaneous 20-msps digitization on two channels. It also offers 8-bit resolution, 32 kilobytes of memory per channel, external trigger capability, software drivers,



CIRCLE 17 ON FREE INFORMATION CARD

and a user-friendly interface. Up to eight of the cards can be installed in the same PC making it equivalent to an eight-channel, 40-MHz or a 16-channel, 20-MHz digital oscilloscope.

The *CompuScope LITE* card purchase includes digital-oscilloscope software permitting users to store, analyze, print, and transmit their data. GageCalc software also permits users to carry out math functions such as FFT and frequency counting. Gage offers software drivers compatible with all popular compliers: Turbo Pascal, Turbo C, Microsoft C, and Turbo Basic. Those drivers can control the board in OEM applications. The software, which runs under MS-DOS, has an installation utility and an AutoDetect feature that is said to be simple to use.

CompuScope LITE–6 costs $995.—**Gage plied Sciences Inc.**, 5 Vanden Abeele, Montr Quebec, Canada H4S 1 Phone: 514-337-68 Fax: 514-337-8411.

PULSE GENERATOR. P tek's Model B-1010 1 H 10 MHz pulse generato cludes includes varia delay and seven pulse w ths, 0 to 5 volts into ohms. Delay time is 0 to and 500 nanoseconds 50 and 500 microseco and 5 milliseconds, va ble in each step.

CIRCLE 18 ON FREE INFORMATION CARD

Seven pulse wid range from 50 nano conds to 50 microseco with each step variab Four operational mo are offered: internal, ex nal, manual, and exter up and down. The pu generator measur 10⅜ × 9 × 3⅝ inches weighs 5¼ pounds.

The *B-1010* pulse ge ator price is $499.— **Protek**, P.O. Box 59, N wood, NJ 07648; Pho 201-767-7242; F 201-767-7343.

PORTABLE PROTOTYPI STATION. How about a p table electronics labora ry to take to school, job—or even on vacati

CIRCLE 19 ON FREE INFORMATION CARD

Global Specialties' PB-503-C is a complete electronics prototyping station housed in a carrying case. It can be used for prototyping analog, digital, and microprocessor circuits and performing many kinds of experiments.

The breadboard has an area large enough to hold circuits with as many as 24 DIP-packaged devices. The portable lab contains a function generator, a power supply with three output voltages, an 8-channel logic probe, and two digital pulsers.

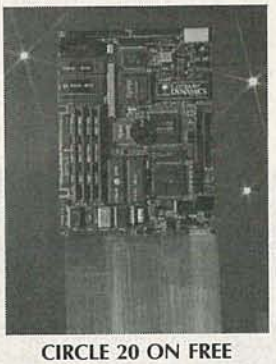
The power supply has a +5-volt, 1 ampere, and two variable 5–15-volt, 0.5-ampere terminals. The function generator produces frequencies from 0.1 Hz to 100 kHz with a choice of sine, square, and triangular waveforms or TTL clock output. The briefcase-sized, fold-down carrying case is roomy enough to store an optional *Proto-Meter 4000* multimeter and *WK-1* wire-jumper kit.

The *PB-503-C* portable prototyping station is priced at $349.95; the *Proto-Meter 4000* price is $139.95, and the WK-1 wire-jumper kit price is $13.95.—**Global Specialties**, 70 Fulton Terrace, New Haven, CT 05412; Phone: 800-572-1028.

486-CLASS SINGLE-BOARD COMPUTER. This PC-compatible, single-board computer from *Computer Dynamics* is intended for embedded OEM applications. It includes an Intel 486-compatible MPU, flash memory, and an advanced video controller.

The board measures 5-3/5 × 7-3/4 inches, taking up only about 10% of the space required by a desktop PC. The board's 25-MHz Cx486SLC MPU executes the 486SX instruction set and all 486SX operating systems, including DOS and Windows.

An on-chip, one-kilobyte cache gives the processor more than twice the speed of a 386SX at the same clock frequency. In addition to the full complement of standard PC functions, the board provides for up to 786 K of flash ROM.



CIRCLE 20 ON FREE INFORMATION CARD

For fixed-program storage, the *SBC-486* has up to 1.5 megabytes of on-board ROM/RAM disk, ensuring quick boot-up and reliable operation. The on-board video controller drives CRT's and flat-panel displays directly. Other features include hard- and floppy-disk controllers, a battery-backed real-time clock, a math co-processor socket, and an SBX interface that lets the user add "non-IBM" expansion boards.

The *SBC-486* board is priced from $936 in OEM quantities.—**Computer Dynamics**, 107 South Main Street, Greer, SC 29650; Phone: 803-877-8700; Fax: 803-879-2030.

Every Cleaning Task Made Easier with New Brushes, Swabs & Wipes

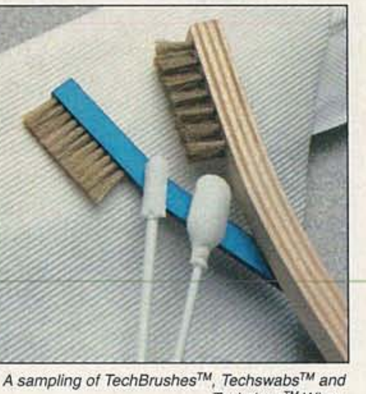
Whether you're tackling the dirtiest job, or cleaning a precision piece of equipment, Tech Spray has a cleaning product that makes the task easier.

Tech Spray has expanded its line of brushes, swabs and wipes to cover the wide variety of cleaning and maintenance needs in the electronic industry.

All TechBrushes™, Techswabs™ and Techclean™ Wipes are precisely manufactured under Tech Spray's rigid specifications.

Tech Spray takes special care throughout the manufacturing process and in its packaging to maximize cleanliness and protection against electrostatic discharge.

For a sample of these, or any Tech Spray product, contact our Technical Assistance Department toll free at **1-800-858-4043**.



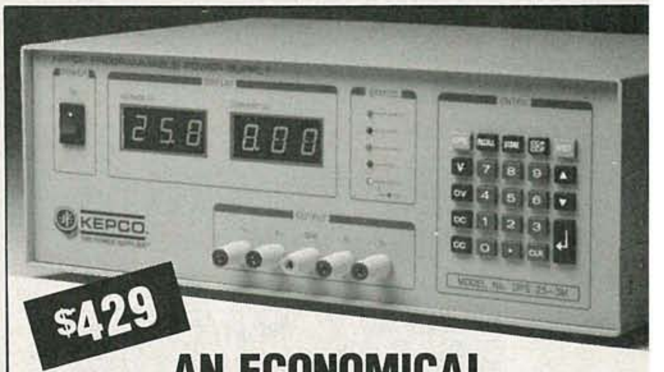
A sampling of TechBrushes™, Techswabs™ and Techclean™ Wipes

TECH SPRAY

TECH SPRAY, Inc.
P.O. Box 949
Amarillo, TX 79105-0949
(806) 372-8523

©1992 TS

CIRCLE 187 ON FREE INFORMATION CARD



AN ECONOMICAL KEYBOARD-CONTROLLED KEPCO BENCH POWER SUPPLY 75 WATTS

Choose from four Digital Power Supplies: 0-12.5V @ 6A, 0-24V @ 3A, 0-40V @ 2A or 0-125V @ 0.5A. Each one offers precise, repeatable voltage control with two current ranges. Fully protected for overvoltage or overcurrent.

Bonus: You can program the output from your PC's serial port (RS232 software included) and read back too!

The DPS is an affordable professional instrument and belongs on your bench.

Want more info? Ask for "DPS" brochure, 146-1768. Call-write-fax: Dept. MXS-87. Kepco Inc. 131-38 Sanford Avenue, Flushing, NY 11352 USA • Tel: (718) 461-7000 • Fax: (718) 767-1102. Use your VISA or MASTERCARD. Immediate delivery, 5-year warranty.

VISA KEPCO THE POWER SUPPLIER™ SINCE 1946 MasterCard

CIRCLE 181 ON FREE INFORMATION CARD

GRAPHICS CALCULATOR. Here is a calculator that plots graphs to speed-up problem-solving. *Texas Instruments' TI-85 Graphics Calculator* combines an advanced scientific calculator with graphics plotter in a handheld package.

CIRCLE 21 ON FREE INFORMATION CARD

The *TI-85* is intended for use in the office, when traveling, and in the field. According to H-P, engineering and science students can purchase this calculator for class work and be assured that it will still be useful in their professional careers after graduation.

The calculator's built-in software allows users to run trial solutions and test a range of strategies. The calculator displays graphs of functions as well as parametric, polar, and differential equations. It can determine any variable in an equation, solve 30 equations simultaneously, and extract the roots of a polynomial up to the 30th order. The calculator can handle complex numbers, matrixes, vectors, lists, and strings.

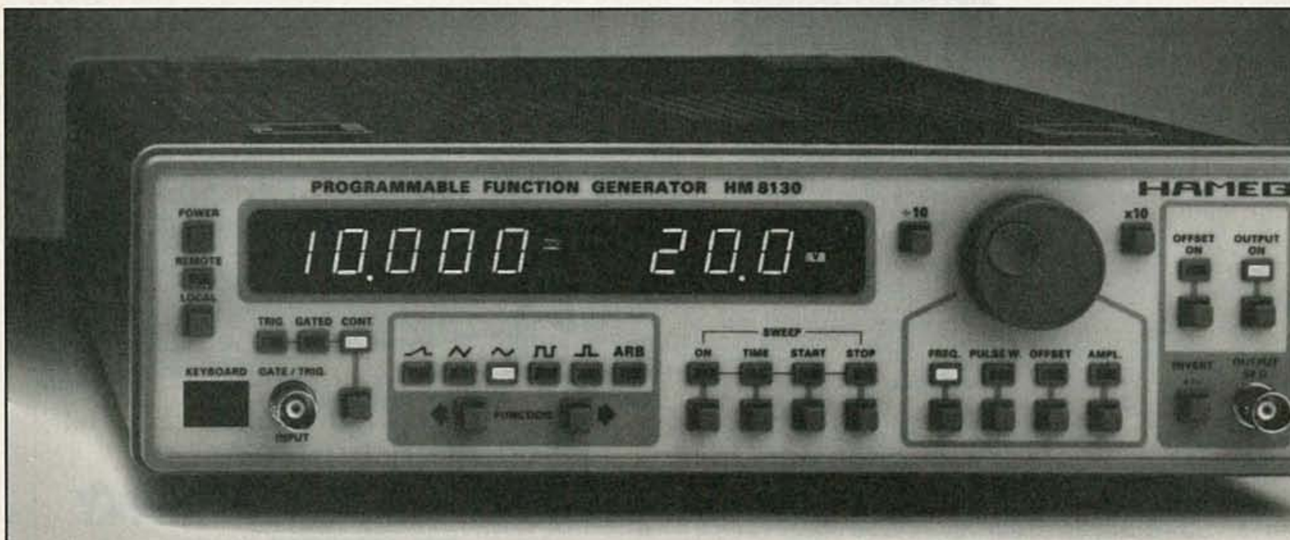
The TI-85 has 32 kilobytes of RAM. A built-in I/O port can link the calculator to a PC or another *TI-85*. Optional *LINK-85* software makes it possible to edit, store, and print programs, graphs, and math notations in IBM-compatible compatibles and Macintosh computers. The display provides eight lines of information with up to 21 characters each or 64 × 128-pixel graphs.

The *TI-85* graphics calculator has a list price of $130.—**Texas Instruments**, Consumer Relations, P.O. Box 53, Lubbock, TX 79408-0053; Phone: 800-TI-CARES; Fax: 800-741-2146.

CONVERTER-MOUNTING KIT. The *MS 15* mounting kit allows *Calex* 1 × 2-inch and 2 × 2-inch DC/DC converters to be used in many different non-AC powered systems. The kit consists of a 2½ × 3-inch card attached to a 15 connector, which mak convenient to rack m many DC/DC conver in any system.

CIRCLE 22 ON FREE INFORMATION CARD

Each connector has No.4 screw holes on ei side for mounting *MS-15*. The kit will acc modate all *Calex* sin and dual-output conver rated from 1.8 through watts. The *MS 15*, w



See us at WESCON/92 Booth 24

HM8130

A new breakthrough in price/performance ratio

- ☐ Synthesized Function Generator; 10mHz to 10MHz
- ☐ 5 Standard waveforms; Sweep mode; Ext. Gating
- ☐ Arbitrary function with 1024 x 1024 points; Interval 100ns
- ☐ Optional: GPIB/RS232 interfaces; External Keypad

Call toll fre 800.247.12

HAMEG Instrumen

1939 Plaza Real
OCEANSIDE, CA 92056
Phone (619) 630-4080
Telefax (619) 630-6507

CIRCLE 190 ON FREE INFORMATION CARD

coupled to those converters, is suitable for use in field-portable, battery-operated systems.

The unit price for the *MS 15* mounting kit is $32—**Calex Mfg. Co., Inc.**, 2401 Stanwell Drive, Concord, CA 94520-4841; Phone: 510-687-4411 or 800-542-3355; Fax: 510-687-3333.

DMM TEMPERATURE HEAD ACCESSORY. The *Fieldpiece* "Stick" series digital multimeter can be converted to a one-piece temperature meter with the addition of the *ATH3 dual temperature head*.

The *ATH3* with the optional *ADL2* test leads can be used with any DMM having "Fluke-style" jacks. The accessory can field-calibrated to an accuracy of ±1°F. The converter accepts inputs from two K-type thermocouples to display them as temperature on a DMM.

CIRCLE 23 ON FREE INFORMATION CARD

A DMM with resolution to 0.1 mV displays resolution to 0.1°F. A DMM with resolution to 0.1°F displays resolution to 1.0°F. Input impedance must be 9 or 10 megohms.

The dual-temperature head has a green LED to indicate "on" and a red LED to indicate low battery. The unit, which is internally powered by a standard 9-volt battery, automatically shuts off after 45 minutes. Two bead-type K-thermocouples are included.

The *ATH3* DMM dual-temperature head is priced at $89.—**Fieldpiece Instruments, Inc.**, 8322B Artesia Blvd., Buena Park, CA 90621; Phone: 714-922-1239; Fax: 714-992-1239.

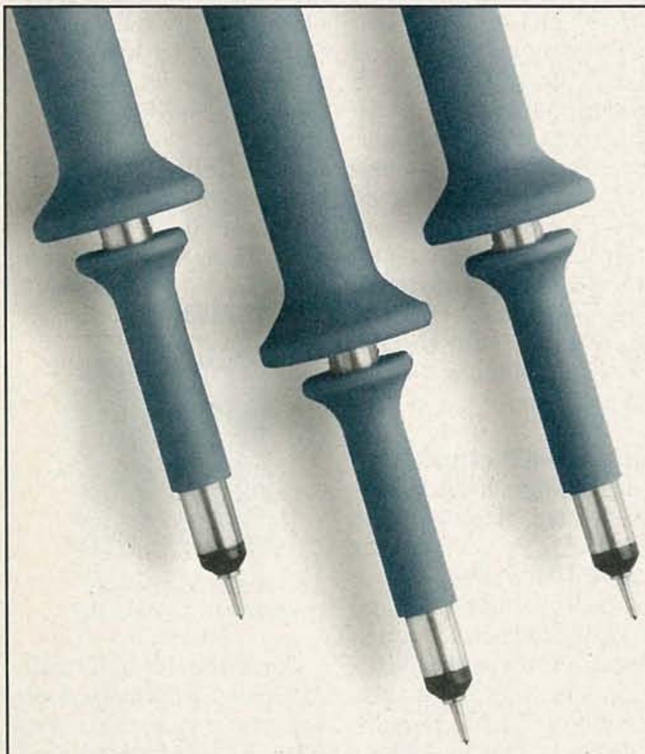
COMPACT MULTIMETERS. *B + K-Precision* has extended its line of low-cost, digital multimeters. Each of the four models in the "Tool Kit" series measure current to 10 amperes, DC voltage to an accuracy of 0.5%, and resistance, as well as test diodes. All of the DMM's have 3½-digit LCD's, audible continuity checking, and overload protection.

The basic *Model 2703* measures voltage , resistance , and DC current. The other models have additional features.

CIRCLE 24 ON FREE INFORMATION CARD

- *Model 2704A* also measures AC current and capacitance, and it makes transistor tests.
- *Model 2706* adds temperature measurement.
- *Model 2707* has a built-in frequency counter and logic-probe.

The DMM prices are: Model 2703A—$39, 2704A—$59, 2706—S79 and 2707—$89.—**B + K-Precision**, 6470 West Cortland Street, Chicago, IL 60635; Phone: 312-889-1448; Fax: 312-794-9740. **R-E**



EVEN AT $39, THE BLUES CAN LAST A LONG, LONG TIME.

Conventional wisdom says if you spend less than forty bucks on a probe, it won't be long until the thrill is gone. But Duraprobes™ start at $39, live practically forever, and work with almost any scope around, so it won't surprise us if you pick up a whole case. After all, some folks were just born to have the blues.

Duraprobe

63W-188581-1

**Brownell / Carolton-Bates / CMI-Metermaster / Contact East / ENTEST / INOTEK
ITC / Jensen Tools, Inc. / Joseph Electronics / Marshall Industries
Radar Electric / R.S. Electronics / Zack Electronics**

CIRCLE 178 ON FREE INFORMATION CARD

NEW LIT

Use The Free Information Card for fast response.

ANALOG DIALOGUE; from Analog Devices, Literature Center, 70 Shawmut Road, Canton, MA 02021; Fax: 617-821-4273; free.

Analog Dialogue is Analog Device's house organ for the dissemination of information about its products and related technology. The company terms it "a forum for the exchange of circuits, systems, and software for real-world signal processing."

CIRCLE 25 ON FREE INFORMATION CARD

This edition (Volume 26, Number 100) features highlight the subject of mixed-signal chips for driving digital radio. It discusses a pair of monolithic I/O chips that provide critical functions for digital mobile-radio communications. The AD7001 and AD7002 are described in a tutorial titled "IF Stages Are Going Digital for Both Analog and Digital Signals."

The journal also carries an article on monolithic sigma-delta converters with 21-bit resolution backed up by a tutorial on sigma-delta architectures. Another article covers a SPICE macromodel of an analog multiplier. Other sections include a new product overview, an advice column on voltage references, and a review of new literature from Analog Devices.

MINIATURE SWITCH CATALOG; from Eaton Corporation, Aerospace & Commercial Controls Division, 4201 North 27th Street, Milwaukee, WI 43216; Phone: 414-449-7483; free.

CIRCLE 26 ON FREE INFORMATION CARD

This catalog (publication number NC-169) contains a technical specification information and illustrations on Eaton's line of miniature switches for electrical and electronic applications. To simplify the search for the switch that will meet your requirement, each product section includes a brief product description and a selection table.

DESKTOP PUBLISHING WITH WORD FOR WINDOWS VERSION 2.0; by Tom Lichty. Ventana Press, P.O. Box 2468, Chapel Hill, NC 27515; Phone: 929-942-0220; Fax: 919-942-1440; $$21.95.

The software Word for Windows, version 2.0 is intended for word processing and desktop publishing. This book offers advice and examples to help users take full advantage of that software. Mr. Lichty's book, which assumes that readers have a working knowledge of Word, explains how to create attractive, well-designed documents on a computer.

CIRCLE 27 ON FREE INFORMATION CARD

It addresses framing and text placement in desktop-publishing. Also covered are the fundamental principles of page design such as proportion, balance, and unity. The book tells the reader how to apply those principles to setting margins, white space, rules, and borders. Other topics include typography, style sheets, multiple columns, and graphics placements. The final chapter contains specifications for recommended printers and printing methods.

KNOB CATALOG; from Rogan Corporation, 3455 Woodhead Drive, Northbrook, IL 60062; Phone: 800-423-1543; free.

You'll be amazed at the variety of sizes, shapes, colors and styles in which a simple product like a knob can be produced. Rogan's catalog proves that push-buttons have yet to usurp the role of rotating controls in electronics. The right selection of knob can make or break the appearance of your product.

CIRCLE 28 ON FREE INFORMATION CARD

This catalog illustra
Rogan's broad range
products, spelling out
options in material, si
style, markings, color, d
orative options, mountir
and dimensions. There a
for example, ergonor
clamping knobs, digi
turns-counting knobs,
strument knobs, and r
tary spec knobs.

**TECHNI-TOOL CATALOG
from Techni-Tool, 5 Apo
Road, P.O. Box 36
Plymouth Meeting,
19462; Phon
215-941-2400; free.**

CIRCLE 29 ON FREE INFORMATION CARD

Techni-Tool's 1992 ca
log gives information
the company's tools, t
kits, test equipment, a
supplies for factory p
duction and professio
trouble-shooting as wel
field service on all kinds
electrical and electro
equipment.

1992 CATALOG; from MCM Electronics, 650 Congress Park Drive, Centerville, OH 45459-4072; Phone: 1-800-543-4330; free.

MCM's latest catalog contains specifications information on more than 17,000 electronics parts and components. This 212-page edition includes reference to 1500 more items than the 1991 edition. Product categories include semiconductors, television and VCR parts, power supplies and regulators, telephone components and accessories, batteries, speakers, and tools.

CIRCLE 30 ON FREE INFORMATION CARD

YOUR VHF COMPANION; edited by Steve Ford, WB8IMY. The American Radio Relay League, 225 Main Street, Newington, CT 06111; $8.00.

CIRCLE 31 ON FREE INFORMATION CARD

This book will be welcomed by veteran VHF operators as well as novices because it contains plenty of useful information in an entertaining, easy-to-read format. For example you'll find out how to participate in all the activities on the VHF bands—FM and repeaters, packet radio, CW and SSB, satellites, and amateur television.

UNDERSTANDING HARMONICS IN POWER DISTRIBUTION SYSTEMS; from John Fluke Mfg. Co., Inc., Service Equipment Group, P.O. Box 9090, M/S 250-E, Everett, WA 98206-9090; Phone: 800-526-4731; $19.95.

Power line harmonics can be a source of unwanted interference in factories and offices that depend on the reliability of line-powered electronic equipment from PC's to copying machines. Harmonics can cause transformers and neutral conductors to overheat and circuit breakers to trip for no apparent reason.

CIRCLE 32 ON FREE INFORMATION CARD

This 17-minute educational video will help you to understand and solve harmonics problems. It covers such subjects as the definition and classification of harmonics, electrical loads, equivalent circuits, and the detection of harmonics. It suggests methods for solving harmonics problems in new and existing buildings. **R-E**

Train at HOME to be an Electronics Technician!

As the demand for computers and microprocessors in business, manufacturing and communications continues to grow, so does the need for qualified technicians. It's not unusual for experienced technicians to earn from $30,000 to more than $40,000 a year.* Now through Peoples College of Independent Studies you can train for this exciting field without interrupting your job or home life.

Choose From Five Programs of Study

- Electronics & Microprocessor Technology
- Industrial Electronics & Microprocessor Technology
- Communications Electronics with Microprocessor Technology
- Computer Servicing & Electronics Technology
- Specialized Associate Degree In Electronics Technology

Professional Equipment Is Included

Depending on the program you select, you'll perfect your skills using this advanced equipment, included in the price of tuition:

- IBM-Compatible Personal Computer
- Digital Multimeter
- Digital Logic Probe
- Elenco Oscilloscope
- Portable Cellular Telephone

(* Source: U.S. Bureau of Labor Statistics)

Exclusive Extras That Enhance Your Training

Peoples College introduces some training firsts to make your learning experience more complete:

- Accelerated Learning System — a scientifically proven study system that helps you learn faster and easier than ever before.
- Video Tutor Training Tapes — give you a permanent, visual record of informative lectures and close-up demonstrations.
- Experience Labs — professionally designed experiments that give you hands-on "bench" experience.
- Industry Certification Training Guide — provided with four of our programs. Prepares you for examinations you may take for your professional license or certification.

Easy Payment Plans — No Finance Charges

To help you get started on your education, Peoples College has reduced tuition rates and offers low monthly payment plans with no finance fees. So don't delay, call or write for more information today!

For COLOR CATALOG Mail Coupon or Call TOLL FREE 1-800-765-7247

Programs offered only in United States, Canada, Puerto Rico and Virgin Islands. No Obligation. No sales person will call.

Our programs are accredited by the Accrediting Commission of the National Home Study Council

YES! I would like to know more about your training programs. Send a catalog to:

Name ______

Address ______

City ______

State ______ Zip ______

Phone # ______

PEOPLES COLLEGE
OF INDEPENDENT STUDIES

233 Academy Drive • P.O. Box 421768
Kissimmee, FL 34742-1768

Member, D.L. Peoples Group R1192

CIRCLE 180 ON FREE INFORMATION CARD

THE PARTS PLACE[SM]

Come in for Your FREE Radio Shack Catalog!

The most important part of your next project is the all-new, 172-page 1993 Radio Shack catalog. It's yours for the asking at our store or dealer near you. Hurry in today—supplies are limited!

TECHLINE™ Tools—The new standard in strength and precision

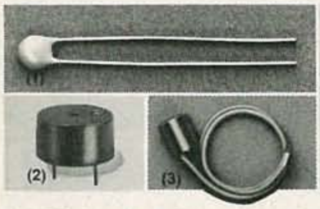
- Precision-crafted with top-quality materials
- Designed for long life and ease of use
- Backed by Radio Shack's 1-Year Limited Warranty

New TECHLINE tools represent Radio Shack's uncompro mising dedication to quality. Each is precision-crafted c long-lasting, hard-working materials and employs the lat est design innovations for comfort and ease of use. And each is backed by our full 1-year limited warranty.

Speedy service and low prices on thousands of parts and accessories!

- FREE delivery to Radio Shack on orders $5 and up
- Semiconductors and ICs ■ Hard-to-find batteries
- CB and scanner crystals ■ Long-life vacuum tubes
- Phono cartridges/styli ■ SAMS® service books

Why pay more for mail-order? Your Radio Shack stocks 1000 electroni components, and another 15,000 are available *fast* from our special-orde warehouse. Ordering is easy! Bring in the exact part number (or old part We'll check availability and order by phone. Delivery time to your nearb Radio Shack for most items is a week.



(1) Picofarad 50-Pack. Delight for tweakers. 50 ceramic capacitors, assorted 1 to 33 pF values. 50 WVDC. #272-806 . . . . **2.99**

(2) Efficient PC-Mount Piezo Buzzer. Tiny yet has 70 dB output and requires only 7 mA at 12VDC. #273-074 . . . . **2.99**

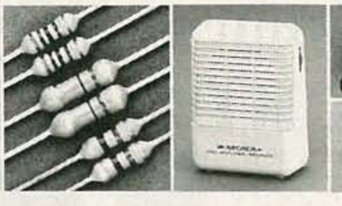
(3) Omnidirectional Electret-Type Mike Element. 30-15,000 Hz. 4 to 10 VDC. #270-092, **2.99**

Test-Equipment Adapters. Great for use with scopes, frequency counters and multimeters. Hook up with the best.

(1) Binding Posts to BNC Plug. 50 ohms impedance. #274-715 . . . . **8.95**

(2) Binding Post to Banana Plug. #274-716 . . . . **Set of 2/4.95**

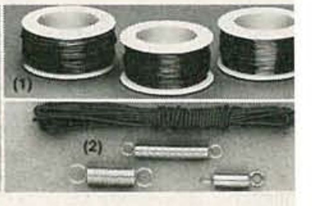
(3) Stackable Dual-Inline Banana Plug. #274-717 . . . . . . **2.99**



Resistor Assortments. Popular values—stock up and save.

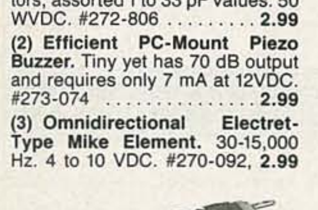
Description	Cat. No.	Set of	Price
Metal-Film 1/8W	271-309	50	2.29
Carbon 1/4W	271-308	100	2.99
Carbon-Film 1/4W	271-312	500	7.95
Carbon 1/2W	271-306	100	3.49

Mini Audio Amp With a Built-in Speaker. Many uses! Tough 3⅜"-high case. Low Radio Shack price. #277-1008 . . . . **11.95**

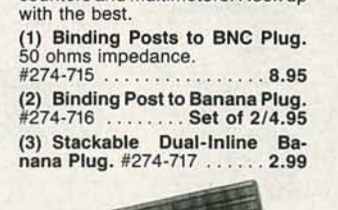


(1) Magnet Wire Assortment. Fc custom coil winding. Includes 4 feet of 22-gauge, 75 feet of 26 gauge and 200 feet of 30-gauge o spools. #278-1345 . . . . **4.9**

(2) Dial Cord Fix-It Kit. Our exclu sive! Includes six feet of high strength cord and three tensio springs. Put a radio back int action! #274-435 . . . . **99**

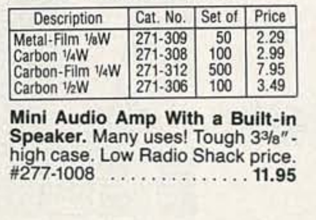


High-Speed 12VDC Mini-Motor. Produces an amazing 15,200 RPM at no load. Ideal for projects, robotics, fun! About 2" long (with shaft). #273-255 . . . . **2.99**



PC/XT Circuit Card. Epoxy. Fits computer expansion bus. 10 1/16" long. #276-1598 . . . . **29.95**

Right-Angle D-Sub 25 Female Connector for Above. #276-1504 . . . **2.69**



Infrared Project Box. Ideal for a remote. Has removable infrared-transparent end panel and space for 9V battery. 7/8 × 2 3/8 × 4 1/4". #270-294 . . . . **4.49**

100-Watt Soldering Gun. For big jobs! Reaches full temperature in seconds. Built-in work light. Replacement tips in stock. UL listed. #64-2193 . . . . **11.95**

Prices apply at participating stores and dealers.

Radio Shack® SINCE 1921
AMERICA'S TECHNOLOGY STORE[SM]
A DIVISION OF TANDY CORPORATION

CIRCLE 78 ON FREE INFORMATION CARD

BUILD THIS SUPER STROBE

Create breathtaking stop-action photos with the Freeze Frame.

JOHN SIMONTON and TREY SIMONTON

SO MUCH OF LIFE IS A BLUR. WHEN you can slow it down and savor it, you discover the most interesting things.

Take, for example, the pictures showing a water-filled balloon being popped by a dart. You might anticipate that the burst balloon would leave a ball of water hanging in the air for a fraction of a second, but would you have guessed that the surface of the water ball would froth the way it does? What a beautiful surprise.

Our Freeze Frame strobe trigger lets you use photographic techniques that substitute a strobe flash for high shutter speeds. You can reproduce these and other stop-action shots either for serious scientific purposes or just because they make such interesting pictures. The inexpensive, easily built unit has been designed to use interchangeable sensors, so that anything that pops, snaps, flashes, or reflects or blocks light can trigger your camera's strobe.

How it works

The complete schematic for the Freeze Frame is shown in Fig. 1. Either of the sensors (phototransistor Q2 or electret microphone MIC1) acts like a variable current sink in series with R1. As light or sound levels change and more or less current sinks into the sensor, a voltage develops across R1.

The processing amplifier for the sensors is built around two stages of an LM324 quad operational amplifier (IC1-a and IC1-b). The amplifier is AC-coupled so that only changes in the triggering signal are detected. The values of the coupling capacitor between stages are intentionally small so that only changes with higher-frequency components (above about 5 kHz) pass through the amplifier. When using the microphone, that means that snaps and pops will be more likely to trigger the unit than other ambient noise, including speech.

Capacitor C2 couples the output of the processing amplifier to the rectifier- and peak-detector section consisting of D1, D5, R9, R10, and C4. The DC voltage that appears across R9 is approximately the same as the peak-to-peak voltage at the output of the amplifier.

The voltage is applied to a threshold detector, which is a

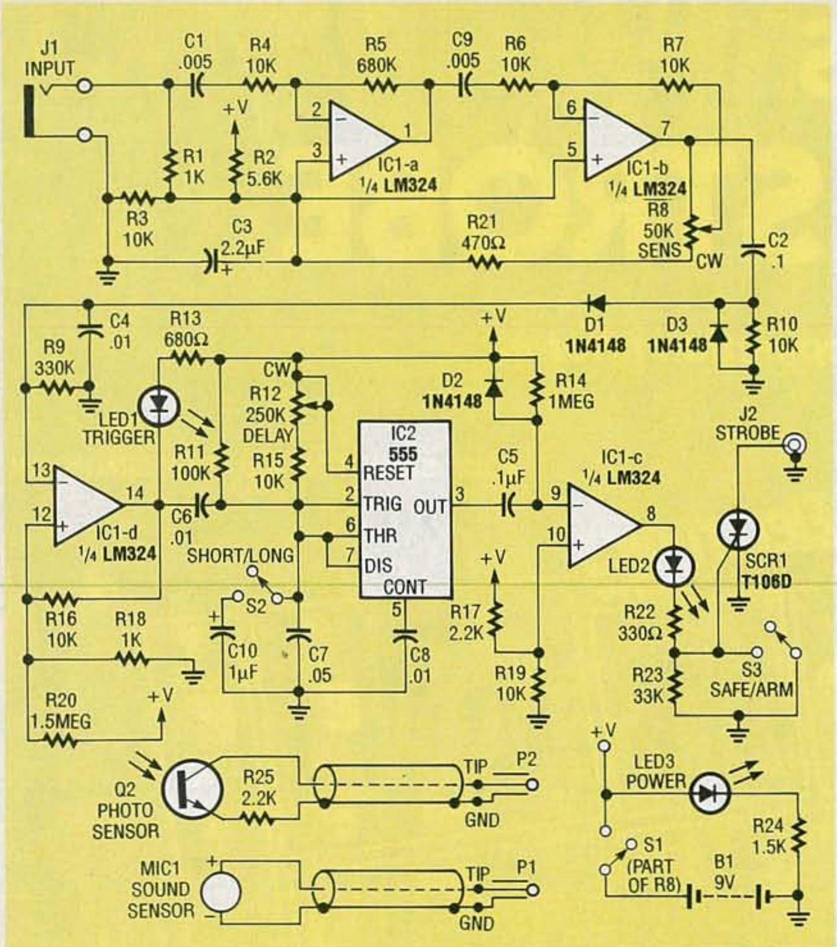
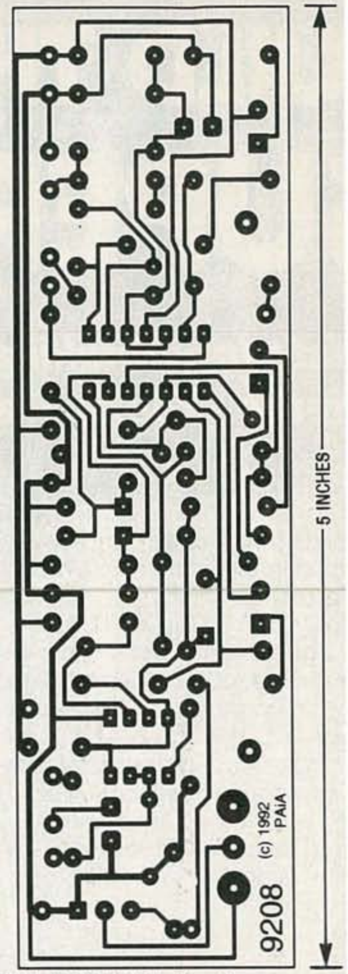


FIG. 1—SCHEMATIC FOR THE FREEZE FRAME. The sensors act like a variable current sink in series with R1. As light or sound levels change and more or less current sinks into the sensor, a voltage develops across R1.



FREEZE FRAME foil pattern.

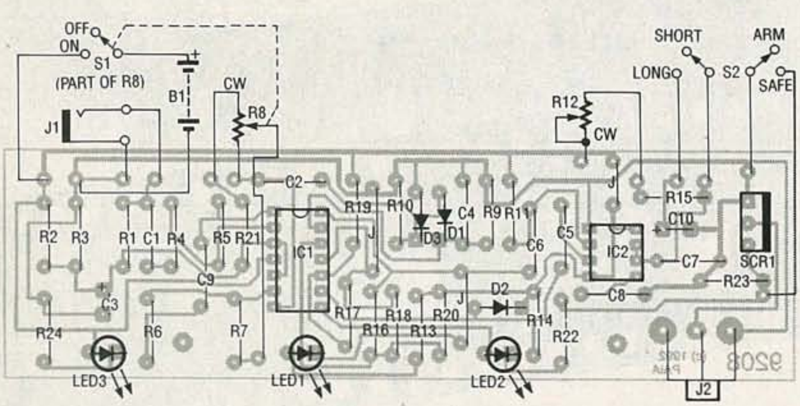


FIG. 2—PARTS-PLACEMENT DIAGRAM. The three wire jumpers can be formed from excess component lead.

Schmitt trigger built around IC1-d. The trigger level is set to a couple of volts and hysteresis is set to about one volt by R16, R18, and R20. At the output of the amplifier, LED1 indicates when a stimulus has exceeded the threshold.

When the output of the threshold detector goes low, C6 couples the transition to the input of the 555-based timer section and triggers it. The amount of delay produced by the timer is set by the DELAY CONTROL R12 and capacitor C7. Capacitor C10 is switched in by S2 when longer delays are needed.

The output of the timer is coupled by C5 to the final amplifier stage in IC1, which is wi[r] as a comparator. At the end [of] the time-out, IC2's output g[o] low and is inverted by IC1-c t[o a] positive transition that tur[ns] on SCR1. The current path [to] SCR1's gate is provided [by] LED2, which also indicates t[hat] the triggering signal has ha[p]pened. As a convenience wh[en] setting up to take phot[os,] switch S3 can be closed [to] ground the gate of SCR1 a[nd] prevent it from firing.

Building the Freeze Frame

You can build the Fre[eze] Frame with just about any c[on]struction technique you like[.] circuit board is always the ne[at]est, quickest, and easiest w[ay,] though, so we've provided a [foil] pattern. You can buy an etch[ed] and drilled board from t[he] source given in the Parts List[. If] you use a PC board, mount a[nd] solder all of the components [fol]lowing the parts-placement [di]agram in Fig. 2. There are th[ree]

PARTS LIST

All resistors are ¼-watt, 5%.
R1, R18—1000 ohms
R2—5600 ohms
R3, R4, R6, R7, R10, R15, R16, R19—10,000 ohms
R5—680,000 ohms
R8—50,000 ohms, audio-taper potentiometer with switch (S1)
R9—330,000 ohms
R11—100,000 ohms
R12—250,000 ohms, linear-taper potentiometer
R13—680 ohms
R14—1 megohm
R17, R25—2200 ohms
R20—1.5 megohms
R21—470 ohms
R22—330 ohms
R23—33,000 ohms
R24—1500 ohms

Capacitors
C1, C9—0.005 µF, ceramic disk
C2, C5—0.1 µF, Mylar
C3—2.2 µF, 10 volts, electrolytic
C4, C6, C8—0.01 µF, ceramic disk
C7—0.05 µF, ceramic disk
C10—1 µF, 10 volts, electrolytic

Semiconductors
IC1—LM324 quad op-amp
IC2—555 timer
D1–D3—1N4148 diode
LED1–LED3—red light-emitting diode
Q1—IR phototransistor
SCR1—T106D silicon-controlled rectifier

Other components
B1—9-volt battery
J1—Miniature phone jack
J2—RCA jack
MIC1—Electret microphone
PL1, PL2—Miniature phone plugs
S1—SPST switch (part of R8)
S2, S3—SPST slide switches
Miscellaneous: case with top panel, knobs, wire, hardware, battery snap, heat-shrink tubing, coaxial cable, circuit board, etc.

Note: The following items are available from PAIA Electronics, Inc., 3200 Teakwood Lane, Edmond, OK 73013 (405) 340-6300:
- **Etched, drilled, and silkscreened PC board (#9208pc)—$12.75**
- **Complete Freeze Frame kit including PC board, case, and all components (#9208k)—$39.75**

Please add $3.50 shipping and handling to each order.

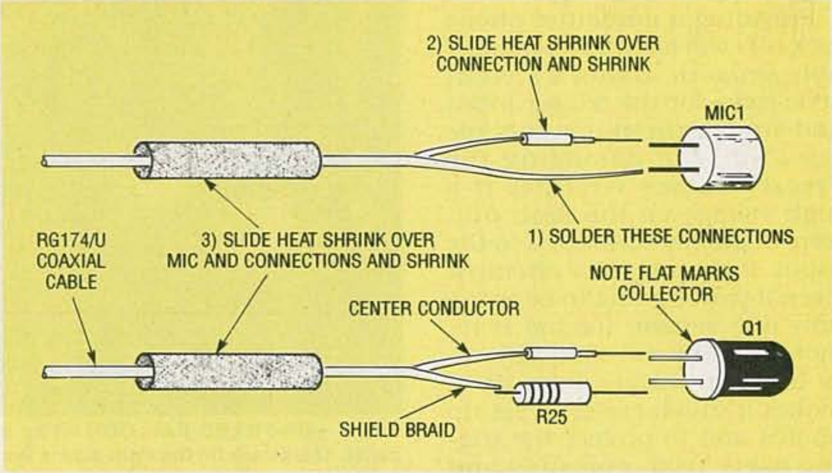


FIG. 3—MAKE THE SENSOR ASSEMBLIES with heat-shrink tubing and small diameter coaxial cable such as RG-174/U. The space between the coaxial cable and the outer heat-shrink tubing is filled with a little silicone rubber.

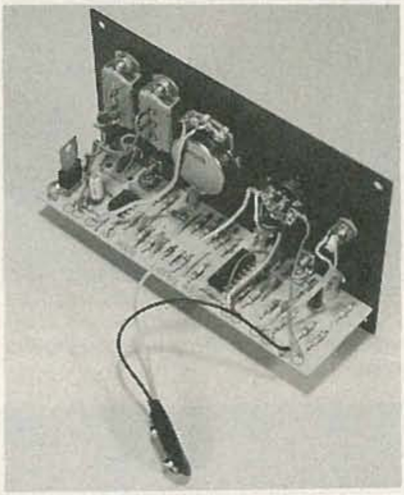


FIG. 4—THE COMPLETED FREEZE FRAME. This is one of the most attractive boards you'll ever see.

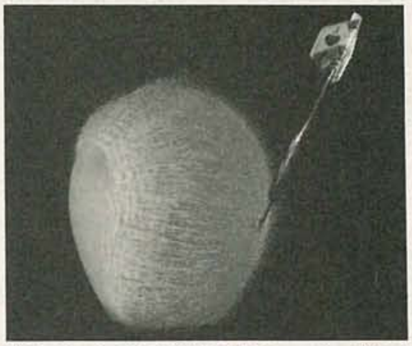


FIG. 5—A DART HITTING a water-filled balloon from an angle. The microphone sensor picked up the sound of the balloon bursting.

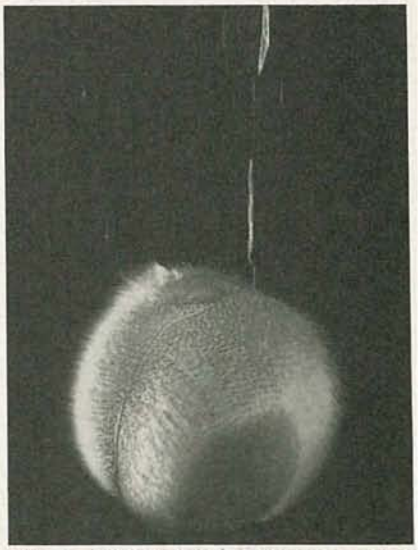


FIG. 6—ANOTHER DART hitting another water balloon, but from directly above.

wire jumpers on the board that can be formed from the excess leads clipped from other components.

A fairly light gauge wire such as AWG 26 is appropriate for making connections between the circuit board and front-panel controls. With any electronic circuit, keeping the wiring between the circuit board and front panel as short and direct as possible is good practice, and with the Freeze Frame it is important because the high signal gains in the sensor-processing amplifier at maximum sensitivity could cause the pickup of stray signals.

The circuit board is laid out so that the LED's and the STROBE-TRIGGER output jack J2 are on an edge of the board where they can look out through holes in the front panel when the board is mounted at a right angle to the panel with "L" brackets.

Providing a miniature phone jack (J1) will allow interchangeable sensors. Using different style jacks for the trigger input and strobe output prevents the possibility of damaging the Freeze Frame's circuitry if a high voltage on the flash unit were suddenly connected to the input of the amplifier circuitry. Even if you're going to be using only one sensor, having it remote from the rest of the circuitry is an advantage because it makes it much easier to set up photos and to protect the trigger parts from splashes and other abuse.

Make the sensor assemblies with heat-shrink tubing and small diameter coaxial cable such as RG-174/U (see Fig. 3). Both the phototransistor and microphone are polarized components, so make sure their positive sides (the collector in the case of Q2) connects to the center conductor of the coaxial cable, which, in turn, connects to the tip of the phone jack. Note the resistor in series with the phototransistor; we mounted it at the detector end of the coaxial cable and made the heat-shrink tubing long enough to cover both it and most of the case of Q2. The space between the coaxial cable and the outer heat-shrink tubing was filled with a little silicone rubber.

An infrared photodetector is recommended because it allows a setup under limited fluorescent lighting, which is low in IR. At the same time, many of the events that will be triggering events (such as things blowing up, for instance) are high in IR.

You will need to modify a flash extension cord by replacing its normal camera-end connector with an RCA plug. There are a couple of things to be aware of here. First check the polarity of the voltage on the flash cord; the positive side must go to the anode of SCR1 (the center of the RCA jack) and the negative side to ground. Also, the voltage on those leads varies widely; on some strobes it might be only a couple of volts, while others might be over 200 volts. There is fairly low energy here in either case, so we're not talking about

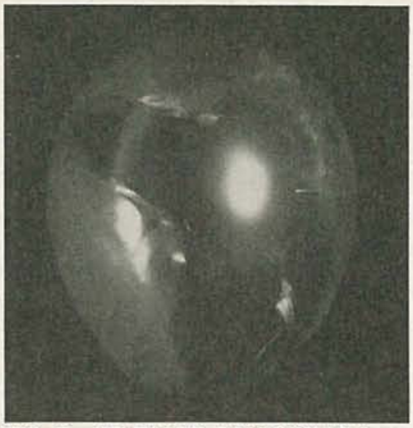


FIG. 7—AIR-FILLED BALLOON hit by a pellet. The streak on the right side is the pellet.

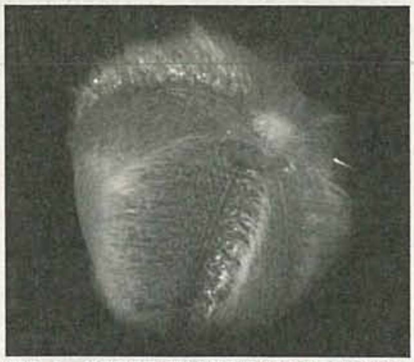


FIG. 8—WATER-FILLED BALLOON hit by a pellet. The sound sensor was used with the report of the gun providing the event trigger.

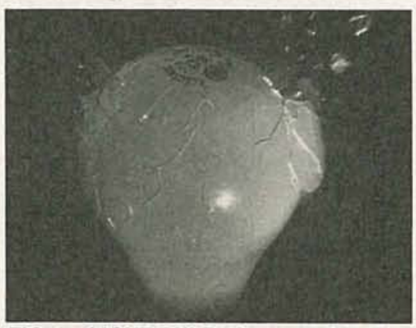


FIG. 9—LIGHT BULB hit by a pellet. The del ay was set at its minimum value for this shot.

FIG. 10—THE LIGHT BULB is almost totally gone in this picture. Don't forget to wear goggles when shattering light bulbs.

a lethal situation. But you'll initely feel the higher voltag you touch it. If you don't wan purchase an extension corc be dedicated to the Fre Frame, you might be able to your existing cord and pa the two ends together with in-line plug and jack pair. M sure the male connector on end of the cord is connectec the flash. Figure 4 shows completed unit.

Testing

Any testing procedure sho start with a close visual insp tion of your work. Make s component polarities have b observed, that all solder joi look good, and that there are solder bridges on the circ board.

Don't plug in a sensor ye our initial tests won't need o Snap in a fresh 9-volt batt and turn the unit on by rotat the sensitivity control clockw beyond the detent; the power dicator (LED3) should light not, check for a dead batt short circuits, etc.

Set the SENSITIVITY (R8) a DELAY (R12) controls to ab the mid-point of their rotati and set the SHORT/LONG swi (S2) to "short." With a w jumper or clip lead, short the and ground lugs of the in jack J1 together. If everythi working properly you sho see both the TRIGGER and F LED's flash briefly and app ently simultaneously. If neit LED flashes, it could indic problems in the sensor-proce ing amplifier, so check the cuitry associated with IC1-a a -b, the polarity and assembly tegrity around diodes D1 a D3, and the circuitry associa with IC1-d. If only the TRIG LED lights, it could indic problems in the timer circu associated with IC2 or the fi comparator IC1-c.

Switch S2 to "long," and o again short the input. Now should be able to see a disce ble time delay between the fl from the TRIGGER and F LED's. If you don't see an vious delay it could mean pr lems with the timer or with and C10.

Now plug in the microphone sensor. With the SENSITIVITY control set to about mid-range, a finger snap from within a foot of the microphone should cause both the TRIGGER and FIRE LED's to light. At maximum sensitivity, a finger snap within several yards should trigger the unit, and at minimum sensitivity you will have to be within a inch or so from the microphone. If there are no obvious differences in the sensitivity of the unit as the SENSITIVITY control is rotated over its range, check the wiring around potentiometer R8. If there is no response from the microphone as an input, check the wiring of the phone plug and coaxial cable of the microphone, as well as the polarity of the microphone.

Plug in the IR sensor and point it at an incandescent lamp (fluorescent or Krypton lights might not have sufficient infrared energy to be detected by the phototransistor), and set the SENSITIVITY control to mid-range. Passing your finger in front of the phototransistor should cause the TRIGGER and FIRE LED's to flash briefly. Striking a match or lighting a cigarette lighter in front of the sensor should trigger the unit. If there are problems here, check the wiring of the sensor, in particular the polarity of the phototransistor.

Finally, mate the RCA plug on the end of your modified flash extension cord with the STROBE jack and turn the strobe on. Set the ARM/SAFE switch (S3) to "arm" and trigger the Freeze Frame. The strobe should flash when the FIRE LED flashes. If not, check the strobe first, making sure its battery is good by firing it with its own test switch. Then check the modifications you've made to the flash's extension cord; make sure that the positive voltage from the strobe connects to the tip of the RCA plug. If there are still no results, check the SCR.

Using the Freeze Frame

The Freeze Frame helps you to get shots that would be difficult to obtain otherwise. But that doesn't mean that they're necessarily going to be easy. The quality of the pictures you get will depend to a large extent on how carefully you set up the shot.

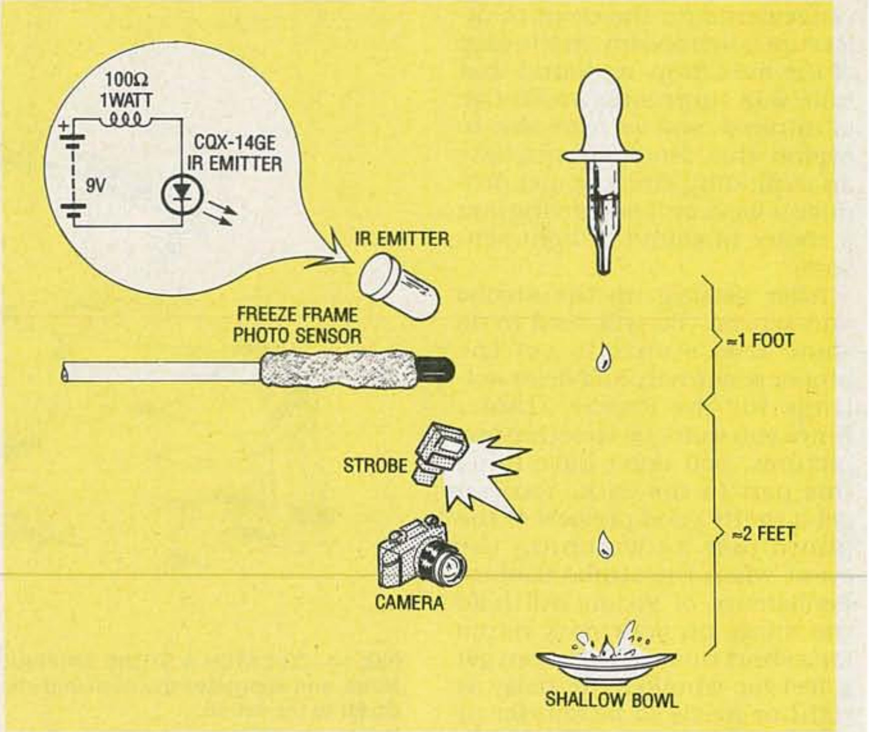


FIG. 11—YOU CAN TRIGGER A MILK DROP by pointing an IR emitter and the sensor in the same direction toward the space through which the drop will fall through.

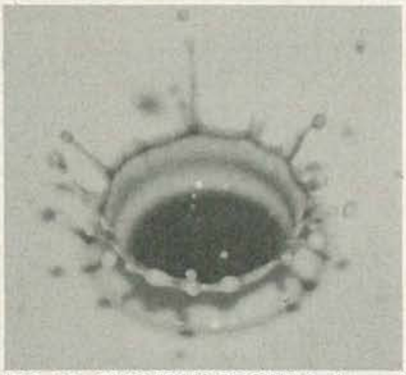


FIG. 12—THIS MILK CROWN is formed after the drop hits.

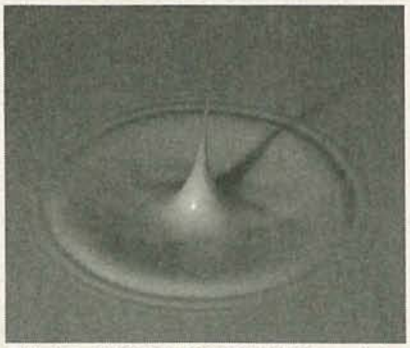


FIG. 13—THIS MILK COLUMN forms later in the sequence.

You can look forward to giving your imagination a workout as you figure out what sensor to use, how to use it, and how to light the subject—not to mention thinking up an interesting picture in the first place.

Each situation will be slightly different, but to get you started we'll cover first some basic principles on the camera side of things, and then look in detail at how the Freeze Frame produced the photos shown here.

As we said in the opening, the essential idea is that you're going to be exposing the film with a brief flash of light while the camera shutter is held open, rather than the usual way of lighting the subject and briefly opening the shutter. The first obvious implication of this is that the photography must be done in the dark—not darkroom dark necessarily, where every tiny little crack must be sealed against light, but dark—a moonless-night-in-the-country kind of dark.

Sensor selection is usually pretty obvious. If the event that you want to photograph makes a sound (like a popping balloon), use the microphone. If the event is very quiet, make arrangements for the event to interrupt a light beam. In the case of the milk drop, we found that milk was surprisingly reflective of infrared, and we were able to exploit this. Some events (like an exploding firecracker) produce a flash and pop giving you a choice of sound or light sensors.

After setting up the strobe and sensor, you will need to do some trial events to get the proper sensitivity and delay settings for the Freeze Frame. Since you won't be shooting any pictures, you don't have to do this part in the dark. You can get a pretty good preview of the photo just by watching the event when the strobe flashes. Persistence of vision will hold the image on your eye's retina for a short time, and you can get a feel for whether the delay is right or needs to be shorter or longer. The range of delay is from 0.5 millisecond to 12 milliseconds when S2 is set to "short" and 10 milliseconds to 0.25 second when set to "long."

Proper placement of the flash makes a big contribution to the quality of the photo. For example, backlighting the subject slightly (placing the strobe so that it lights the subject from behind) will keep any background clutter from showing up on film. When backlighting, make sure the strobe doesn't flash directly into the camera lens or close enough to cause lens flares, unless you want them. Strategically placed "light baffles" can make things that you don't want in the photo, such as supports for the subject, disappear by keeping them in shadow. Sheets of cardboard would be our choice material, but we used books or whatever else we could lay our hands on.

When you're trying to freeze motion, you need brief flashes of light. Strobes that are too "smart" can produce a flash that is amazingly long; we figure several milliseconds judging from the blurred results of our first shots. Switch your flash to its "dumb" (manual) mode and minimum energy settings if you get blurred results. If you are not able to do this, switch to another flash. A modern Vivitar 636AF was smarter than we were, so we wound up using an inexpensive and ancient Vivitar 253 for all of the shots shown here.

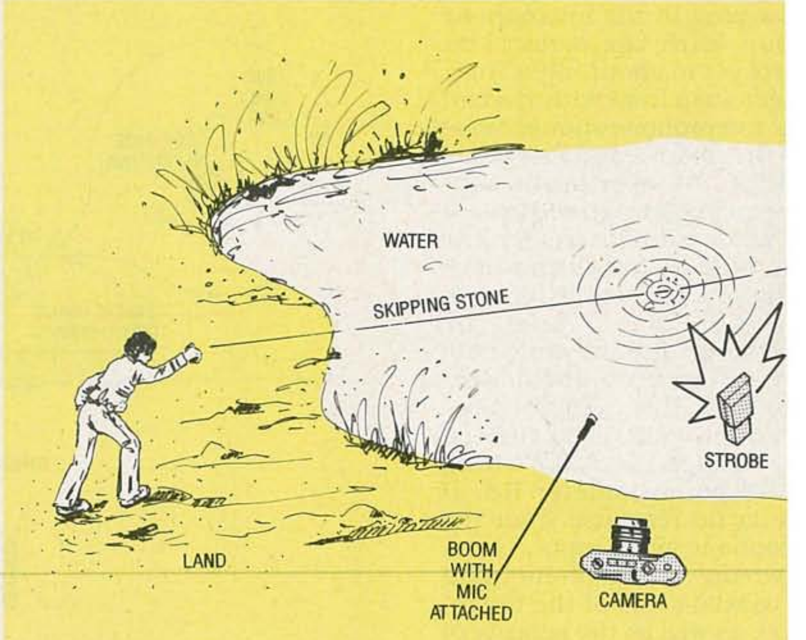


FIG. 14—TO CATCH A STONE SKIPPING ACROSS WATER, we set up the camer shore, and supported the flash and microphone sensor out in the water to get closer to the action.

FIG. 15—THIS STONE was in the middle of skipping when we "caught" it.

You can use whatever film you're used to; these shots were done on Kodachrome 64 with aperture settings ranging from f8 to f11. We used a fairly long lens (35–80mm zoom) because taking some of these shots was a messy proposition and we wanted to keep the camera as far away as possible. Remember, the larger the f-stop, the greater the depth of field. That is important when you're not completely sure wher the pieces of a subject wil when the shot is taken.

A tripod was used to free hands needed elsewhere, the camera can be handl without much fear of blur because the strobe will stop action. A cable or other ren release can be used to open shutter, but our Minolta M um 7000 had a self timer we used instead. We found a 2-second exposure was l enough to let us take a pic without rushing, and sh enough to keep the film f being exposed.

As the battery in a str ages, it takes longer for the to charge high enough to again. That can become an noying delay if the flash is in vertently fired during set The ARM/SAFE switch keeps from happening. Leave switch in the "safe" position til you're ready to shoot a ture, then switch it to "arm

Once we finished setting adjusting the camera, str and subject placement, d times, sensitivity, and other justments, the general quence for all shots was same:

1) Arm the Freeze Frame an tivate the self timer

2) Darken the scene
3) Pray while waiting for the shutter to open
4) Do the event
5) Wait for the shutter to close and relight the scene
6) Figure out what went wrong and do the next one

Balloons and darts

Figures 5 and 6 were shot with the microphone sensor to pick up the sound of a water-filled balloon bursting. The microphone was placed close to the subject, just out of the frame. No protection against splashes was needed in the case of the water balloon because splashing is minimal—most of the water just falls and forms a puddle.

In the case of the water-filled balloons, the SENSITIVITY (R8) setting was important because the event didn't generate much more noise than the self-timer opening the camera shutter. (With too much sensitivity, the strobe triggered when the shutter opened.) With air-filled balloons, the SENSITIVITY is not as critical because the balloons generate a louder sound when they pop.

The SHORT/LONG switch (S2) was set to "short" for those shots with the DELAY control (R12) set for a very short period. In fact, it was the shortest possible delay in most of the photos. The balloons were all sitting on an up-ended spray-can lid for support. Light baffles kept the support from being lit.

Balloons and pellets

Figures 7 and 8 were produced by shooting at a balloon with an air rifle (the balloon in Fig. 7 is filled with air and the one in Fig. 8 is filled with water). The sound sensor was used, and the report of the gun provided the event trigger. The SENSITIVITY control was set to minimum. The rifle was securely clamped to a tripod about 4 feet from the target and carefully aimed during set-up. Several sheets of corrugated cardboard were used as a back-stop for the pellets. We chose a pump-type air rifle rather than a cartridge-powered one because, by pumping it the same number of times for each event, we found it had a more constant muzzle velocity.

Because air balloons are not as messy as water ones, we used them for setup. Simply place a balloon, arm the strobe, shoot the balloon, and see what happens. Don't blink, or you'll miss the part of the event illuminated by the flash. If what you see by the light of the flash is the balloon just sitting there, increase the delay. If you don't see any balloon, decrease the delay. If you're not sure what you saw, shoot a picture anyway. (There is such a thing as serendipity.)

It's interesting to notice the difference between water balloons burst with a dart and those hit with a pellet. While the dart simply slides in, leaving the water in the balloon almost undisturbed (Fig. 5), the energy from the impact of the pellet sets up a shock wave like that shown in Fig. 8. In some of the photos you can see the pellet as a streak in the right-hand side of the frame.

FIG. 16—A CAPACITOR EXPLODING is really quite a spectacle if you can really see what happens.

Light bulbs and pellets

Shooting at light bulbs with a pellet gun (Figs. 9 and 10) is set up the same way and with similar SENSITIVITY and DELAY settings as shooting at balloons with pellets. Safety first here: Don't forget your protective safety goggles.

Milk drops

This is the "classic" stop-action photo, with a tip of the hat to strobe photography's pioneer, Dr. Harold Edgerton. Since the splash produced by the drop is pretty quiet, the phototransistor is the sensor of choice. We tried the microphone, but couldn't keep the camera shutter from pre-triggering the strobe. This common picture is usually taken by having the drop fall between a collimated light source and photodetector. We tried that with our somewhat less-than-laboratory-grade stands and supports. It was difficult to get the eyedropper we were using as a drop source in just the right position to break the beam. After playing around for a while, we found that milk is surprisingly reflective of infrared. By placing an IR emitter and the sensor facing in the same direction pointing toward the space through which the drop would fall, we got very reliable triggering (see Fig. 11). The SENSITIVITY control was set nearly to maximum.

In these pictures we used the long delay range. By adjusting the DELAY control, we were able to get shots of both the familiar milk "crown" (Fig. 12) and the reaction column that forms later in the sequence (Fig. 13).

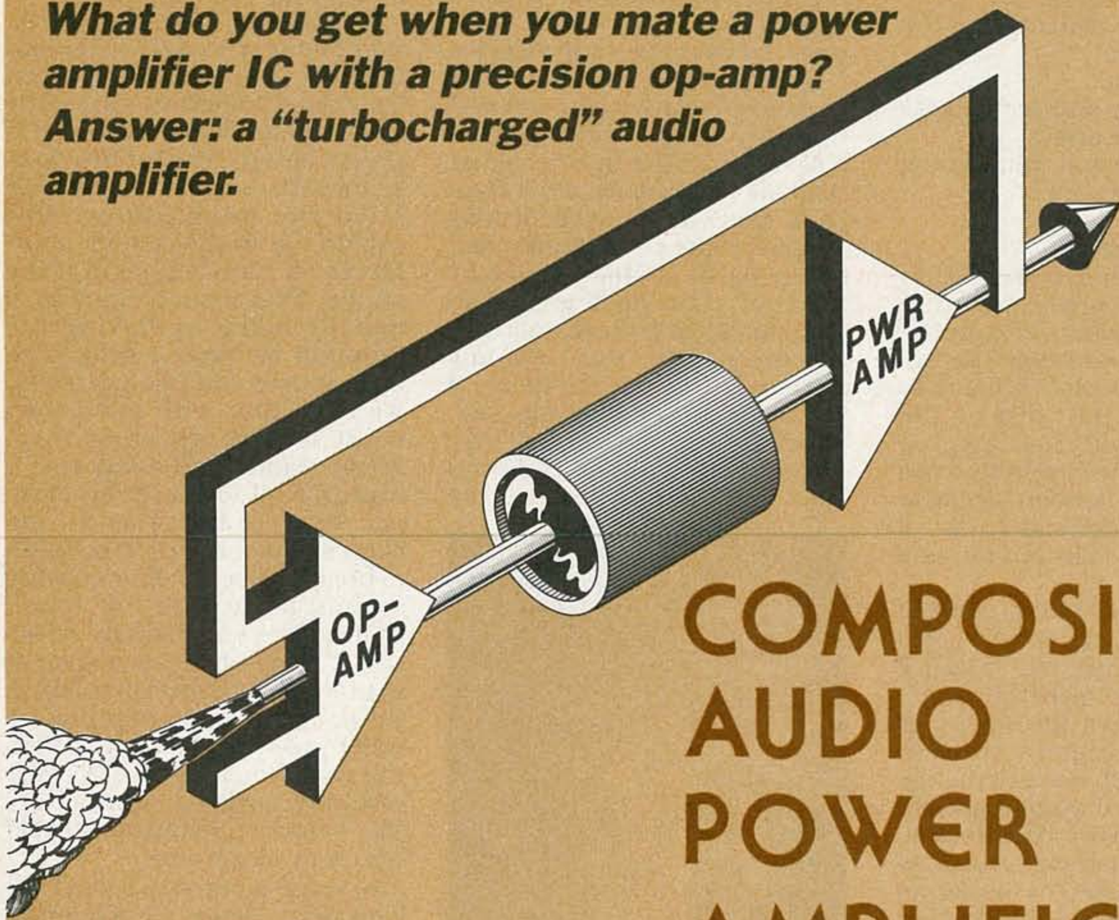
To help visualize the distribution of flow vectors induced by the momentum imparted to the resting fluid by the fluid in motion, we dyed the medium—just kidding. We thought it would look interesting to put some food coloring in the drops; nevertheless, it shows that the fluid that was in the drop winds up in the crown of the splash.

Skipping stones

These were fun. We set up outdoors by the side of a small country lake on a moonless night. A convenient wall gave us a dry place to put the camera and throw rocks from, but the support for the flash was put out in the water to get it closer to the action (see Fig. 14). The microphone was used as a sensor to trigger from the splash of the stone hitting the water. After en-

continued on page 87

What do you get when you mate a power amplifier IC with a precision op-amp? Answer: a "turbocharged" audio amplifier.



COMPOSITE AUDIO POWER AMPLIFIERS

CHARLES KITCHIN, SCOTT WURCER, AND JEFF SMITH

NOW YOU CAN BUILD YOUR OWN high-performance audio amplifiers from inexpensive components and beat the high price of factory-made amplifier modules. The composite amplifiers described here can improve stereo systems and other audio equipment with moderate power output. As you read this article you will probably be able think of many applications for these circuits.

The five souped-up audio amplifiers are made by inserting monolithic power amplifiers in the feedback loops of operational amplifiers. The "turbocharged" composites retain the low distortion and offset of the op-amps and the high-current handling capability of the power amplifiers.

The amplifiers described here are: two simple 10-watt composites, a 33-watt bridge composite, a 40-watt composite with a single-ended summing connection, and a 70-watt composite with two current-summing amplifiers in a bridge configuration. The output power values of all circuits are in root-mean-square (rms) watts.

Figure 1 is the pinout and functional diagram for the Analog Devices AD711JN, the precision, high-speed op-amp that is a part of all the composite amplifiers described here. The op-amps include both bipolar and field-effect transistors fabricated in a process known as BiFET technology. The pinout diagram is for plastic and ceramic DIP's.

Figure 2 is the pinout diagram for the National Semiconductor LM1875, the 20-watt power audio amplifier (power amp) in all of the composite plifiers in this article. It is pa aged in a flat-pack plas TO-220 case.

Single-unit or low-volu prices on the op-amps a power amplifiers are subjec wide variations among the v ous vendors. However, calc tions based on compone from nationally adverti sources show the cost of composites to be quite low. component costs for each c posite amplifier (except power supply) were sum and divided by the amplif rated output power, and th sults averaged out to be than $1 per watt.

A 10-watt composite

Figure 3 shows the basic c posite amplifier circuit v IC2, an LM1875, in the f

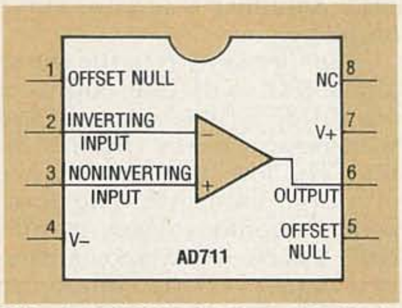


FIG. 1—PINOUT AND FUNCTIONAL BLOCK DIAGRAM for the AD711JN operational amplifier in an 8-pin DIP.

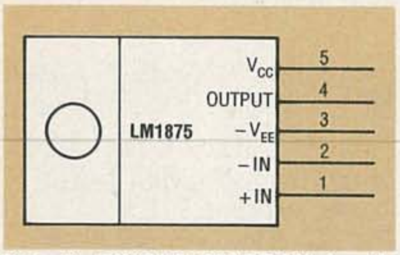


FIG. 2—PINOUT DIAGRAM for the LM1875 amplifier in a TO-220 case.

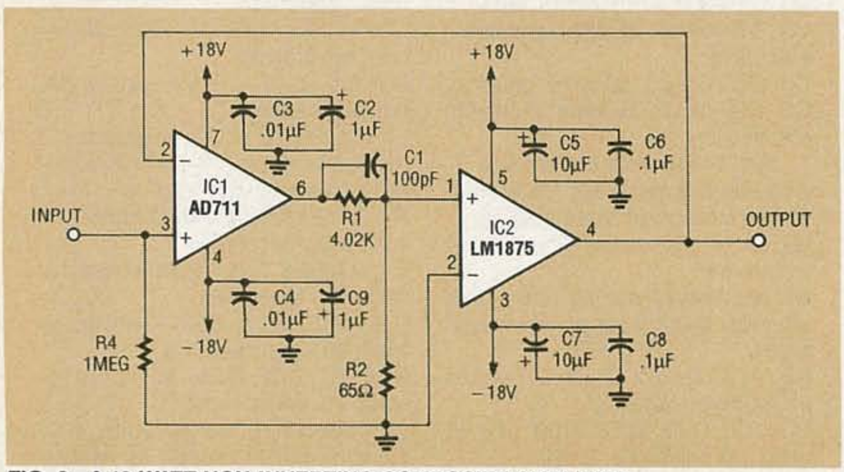


FIG. 3—A 10-WATT NON-INVERTING COMPOSITE AMPLIFIER

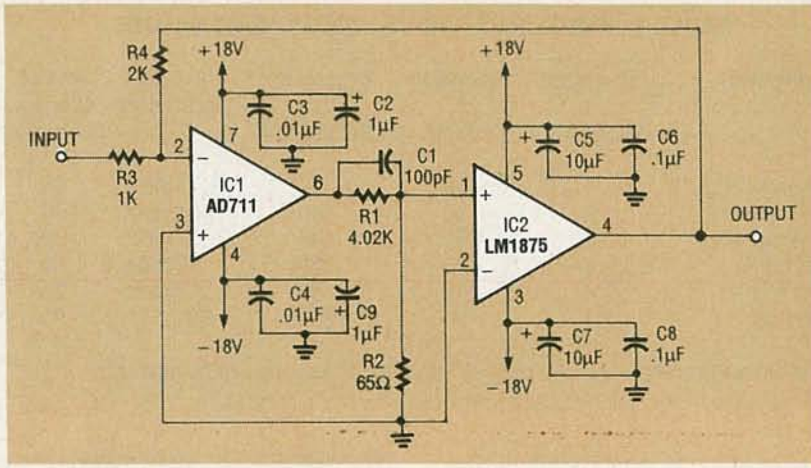


FIG. 4—A 10-WATT INVERTING COMPOSITE AMPLIFIER.

back loop of IC1, an AD711JN. The circuit is a non-inverting, high input-impedance, unity-gain follower. It delivers 10 watts rms into an 8-ohm load at 1 kHz, with a total harmonic distortion of less than 0.003%. Total harmonic distortion (THD), a figure of merit for an amplifier, is the total root-mean-square (rms) harmonic voltage in a signal, as a percentage of the voltage at the fundamental frequency. THD should be as low as possible. The maximim offset voltage of this amplifier is 1 millivolt.

The basic composite circuit can also be configured as a low input-impedance inverting amplifier as shown in Fig. 4. That circuit causes approximately 10 dB less distortion than the non-inverting configuration of Fig. 3 because the non-inverting pin of IC1, the AD711JN, is grounded. The AD711JN produces more distortion when it is connected as a follower (Fig. 3) because of its large common-mode signal.

Both IC's are operating within the same loop in Fig. 4, so a phase-lead network, consisting of capacitor C1 and resistors R1 and R2, provides the necessary compensation to stabilize the response of both the AD711JN and the LM1875. This network can be tailored for specific applications by providing a trade-off between bandwidth and phase margin as listed in Table 1.

The THD values given for these circuits include both distortion and noise. At low frequencies, noise is the predominant error source; at higher frequencies, distortion will increase because of the finite open-loop gain of the amplifiers. Even with this frequency-related increase, THD remains extremely low over the entire audio range.

When functioning independently, the THD of the LM1875 power amplifier vs. power output peaks at about 0.5 watt. It produces about 0.05% THD into an 8-ohm load and 0.1% THD into a 4-ohm load at this power level. That variation in THD vs. power level is characteristic of thermal feedback on the IC chip. It is also one of the benefits of thermally isolating an external amplifier within a feedback loop.

FET-input op-amps with low first-stage transconductance (such as the AD711JN) tolerate a larger voltage swing on their inputs than bipolar op-amps without producing the characteristic bipolar op-amp overload distortion. When open-loop gain decreases, producing a larger error on the summing junction, a FET-input op-amp behaves more linearly than a bipolar op-amp, making it the optimum choice as the control amplifier in composite circuits.

Step response is an important consideration in many audio- amplifier applications. The composite amplifiers described here take advantage of the performance features of the AD711JN. For example, the AD711JN has twice the slew rate of the LM1875; if the AD711JN

TABLE 1—PERFORMANCE VS. COMPONENT VALUES

Connection	Resistor 1 (Kilohms)	Resistor 1 (Ohms)	Capacitor 1 (Picofarads)	–3dB Bandwidth	Phase Margin (Degrees)
Non-inverting	4	200	30	1.77MHz	35
Non-inverting	4	100	68	1.58MHz	70
Non-inverting	4	65	100	1.34MHz	85*
Inverting	4	400	30	1.8MHz	25
Inverting	4	200	68	1.6MHz	25
Inverting	4	80	100	890kHz	90*

*Best transient response and highest stability at expense of bandwidth

were slower, the LM1875 could overshoot significantly before it is corrected by the AD711JN. On the other hand, if the AD711JN were much faster than the LM1875, the driver would slew to the supply rail before the buffer could respond.

Higher power composites

The composite circuit concept can be expanded by connecting two or more of them together. High-power amplifiers normally include discrete transistors with high breakdown voltages (typically over 100 volts) and high current-handling ability. Small IC power amplifiers have breakdown voltages in the 30- to 50-volt range. Maximum power delivered to the load is directly related to the supply voltage.

A bridge configuration applies power to the load differentially. Therefore, it can provide twice as much driving voltage to the load as a parallel or current-summing configuration. This permits higher power output from a given supply voltage (assuming that the increased current demand can be met). Also, the slew rate delivered to the load is greater than the slew rate of either of the two IC driving amplifiers.

33-watt composite bridge

The circuit shown in Fig. 5 combines two non-inverting composite amplifiers, A and B, in a bridge or differential output connection. It operates with an overall gain of 30 and it provides 33 watts rms to an 8-ohm load with less than 0.002% THD at 1 kHz. Amplifier C is a DC s amplifier.

Amplifier D inverts the ir signal 180° so that the outpı amplifier B is non-inver with respect to the circuit's put. The low input-impeda of a high-gain inverting c posite amplifier makes it c cult to drive. To overcome t two non-inverting compo amplifiers have been configu as a bridge amplifier, and or them is driven with a single amp inverter.

PARTS LIST

Figs. 3 and 4—10-watt composite amplifiers

All capacitors are 5%, 50 volts, silvered-mica except as stated below.

C3, C4—0.01 µF, 50 volts, ceramic
C5, C7—10 µF, 35 volts, aluminum electrolytic
C6, C8—0.1 µF, 50 volts, ceramic
C2, C9—1 µF, 35 volts aluminum electrolytic

Fig. 5—33-watt composite

All resistors are ¼-watt, 5%, metal-film except as stated below.

R7, R15—1,500 ohms, 5-watt, 20%, wirewound

All capacitors are 50 volts, 5%, silvered-mica except as stated below

C2, C3, C10, C11, C14 to C17—0.01 µF, 50 volts, ceramic
C5, C7, C20, C22—100 µF, 35 volts, aluminum electrolytic
C6, C8, C21, C23—0.1 µF, 50 volts, ceramic
C25–C32—1 µF, 35 volts, aluminum electrolytic
C9, C13—0.47 µF, 20 %, 50 volts, polypropylene
C12, C24—0.27 µF, 20 %, 50-volt mylar

Fig. 7—40-watt composite

All resistors are ¼-watt, 5 %, metal-film except as stated below

R6, R8—1000 ohms, ¼-watt, 1 %, metal film
R7, R16—2000 ohms, ¼-watt, 1%, metal film
R11, R17—1 ohm, 5-watt, 20%, wirewound
R12, R18—0.33 ohm, 5-watt, 5%, wirewound

All capacitors are 50 volts, 5%, silvered-mica except as stated below

C2, C3, C7, C8, C15, C16—0.01 µ 50 volts, ceramic
C10, C12, C18, C20—100 µF, 3 volts , aluminum electrolytic
C11, C13, C19, C21—0.1 µF, 5 volts , ceramic
C23–C28—1 µF, 35 volts, alum num electrolytic
C4, C5—0.47 µF, 50 volts, 20% polypropylene

Fig. 8—70 watt-composite

All resistors are ¼-watt, 5%, meta film except as stated below

R4, R8, R23, R27—1000 ohms, ¼ watt, 1%, metal film
R5, R9, R24, R28—2000 ohms, ¼ watt, 1%, metal film
R12, R16, R31, R35—1-ohm, 5 watt, 20%, wirewound
R13, R17, R32, R36—0.33 ohm, 4 watt, 5% wirewound

All capacitors are 50 volts, 5% silvered-mica except as state below

C3, C4, C7, C8, C14, C15, C22 C23, C26, C27, C30, C31, C37 C38,—0.01 µF, 50 volts, ceramic
C10, C12, C18, C20, C33, C35 C40, C42—100 µF, 35 volts, alum num electrolytic
C11, C13, C18, C20, C34, C36, C4 C43—0.1 µF, 50 volts ceramic
C46–C57—1 µF, 35 volts, alum num electrolytic
C2, C5, C25, and C28—0.47 µF, 5 volts, 20%, polypropylene

All semiconductors are Analo Devices AD711JN and Nationa Semiconductor LM1875

Note: AD711JN's are available i single quantities from Active Electronics, Woburn, MA 0180 and LM1875's are available fror several *Electronics Now* adver tisers.

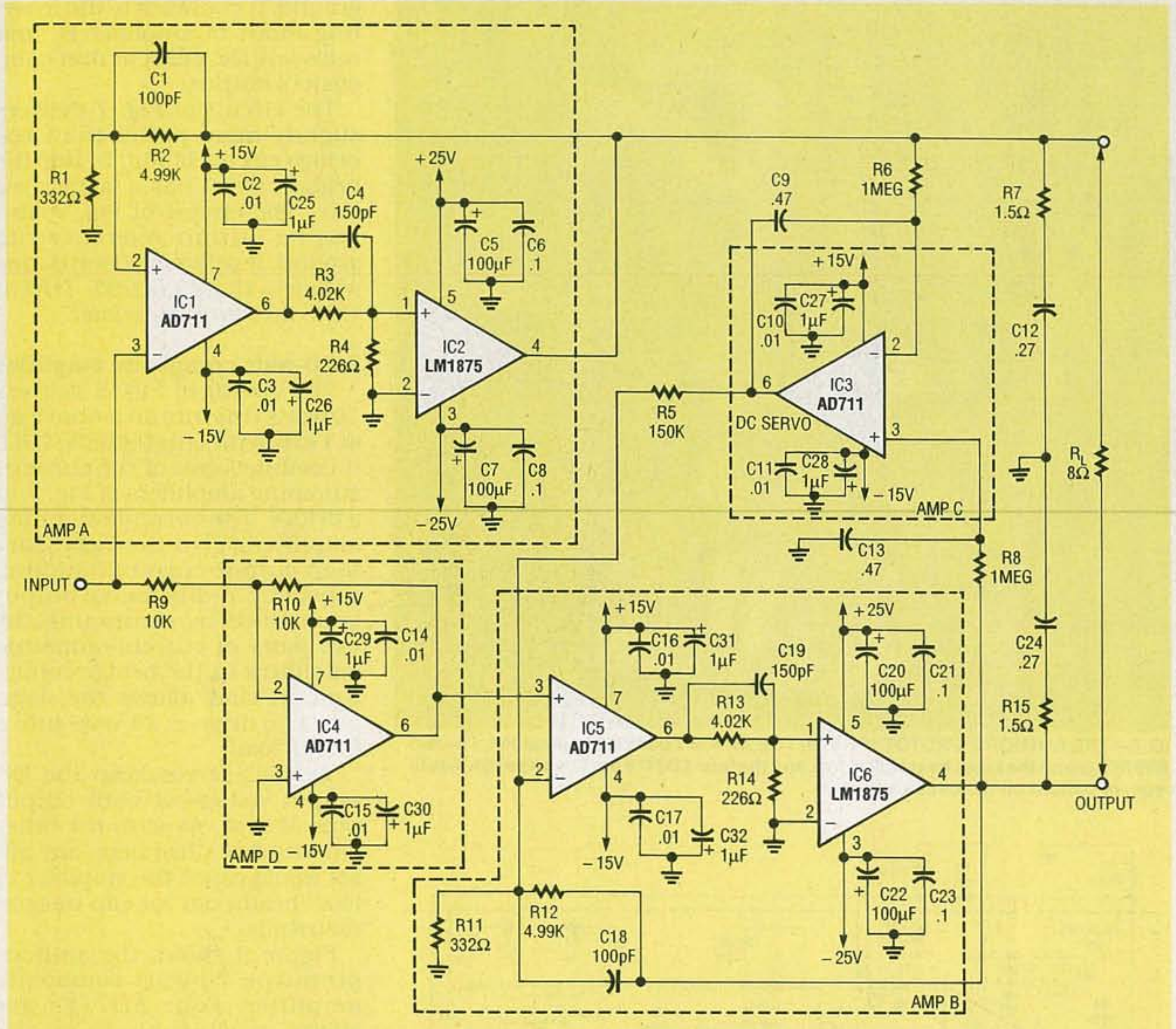


FIG. 5—A 33-WATT BRIDGE COMPOSITE AMPLIFIER.

Figure 6 shows the authors' prototype for the 33-watt bridge amplifier. The four AD711JN's are shown mounted in the middle of the circuit board (white patches), and the two LM1875's are shown mounted on the heatsink (black surface).

The DC servo amplifier

The compound composite amplifiers of Figures 5, 7, and 8, all include DC servo amplifiers that share a common function although some of their internal components vary. The DC servo in Fig. 5 (Amplifier C) will sense any net *difference* in DC voltage appearing across the load—and therefore any DC current through the load. The amplifier will servo any net difference in DC output voltage through amplifier B, thus minimizing wasted power. The output of each composite passes through a low-pass filter that removes AC signals from the servo loop.

If the output of amplifier A were *more* positive than the output of amplifier B, the output of servo amplifier C would become *less* positive. Its output would then drive amplifier B, which inverts the polarity again. This inversion makes amplifier B's output increasingly *more* positive until the two DC output voltages are equal.

The single servo amplifier in the Fig. 5 circuit forces the DC offsets of the other amplifiers into equality, but does not remove them. Any DC voltage applied to the circuit's input will still appear at both LM1875 outputs, amplified by the circuit gain. Therefore, the maximum voltage swing or "headroom" available will be reduced, and if appreciable, maximum output power will be reduced. If DC voltage is present on the input source, capacitive input coupling is necessary.

A 40-watt composite amplifier

The circuit in Fig. 7 combines the outputs of two non-inverting composite amplifiers. Output current is summed with resistors, and the output is referenced to ground. The output from the first composite, amplifier B, is coupled to the non-inverting input of amplifier A. No

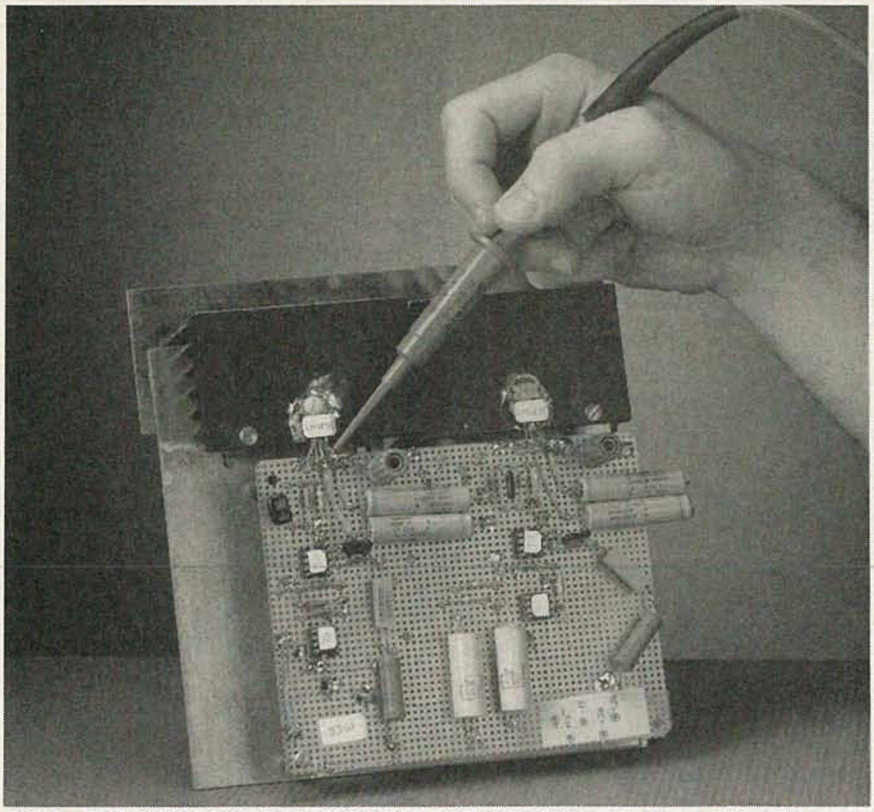


FIG. 6—THE AUTHORS' PROTOTYPE FOR THE 33-WATT composite amplifier. The two LM1875's are on the black heat sink at top, and the four AD711's are the white patches in a square pattern on the circuit board.

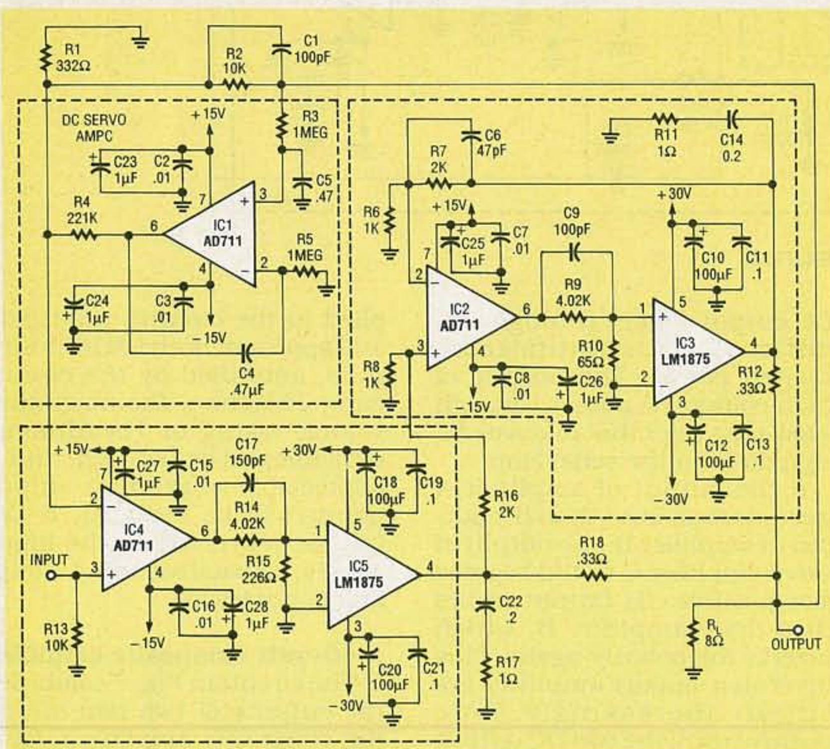


FIG. 7—A 40-WATT COMPOSITE AMPLIFIER that includes a single-ended summing connection.

phase inversion is needed because the two outputs are simply added together. Amplifier C is a DC servo that differs from its counterpart in Fig. 5 because its input is referenced to ground. It connects to the in ting input of amplifier B, nulls any DC offset at that c posite's output.

The circuit of Fig. 7 deli slightly more power than bridge circuit of Fig. 5, but bridge circuit has a faster rate. The circuit of Fig. 7 has its output reference ground. It delivers 40 watts with less than 0.0029% TH 1kHz into an 8-ohm load.

A 70-watt composite ampl

The circuit of Fig. 8 deli 70 watts rms into an 8-ohm at 1 kHz with only 0.003% T It combines two of the curr summing amplifiers of Fig. a bridge. The current-summ amplifiers give the neces high output-current hand capability. A differential ou is obtained by connecting two pairs of current-summ amplifiers in the bridge co uration that allows the c posite to drive ± 34 volts in 8-ohm load.

Two DC servos keep the output voltage at both ou pins at zero. As with the o circuits described here, any set would cause the amplifi lose "headroom" or clip uns metrically.

Figure 9 shows the auth prototype 70-watt compo amplifier. Four AD711's shown as white blocks on circuit board (lower left), three more are shown on the cuit board at lower right. four LM1875's are shown horizontal row on the heat (gray area) above the cir boards.

Figure 10 is a graph sho THD (including noise) vs. p output plotted from the auth breadboard versions of the cuits described in this art For comparison purposes plot of THD vs. power outpu the LM1875 as a stand-alon vice has been taken from National Semiconductor da

Building the amplifiers

These circuits can be l with dual or quad version the AD711 if you want to board space. The AD711JN all of the op-amp requireme

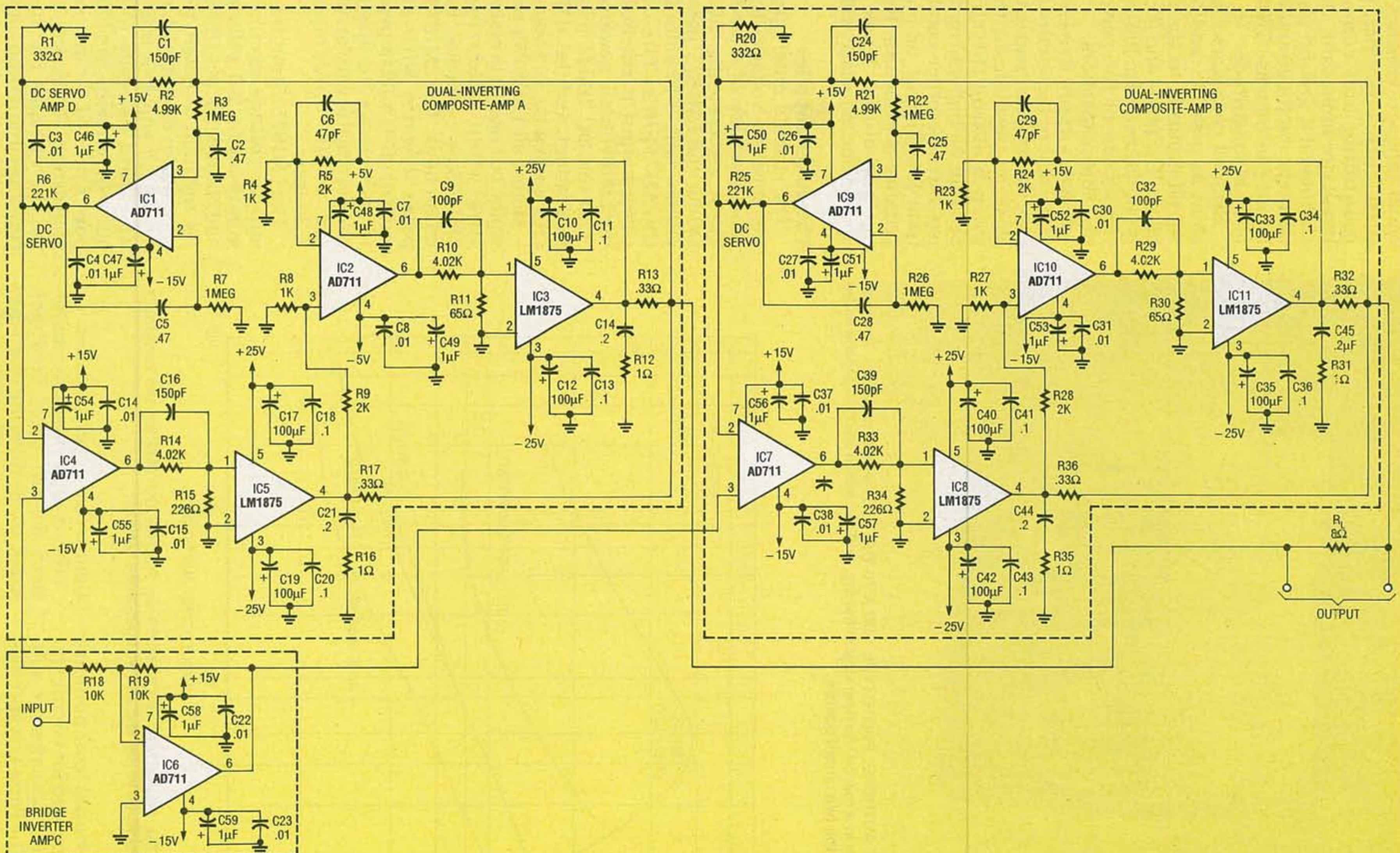


FIG. 8— A 70-WATT COMPOSITE AMPLIFIER

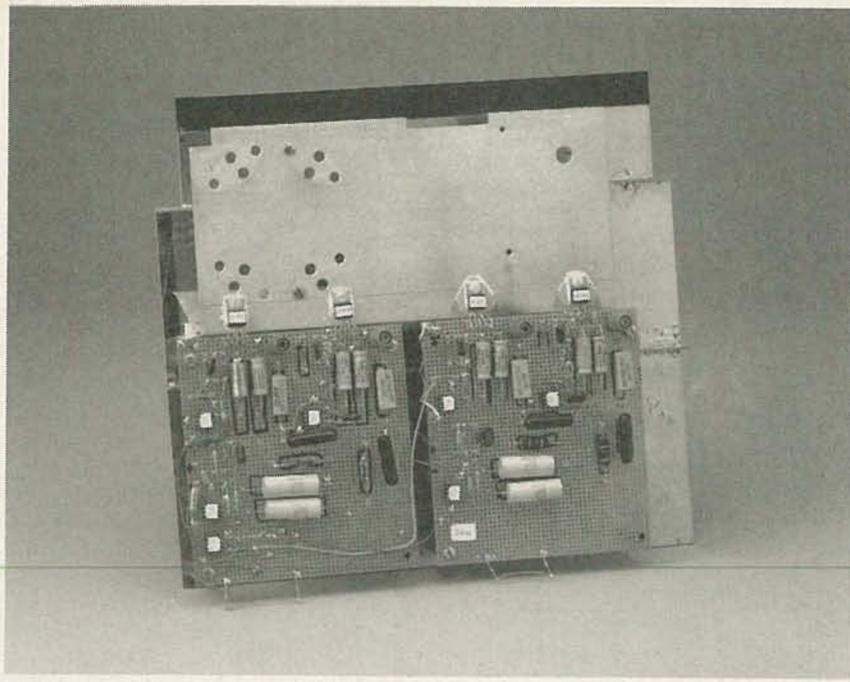


FIG. 9—THE AUTHORS' PROTOTYPE FOR A 70-WATT composite amplifier. The four LM1875's are in a row on the heat sink at the top, and the seven AD711's are the white patches on the two circuit boards.

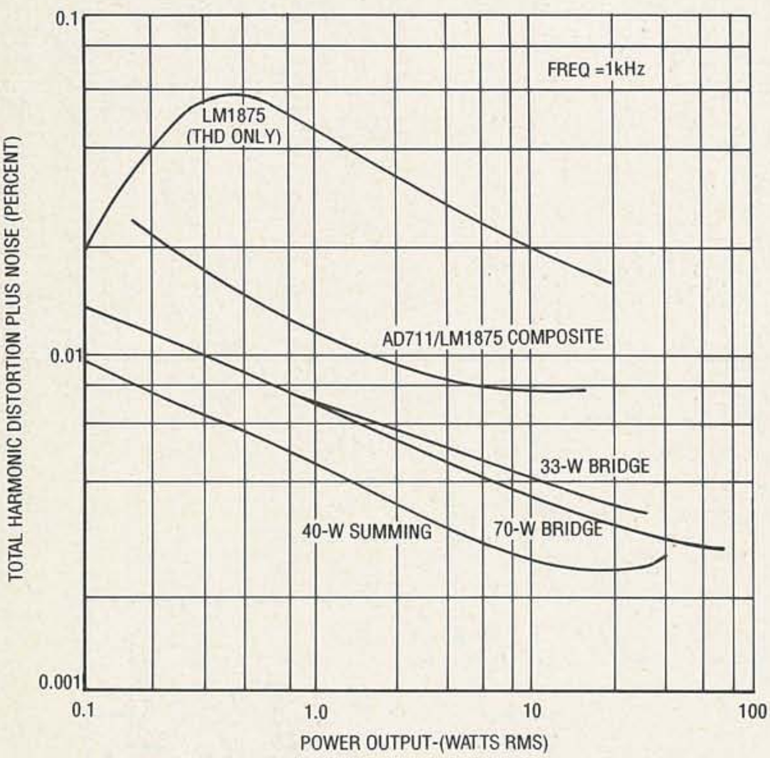


FIG. 10—TOTAL HARMONIC DISTORTION vs. POWER OUTPUT for the composite amplifiers discribed in the text and a stand-alone LM1875.

but additional components might be needed for circuit stability if other op-amps are substituted. The Parts List specifies the components selected for optimum circuit performance.

The composites have amplifiers within their feedback loops, so the differing frequency response poles of each amplifier could interact, causing circ instability. Therefore, pro grounding and compon layout are important. Build circuits on a ground plane. adequate circuit grounding a layout can increase THD by order of magnitude.

Keep all component leads short as possible, and conn signal grounds to the grou plane. The plane and the po grounds are tied to the comn connection of the power s ply's filter capacitors.

Power supply bypassing important in these circuits. cate the by-pass capacitors close as possible to the I when building the circui Separate all high-current ca ing wires or other conduct from low-current or high-i pedance conductors. Keep put and output leads as apart as board space will all

The power supplies

The circuits must operate the specified voltages to rea the power levels stated he Those are typically ±25-vo DC for the LM1875 power a plifiers and ±15-volts DC the AD711JN's. The high power output is reached wh the LM1875's are powered fr ±30-volt-DC (their maxim safe rating), and the AD711J are powered by ±15 volt-DC

Mount all LM1875's on he sinks, but use an oversize he sink when operating a LM1875 at ±30 volts, its m imum limit. The LM1875 dis pates 2 watts with an i current of 70 milliamperes a 15 volts. However, dissipat rises to 6 watts with an idle c rent of 100 milliamperes ±30-volts.

The LM1875's limit the pow supply voltage excursion minus about 2.5 volts on and bottom. For a ±18-volt s ply the limit is about 15 wa rms into an 8-ohm load, and a ±15-volt supply it is about watts rms. Estimate your v age requirements to obtain power needed for any spec application. Remember that supply voltages mean coo running circuits and higher cuit reliability.

Add a convenient hold feature to any phone!

TELEPHONE HOLD BUTTON

BILL GREEN

WE ALL KNOW THE STORY: WE'RE ON the phone in one room and need to be in another. So we lay down the first phone, go to the other phone and pick it up, go back to the first room and hang up that phone, and then go back to the second phone—the one we needed to be on in the first place. Or maybe we don't go back and hang up the first phone, so that when we finish our conversation we forget that it's off-hook—and then wonder why we didn't get the important long-distance call that we were expecting.

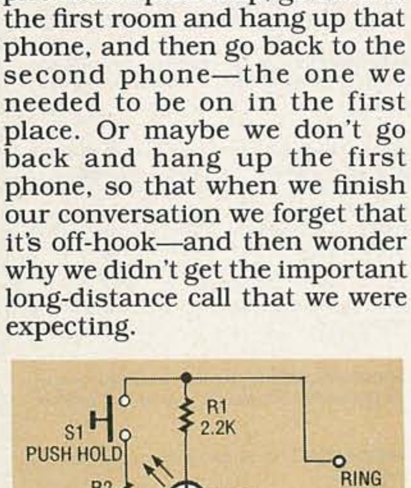


FIG. 1—HOLD-MODULE SCHEMATIC. When S1 is pressed, the SCR fires and places LED1 and R1 across the phone line. The line voltage drops to about 20 volts, which holds the connection to the phone company's central office.

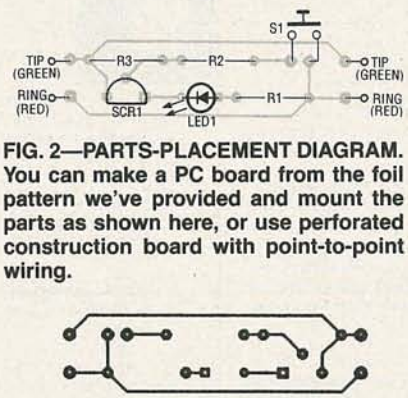
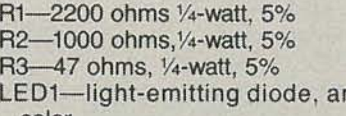


FIG. 2—PARTS-PLACEMENT DIAGRAM. You can make a PC board from the foil pattern we've provided and mount the parts as shown here, or use perforated construction board with point-to-point wiring.



FULL-SIZE hold-button foil pattern.

PARTS LIST

- R1—2200 ohms ¼-watt, 5%
- R2—1000 ohms, ¼-watt, 5%
- R3—47 ohms, ¼-watt, 5%
- LED1—light-emitting diode, any color
- SCR1—2N5064, TIC47, MCR104 or equivalent silicon-controlled rectifier
- S1—Normally-open pushbutton switch
- PC board or perforated construction board, enclosure, wire, solder, etc.

If the above scenario is more real than you'd like to admit, we have a design for a simple and cheap little automatic hold module. It's so cheap (about $2.00) that you can make one for each of your phones.

How it works

As you can see from the schematic in Fig. 1, the hold module connects across the phone line. When all phones are on-hook, there is about 36 to 48 volts DC across the module. When S1 is pressed, the SCR fires and places LED1 and R1 across the phone line, which causes the voltage to drop to about 20 volts. Enough current flows to keep the SCR conducting when S1 is released. It's also enough current to keep the connection in the phone company's central office, so the phone is on hold. When any phone is picked up, the load of that phone causes the line voltage to drop to about 6 volts. At that point there is not enough current through the SCR to keep it conducting, so it turns off. When the phone is placed back on hook the line is released. Indicator LED1 glows when the hold is engaged. The gate of SCR1 is kept from floating and turning on when S1 is open by R3, and R2 limits the turn-on current through the SCR's gate.

The SCR (a 2N5064 or equivalent) has a 200-volt forward and reverse blocking voltage. The maximum ring voltage on the phone line is 140 volts. The 2N5064's minimum hold current is 5.0 mA at 25 degrees C.

Assembly

We have included a PC-board foil pattern for the hold module although it is simple enough to build on perforated construction board with point-to-point wiring. Figure 2 is the parts-placement diagram for the board. Select a small case for the project, or mount it inside your telephone. The prototype was installed in a telephone outlet box with a built-in modular jack, and a modular plug was added. That allows the hold module to be in-

continued on page 74

Electronics Paperback Books

GREAT PAPERBACKS AT SPECIAL PRICES

☐ **BP248—TEST EQUIPMENT CONSTRUCTION ..... $5.95.** Details construction of simple, inexpensive, but extremely useful test equipment. AF Gen, Test Bench Ampl, Audio Millivoltmeter, Transistor Tester and six more.

☐ **BP267—HOW TO USE OSCILLOSCOPES AND OTHER TEST EQUIPMENT ..... $6.95.** Mastering the oscilloscope is not really too difficult. This book explains all the standard controls and functions. Other equipment is also described.

☐ **BP265—MORE ADVANCED USES OF THE MULTIMETER ..... $5.95.** Use these techniques to test and analyze the performance of a variety of components. Also see how to build ad-ons to extend multimeter capabilities.

☐ **BP256—INTRO LOUDSPEAKE AND ENCLOSU DESIGN ..... $5.95.** explore the variety enclosure and spea designs in use today the reader can und stand the principles volved.

☐ **CMOS1—CMOS POCKET GUIDE 1 ..... $18.95.** Works like the TTL Guides but covers all commonly used CMOS standard devices. Six major sections. The first shows the device schematic. Next is a brief description of the component and is followed by full operating details. The fourth section lists major applications, while the 5th and 6th sections present essential data for that device and a list of the relevent manufacturers. The final two sections are a valuable cross-reference.

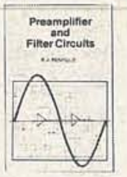
☐ **BP299—PRACTICAL ELECTRONIC FILTERS ..... $6.95.** Presents a dozen filter-based practical projects with applications in and around the home or in the constructor's workshop. Complete construction details are included.

☐ **BP249—MORE ADVANCED TEST EQUIPMENT CONSTRUCTION ..... $6.95.** Eleven more test equipment construction projects. They include a digital voltmeter, capacitance meter, current tracer and more.

☐ **BP245—DIGITAL AUDIO PROJECTS ..... $5.95.** Practical circuits to build and experiment with. Includes A/D converter, input amplifier, digital delay line, compander, echo effect and more.

☐ **BP247—MORE ADVANCED MIDI PROJECTS ..... $5.95.** Circuits included are a MIDI indicator, THRU box, merge unit, code generator, pedal, programmer, channelizer, and analyzer.

☐ **BP257—INTRO TO AMATEUR RADIO ..... $6.95.** Amateur is a unique and fascinating hobby. This book gives the newcomer a comprehensive and easy to understand guide to the subject.



☐ **BP309—PREAMPLIFIER AND FILTER CIRCUITS ..... $6.95.** Provide circuits and backgroun info for a range of pre amplifiers, plus tone con trols, filters, mixers an more. All are high-perfor mance circuits that can b built at a reasonable cos

☐ **BP303—UNDERSTANDING PC SOFTWARE ..... $6.95.** This book will help you understand the basics of various types of business software in common use. Types of software covered include word processors, spelling checkers, graphics programs, desktop publishing, databases, spreadsheets and utilities.

☐ **BP251—COMPUTER HOBBYISTS HANDBOOK ..... $8.95.** A wrapup of everything the computer hobbyist needs to know in one easy to use volume. Provides a range of useful reference material in a single source.

☐ **PCP115—ELECTRONIC PROJECTS FOR HOME SECURITY ..... $10.00.** 25 projects ranging from a single-door protection circuit that can be completed in an hour or two, to a sophisticated multi-channel security system. Each project is described in detail with circuit diagrams, explanations of how it works, instructions for building and testing, and how to adapt circuits to meet special requirements.

☐ **BP195—INTRODUCTION TO SATELLITE TV..... $9.95.** A definitive introduction to the subject written for the professional engineer, electronics enthusiast, or others who want to know more before they buy. 8 × 10 in.

☐ **BP190—ADVANCED ELECTRONIC SECURITY PROJECTS.....$5.95.** Includes a passive infra-red detector, a fiber-optic loop alarm, computer-based alarms and an unusual form of ultrasonic intruder detector.

☐ **BP235—POWER SELECTOR GUIDE.....$10.00.** Complete guide to semiconductor power devices. More than 1000 power handling devices are included. They are tabulated in alpha-numeric sequency, by technical specs. Includes power diodes, Thyristors, Triacs, Power Transistors and FET's.

☐ **BP234—TRANSISTOR SELECTOR GUIDE.....$10.00.** Companion volume to BP235. Book covers more than 1400 JEDEC, JIS, and brand-specific devices. Also contains listing by case type, and electronic parameters. Includes Darlington transistors, high-voltage devices, high-current devices, high power devices.

☐ **BP99—MINI-MATRIX BOARD PROJECTS..... $5.50.** Here are 20 useful circuits that can be built on a mini-matrix board that is just 24 holes by ten copper-foil strips.

☐ **BP117—PRACTICAL ELECTRONIC BUILDING BLOCKS—Book 1.....$5.75.** Oscillators, Timers, Noise Generators, Rectifiers, Comparators, Triggers and more.

☐ **BP184—INTRO TO 68000 ASSEMBLY LANGUAGE..... $6.95.** The 68000 is a great new breed of microprocessor. Programming in assembly language increases the running speed of your programs. Here's what you need to know.

☐ **BP239—GETTING THE MOST FROM YOUR MULTIMETER..... $5.95.** Cove basics of analog and digital meters. Methods of component testing includes transistors, thyristors, resistors, capacitors and other active and passive devic

☐ **BP97—IC PROJECTS FOR BEGINNERS.....$5.50.** Power supplies, radio a audio circuits, oscillators, timers, switches, and more. If you can use a soldering i you can build these devices.

☐ **BP37—50 PROJECTS USING RELAYS, SCR'S & TRIACS.....$5.50.** Build p ority indicators, light modulators, warning devices, light dimmers and more.

☐ **RADIO—100 RADIO HOOKUPS.....$3.00.** Reprint of 1924 booklet presents ra circuits of the era including regenerative, neutrodyne, reflex & more.

☐ **BP42—SIMPLE LED CIRCUITS..... $5.50.** A large selection of simple applicatio for this simple electronic component.

☐ **BP122—AUDIO AMPLIFIER CONSTRUCTION.....$5.75.** Construction details preamps and power amplifiers up through a 100-watt DC-coupled FED amplif

☐ **BP92—CRYSTAL SET CONSTRUCTION..... $5.50.** Everything you need to kn about building crystal radio receivers.

☐ **BP179—ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF ROBOTS ..... $7.50.** Data and circuits for interfacing the computer to the robot's motors and sensors.

CHECK OFF THE BOOKS YOU WANT

☐ **BP255—INTERNATIONAL RAD STATIONS GUIDE ..... $7.95.** Provid the casual listened, amateur radio DX and the professional radio monitor with essential reference work designed guide him or her around than ever mo complex radio bands.

ELECTRONIC TECHNOLOGY TODAY INC.
P.O. Box 240, Massapequa Park, NY 11762-0240

Name ______________________
Address ______________________
City __________ State __________ Zip __________

RE1192

SHIPPING CHARGES IN USA AND CANADA

$0.01 to $5.00	$1.50
$5.01 to $10.00	$2.50
$10.01 to 20.00	$3.50
$20.01 to 30.00	$4.50
$30.01 to 40.00	$5.50
$40.01 to 50.00	$6.50
$50.01 and above	$8.00

SORRY No orders accepted outside of USA & Canada

Number of books ordered ☐

Total price of merchandise .... $ ________
Shipping (see chart) .... $ ________
Subtotal .... $ ________
Sales Tax (NYS only) .... $ ________
Total Enclosed ... $ ________

All payments must be in U.S. funds

UNIVERSAL REMOTE CONTROL

Add the luxury of a remote control to nearly any project you can think of.

FRED EADY

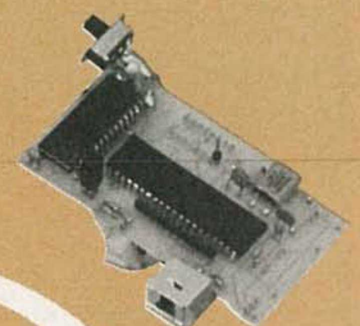
ALMOST EVERY PIECE OF MODERN audio/video equipment comes equipped with an infrared remote control. But how many of your home-built electronic projects have a remote control? Probably none, because you can't readily convert a television or VCR remote to your own application, and remote controls that you can easily interface to your own projects are not commercially available.

To us, "Not commercially available" means "Let's build our own!" This article describes a multifunction infrared (IR) remote control system—a transmitter and receiver—that you can build in one evening. The system is designed to control four different types of devices: switches, servo motors, a stepper-motor robot (see **Radio-Electronics**, April 1991), and a dual digital potentiometer IC. Only one kind of device can be controlled at a time, but enough technical information is included in this article for you to adapt the remote-control system to almost any application.

IR transmitter theory

The IR transmitter is based on IC1, an INS8048L microprocessor that attains high-speed operation with very low power consumption. That microprocessor is responsible for driving and reading the 16-key keypad and generating the 40-kHz modulated infrared drive signal. Let's take an in-depth look at how those two tasks are accomplished.

A schematic depiction of the 16-key keypad is shown in Fig. 1. If you're interested in the "down and dirty" program details, a fully documented machine language listing (IRXMIT.ASM) is available as part of a self-unarchiving ZIP file called IRSYSTEM. EXE on the RE-BBS (516-293-2283, 1200/2400, 8N1). The keypad used in this project was from All Electronics Corp., PO Box 567, Van Nuys, CA 91408 (800) 826-5432, (part No. KP-16). Any functionally equivalent keypad can also be used. Each key contact surface inside the keypad is an intersection of a particular row and column. As you can see from Fig. 1, the 0 key is an intersection of row 1 and column 1, and the 9 key is an intersection of row 4 and column 3. Although the layout of the keys in Fig. 1 doesn't match the actual



layout of the keys on the keypad, Fig. 1 is electrically correct. Also, while the 5 × 5 grid allows up to 25 keys, the actual keypad has only 16 keys.

Rows 1 through 5 are normally held at a TTL high level. To determine which key has been pressed, IC1 successively applies TTL logic lows to each row from 1 to 5, and then reads the output of the columns. When a key is pressed, its row and column are shorted together, and the low applied to the row is transferred to the column (which is normally held high). As an example, if row 1 is being scanned and the 0 key is depressed, a low will be read by IC1 at column 1. That low will be decoded as a "0." A succession of "0" characters will be sent as long as you hold the 0 key depressed. Table 1 shows how the pins on the back of the keypad connect to the pins on the microprocessor and the corresponding microprocessor ports.

Infrared transmitter

The enemies of the infrared signals that emanate from the transmitter are incandescent light, fluorescent light, and sunlight. Large amounts of

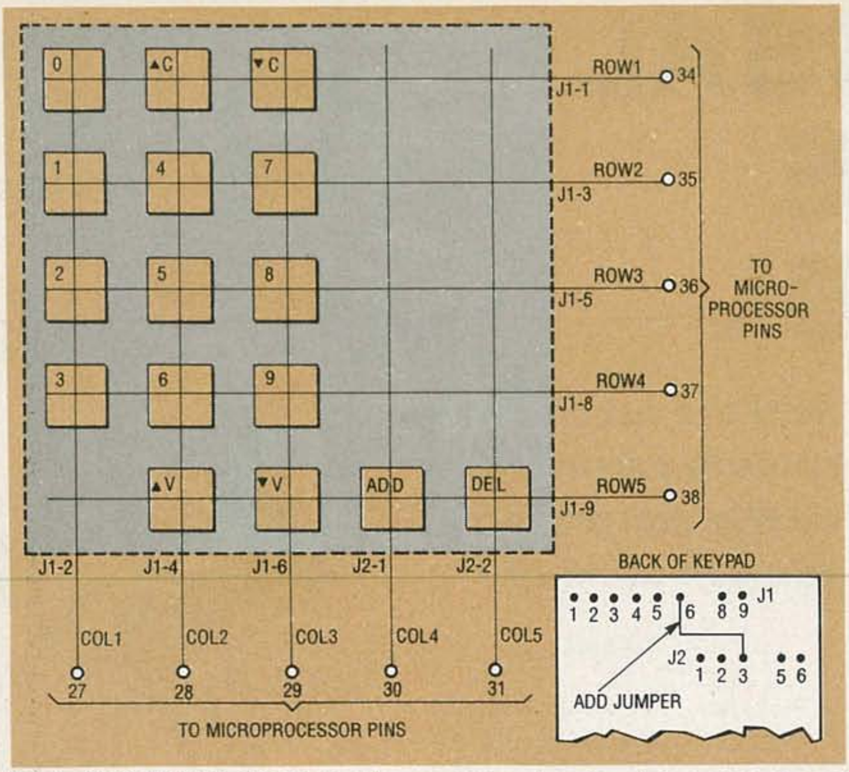


FIG. 1—KEYPAD SCHEMATIC. Each key contact surface is an intersection of a particular row and column. The physical layout of the keypad does not match the electrical layout.

TABLE 1
KEYPAD CONNECTIONS

Keypad (see Fig. 1)	Microprocessor Pin	Port
J1-1	34	P17
J1-2	27	P10
J1-3	35	P24
J1-4	28	P11
J1-5	36	P25
J1-6	29	P12
J1-8	37	P26
J2-1	30	P13
J2-2	31	P14
Also jumper J1-6 to J2-3 on back of keypad		

modulated, noisy infrared energy are produced by those light sources. Most of the interference is modulated in the 50- or 60-Hz range. A simple red plastic filter will screen out some of the noise, but to overcome the extraneous infrared interference, the transmitted infrared signal must be modulated at a high carrier frequency. In our system, the carrier frequency is 40 kHz—which is required by the GP1U52X receiver module used.

The IR transmitter schematic is shown in Fig. 2. The 40-kHz carrier originates at pin 11 of IC1 (ADDRESS LATCH ENABLE, or ALE) which provides a square wave that is exactly one fifteenth of IC1's oscillator frequency. In our system, that is 6 MHz divided by 15, or 400 kHz. The 400-kHz signal is applied to the CLK input of IC3, a 4017 CMOS decade counter which is configured to divide by 10 to obtain the desired 40-kHz carrier.

The resultant 40-kHz signal at pin 12 of IC3 is gated by the output port P15 (pin 32) of the microprocessor and fed to pin 3 of inverter/driver IC4, a 4049 CMOS inverting buffer. That buffer serves two purposes: First, it inverts the idle state of IC3 so that MOSFET Q1 is turned off when no characters are being transmitted. Second, it provides sufficient drive to the gate of Q1 so that maximum infrared energy is emitted by the infrared LED's.

As stated before, the 40 kHz carrier signal at pin 2 of IC4 drives Q1's gate which turns Q1 on and illuminates two IR LED's (LED1 and LED2) producing a 40-kHz modulated IR signal. A logical "1" is a 1-millisecond pulse of IR light and a logica is a 0.5-millisecond pulse. E bit is separated by at least millisecond to allow the IF tector to synchronize. Figu depicts how a transmi character "9" would look o oscilloscope. The transmi "1's" and "0's" are comvine groups of eight to form 16 tinct characters as shown i ble 2. To avoid sequence er and to allow the receiver to chronize between transı sions, a 50-millisecond period is placed between tr mission of each character.

Infrared receiver

The receiver, whose s matic is shown in Fig. 4 based on the Sharp GP1U52 module, and the INS8048L croprocessor. The IR receive tects and decodes the IR si from the transmitter. C again, if you want the raw tails, consult the machine listings IRSWITCH.ASM, SERVO.ASM, IRRECROB. and IRPOT.ASM, which are of the ZIP file called SYSTEM.EXE on the RE-I

The GP1U52X IR Receiver modulator is a hybrid IC frared detector. A PIN (posi intrinsic-negative) photod feeds an amplifier and lin that provides a strong, c signal which is filtered t move all frequencies outsid 40-kHz passband. The re tant signal is demodulate provide a waveform minus

TABLE 2
KEYPAD CHARACTERS

Key	Row	Col	Binar
0	ROW1	COL1	00001
UP C	ROW1	COL2	10100
DW C	ROW1	COL3	10110
1	ROW2	COL1	00011
4	ROW2	COL2	01001
7	ROW2	COL3	01111
2	ROW3	COL1	00101
5	ROW3	COL2	01011
8	ROW3	COL3	10000
3	ROW4	COL1	00111
6	ROW4	COL2	01101
9	ROW4	COL3	10010
UP V	ROW5	COL2	11000
DW V	ROW5	COL3	11010
ADD	ROW5	COL4	11100
DEL	ROW5	COL5	11110

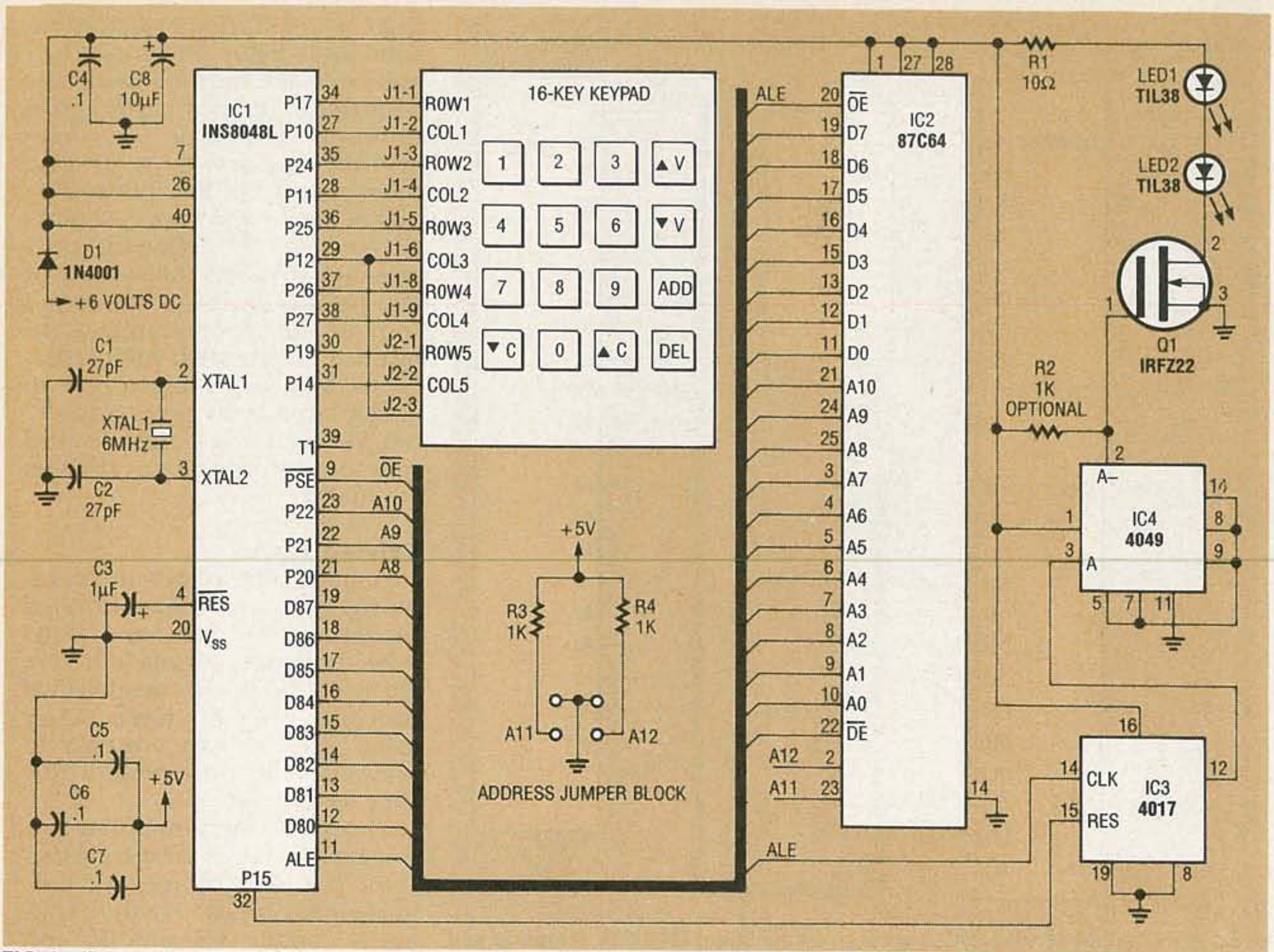


FIG. 2—IR TRANSMITTER SCHEMATIC. The 40-kHz carrier is derived by dividing IC1's oscillator frequency (6 MHz) by 15, to get 400 kHz, which is divided by 10 by IC3.

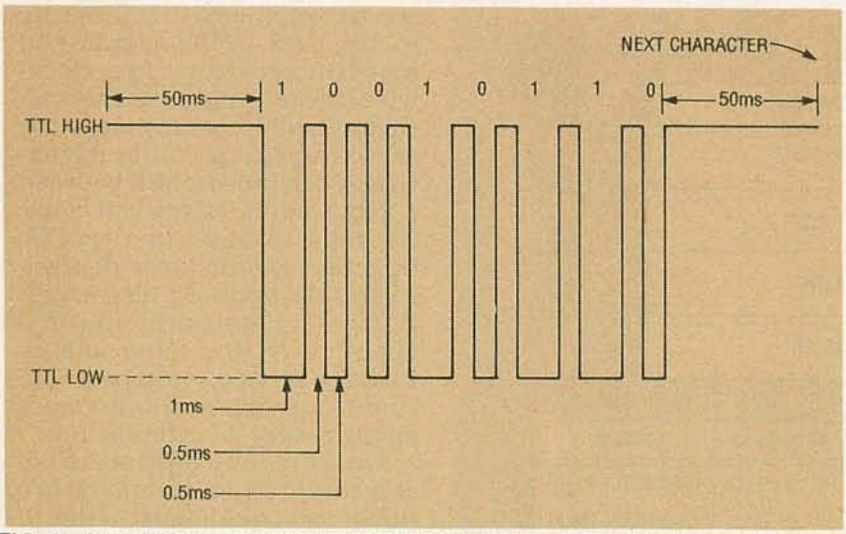


FIG. 3—A TRANSMITTED CHARACTER "9" would look like this if seen on an oscilloscope. The transmitted "1's" and "0's" are put together in groups of eight to form 16 distinct characters as shown in Table 2.

carrier.

The demodulated signal is presented to IC1 via the event counter input (T1, pin 39). At this time the program residing in IC2 (an 87C64 EPROM) takes over. The idle state of the GP1U52X is normally high. As soon as the output pin of the IR detector transitions low, IC1 starts an internal timer to measure the incoming pulse width. Depending upon whether the pulse width is 0.5 or 1 millisecond, a binary 0 or 1, respectively, is stored in a holding register. Once 8 bits are received, IC1 attempts to match the 8-bit word with a term in its internal table to determine which character has been received. How the received character is used depends upon which one of the four functions is selected.

Transistors, buffers, & relays

See Fig. 5 for program-selection information. IRSWITCH.ASM, the first of four programs contained in the EPROM, is selected by jumpering both address jumpers (A11 and A12).

Basically, keys 1–8 on the keypad select ports P10–P17 (pins 27–34) of IC1 respectively. The TTL logic levels at P10–P17 can turn on a switching transistor,

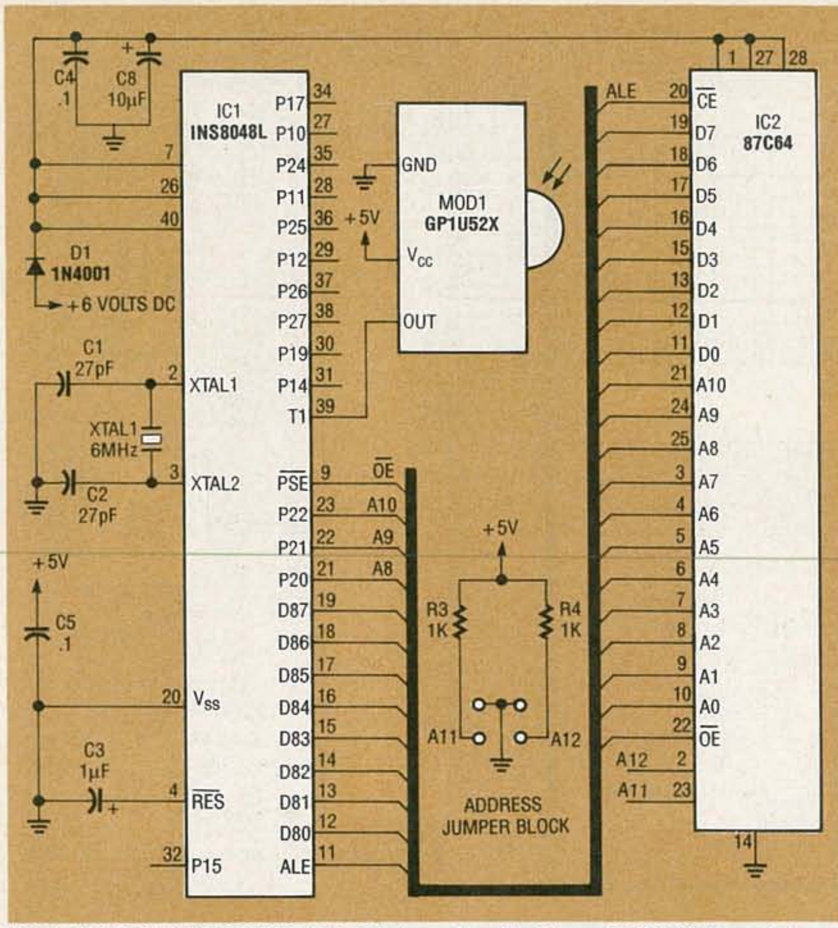
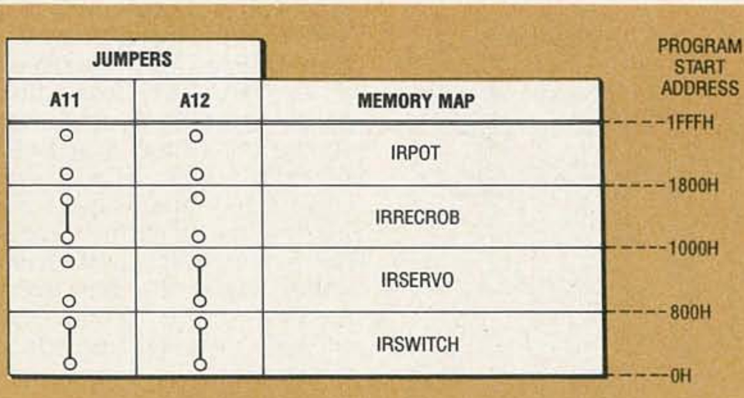


FIG. 4—IR RECEIVER SCHEMATIC. It is based on the Sharp GP1U52X IR module and INS8048L microprocessor. The GP1U52X is a hybrid IC/infrared detector that provides a strong clean signal for later filtering and demodulation.



A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0	ADDRESS
J	J	0	0	0	0	0	0	0	0	0	0	0	IRSWITCH = 0000H
J	1	0	0	0	0	0	0	0	0	0	0	0	IRSERVO = 0800H
1	J	0	0	0	0	0	0	0	0	0	0	0	IRRECROB = 1000H
1	1	0	0	0	0	0	0	0	0	0	0	0	IRPOT = 1800H

JUMPER ON=0 OR J
JUMPER OFF=1

FIG. 5—PROGRAM-SELECTION INFORMATION. Four different programs (IRSWITCH.ASM, IRSERVO.ASM, IRRECROB.ASM, and IRPOT.ASM) are stored in the receiver's EPROM. The programs are selected via jumpers A11 and A12.

drive a TTL buffer, or activate a solid-state relay. Pressing the ADD key allows any following key depression of keys 1 through 8 to output a high on the corre-sponding port. Conversely, pressing the DEL key followed by any of keys 1 through 8 signals IC1 to take the following port selection low. That allows any of the eight outputs to be turned "on" or "off" individually with-out interfering with each other To see this, use a logic probe to check P10 as you press ADD or DEL followed by a 1. ADD 1 should take P10 high while DEL 1 returns P10 to low.

Driving servos

Hobby-grade servos are com monly found in radio-controlled model aircraft and cars. How ever, because servos conver electrical pulses to mechanica motion, they do have many other uses. Servos are easy to use once you understand how they work.

The most common hobby ser vos have a three-wire termina tion: positive voltage, ground and signal input. Positive volt age is usually +5-volts DC an the signal is a TTL-compatibl variable-width pulse. A 1.5-mi lisecond pulse will center th servo rotor. Increasing the puls width to 2 milliseconds wi move the servo rotor fully clock wise. Decreasing the pulse wic th to 1 millisecond moves th servo rotor fully counterclock wise. So, a pulse width betwee 1 and 2 milliseconds will caus the rotor to travel in a specif direction and distance depend ing on the applied pulse widtl Pulses are normally applie about every 16 milliseconds t hold the servo rotor in positio In our application, pulses ar applied every 45 milliseconds.

The IR remote control syste can control a maximum of tw hobby servos as shown in Fig. The program IRSERVO.ASM which is selected by jumperin only A12, is used to drive ther The servos are operated b pressing the UP V and DOWN keys for counterclockwise ar clockwise rotation, respective The 0 key will center the select servo rotor. Selection of servos and 2 is performed by pressing 1 for servo 1 and 2 for servo 2. The drive signal for servo 1 originates at pin 27 of IC1 (P10) and the drive signal for servo 2 originates at pin 28 (P11). When servo 1 is active, a high is present at pin 35 of IC1 (P24), and when servo 2 is active, a high is present at pin 38 (P27). You can use those outputs to drive LED indicators with a PN2222 transistor, as shown in Fig. 6.

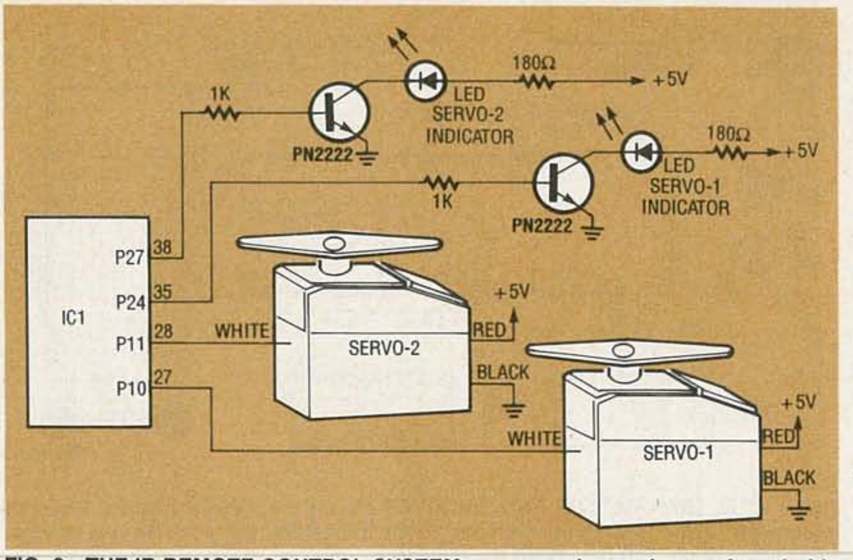


FIG. 6—THE IR REMOTE CONTROL SYSTEM can control a maximum of two hobby-grade servos. The LED's indicate which servo is active.

Robot remote control

Do you remember Ken the robot from the April 1991 issue of **Radio-Electronics**? He had a mind of his own, but the IR remote-control system will let you teach him some manners. The IR system gives you override control of Ken's motions. You will need to change or reprogram the original 8748H microcontroller with the new version of the machine language, IRROBOT.ASM, which is included in the ZIP file IRSYSTEM.EXE on the RE-BBS. (A new, preprogrammed 8748H containing IRROBOT.ASM is available from the source given in the Parts List.)

The IR receiver unit, which must be mounted directly on the robot, decodes the UP V key as forward, DOWN V as reverse, UP C as left, and DOWN C as right. The 0 key stops Ken in his tracks. If you want Ken to roam as he originally did, the DEL key puts him in his roving mode. All of the key combinations and codes used to manipulate Ken, as well as details on how it's done, can be found in the header section and main body of the program IRRECROB.ASM (included in IRSYSTEM.EXE). That program is set by jumpering only A11. Figure 7 details the connections between the IR receiver unit and the robot.

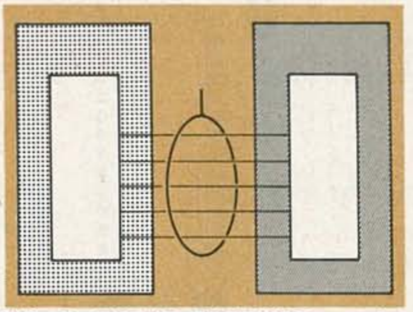


FIG. 7—THE IR RECEIVER can be mounted on Ken the robot (see Radio-Electronics, April 1991) to give you full control over him.

Remote potentiometer

Program four, IRPOT.ASM, remotely controls a digital potentiometer. The DS1267 dual solid-state potentiometer (made by Dallas Semiconductor) is composed of 256 resistive sections. Tap points are provided between each resistive section, and each tap point is accessed

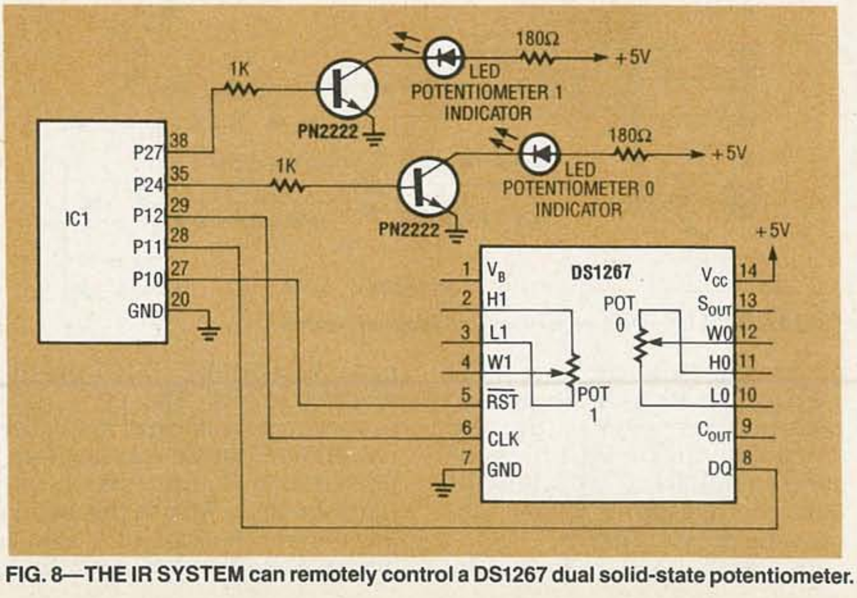


FIG. 8—THE IR SYSTEM can remotely control a DS1267 dual solid-state potentiometer.

PARTS LIST—TRANSMITTER

All resistors are ¼-watt, 5%.

R1—10 ohms
R2–R4—1000 ohms

Capacitors

C1, C2—27 pF, ceramic disk
C3—1 µF, 35 volts, tantalum
C4–C7—0.1 µF, Mylar
C8—10 µF, 10 volts, electrolytic

Semiconductors

IC1—INS8048L microprocessor (National)
IC2—87C64 EPROM with transmitter program installed
IC3—MC14017 CMOS decade counter
IC4—MC14049 CMOS inverting buffer
D1—1N4001 diode
Q1—IRFZ22 MOSFET
LED1, LED2—TIL38 infrared light-emitting diode

Other components

XTAL1—6-MHz crystal

Miscellaneous: On/off switch, 16-key keypad (All Electronics part number KP-16 or equivalent), PC board, plastic case, 6-volt battery, ribbon cable, wire, solder, etc.

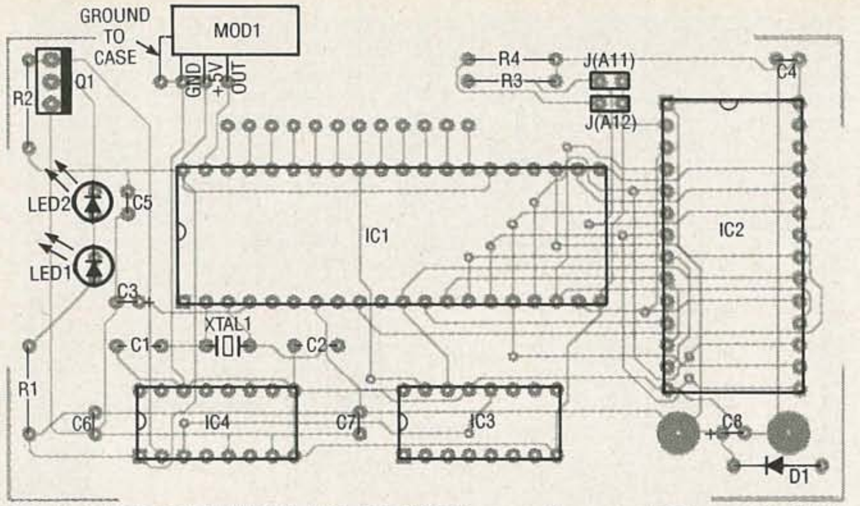
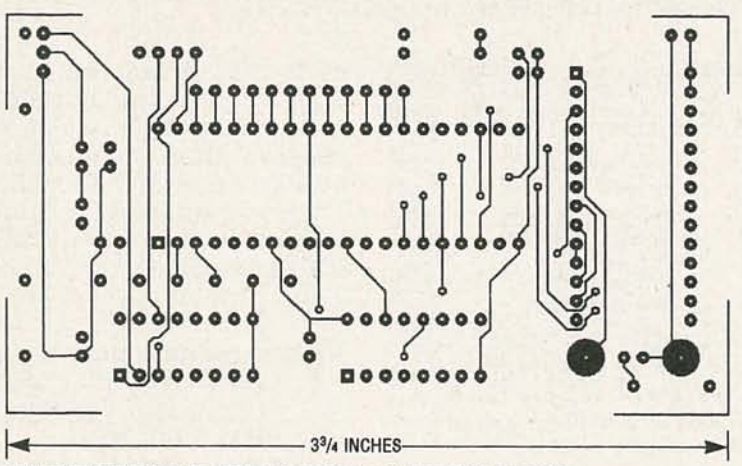
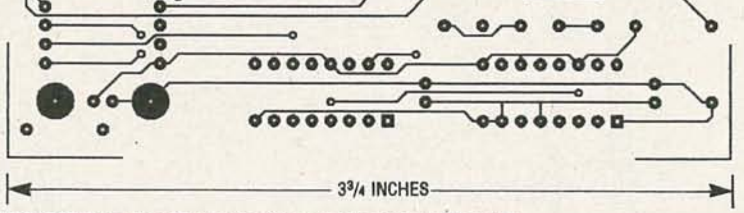


FIG. 9—THE TRANSMITTER AND RECEIVER are on the same PC board. Build the transmitter first, checking off each part in the transmitter parts list as you go. Put it aside when done, and then build the receiver.



COMPONENT SIDE for the IR transmitter and receiver boards.



SOLDER SIDE for the IR transmitter and receiver boards.

by the wiper. By clocking a 17-bit digital code into the DQ pin, each potentiometer within the IC can be adjusted independently. The part is available with different resistance values, depending on your needs.

Figure 8 shows how to connect the DS1267 to IC1 on the receiver board. The UP V and DOWN V keys raise and lower the resistance, while 0 selects potentiometer 0 and 1 selects potentiometer 1. We use the 0 and 1 keys here instead of 1 and 2 because the DS1267 data sheet labels the potentiometers a[s] and 1. Again, pin 35 of IC1 high when potentiometer 0 active, and pin 38 is high wh potentiometer 1 is active. can also use the LED indica circuits connected to pins and 38 of IC1. Both jumpers and A12 must be removed to cess IRPOT.ASM.

PARTS LIST—RECEIVER

All resistors are ¼-watt, 5%.

R1, R2—not used
R3, R4—1000 ohms

Capacitors

C1, C2—27 pF, ceramic disk
C3—1 µF, 35 volts, tantalum
C4, C5—0.1 µF, Mylar
C6, C7—not used
C8—10 µF, 10 volts, electrolytic

Semiconductors

IC1—INS8048L microprocessor (Na tional)
IC2—87C64 EPROM with receiver pro grams installed
IC3, IC4—not used
D1—1N4001 diode
Q1—not used
LED1, LED2—not used

Other components

XTAL1—6-MHz crystal
MOD1—GP1U52X IR detector modu (Sharp), or Radio Shack part numb 276-137

Miscellaneous: On/off switch, P board, two jumper blocks, wire, sold etc.

Note: A complete kit of parts for t transmitter and receiver (not inclu ing a battery and case) is availab for $49.00 plus $3.00 S&H from Fr Eady, PO Box 541222, Merrit Islan FL 32954. Check or money ord only. For technical assistance c 407-454-9905.

Common factors

The receiver and transmi circuitry are almost identi and they are built on the sa PC board. Parts common both circuits have the sa part number, and parts ad or removed from one of the cuits will have correspond part numbers added or moved. So, when a particu part number that's containe both circuits is mentioned, part performs the same fu tion in both circuits. Whe part contained in only one of circuits is mentioned, The re ence is limited to that particu circuit.

The first and most import part common to both circui

Continued on page

BUILD A POWER CONTROLLER FOR AUTOMOTIVE ACCESSORIES

Add that custom touch to your automotive accessories with our power-controller module.

DAVID J. SWEENEY

ADDING ACCESSORIES TO A CAR OR truck was once a simple chore. Just run some heavy wire from the car battery to the load, through the fire wall to the dashboard, and connect the wires in series with a fuse and a toggle switch and the job was complete. With that huge, high-current switch mounted on a bracket strapped to the dashboard, a flip of the wrist would activate the new accessory and testify to the owner's expertise and initiative.

But a plain old toggle switch hanging from the dashboard doesn't cut it anymore; it presents a tacky, unprofessional appearance in today's motor vehicles. Besides looking bad, an old-fashioned lever switch could make you look bad, too. If you were to leave the power on when the ignition key is off, you could kill the battery.

You can personalize your dashboard and avoid those toggle-switch headaches with our simple pushbutton power controller for high-current accessories. When you're finished, you'll have a "smart" switch that blends in with the existing dashboard controls. An LED can also be installed to indicate the power state.

The motor vehicle power controller is specially designed for under-the-hood mounting. It is designed to switch a high current when it receives a positive-going pulse from a momentary switch. It could also be controlled by a specialized device like a remote control radio receiver. Pulses from a 555 timer IC could be used to trigger the power controller to flash warning lights.

For pushbutton use, only a thin control wire runs to the dashboard, which helps make mounting easy. As shown in Figure 1, a small switch, with an LED power indicator, controls power to a load, which could be lights, a siren, a winch solenoid, or any other device that draws up to 10 amps. A fuse, which should be mounted as close to the battery as possible, protects the switched power. Pressing the dashboard-mounted switch once activates a relay that supplies power to the load; pressing the switch a second time disconnects power from the load.

The author designed the power controller for a pair of quartz halogen lights that he added to his car. The power controller delivers the 8 amps required for the fog lights, and it's controlled from a tiny pushbutton blended into the dashboard, as shown in Fig. 2.

The power controller operates only with the ignition on. Therefore, if the driver doesn't remember to turn off the lights, the controller will. That way you won't find a dead battery the next time you go to drive the car.

Circuitry

Figure 3 shows the

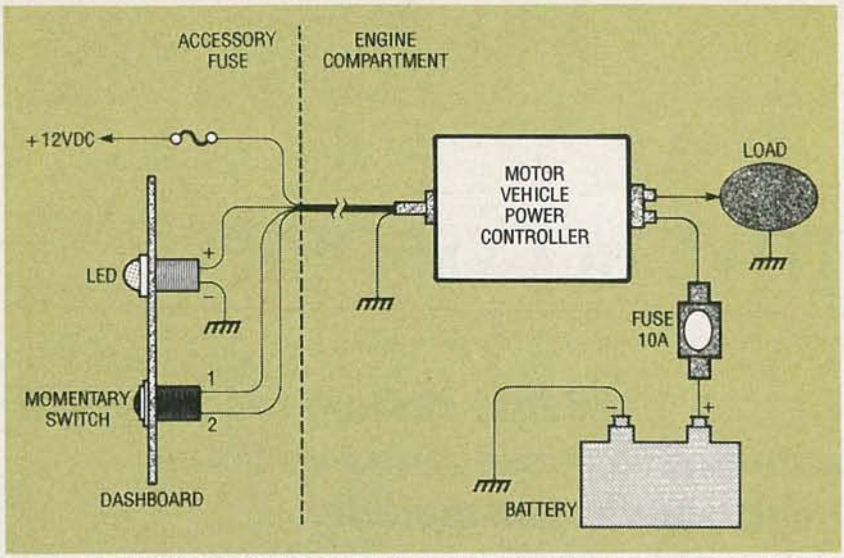
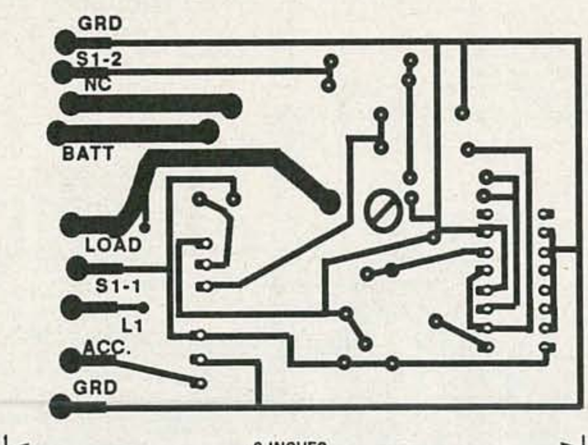


FIG. 1—THE POWER CONTROLLER lets a small pushbutton control power to a load that draws up to 10 amps.

FIG. 2—THE AUTHOR DESIGNED the power controller for a pair of quartz halogen lights that he added to his car. The lights are controlled from a tiny pushbutton switch blended into the dashboard.



FOIL PATTERN for the power controller.

schematic for the power controller. The controller is powered from the vehicle's accessory switch, so the load can receive power only when the ignition key is in the "on" or "accessory" position. Relay RY1 does t high-current switching (up 10 amps), and its coil requi only 38 milliamps.

When you turn on the ig tion switch in your car a press S1, capacitor C3 charg causing pin 2 of IC1 (we only u half of a CD4013 dual flip-fl to toggle high. The high outp from pin 2 of IC1 is applied the gate of FET transistor which in turn energizes re RY1. The relay connects the lo (up to 10 amps) to the car b tery. After C3 discharges, a su sequent high from S1 will tog the flip-flop again, openi RY1's contacts. Capacitor C2 sets the flip-flop to ensure t pin 2 is low and that the loa disconnected when the acces ry voltage is first applied. F transistor Q1 can easily drive extra relay in parallel with R

PARTS LIST

All resistors are ¼-watt, 5%.
R1—10,000 ohms
R2—3300 ohms
R3—1000 ohms
R4—2200 ohms
R5—1500 ohms
R6—10,000 ohms
R7—2.2 megohms

Capacitors
C1—0.1 μF, ceramic
C2—0.02 μF, ceramic
C3—0.3 μF, ceramic

Semiconductors
IC1—CD4013 dual flip-flop IC2–LM7812 12-volt regulator
Q1—IRF511 field-effect transist (FET)
D1—1N914 diode
LED1—light-emitting diod (choose color to match existin lighting on dashboard)

Other components
S1—momentary SPST pushbutt switch (choose one that close matches existing switches dashboard)
F1—10-amp fuse
SO1—5-pin DIN socket
PL1—5-pin DIN plug
RY1—12-volt, 10-amp relay (Rad Shack part number 275-248, equivalent)

Miscellaneous: PC board, 10-am terminal strip, inline fuse hold aluminum plate, encapsulati material, wire, solder. etc.

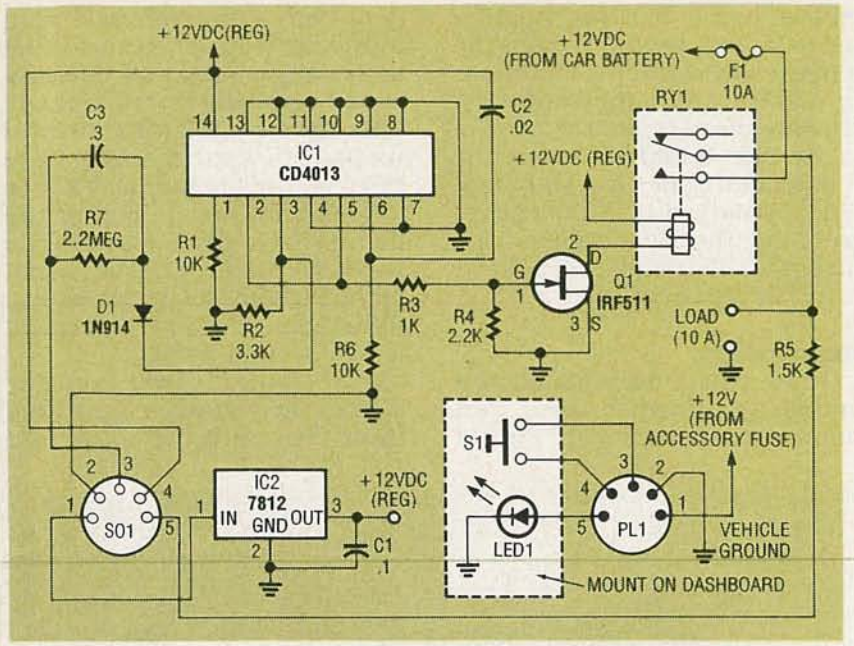


FIG. 3—POWER-CONTROLLER SCHEMATIC. Because the power controller is powered from the vehicle's accessory switch, the load can receive power only when the ignition key is on.

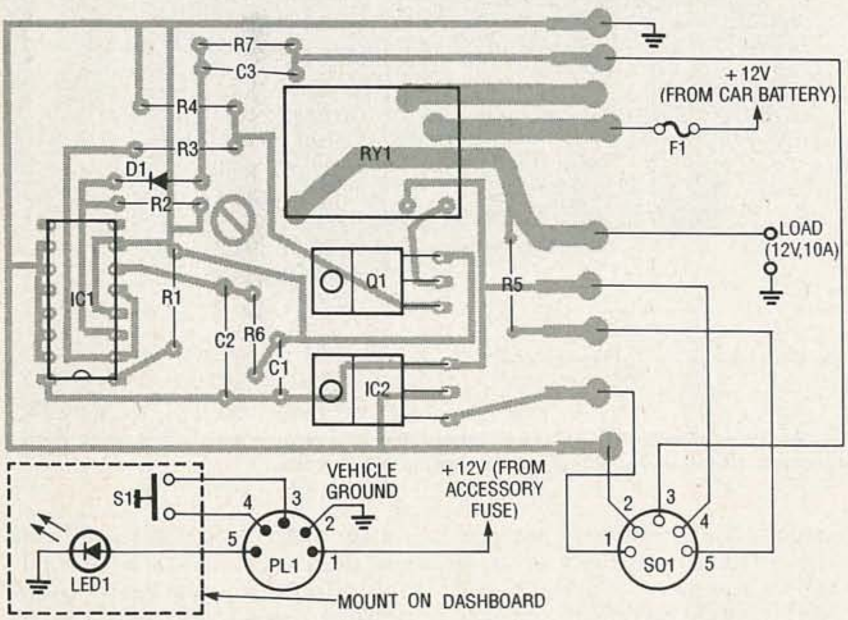


FIG. 4—ALL OF THE PARTS mount on a single-sided PC board for which we've provided the foil pattern.

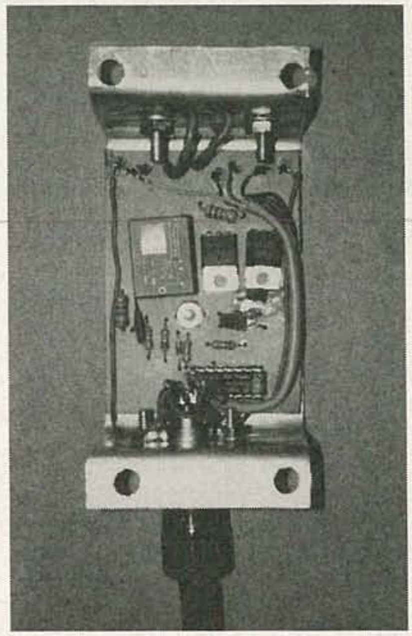


FIG. 5—THE POWER-CONTROLLER board is mounted on a 0.064-inch aluminum plate bent into a U-shaped frame. The DIN socket and the terminal strip are mounted on the sides of the U-bracket.

in case you want to control a second 10-amp load. (Do not connect two 10-amp loads to one relay.)

An LM7812 12-volt DC regulator (IC2) provides a stable voltage to run the circuitry, regardless of fluctuations in the vehicle's power. Capacitor C1 provides decoupling for RY1.

Construction

All of the parts for the power controller should be easy to find at most electronics supply houses. The electronic components are mounted on a single-sided printed circuit board as shown in Fig. 4. We've provided the foil pattern for the PC board in case you want to make your own. Otherwise, use point-to-point wiring and perforated construction board. Be sure that the gauge of the wire you use for the load connections can handle 10 amps.

A DIN socket (SO1) provides the low-current external connections to S1, LED1, accessory power, and ground. A matching DIN plug (PL1) plugs into SO1 to make those connections. (The load's power and ground connections should be separate from the DIN connector). The DIN connector also makes it easier to change a power-controller module in case of failure, without having to disconnect any wiring. If you don't have a 5-pin DIN connector, you can use 4-conductor phone wire to connect the module to power, ground, LED1, and S1. If you do that, you must ground the LED to the dashboard or any chassis ground as shown in Fig. 1. A terminal strip provides the connections from the load to the relay contacts.

To make the power controller as durable as possible in a car's engine compartment, the circuit board was mounted on a 0.064-inch aluminum plate bent into a U-shaped frame, as shown in Fig. 5. The DIN socket and the terminal strip were mounted on the sides of the U-bracket. The entire circuit was then encapsulated in a clear plastic resin block (the product is called Casting Resin) as

Earn Your B.S. Degree in ELECTRONICS or COMPUTERS

By Studying at Home

Grantham College of Engineering, now in our 42nd year, is highly experienced in "distance education"—teaching by correspondence—through printed materials, computer materials, fax, and phone.

No commuting to class. Study at your own pace, while continuing on your present job. Learn from easy-to-understand but complete and thorough lesson materials, with additional help from our instructors.

Our Computer B.S. Degree Program includes courses in BASIC, PASCAL and C languages — as well as Assembly Language, MS DOS, CADD, Robotics, and much more.

Our Electronics B.S. Degree Program includes courses in Solid-State Circuit Analysis and Design, Control Systems, Analog/Digital Communications, Microwave Engr, and much more.

An important part of being prepared to *move up* is holding the right college degree, and the absolutely necessary part is knowing your field. Grantham can help you both ways—to learn more and to earn your degree in the process.

Write or phone for our free catalog. Toll free, 1-800-955-2527, or see mailing address below.

•

Accredited by the Accrediting Commission of the National Home Study Council

•

GRANTHAM College of Engineering
Grantham College Road
Slidell, LA 70460

shown in Fig. 6. Encapsulation is not necessary, but it helps the circuit withstand the vibration, humidity, and temperature extremes found under the hood of a car. You should make sure the power controller works before encapsulating it. After encapsulation, the unit becomes "disposable" if it fails because it can't be repaired.

Installation

After you've encapsulated a working module, you can mount it in your car. Find a place for the module somewhere under the hood away from a high heat source. (For example, avoid the exhaust-manifold side of the engine.) Route the control wire through the fire wall and connect it to the switch and LED indicator, which you should mount in the driver's compartment. Be sure to drill the mounting holes slowly in plastic.

Snaking wires through a fire wall can be difficult. Sometimes there's a plastic plug that can be removed to gain access to the interior of the car from the engine compartment. Be sure to weatherproof such openings after the power controller is installed so your car won't be draf-

ty. If there's no removable pl in the fire wall, try to snake t new wires through an openi where existing wires alrea pass through. It's often help to poke a coat-hanger w through the fire wall and to u a hook bent on the end of t hanger to pull the wir through in much the sa manner as an electrician use fish tape to snake electri wires through walls.

Next connect power from t load to the controller, and th from the controller to the battery. After checking all connections, install fuse You should now be ready to behind the wheel, turn on ignition, and operate the l that is connected to the po controller.

You can expand the desig the controller to incorpor two relays, both powered by or to connect something to normally-closed (NC) side RY1. However, building an ad tional power controller migh just as easy. Once you get u to the convenience of our mo vehicle power controller, could end up adding a num of custom pushbutton-c trolled accessories to your au mobile.

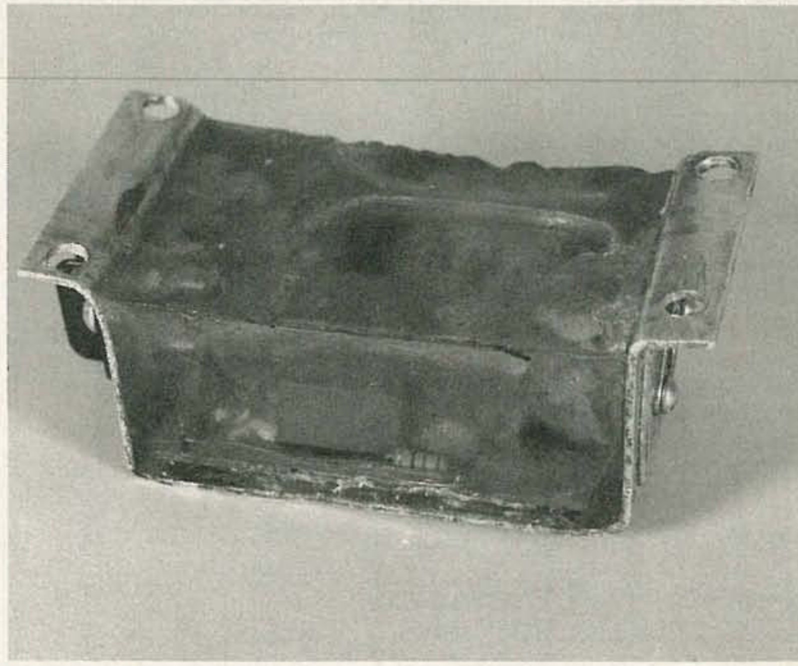


FIG. 6—THE ENTIRE CIRCUIT is encapsulated in a clear plastic resin block he withstand vibration, humidity, and temperature extremes.

RAY M. MARSTON

555 OSCILLATORS

Put the 555 time to work as a Schmitt trigger or as the heart of light and temperature alarms and drivers, a metronome, and a continuity checker.

TWO PREVIOUS ARTICLES (SEPtember, page 58 and October page 69 explained the operation of the popular and versatile industry-standard 555 timer IC as a monostable and astable multivibrator. They gave examples of its use in accurate time delay or oscillator circuits.

This third article starts by discussing the 555 as the key component in a Schmitt trigger circuit. It goes on to explain the role of the 555 in various astable multivibrator or oscillator circuits with many practical applications. Those circuits include light- and dark- as well as hot- and cold-actuated alarms. Other circuits are a code practice oscillator, a door buzzer, a continuity tester, a signal generator, and a metronome. Various light-actuator and relay-driver circuits are included.

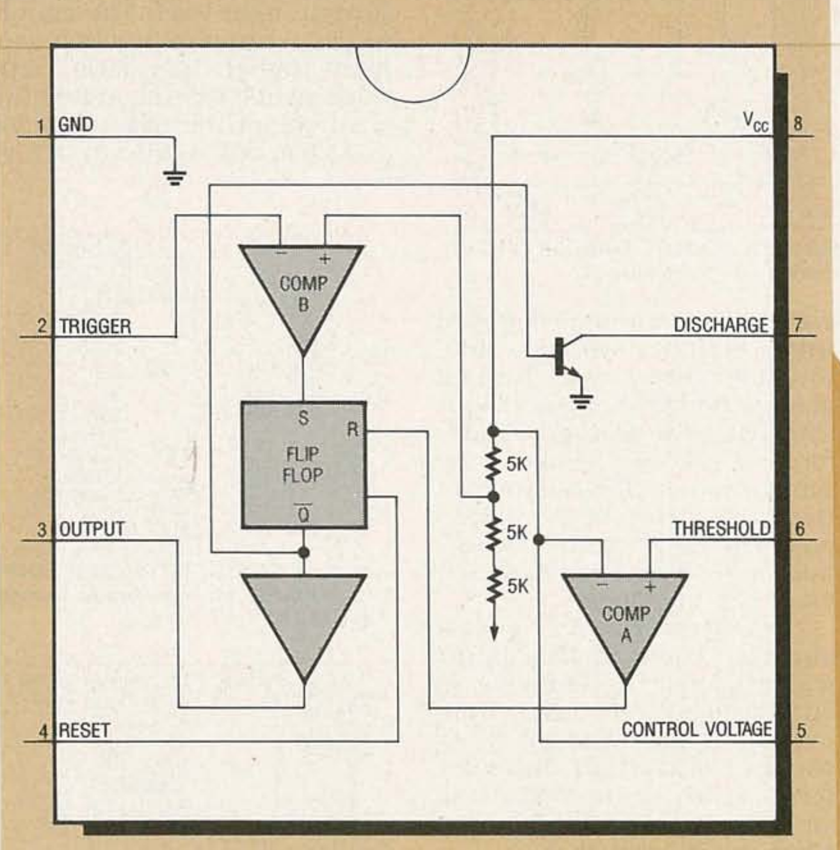


FIG. 1—PINOUT AND FUNCTIONAL BLOCK diagram of the 555 timer IC.

Schmitt trigger

Figure 1 is the pinout and functional block diagram for the 555 timer IC. In previous articles it was pointed out that for a 555 in the time-delay operation mode, timing can be precisely controlled by one external resistor and one capacitor. For astable operation as an oscillator, the free-running frequency and duty cycle can be accurately controlled with two external resistors and a single capacitor.

It is worth recalling that the 555 can be triggered and reset on falling waveforms, and the output circuit can source or sink up to 200 milliamperes, or drive TTL circuits. The 555's features include normally on and normally off outputs.

Figure 2-a illustrates the 555 IC as the active component in a Schmitt trigger circuit. Notice that the 555's TRIGGER pin 2 and THRESHOLD pin 6 are connected to form an input terminal. External input signals are applied directly at that point. The OUTPUT pin 3 becomes the output terminal.

Internal comparators A and B (see Fig. 1) are biased with an on-chip voltage divider. That divider biases comparator A at two-thirds of the supply voltage, and the non-inverting terminal of comparator B at one-third of the supply voltage. Comparator A drives the R input and comparator B drives the S input of the on-chip R-S flip-flop.

When the input voltage of the circuit in Fig. 2-a rises above two-thirds of the supply voltage, the 555 output switches to its low state. It remains there until the input voltage falls below one-third of the supply voltage. Then the output switches high and remains high until the input rises above the two-thirds supply level again.

The difference between those two trigger levels is called the *hysteresis* value. It is one-third of the supply in Fig. 2-a. That large hysteresis makes the circuit useful in signal conditioning where noise and ripple must be rejected, as shown in Fig. 2-b.

Figure 3 shows how the cir-

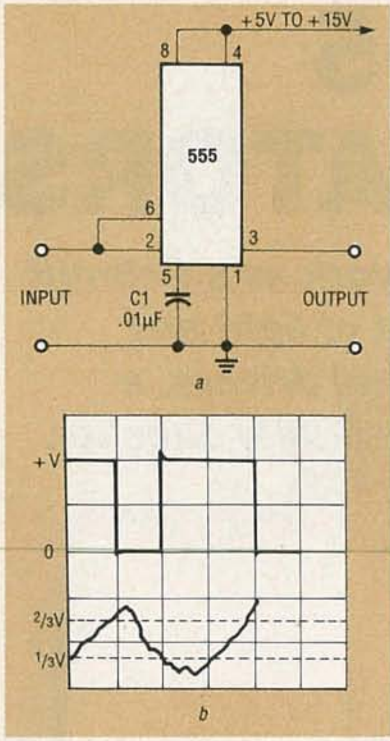


FIG. 2—A SCHMITT TRIGGER CIRCUIT formed with a 555 timer IC.

cuit in Fig. 2-a can be modified into a high-performance sine- to square-wave converter useful at input frequencies up to about 150 kHz. The voltage divider formed by R1 and R2 biases the input terminal (pins 2 and 6) of the 555 at its quiescent value of one-half the supply voltage (i.e., midway between the upper and lower trigger values).

The sine-wave input signal is superimposed on this point with capacitor C1. Square-wave output signals are taken from pin 3 of the IC. Resistor R3 is wired in series with the input terminal to ensure that the sine-wave signal is not distorted when the 555 switches.

Figure 4 shows how the Schmitt trigger circuit can be made into a dark-activated relay actuator by wiring the light-dependent voltage divider consisting of potentiomenter R1 and photocell R2 to the input terminal of the IC. The potentiometer and photocell resistance values are nearly equal at the middle of the light-activation range.

The inherently high input backlash or hysteresis of the Schmitt trigger limits the usefulness of this circuit to very specialized light-sensing applications. A more useful relay-driving, dark-activated switching circuit is shown in Fig. 5. It acts as a fast comparator rather than a true Schmitt trigger. The THRESHOLD pin 6 to internal comparator A of the 555 is tied permanently high by resistor R3, while the output of the light-sensing potentiometer R1 and photocell R2 voltage divider is applied to TRIGGER pin 2 of comparator B.

The photoresistive element for this circuit can be any cadmium-sulfide photocell whose resistance is between 470 ohms and 10 kilohms at the desired turn-on light level. The circuit in Fig. 5 can also function as a light- (rather than dark-) activated switch by exchanging the positions of the potentiometer and photocell, as shown in Fig. 6-a.

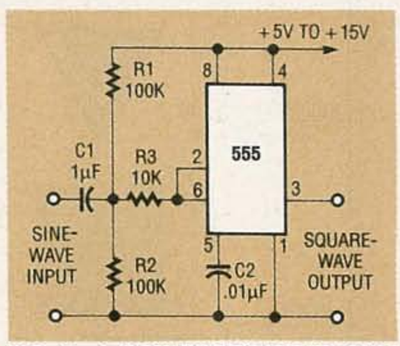


FIG. 3—A SCHMITT TRIGGER SINE- AND SQUARE- wave generator formed with a 555 IC.

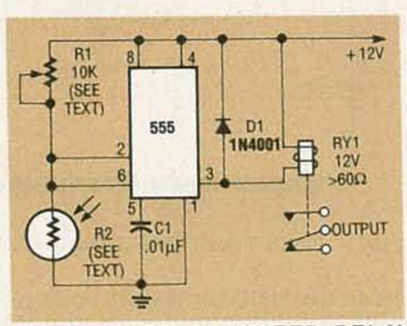


FIG. 4—DARK-ACTIVATED RELAY SWITCH BASED on the 555 has a lot of hysteresis.

The circuit can also function as a temperature-activated switch by substituting a thermistor with a negative temperature coefficient for the photocell, as shown in Figs. 6-b and 6-c. (A thermistor with a negative temperature coefficient decreases in resistance as temperature increases.) The the mistor for this application mu have a resistance value betwe 470 ohms and 10 kilohms at t desired turn-on temperatu Thermistors are typically pac aged as radial-leaded disks, a their resistance values are sp ified at 25° C.

Stable of oscillators

The 555 in the astable mu vibrator or oscillator mode h three outstanding advantag over other kinds of oscillato

- Excellent frequency stabil with variations in supply vo age and temperature.
- Frequency variable over wide range with a single pot tiometer control.
- Low impedance output t can source or sink currents to 200 milliamperes.

Figure 7 shows the 555 as semiconductor IC in a Mo code practice oscillator. The cuit is an oscillator with its quency variable from 300 H 3 kHz by adjusting tone con potentiometer R3. The so volume of headphone Z1 ca varied with potentiometer and the headphones can h any DC resistance from a ohms up to a few megohms. oscillator circuit draws quiescent current until the n mally-open Morse key conn the circuit to the 5- to 15- supply.

Figure 8 shows the 555 as semiconductor device in a s ple electronically actuated d buzzer. Pushbutton switch connects the 555 to the 9- battery, and the output of th is coupled to speaker SP through capacitor C4. Cap tor C1 produces a low sup line impedance, ensuring

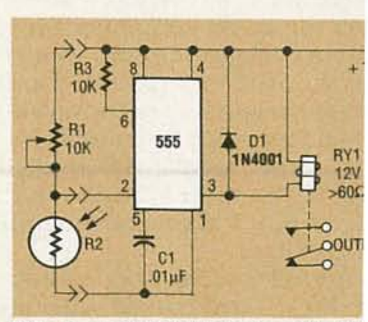


FIG. 5—MINIMUM-BACKLASH, DA ACTIVATED relay based on the 555

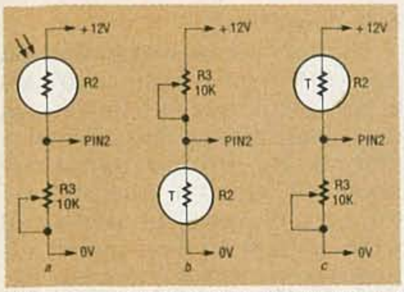


FIG. 6—ALTERNATIVE SENSOR CIRCUITS for Fig. 5 provide actuation by light (a), under-temperature (b), and over-temperature(c).

quate output drive current to the speaker when S1 is closed. The circuit generates a monotone buzzing sound set by potentiometer R2.

Figure 9 shows the 555 as the semiconductor component in a continuity tester that generates an audible tone only if the resistance between the test probes is less than a few ohms. The circuit's operation depends on an output tone that sounds only if the RESET (pin 4) is biased positive to about 600 millivolts or greater by sensitivity potentiometer R5. Pin 4 is normally pulled to ground by resistor R2, so no tone is heard.

For the buzzer in the circuit of Fig. 9 to sound, the two probe tips must touch, connecting R2 to the output of the reference generator formed by resistor R3 and Zener diode D1 through sensitivity potentiometer R5. Potentiometer R5 must be carefully adjusted so that a buzzing sound is barely audible. Consequently, if the resistance between the probe tips exceeds a few ohms when a continuity test is being made, the buzzing tone will not be heard. The circuit draws several milliamperes whenever S1 is closed, even if the probe tips are not touching.

Figure 10 shows the 555 functioning as a signal generator for testing both audio and radio-frequency circuits. The circuit oscillates at a frequency of a few hundred hertz when S1 is closed. Its square-wave output is very rich in harmonics, and those can be detected at frequencies up to tens of megahertz with a radio receiver. The signal level can be varied by adjusting potentiometer R3.

In Fig 11 the 555 is the active component of a metronome with a beat rate variable from 30 to 120 beats per minute. The beat rate can be set by adjusting potentiometer R3, and the beat level can be set by adjusting potentiometer R4. This circuit is a modified version of the standard astable multivibrator in which the main timing network is driven from OUTPUT pin 3 of the IC.

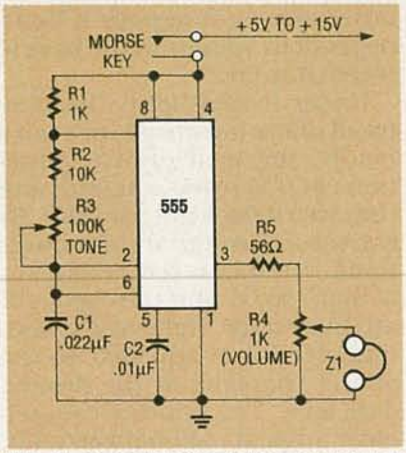


FIG. 7—CODE-PRACTICE OSCILLATOR with variable tone and volume.

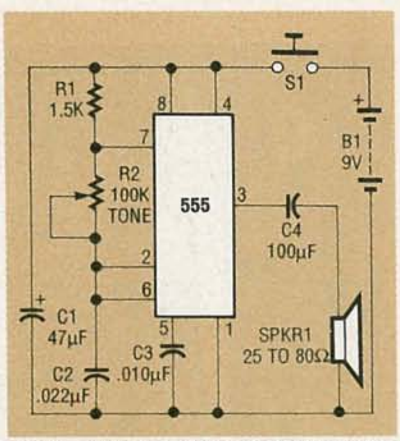


FIG. 8—ELECTRONIC DOOR BUZZER based on the 555.

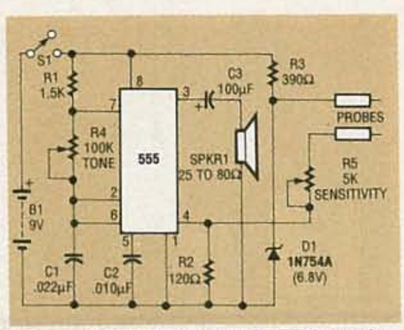


FIG. 9—CONTINUITY TESTER based on the 555.

When the output switches high, C1 charges rapidly through diode D1 and resistor R1 in series to generate a beat pulse only a few milliseconds long. When the output switches low again, C1 discharges through potentiometer R3 and resistor R2 in series to provide an *off* period of up to two seconds (30 beats per minute). The output pulses are fed to speaker SPKR1 through level-control potentiometer R4 and buffer transistor Q1.

LED flashers and alarms.

Figures 12 to 14 show the 555 in LED flasher applications in which the LED's have equal *on* and *off* switching times. With the component values shown, each circuit flashes at a rate of about one flash per second.

The circuit in Fig 12 has a single-ended output. Either a single LED (or LED's in series) can be connected between the OUTPUT pin3 and GROUND pin 1 of the 555, and all LED's turn on and off together. Resistor R3 sets the *on* current of the LED's.

The circuit in Fig. 13 is similar to that of Fig. 12, but it has a double-ended output connection. The LED's above pin 3 are

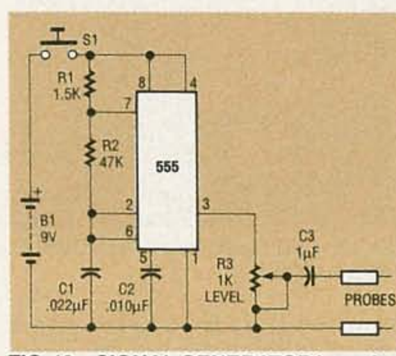


FIG. 10—SIGNAL GENERATOR based on the 555

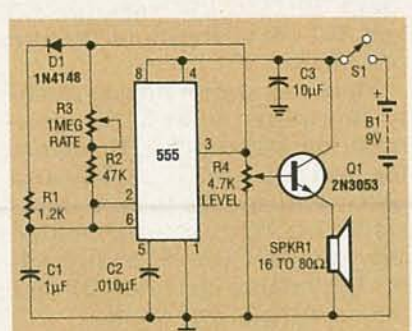


FIG. 11—METRONOME CIRCUIT based on the 555.

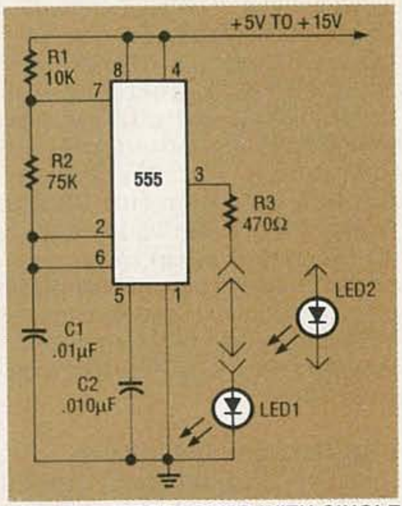


FIG. 12—LED FLASHER WITH SINGLE-ENDED output.

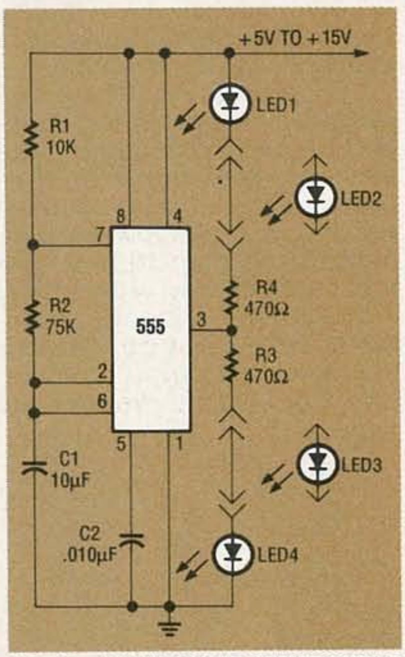


FIG. 13—LED FLASHER WITH DOUBLE-ENDED output.

on when the LED's below pin 3 are off, and vice versa. Resistor R3 sets the *on* currents of the lower LED's, and resistor R4 sets the *on* currents of the upper LED's.

Figure 14 shows how to modify the circuit in Fig. 12 for automatic dark-actuation. Resistors R3 and R4, photocell R1, and potentiometer R2 form a light-sensitive Wheatstone bridge that triggers the 555 through bridge balance-detector Q1 and the RESET pin 4 of the IC.

The oscillator is normally disabled by resistor R6, which pulls RESET pin 4 close to zero volts. The circuit oscillates only when pin 4 is pulled to a positive voltage greater than 600 millivolts. That can be achieved only by turning on Q1.

As one arm of the Wheatstone bridge, resistors R4 and R5 apply a fixed half-supply voltage to the emitter of Q1. The photocell and potentiometer form the other arm that applies a light-dependent voltage to the base of transistor Q1.

Under bright light, the photocell offers low resistance. As a result, the base-emitter junction of Q1 is reverse biased, and the circuit does not oscillate. By contrast, under dark conditions, the photocell resistance is high, so Q1 and the oscillator are biased on. Normally, potentiometer R2 is adjusted so the 555 is triggered at the desired dark level. The photocell should have a resistance between 470 ohms and 10 kilohms under this condition.

The precision gating meth described can trigger a varie of 555 oscillator circuits to fo useful audible alarms and re drivers. By interchanging t photocell with the potention ter, or replacing the photoc with a thermistor having negative temperature coef cient, those circuits can be tr gered by increases or decreas beyond preset values in eit light or temperature. Figures to 17 illustrate practical exa ples of such circuits.

Figure 15 shows an automa heat- or light-actuated re driver. The circuit works w any 12-volt relay having a c resistance greater than ab 60 ohms. When actuated, circuit triggers the relay RY1 and off about once per seco

A heat-or light-activated r notone alarm is shown in F 16. When triggered, this circ

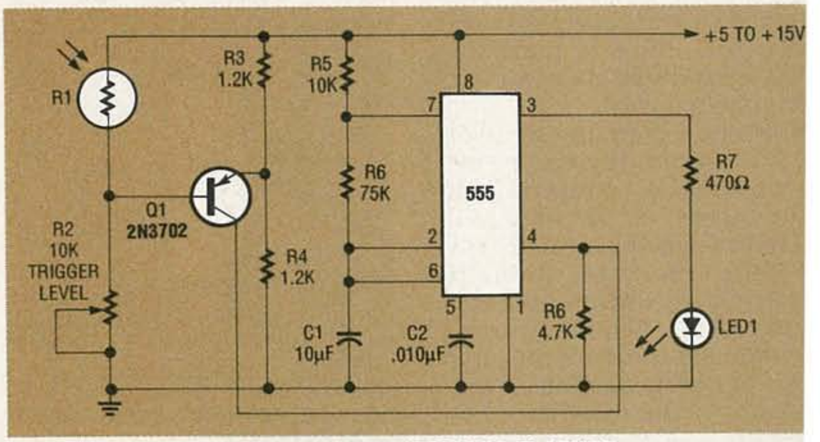


FIG. 14—AUTOMATIC (DARK-ACTUATED) LED FLASHER.

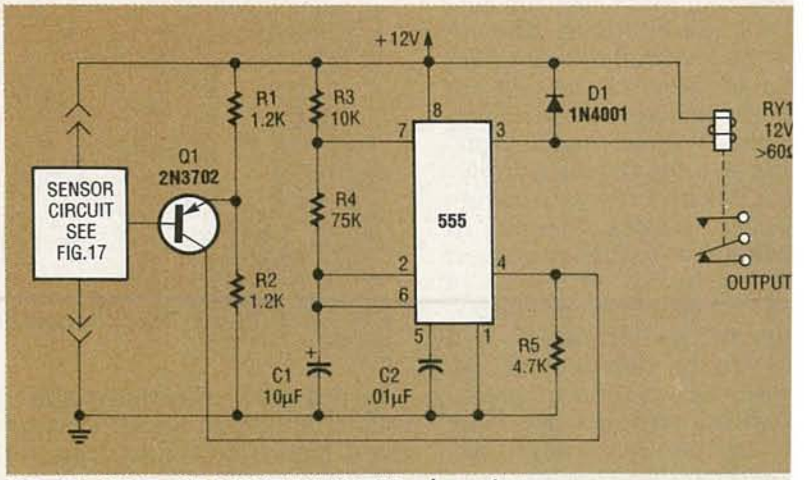


FIG. 15—HEAT- OR LIGHT-ACTUATED relay pulser

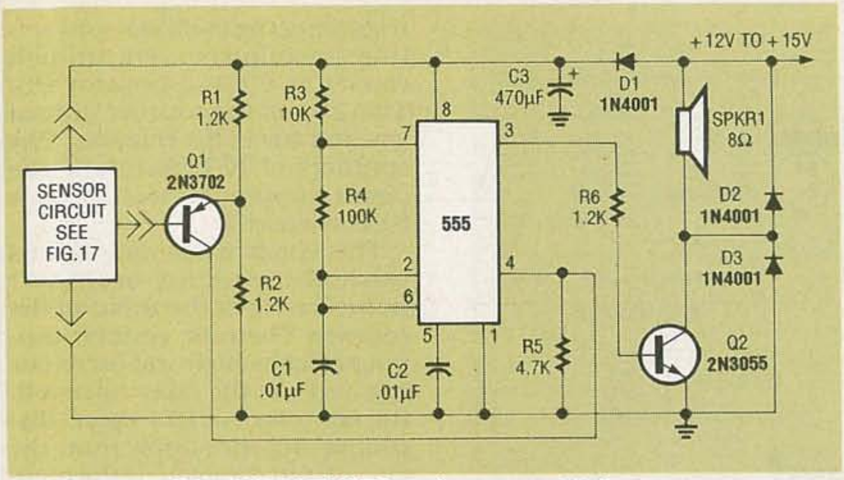


FIG. 16—HEAT- OR LIGHT-ACTUATED medium-power 800-Hz alarm.

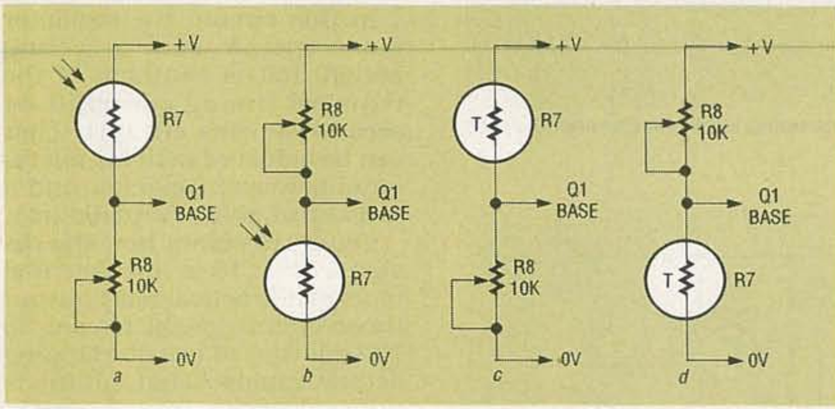


FIG. 17—ALTERNATIVE SENSOR CIRCUITS for Figs. 14 or 15 for actuation by darkness (a), light (b), under-temperature (c), or over-temperature (d).

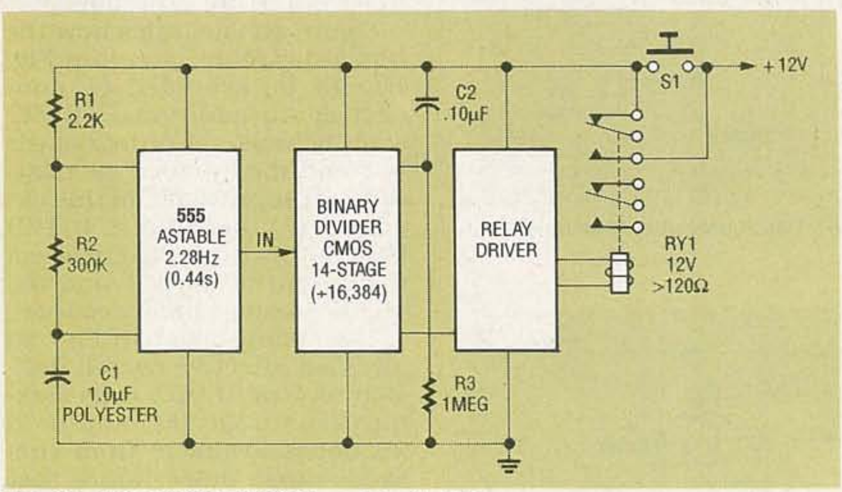


FIG. 18—A 60-MINUTE TIMER based on the 555.

generates a buzzing sound at about 800 Hz. Several watts of power are drawn from speaker SPKR1 through buffer transistor Q2. The resulting high speaker output current could transfer ripple voltage to the power supply so diode D1 and capacitor C3 protect the circuit from that interference. Diodes D2 and D3 clamp the inductive switching spikes of the speaker, protecting Q2 against damage.

Alternative sensor circuits that can automatically activate the circuits of either Figs. 15 or 16 are shown in Fig. 17. If light actuation is desired, the sensor should be a cadmium-sulfide photocell. If the circuit is to be triggered when light level *falls* to a preset value (dark actuation), the circuit of Fig 17-a should be used. If the circuit is to be triggered when the light intensity *rises* to a preset value (light actuation), the circuit of Fig 17-b should be used.

If you want temperature actuation, use a thermistor with a negative temperature coefficient as the sensor. For under-temperature operation, use the circuit of Fig. 17-c; for over-temperature operation, use the circuit of Fig. 17-d. Regardless of the kind of operation desired, the sensor element must have a resistance value between 470 ohms and 10 kilohms at the desired trigger level.

Long-period timers

A 555 can function as a superb manually-triggered relay-driving timer when it is connected in the monostable or pulse-generator mode. In practical applications, such a circuit will not generate accurate timing signals of more than a few minutes because they require an electrolytic capacitor with a high capacitance value. Electrolytic capacitors typically have wide tolerance values (−50 to +100%) and large and unpredictable leakage currents.

If the 555 is to be the active component in long-period timers, the external circuitry must include a capacitor other than an electrolytic. Figure 18 shows, as a block diagram, the principles behind a design for a 60-minute relay-driving timer. In this case, the 555 is organized in the astable mode. It has its output connected to the relay driver through a 14-stage binary divider IC. That configuration gives an overall division ratio of 16,384.

If the output of the 555 is set to zero at the start of an input count, the output will switch high upon receiving the 8192nd input pulse. The circuit will remain high until the 16,382nd pulse arrives. At that time, the output will switch low again, completing the normal operating sequence.

In Fig. 18, the timing sequence is initiated by closing S1, which connects the supply to the circuit, simultaneously

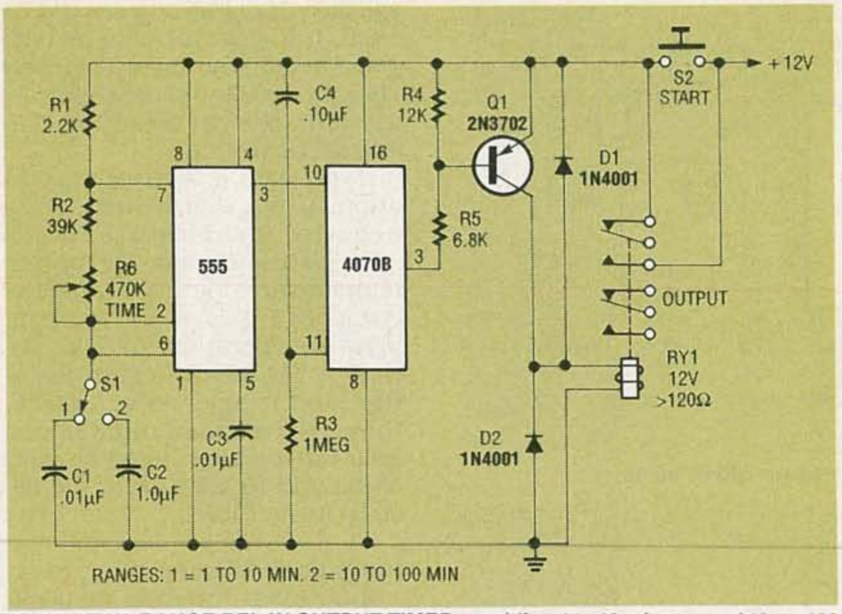


FIG. 19—TWO-RANGE RELAY OUTPUT TIMER providing 1 to 10 minute- and 10- to 100-minute intervals.

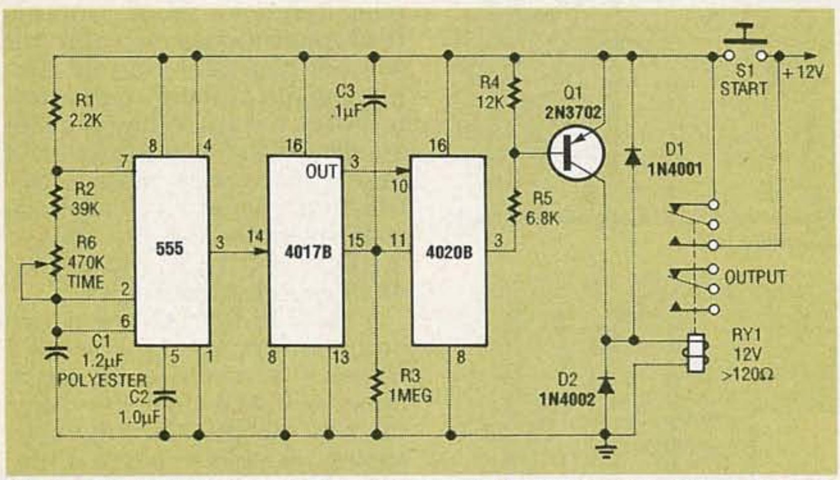


FIG. 20—EXTRA-LONG PERIOD RELAY OUTPUT TIMER provides 100-minute to 20-hour intervals.

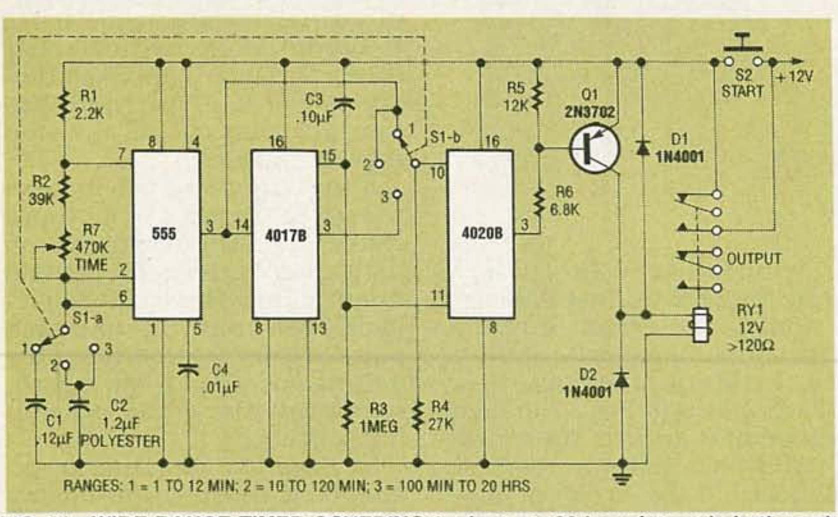


FIG. 21—WIDE-RANGE TIMER COVERING 1-minute to 20-hour intervals in three decade ranges.

triggering the oscillator and s
ting the counter to zero throu
capacitor C2 and resistor F
That drives the counter outp
low and turns the relay on. T
contacts of RY1 maintain t
power supply connection or
S1 is released.

This condition is maintain
until the 8192nd oscillat
pulse arrives at the input of t
counter. Then the counter o
put switches high and turns t
relay off. As the relay turns
the contracts of RY1 open, c
connecting the supply from t
circuit and completing the op
ating cycle.

In this circuit, the oscilla
must operate with a cycli
period that is 1/8192nd of
required timing period (0.
second for this circuit). Tl
can be achieved with a 1 mic
farad polyester capacitor an
resistor of about 300 kilohı

Figure 19 shows how the
sign in Fig. 18 is implemen
to form a practical relay-out
timer circuit useful for one
100 minutes in two overlapp
decade ranges. That circui
powered from a 12-volt sup
The relay must have a coil re
tance of 120 ohms or more.

Figure 20 illustrates how
time delay of the circuit in I
19 can be extended by c
necting an additional divi
stage between the output of
555 and the input of the re
driving output state. In this
cuit a divide-by-ten 401
CMOS IC is connected betw
the output of the 555 and
4020B 14-stage binary cour

The arrangement in Fig.
gives an effective overall c
sion ratio of 81,920, thus m
ing delays from 100 minute
20 hours available from
single-range timer. Notice
both of the divider IC's are a
matically reset by the se
combination of capacitor
and resistor R3 when switcl
is closed.

Figure 21 shows to modify
circuit in Fig. 20 to mal
wide-range general-purp
timer that covers one minu
20 hours in three decade-b
ranges. The divide-by-ten s
is active only when switch
is at position 3.

ore
ssons!

More
Services

A Shocking Offer!

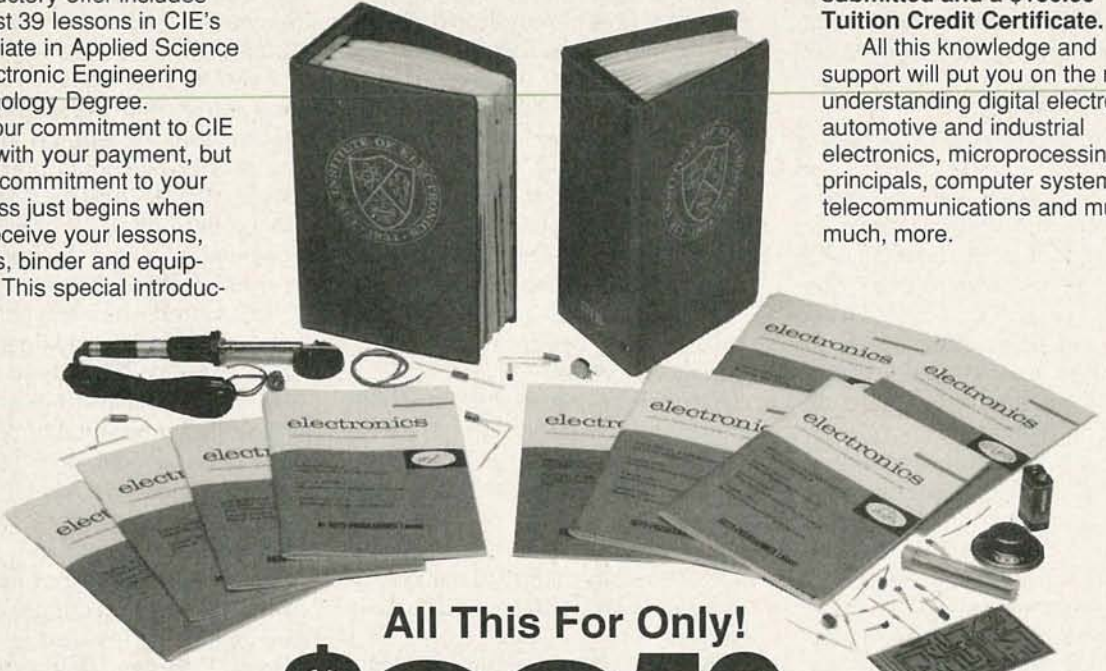
Now you don't have to be enrolled at CIE to receive our introductory Electronic and Electricity Lesson Modules. This program is available for a limited time to non-students for the shockingly low price of only $99.50.

With CIE's patented AUTO-PROGRAMMED method of learning you will quickly learn and then master the basics of electronics and electricity and then move on to... DC/AC circuit theories, fundamentals of bi-polar junction transistors (BJT), field effect transistors (FET), wiring, diagram and schematic readings, component identification, soldering techniques... and much, much, more. This introductory offer includes the first 39 lessons in CIE's Associate in Applied Science in Electronic Engineering Technology Degree.

Your commitment to CIE ends with your payment, but CIE's commitment to your success just begins when you receive your lessons, exams, binder and equipment. This special introductory price includes all the benefits and assistance CIE normally extends to its full time students. You'll be entitled to unlimited access to CIE's faculty and staff to assist you in your studies via a toll free 800 number six days a week, 24-hour turnaround on grading your submitted exams, CIE bookstore privileges, a patented learning method, reference library, access to CIE's electronic bulletin board and a free issue of CIE's school newspaper The Electron.

And best of all, when you decide to continue your electronics education in any of CIE's programs you'll receive full academic credit for successful lessons submitted and a $100.00 Tuition Credit Certificate.

All this knowledge and support will put you on the road to understanding digital electronics, automotive and industrial electronics, microprocessing principals, computer systems, telecommunications and much, much, more.



All This For Only!

$99.50

- **$100.00 Tuition Credit**
- **Academic Credit**
- **Free issue of The Electron**
- **Build your personal burglar alarm**
- **Toll Free Instructor Assistance**
- **24-hour grading**
- **CIE bookstore privileges**
- **39 theory and hands-on training lessons and exams.**
- **Patented learning method**
- **CIE electronic bulletin board privileges**

☐ **Yes! Send me CIE's Introductory Electronic and Electricity Lessons and Equipment.** A7315

Name: ______

Street: ______ Apt#: ______

City: ______

State: ______ Zip: ______

Age: ______ Phone: (______) ______

CIE

BOOKSTORE
1776 East 17th Street
Cleveland, Ohio 44114

Total Merchandise: $99.50

Ohio Residents add 7% Sales Tax: ______

California Residents add 6 1/2% Sales Tax: ______

Total This Order: ______

Shipping and Handling Charge: $5.00

Method of Payment/Amount Enclosed: $ ______

☐ Personal Check or Money Order

☐ Master Card ☐ Visa ☐ Discover

Card Expiration Date: ______

Signature: ______

DISCOVER VISA MasterCard

CHARGE BY PHONE!
9 AM to 4:30 PM Eastern Time;
1-800-321-2155 ext. A7315

HARDWARE HACKER

Distant FM reception, UFO resources listing, UHV and VHF amplifier TV/FM booster circuits, and pseudoscience research.

DON LANCASTER

Judging from the letters and helpline calls, there's clearly a bunch of interest in alternate-science and pseudoscience topics among **Electronics Now** readers. Some genuinely believe, and others (like me) find these subjects fascinating reading.

The two centermost secrets to all hardware hacking are curiosity and a sense of wonder—which explains why such wide-ranging topics as specialty hardwoods, Grecian urns, Buckeyball research, rubber iguanas, the *Powder & Bulk Solids* trade journal, and tinaja questing all are vastly more mainstream to hardware hacking than they would appear at first glance.

I come at all this from a traditional formal engineering background. I strongly believe in such things as the laws of thermodynamics, and the value of performing simple and verifiable experiments.

I also realize that getting relevant and accurate results in the lab end up nearly always to be the exception, rather than the rule. I am a highly skeptical inquirer, albeit one who very much loves to run a stick over the bars of establishment cages. And I'm someone who always likes to encourage people to think things out for themselves.

As a researcher, I feel there is a fuzzy something out there that I'll call *the edge*. This side of the edge, things seem (at least to me) "probably true." On the far side of the edge, things appear "probably false." To determine which side of the edge a subject currently lies on, I'll often first apply the laws of physics and my ability to perform experiments. Second, I'll ask what the laws of statistics have to tell us on the odds of an occurence and on the data sample sizes. And third, I'll try to apply Ockham's razor to find out if there is a simpler explanation or a more likely underlying cause.

After that, I'll ask some crucial cultural questions such as: Where is the cash flow? (You should always follow the money.) Who benefits? Who loses? What psychological or other needs are being filled in all those persons involved? Could this make a good hoax?

Were magic cookies involved? Are there any personality disorders? What irrelevant links are there to religions, conspiracies, or any politics? Has this ground ever gotten plowed before? How thoroughly? By whom?

Do things seem *slightly* ratty? Are there "just enough" noise, loose ends, conflict, and missing pieces to fit the way the real world actually works? Are all of the t's dotted and the i's crossed, rather than vice versa? Are results carried to eight-decimal-place precision conspicuously absent?

Finally, I'll try to apply my "likes water, looks like a duck, and quacks like a duck" filter. Especially if eggs are about to be laid.

All of which leads up to my...

Thoughts on UFO's

On to today's story. You see, I was abducted by a UFO enthusiast. Yup, a close encounter of the zeroth kind.

Actually, I guess I did pay him to be abducted. Mike Sherlock run great (and incredibly low cost) cret hideaway escape in the m remote portion of New Mexico's derness outback. The *Black Ra Lodge*.

Mike is a sometime Hollyw type who has gathered great he ing bunches of footage into w uncut, is twelve hours of video tatively titled *The UFO Marat* He is now in the process of edi down and securing the rights fo eventual commercial release.

This material runs the gamut f fully professional and largely im cable network-TV footage on d (wayyy... on down) to grainy bl and-white home videos from so ern Florida box-only addresses. special effects wouldn't even the cutting room floor of a 19 grade-Z sci-fi horror flick.

For once, I am at a loss for wo To call this "lore" is condescend But calling it "evidence" is strong. Besides, that word " dence" has vastly different m ings to an engineer, a lawyer, priest. So a neutral working de tion, the UFO *resource base,* is sum total of the available words images on this topic that are rea ably coherent and more or less vant to the subject.

After sitting through a full tw hours of video and then son have come to three tentative clusions on UFO's:

(1) The scope, breadth, and de the UFO resource base is larger than I thought it was.

(2) The potential credibility least a significant subset of the resource base appears to be h than I expected.

(3) The current UFO resource represents a multimillion *industry* that now employs sands on an international b

NEED HELP?

Phone or write your **Hardware Hacker** questions directly to:
Don Lancaster
Synergetics
Box 809
Thatcher, AZ 85552
(602) 428-4073

both in and out of government.

UFO Magazine appears to be the leading industry trade magazine, and the highest profile watchdog group is the *Skeptical Inquirer*. The best directory on the subject is the new *Almanac of UFO Organizations*. It's written by David Blevins, published by *Phadera*, and stocked by *Arcturcus*, among others. It's sort of a combined *Thomas Register* and *Michelin Guide*. I'd give it a four ET rating.

Our resource sidebar for this month shows you many of the leading places to go for further information on UFO's and any related phenomena—both pro and con. Treat it as you would any other resource listing.

And a related contest...

As for our contest this month, just answer the question *Are we alone?* in 70,000 words or less and send it in to me. There'll be dozens of my usual *Incredible Secret Money Machine II* books, along with an all-expense-paid (FOB Thatcher, AZ) *tinaja quest* for two going to the best of all.

Be sure to send all of your entries directly to me here at *Synergetics*, rather than over to the **Electronics Now** editorial offices. The entry deadline will be extended for any responses arriving from fifty light years or more away. Especially if they don't have tinajas.

Long distance FM

We have had quite a few entries in our ultra-long distance FM reception contest, so I thought we might review what can and cannot be done here.

With most problems, there are usually both technical and cultural solutions. Judging from the absolute outrage *Post-Newsweek Cable* has caused locally by dropping all quality FM station coverage here in the Gila Valley, I suppose such things as petition drives, suitably annoying the politicians, rattling the Corporation Commission's cage, encouraging the competition, or promoting translators could be effective.

So would changing listening habits. And newer FM transmission schemes are in the works with much higher effective ranges, especially for stereo. But I'm voting with my wallet; I simply prefer not to send any of my hard-earned cash any longer to those whom I feel are clearly biting the hand that feeds them.

At any rate, broadcast FM stations transmit in a frequency range from 88.1 to 107.9 MHz on channels spaced 200 kHz apart. This is in a portion of the radio spectrum where thermal noise ultimately limits distance reception—although daytime ignition noise can become dominant in urban areas.

FM reception of any nearby stations can become complicated by *multipath*, where the signals bounce around any nearby hills and structures. Steel or wire present in buildings can also act as partial or total shields. And any strong nearby station that's close in frequency to a weaker distant one can also give you fits.

Urban solutions tend to center on small directional antennas with deep nulls, in shielded transmission lines that are carefully matched, and in good receiver selectivity.

For remote rural areas, plain old low signal strength will usually be the main problem. But no matter where you are, the higher you can get your antenna, and the nearer you can get to a straight shot at the transmitter, the better your received signal.

FM signals are often horizontally polarized and travel best in a line-of-sight. In the basin-and-range Southwest, it is to have many stations come booming in on most any mountaintop from hundreds of miles away—on the cheapest receivers with zilch for an antenna. But distant reception can get difficult fast if you lose line-of-sight.

Many contest entries suggested putting an antenna on the mountain and then rebroadcasting somehow.

Perhaps as a *passive repeater* (two unpowered back-to-back antennas that work surprisingly well in special instances); an *active repeater* (isolated rebroadcasting on the same frequency to prevent feedback); a *translator* (low-power rebroadcasting on some other frequency); or an *optical link* (which sends out highly directional modulated light pulses). Sadly, these don't seem too practical for me, since either going clandestine or hassling the Forest Service or BLM would be involved. There would also be lightning and power problems.

The *gain* of an antenna is simply how much better it works in its best direction than a comparable *isotropic* antenna that accepts signals equally well from any direction. Raising the gain of your antenna by a mere three decibels is the same as having the station *double* the transmitted power. The standard baseline FM antenna is called a *dipole* and is shown in Fig. 1-*a*. The dipole has a "figure-8" pattern which gives it a peak gain of around two decibels above isotropic.

The dipole can be reduced in size by using twinlead with its 0.7 velocity factor. Figure 1-*b* shows the standard hang-it-on-the-wall indoor FM Tee antenna. But don't forget that this antenna has a "figure-8" reception pattern, so pick your wall accordingly.

If one dipole is good, then more of them should be better. A group of dipoles form an *array*. It turns out that you do not have to power all of your dipoles. Some of them can be *passive* or *parasitic* elements. The first parasitic element goes behind your dipole, and is called a *reflector*.

One or more additional parasitic elements can go in front of the dipole, and are called *directors*. Usually, there is only a single reflector but multiple directors. The directors are usually shorter than the reflector. Those two clues tell you which way to initially "point" any antenna.

Figure 1-*c* shows you one popular arrangement for active and passive antenna elements called a *Yagi* array. Yagi antennas are compact, have high gain, and exhibit stong front-to-back ratios.

Yagi antennas can be designed for a single station, for the entire FM band, or for all of FM and television combined. Broadbanding is done by changing the sizes, lengths, and positioning of the elements. All other things being equal, the narrower the bandwidth, the higher the antenna's gain.

Ferinstance, a single-channel, five-element Yagi might have a gain of 11 dB. That same antenna broadbanded could have only a 5-dB gain. Thus, a single-station FM Yagi will usually deliver a stronger signal than will an "all band" TV antenna.

Since they obviously would have to be expensive special orders, you'll normally build your own custom-cut Yagi antennas. One secret to narrow band and high gain is to use *very thin* directors. I've posted an FMYAGI.PS design program to my *GEnie* PSRT. We might look at this program some more in a future column. Let me know if you are interested.

Yes, antennas can be stacked. But doing so often isn't worth the hassle. The second antenna at best adds only three decibels to what you've already got. And without proper impedance matching, you can actually *degrade* your signal.

While Yagi-style FM antennas are often the simplest and best, there is another Hacker alternative. This one is called a *rhombic* antenna. It is just a parallelogram of wire sent either around or across your room. Figure 2 shows the details.

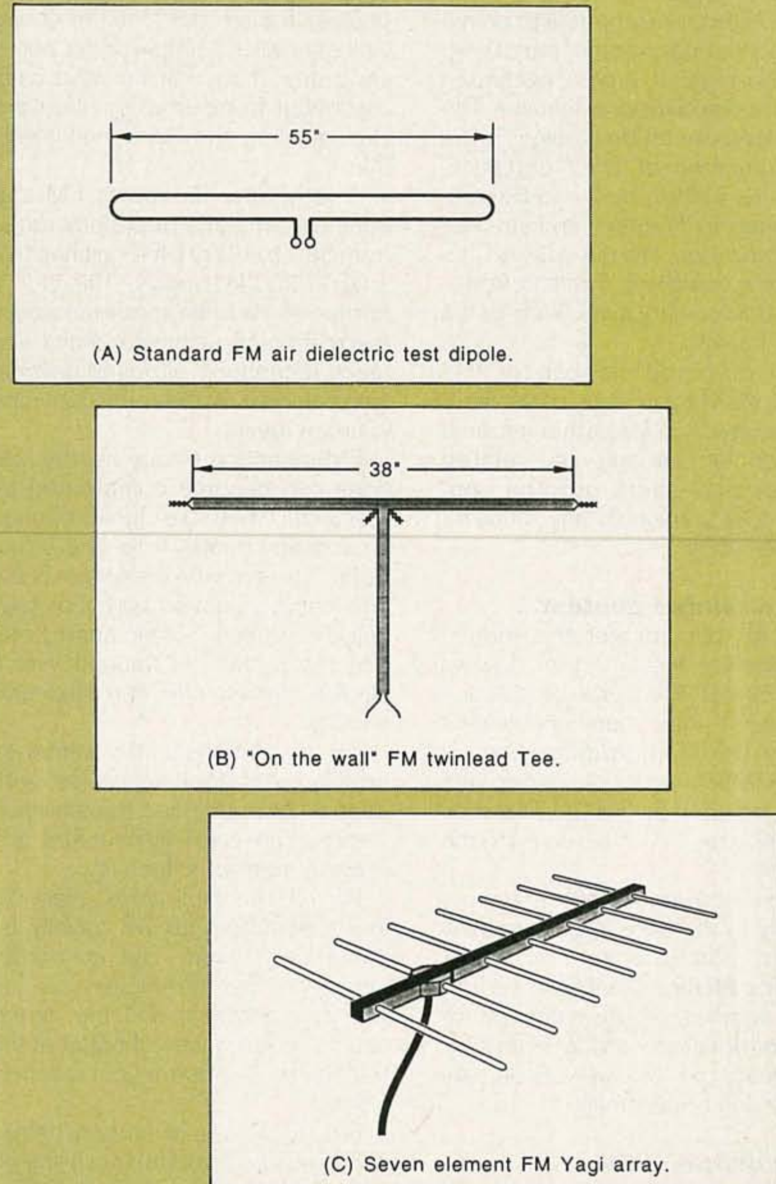
Inherently, a rhombic has a much larger area and thus (when properly designed, properly aligned, and used in a proper location) intercepts more signal for a potentially higher gain. Large (70-foot) FM outdoor double rhombics can reach a mind-numbing 28 decibels of gain! Broadband, yet.

But there is so much that can go wrong with a rhombic design, and so much cut and try is involved that you might want to save this as a last resort. And then only when there are no strong local stations.

One useful paper on rhombic antennas is *Improved Antennas of the Rhombic Class*, run in the March 1960 *RCA Review*. You also might want to check *Try a Rhombic FM Antenna* in the January 1982 i of *Audio*.

More info on Yagis, rhom and antennas in general ca found in any of a number of cc or ham texts. The ARRL's *An Book* or the *Antenna Engine Handbook* by Jasik are typical sics on the subject.

Reception of FM signals ca up more art than science. So, are interested in only one part FM station and all else fail black magic. Change the an direction and position it to try t a local hot spot. You could try pieces of conductor in or nea



(A) Standard FM air dielectric test dipole.

(B) "On the wall" FM twinlead Tee.

(C) Seven element FM Yagi array.

FIG. 1—SOME POPULAR FM antennas based upon ordinary dipoles.

NEW FROM
DON LANCASTER

HARDWARE HACKER STUFF

Hardware Hacker Reprints II or III	24.50
Midnight Engineering Reprints	18.50
Resource Bin Reprints	12.50
Incredible Secret Money Machine	18.50
CMOS Cookbook	24.50
TTL Cookbook	24.50
Active Filter Cookbook	24.50
Micro Cookbook vol I or II	19.50
Lancaster Classics Library	119.50

POSTSCRIPT STUFF

Ask The Guru Reprints I, II or III	24.50
LaserWriter Secrets (IIe/Mac/PC)	29.50
PostScript Show & Tell	39.50
Intro to PostScript VHS Video	39.50
PostScript Beginner Stuff	39.50
PostScript Cookbook (Adobe)	16.50
PostScript Ref. Manual II (Adobe)	28.50
PostScript Program Design (Adobe)	22.50
Type I Font Format (Adobe)	15.50
LaserWriter Reference (Apple)	19.50
Real World Postscript (Roth)	22.50
PostScript Visual Approach (Smith)	22.50
Thinking in PostScript (Reid)	22.50
Undst PS Pgrmmg (Holtzgang)	29.50
The Whole Works (all PostScript)	349.50

BOOK-ON-DEMAND STUFF

Book-on-demand resource kit	39.50
GEnie PSRT sampler (IIe/Mac/PC)	39.50

FREE VOICE HELPLINE VISA/MC

SYNERGETICS
Box 809-RE
Thatcher, AZ 85552
(602) 428-4073

CIRCLE 219 ON FREE INFORMATION CARD

NAMES AND NUMBERS

ARRL
225 Main Street
Newington, CT 06111
(203) 666-1541
CIRCLE 316 ON FREE INFORMATION CARD

Cryptosystems Journal
Box 188
Newton, PA 18940
(215) 579-9888
CIRCLE 317 ON FREE INFORMATION CARD

Experimental Musical Insts
Box 784
Nicasio, CA 94946
(415) 662-2182
CIRCLE 318 ON FREE INFORMATION CARD

GEnie
401 N Washington Street
Rockville, MD 20850
(800) 638-9636
CIRCLE 319 ON FREE INFORMATION CARD

Guitar Digest
PO Box 1252
Athens, OH 45701
(614) 592-4614
CIRCLE 320 ON FREE INFORMATION CARD

Journal Computer Game Design
5251 Sierra Road
San Jose, CA 95132
BBS: GEnie JCGD
CIRCLE 321 ON FREE INFORMATION CARD

Lindsay Publications
PO Box 538
Bradley, IL 60915
(815) 935-5353
CIRCLE 322 ON FREE INFORMATION CARD

Mini-Circuits Lab
PO Box 350166
Brooklyn, NY 11235
(718) 934-4500
CIRCLE 323 ON FREE INFORMATION CARD

Motorola
5005 E McDowell Road
Phoenix, AZ 85008
(800) 521-6274
CIRCLE 324 ON FREE INFORMATION CARD

Powder & Bulk Solids
PO Box 650
Morris Plains, NJ 07950
(201) 292-5100
CIRCLE 325 ON FREE INFORMATION CARD

Solar Mind
759 South State St #81
Ukiah, CA 95482
(707) 468-0878
CIRCLE 326 ON FREE INFORMATION CARD

Synergetics
Box 809
Thatcher, AZ 85552
(602) 428-4073
CIRCLE 327 ON FREE INFORMATION CARD

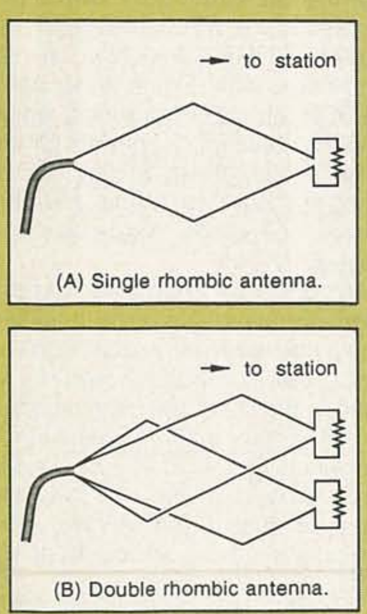


FIG. 2—THE RHOMBIC FM ANTENNA is humongously large, but it does offer exceptionally high gain over a quite a wide bandwidth.

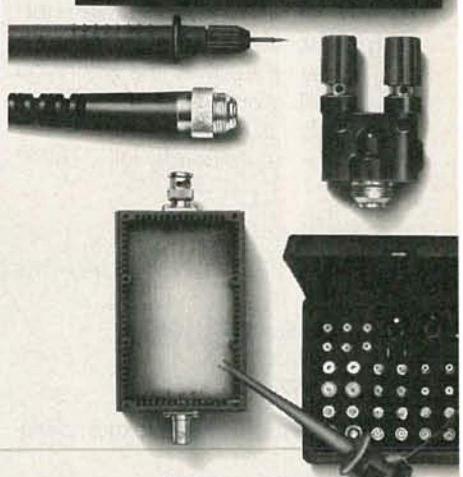
antenna. In one trial I found that shorting the antenna crossfeed with an aluminum yardstick dramatically improved the results for one target station.

Some FM stations add vertical or circular polarization to their patterns to improve mobile reception, so a non-horizontal antenna might sometimes work better than you would first expect. Try it and see. Should you be mainly interested in one station, call the station and ask what pattern it uses.

One final trick to deal with a noisy FM signal is to reduce its bandwidth. The quickest and simplest way to do this is to switch from stereo to mono. That halves the bandwidth and thus reduces noise by three decibels. Many modern automotive stereo receivers do that automatically.

It is also possible to use low-pass filters (such as the treble control or messing with the loudness curve) to further reduce the perceived noise.

Over 5700 Quality Choices.



Put Us To The Test.

If you haven't already used Pomona test accessories, you should. They're the best because they're made that way. They give you reliable, accurate test connections or an interface that you can install and forget.

You can choose from over 5,700 standard, low-cost test accessories: RF connectors, cable assemblies, DMM test leads, Grabber® test clips, boxes, adapters, field service test kits and lots more, including Pomona's new Rotating Micrograbber® test clip for fine-pitch ICs or fine wire.

Rotating Micrograbber® fine-pointed pincer with rotating body can be bent to 35° angle.

We're Making Technology Easier to Live With.

Call, FAX or write today for your free copy of Pomona's 140-page 1992 *Electronic Test Accessories Catalog.*

ITT Pomona
The World Leader In Test Accessories
1500 E. Ninth Street, P.O. Box 2767 Pomona, CA 91769.
(714) 469-2900 FAX (714) 629-3317.

CIRCLE 101 ON FREE INFORMATION CARD

You end up losing the station's high frequencies as well.

We better throw in some obvious safety warnings here: Outside and/or high antennas must have lightning protection. Antennas can kill you if they hit a power line when you are installing one. And any ladders and heights in general could be the cause of nasty to deadly falls. Think!

FM booster amplifiers

Will an FM "booster" amplifier help us at all? Can't we simply make the received signal louder? For a number of reasons, booster amplifiers can be anything from a disappointment to an outright disaster. But, with some care, boosters do have their uses.

For any chosen station, any given receiving antenna at any given pla pointing in any given direction, the will be so many microvolts of sig appearing at your antenna terr nals. There will also be so ma microvolts of *thermal agitation no* appearing across the antenna ter nals. At FM and higher frequenci the amount of this rural noise u ally gets set by the *temperature* the antenna, and little else. At le for a given bandwidth.

The ratio of those two voltage known as the *signal-to-noise ra* A S/N ratio that can produce 20 of limiter *quieting* is needed to g you "good" FM reception. Anyth less gets progressively noisier more annoying.

For a given fixed bandwidth reception scheme, *there is known amplifier or other electr method to improve the input sig to-noise ratio across your ante terminals!*

All the booster amplifier can c amplify *both* the signal *and* noise together. Thus, if your ir signal-to-noise ratio is too low, t is *no way* that *any* amplifier can you. You just cannot amplify a si that is not there!

Further, any booster amplifie add its *own* noise and always *l* your signal-to-noise ratio. The e amplifier noise over and above thermal background is known a *noise figure*. With care and latest of UHF transistors, an first-stage noise figure under h decibel (around five percent a tude) can easily be achieved. O other hand, throw in any ol cheapo transistor, and your noise figure can easily get rageously bad.

Worse yet, if there are any s signals that are also being amp they can overload your boo amp, splattering themselve across the band and creating or spurious signals. It's real ea convince yourself that your bo amp gave you "lots" of new tions; in reality it is just the modulation from strong loca nals.

Finally, quite a bit of design has gone into the front end of premium FM receivers. Unles booster has a *better* design your FM receiver, it is almost c

UFO RESOURCES

Arcturcus Book Service
PO Box 831383
Stone Mountain, GA 30083
(404) 297-4624
CIRCLE 328 ON FREE INFORMATION CARD

Black Range Lodge
Star Rt. 2, Box 119
Kingston, NM 88042
(505) 895-5652
CIRCLE 329 ON FREE INFORMATION CARD

Borderland Science Res Fnd
PO Box 429
Garberville, CA 95542
(707) 986-7211
CIRCLE 330 ON FREE INFORMATION CARD

Eden Press
Box 399
Careywood, ID 83809
(208) 683-2439
CIRCLE 331 ON FREE INFORMATION CARD

Genesis III Publishing
PO Box 25962
Munds Park, AZ 86017
(602) 955-8034
CIRCLE 332 ON FREE INFORMATION CARD

High Energy Enterprises
PO Box 5636
Security, CO 80931
(719) 475-0918
CIRCLE 333 ON FREE INFORMATION CARD

Lindsay Publications
PO Box 538
Bradley, IL 60915
(815) 935-5353
CIRCLE 334 ON FREE INFORMATION CARD

Mutual UFO Network
103 Oldtowne Road
Seguin, TX 78155
(512) 379-9216
CIRCLE 335 ON FREE INFORMATION CARD

ParaNet Info Service
PO Box 172
Wheat Ridge, CO 80034
(303) 431-8796
CIRCLE 336 ON FREE INFORMATION CARD

Phaedra Enterprises
PO Box 1241
San Bruno, CA 94066
(415) 359-0432
CIRCLE 337 ON FREE INFORMATION CARD

Search Magazine
PO Box 81
Rosholt, WI 54473
(715) 344-5585
CIRCLE 338 ON FREE INFORMATION CARD

Skeptical Inquirer
PO Box 703
Buffalo, NY 14226
(716) 636-1425
CIRCLE 339 ON FREE INFORMATION CARD

Strange Magazine
PO Box 2246
Rockville, MD 20847
(301) 881-3530
CIRCLE 340 ON FREE INFORMATION CARD

UFO Audio/Video Clearinghouse
PO Box 342-M
Yucaipa, CA 92399
(714) 795-3361
CIRCLE 341 ON FREE INFORMATION CARD

UFO Books
PO Box 1053
Florence, AZ 85232
(602) 868-4273
CIRCLE 342 ON FREE INFORMATION CARD

UFO Database
PO Box 1053
Sunland, CA 91041
(818) 769-2917
CIRCLE 343 ON FREE INFORMATION CARD

UFO Magazine
PO Box 1053
Sunland, CA 91041
(818) 951-1250
CIRCLE 344 ON FREE INFORMATION CARD

UFO Newsclipping Service
Rt. 1 Box 220
Plumerville, AR 72127
(501) 354-2558
CIRCLE 345 ON FREE INFORMATION CARD

to degrade, rather than improve your reception. Most of those el-cheapo bargain boosters found in the yuppy catalogs will often make your signals *more*, rather than less noisy.

So, what good is a booster? A high-quality and properly designed booster can make up for transmission losses down long cables. They can present a more standard and a better matched load to your antenna. They can make up for a cheaper receiver front-end design—or for standing waves and some impedance unbalances. And they are particularly useful when you want to drive two or more receivers from one antenna at the same time.

Figure 3 shows a simple broadband hacker VHF amplifier you might like to experiment with. It uses a low-cost integrated amplifier from *Mini-Circuits Labs*. Since this is a very wideband circuit, you have to watch for saturation effects from any interfering signals. And thorough shielding is a must. Naturally, adding resonant circuits and limiting your bandwidth can give you *much* better results for the frequencies you are interested in. But that sure makes the design a lot more complicated.

Radio Shack has a newer 15-1108 broadband TV/FM booster that uses a pair of exceptionally hot *Motorola* MRF571 transistors. They have an 8-gigahertz cutoff frequency and an FM band noise figure of only 0.4 decibels! Approximate schematics for the antenna and the base units are shown in Figures 4 and 5.

The antenna unit is made up from a switchable FM trap (just what we do *not* need!) and one fairly low-gain amplification stage and cable driver. The twinlead serves two purposes: It routes DC power up from their base station and downlinks your partially amplified RF signals. The polarity of the DC power determines whether the FM trap gets switched in or out. Ordinary silicon diodes do the switching.

You might like to experiment with eliminating the FM trap. I don't trust its being there at all, even in its supposedly "off" position. To do this, you could try removing L1, L2, R2, and CR2, while replacing L3 with the shortest possible jumper.

The base station is made up of a power supply and another transistor that acts as a line driver or as a distribution amplifier. There's also an adjustable attenuator to optimize the signal levels.

Please let me know about your experiences in the way of receiving distant FM in difficult areas.

New tech lit

Motorola has announced several really exciting new chips. Especially the new MC144143 single-chip *Closed Caption TV Decoder* and its

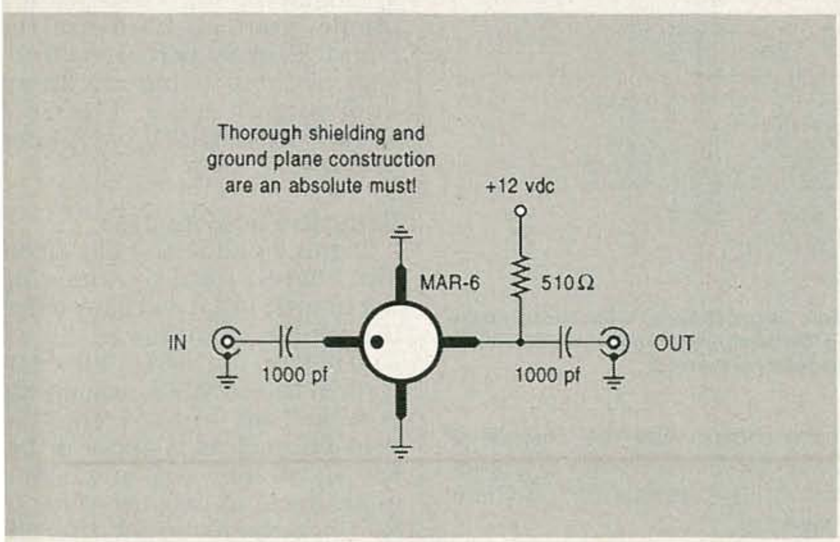


FIG. 3—MINI-CIRCUITS LABS offer a number of ultra low-cost and easy-to-use broadband VHF/UHF amplifiers and kits. This circuit forms an FM booster with a 20-decibel gain and a 1-decibel noise figure. Input and output impedances are 50 ohms. Pre-filtering must be used to reject any strong out-of-band signals.

DIGITAL VIDEO STABILIZER
ELIMINATES ALL VIDEO COPYGUARDS

While watching rental movies, you will notice annoying periodic color darkening, color shift, unwanted lines, flashing or jagged edges. This is caused by the copy protection jamming signals embedded in the video tape, such as Macrovision copy protection. THE DIGITAL VIDEO STABILIZER: RXII COMPLETELY ELIMINATES ALL COPY PROTECTIONS AND JAMMING SIGNALS AND BRINGS YOU CRYSTAL CLEAR PICTURES.

WARNING
THE DIGITAL VIDEO STABILIZER IS INTENDED FOR PRIVATE HOME USE ONLY. IT IS NOT INTENDED TO COPY RENTAL MOVIES OR COPYRIGHTED VIDEO TAPES THAT MAY CONSTITUTE COPYRIGHT INFRINGEMENT.

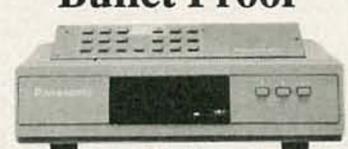
FEATURES
- Easy to use and a snap to install
- State-of-the-art Microchip technology
- 100% automatic
- Compatible to all types of VCRs and TVs
- The best and most exciting Video Stabilizer in the market
- Light weight (8 ounces) and compact (1x3.5x5")
- Uses a standard 9 Volt battery (last 1-2 years)
- Fast UPS delivery
- Air shipping available
- UNCONDITIONAL 30 day money back guarantee
- 1 year warranty

(Dealers Welcome)
FREE 20P Catalog

To Order: **$59.95** ea +$4 for p & h
Visa, M/C, COD Mon-Fri: 9-6 EST
1-800-445-9285
ZENTEK CORP. DEPT. CRE11
3670-12 WEST OCEANSIDE RD. OCEANSIDE, NY 11572

CIRCLE 188 ON FREE INFORMATION CARD

CABLE TV DESCRAMBLERS
How You Can Save Money on Cable Rental Fees
Bullet Proof



	1 Unit	5+
BEST Super Tri-Bi Auto/ Var. Gain Adjustment	$119.95	$85
Jerrold Super Tri-Bi	$109.95	$79
Scientific Atlanta	$109	$79
Pioneer	$109	$79
Panasonic TZPC145	$99.95	$79
Stargate Converter	$95	$69
Digital Video Stabilizer	$59.95	$29
Wireless Video Sender	$59.95	$49.95

US Cable'll Beat Anyone's Price Advertised in this Magazine!

30 Day Money Back Guarantee
FREE 20 page Catalog
Visa, M/C, COD or send money order to:
U.S. Cable TV Inc. Dept. KRE11
4100 N. Powerline Rd., Bldg. F-4
Pompano Beach, FL 33073
1-800-772-6244

For Our Record
I, the undersigned, do hereby declare under penalty of perjury that all products purchased, now and in the future, will only be used on Cable TV systems with proper authorization from local officials or cable company officials in accordance with all applicable federal and state laws. FEDERAL AND VARIOUS STATE LAWS PROVIDE FOR SUBSTANTIAL CRIMINAL AND CIVIL PENALTIES FOR UNAUTHORIZED USE.

Date:________
Signed:________________

No Florida Sales!

CIRCLE 189 ON FREE INFORMATION CARD

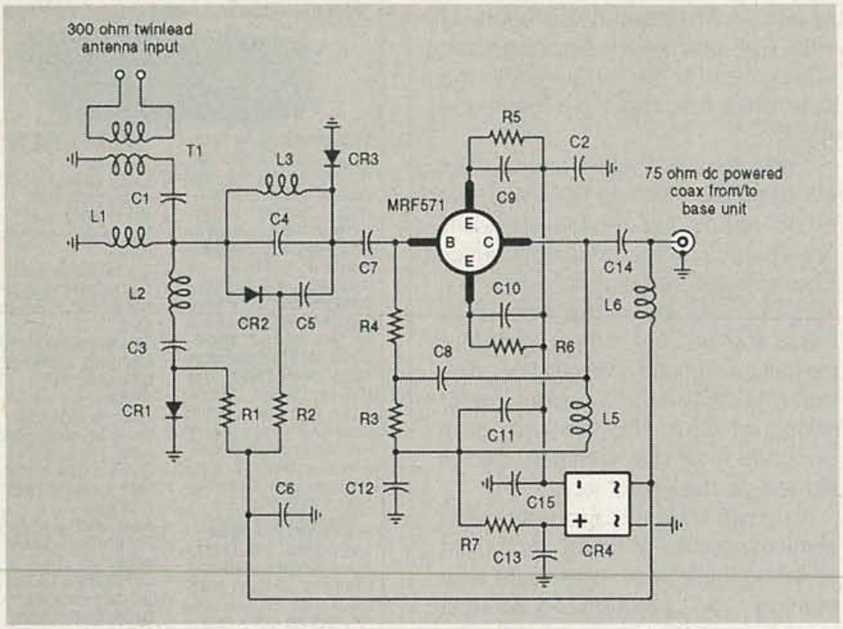


FIG. 4—APPROXIMATE SCHEMATIC for the Radio Shack 15-1108 TV/FM booster antenna unit. The polarity of the DC power routed up the coaxial cable determines if the FM trap will be switched in or out. The low-cost Motorola transistors used have an 8-gigahertz bandwidth and an FM noise figure of 0.4 decibels!

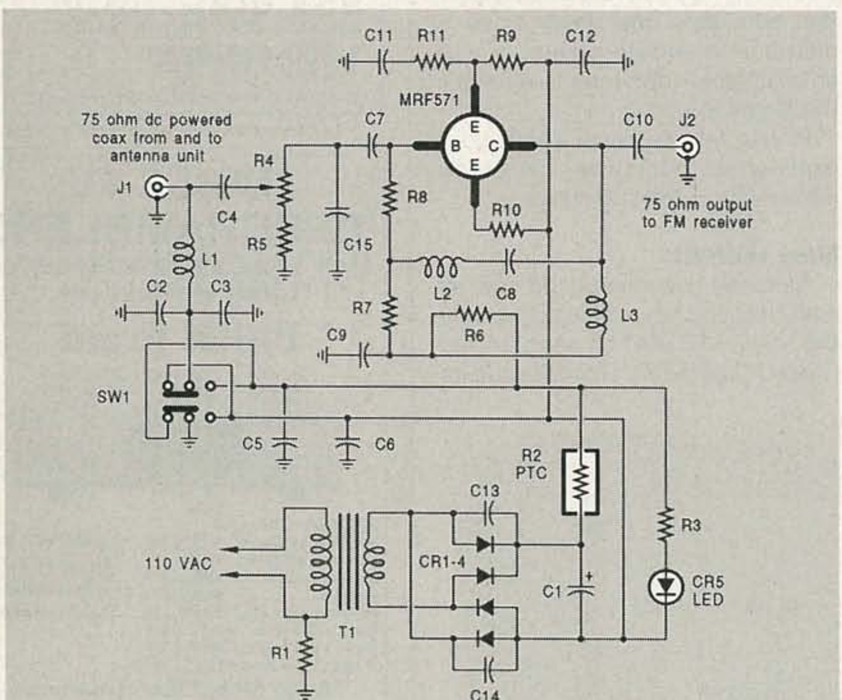


FIG. 5—APPROXIMATE SCHEMATIC for the Radio Shack 15-1108 TV/FM booster base unit. Switch SW1 remotely activates the FM trap. Be careful not to mix up your cables; the DC power on the coaxial cable could cause receiver damage.

new DSP56401 *Digital Audio Transceiver*. Preliminary data sheets and application notes are available from Motorola.

We have a collection of unusual publications this month. Tony Patti still prints his *Cryptosystems Journal* that's big on cryptography and chaos topics. And the *Journal of Computer Game Design* is a great labor-of-love newsletter by Chris Crawford.

Two unique music newsletters are *Experimental Musical Instruments* and *Guitar Digest*. And *Solar Mind* has just introduced its "Holistic Approaches to Technology & Environment."

The folks at *Lindsay Publicat*[...] are offering a large number of titles. These include a turn-of-century reprint on *Large Induc*[...] *Coils*, and a new one on do-it-yourself *Lightning Bolt Generat*[...] Lindsay has some great free c[...] logs. These are "must have" ha[...] resources.

I've been self-publishing qui[...] few titles these days using my *Book-on-demand* process. Inclu[...] are my *Hardware Hacker* repri[...] & III, my *Ask the Guru* reprints I, III; my *Blatant Opportunist I*, the *Resource Bin I*, and my *LaserW*[...] *Secrets* book and disk combo. my nearby *Synergetics* ad or ca[...] your free hardware hacking chure for more details.

As usual, we've gathered ma[...] the resources mentioned toge[...] into either of the *Names & Num*[...] or the *UFO Resources* sidebars be sure to check these out b[...] you call our no-charge tech hel[...] or phone for a free hacker se[...] brochure.

TELEPHONE HOLD

continued from page 45

stalled in line with any [...] phone. The PC board has (green) and RING (red) avail[...] at two places for the mod[...] jack and plug. However, if are installing the board insi[...] phone, you can hardwire circuit directly across TIP [...] RING, without using any i[...] and output jacks. Figu[...] shows the author's compl[...] prototype.

Using the hold module

To put a phone on hold, [...] and hold S1 until you han[...] the phone; LED1 will glow [...] the phone is on-hook. A[...] said before, the hold is auto[...] ically released when any p[...] is picked up. In the event your phone line is above o[...] low 40 volts by very much. might need to vary the val[...] R1 to compensate for the ference. The hold module not put a significant load telephone line, so you can as many of them as you lik[...]

Plug a Friend into Electronics NOW® and Save $17.43!

This Christmas give an electrifying gift ... plug a friend into Electronics Now and brighten the whole new year! Whether electronics is your friend's livelihood or hobby, your gift will illuminate the whole spectrum of electronics throughout the coming year and provide a monthly reminder of your friendship.

Electronics Now will keep your friend informed and up-to-date with new ideas and innovations in all areas of electronics technology ... computers, video, radio, stereo, solid state devices, satellite TV, industrial and medical electronics, communications, robotics, and much, much more.

We'll provide great plans and printed circuit patterns for great electronic projects. In just the last year, Electronics Now has presented amateur TV equipment, computer peripherals, stereo transmitters, test equipment, speakerphones, robots, audio amplifiers, power inverters, and much more.

In coming issues, Electronics Now will present practical, educational, and money-saving projects like: an electronic drum, an audio effects generator, communications equipment, a light-beam communicator, a remote car starter, an uninterruptible power supply, and many others!

PLUS ... equipment troubleshooting techniques ... circuit design ... reports on new technology and new products ... equipment test reports ... in-depth coverage on computers, video, audio, shortwave radio ... and lots more exciting features and articles.

*Basic sub rate — 1 yr/$19.97 2 yrs/$38.97

SAVE $17.43* ... OR EVEN $35.83* ... For each gift of Electronics Now you give this Christmas, you save a full $17.43* off the newsstand price. And as a gift donor, you're entitled to start or extend your own subscription at the same Special Holiday Gift Rate — you save an additional $17.43*!

No need to send money ... if you prefer, we'll hold the bill till January, 1993. But you must rush the attached Gift Certificate to us to allow time to process your order and send a handsome gift announcement card, signed with your name, in time for Christmas.

So do it now ... take just a moment to fill in the names of a friend or two and mail the Gift Certificate to us in its attached, postage-paid reply envelope. That's all it takes to plug your friends into a whole year of exciting projects and new ideas in Electronics Now!

NEW!

NO-CODE
HAM
LICENSES ARE
HERE!

All About Ham Radio by Harry Helms, AA6FW, tells how to get your *codefree* ham license and talk to the world. In over 300 pages, you'll learn about:

- packet (computer-to-computer) radio
- ham television
- using ham radio satellites
- contacting stations in foreign countries

and many other exciting topics explained in a friendly, humorous style without a lot of math and or technical jargon. If you've been wanting a ham license, this is the book you've been waiting for!

Only $19.95 at bookstores and radio equipment dealers. Or order direct from HighText! Add $3 shipping ($4 to Canada, $5 elsewhere). CA please add sales tax. U.S. funds only please.

HighText
publications inc.

7128 Miramar Rd., Suite 15L
San Diego, CA 92121

Try the
Electronics NOW®
bulletin board system
(RE-BBS)
516-293-2283

The more you use it the more useful it becomes.

We support 1200 and 2400 baud operation.

Parameters: 8N1 (8 data bits, no parity, 1 stop bit) or 7E1 (7 data bits, even parity, 1 stop bit).

Add yourself to our user files to increase your access.

Communicate with other R-E readers.

Leave your comments on R-E with the SYSOP.

RE-BBS
516-293-2283

UNIVERSAL REMOTE

continued from page 56

IC2, an 87C64 8K × 8 CMOS EPROM, which contains the machine language instructions for all functions provided by the remote-control system. The 87C64 is identical to the industry-standard 27C64, except that the 87C64 contains an internal address latch and the 27C64 part does not. For those interested in programming the EPROM, there is a modification you can make to the programmer we ran in November 1991. Send a self-addressed stamped envelope to the author for details (see the parts list). In normal use of the INS8048L, address lines A0–A7 need a separate 74LS373 address latch because the lower eight data and address lines are multiplexed between address and data by the INS8048L processor. Because power consumption must be kept to a minimum, and space is at a premium, eliminating a 74LS373 address latch by using the built-in function of the 87C64 works in our favor.

In both circuits, capacitors C1 and C2 are used by the built-in oscillator of IC1. A 6-MHz crystal (XTAL1) ensures high accuracy for timing routines, and it provides the basis for the 40-kHz carrier on the transmitter module. All 0.1 µF capacitors are standard TTL noise-bypass components, while C8, a 10 microfarad electrolytic, minimizes voltage drop at the battery terminals. Capacitor C3 is used to reset the processor.

In the transmitter, R1 limits current and, along with Q1, allows a high-current 40-kHz pulse to be applied to the IR LED's. Resistors R3 and R4 provide pull-up for address lines A11 and A12. On the transmitter, install jumpers A11 and A12.

The system is designed to operate from a +6-volt DC supply. Diode D1 drops the +6-volts DC down to around +5.3 volts. The system works fine without the diode, but it's best to leave it in the circuit because voltages above +5 volts can lower the life expectancy of semiconductors.

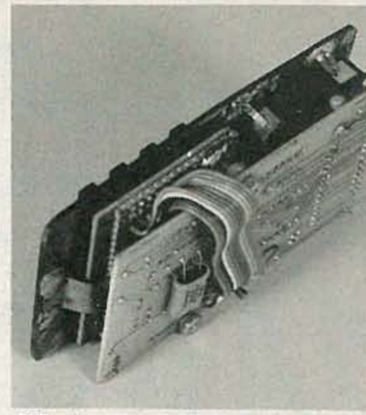


FIG. 10—THE PROTOTYPE TRANSI TER is housed in a plastic case wi single-sided, copper-clad PC-bo blank machined as its top panel.

Building the system

As mentioned before, transmitter and the receiver both on the same PC board. can use the supplied foil p terns to make your own (yo need at least two), or they available from the source gi in the Parts List. The transr ter and receiver boards are id tical except for a few com nents. Figure 9 shows the pa placement diagram for b boards. Follow the parts list the board you are building, install only the parts in that Check off each part as you stall it to avoid confusing two boards. Build the transi ter first, and put it aside whe is done.

Install the capacitors, pay special attention to their po ities. Be sure to install jump at the A11 A12 locations for transmitter only. It's advis to use sockets in this pro Install the IR LED's and Mount them in any positio long as they can able to rac IR freely. Gate-pull-up resi R2 is optional.

Once you are satisfied tha your work is correct, attach 16-key keypad with a piec ribbon cable. Cut a piece of per-clad perforated c struction board with holes inch on centers to the same as the keypad. Mount it over keypad pins and solder the forated construction boar the keypad pins. This will n it easier to solder and m the keypad.

A functioning transm

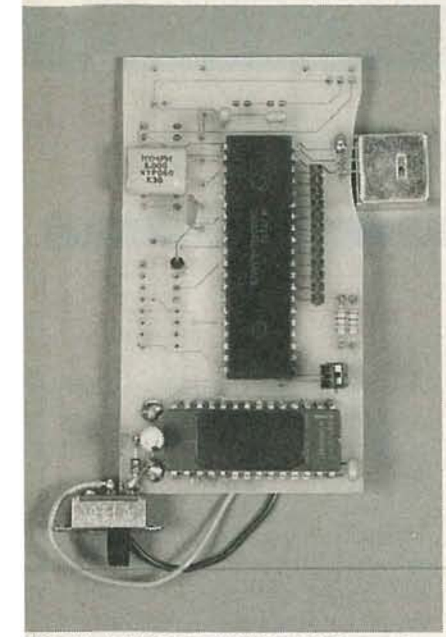


FIG. 11—THE RECEIVER BOARD can be mounted on the project you are adapting it to. You can attach the GP1U52X IR module directly to the PC board as shown here, or run wires to it off-board.

can be tested with the GP1U52X infrared detector module from the receiver. You'll also need a logic probe or scope. Attach a +5-volt DC supply to the GP1U52X (see Fig. 9 for pinout information). Apply power to your probe or scope, which should be connected to the output pin of the IR detector. Apply power to the transmitter and press any key. You should see a change in the scope patterm from the output pin of the IR module if the transmitter is operating properly.

Install the transmitter in a suitable enclosure. A red arcylic lens will improve the appearance of the remote control, but it is not a requirement. The layout of the components on the circuit board is not critical. The prototype is housed in a plastic case with a single-sided copper-clad PC-board blank machined as the top panel (the copper side is installed on the inside of the case). Rectangular openings were cut in the blank for mounting the power switch and keypad. Brass strips, soldered from the copper on the top panel to the copper on the perfboard installed on the keypad, are used to mount the keyboard to the top panel. The prototype has a 6-volt "J"-type battery because of its size and shape. However, any +6-volt DC power source will be satisfactory for this project. The prototype transmitter is shown in Fig. 10.

Now assemble the receiver. Install the parts indicated in the parts list for the receiver and the parts-placement diagram. Attach the GP1U52X to the PC board or, optionally, run wires to it off-board. Be sure to ground the metal case of the module. Install jumper blocks at the A11 and A12 locations as shown in Fig. 11. The figure shows the completed module.

Test the receiver module in the switch mode (jumper A11 and A12 on the receiver). With a logic probe to monitor P10 (pin 27 of IC1 on the receiver), you should be able to toggle P10 by pressing ADD or DEL followed by a 1. ADD 1 should take P10 high while DEL 1 returns P10 to low. If this function works, the rest of the applications will also operate properly. **R-E**

INTRODUCTORY OFFER

Genuine Coin Jewelry

Attracts attention!

Breath-taking designs!

Exquisite jewelry made from government-minted coins. Each coin pendant has its background cut away by hand with saws as thin as 16 thousandths of an inch leaving the coin's figure floating inside its rim. Each hand-crafted coin is cleaned and polished before 24K gold and silver is added artfully to selected portions of the coins. Finally, the coin is protected from wear and discoloration by a super-clear impervious plastic micro-coating that will not crack, chip or peel. Each coin pendant is packaged in a Shimmerlite jewelry box complete with 24-inch chain layered in 14K gold.

Each coin pendant complete with chain and jewelry box is priced at $39.95 which includes postage and handling. Please be sure to indicate coin(s) desired and quantity.

Order Your Coin Pendant Today!

Please send my order of Coin Pendant(s) as indicated in the order form below.

No.	Pendant Description	Quantity
101	US Walking Liberty Half Dollar	
118	US Statue of Liberty Half Dollar	
120	Bahama 50-cent Blue Marlin	

Total Number of Pendants ______ at $39.95 each. Total amount of Order $ ______

☐ Check or Money Order enclosed made payable to CLAGGK Inc.

Charge my ☐ Visa ☐ MasterCard

Account No. ______ Exp. Date ____/____

Credit Card Signature ______

Print Name ______

Address ______

City ______ State ______ Zip ______

No telephone orders or C.O.D. Signature required on credit card orders. All prices include postage and handling. Payments in U.S.A. funds only. New York residents must include local applicable sales taxes. No foreign orders.

Mail orders to CLAGGK Inc. Pendant Offer, P.O. Box 4099, Farmingdale, NY 11735. Telephone orders to 1-516-293-3751. FAX orders to 1-516-293-3115.

AUDIO UPDATE

Audio evaluations—A non-mystical approach

LARRY KLEIN

My wife knows far more about computers than I do. In fact, she was working with them professionally in the days when punch cards were the only way to go. Furthermore, she won a science award in high school, regularly use-tested and wrote up VCR's for a home-video magazine, and 14 years ago asked me to marry her. Obviously, an intelligent, clear-thinking young woman ... .

You can imagine my shock when she came home one day with over $100 worth of Estee Lauder cosmetics. She had bought into the female illusion that cheap chemicals in expensive bottles will deliver or restore youth and beauty.

What relevance has all this to the the subject of audio?

Large numbers of intelligent audiophiles continue to seek dreams in expensive containers uninfluenced by cynics such as myself who tell them that they are deluding themselves and depleting their bank accounts for no objective reason. There is no scientific evidence that super-expensive equipment objectively performs better—although they might hear it that way—than the run-of-the-mill products owned by ordinary mortals such as you and me.

Objective/subjective truth

The concept of "objective" is a key confusion block in most audiophile discussions. Music, an audiophile would argue, is a subjective experience, not an objective one. I agree, but *objective reality* exists, and real-world events impinging on our senses are the sources of all of our subjective experiences.

Note that I'm not claiming that an audiophile's subjective experience of quality doesn't exist. I'm saying that the special qualities experienced are usually not being produced by the objective electronic performance of the equipment under evaluation, but reside entirely in the perceptions of the listener. I suspect that other qualities of an amplifier, *e.g.*, its cost, weight, and manufacturer's reputation, might be largely responsible for the superior sound heard by the devout audiophile.

This leads me to question the ethics and good sense of the subjective reviewers who recommend high-end equipment that costs thousands of dollars more than conventional products but which, in truth, sound no better. Happily, there is a way to bypass the "Yes, I hear it, even if you don't" problem. It involves changing the question from "Can you hear the improvement?" to "Can you hear an error signal?"

Nullification

Many years ago, David Hafler, of Dynaco fame, invented a sort of poor man's four-channel system. It consisted essentially of an additional speaker (or a pair of series-connected additional speakers) connected directly across the two hot, or positive, terminals of the amplifier in use. Connecting a speaker in such a fashion feeds it a signal containing only the differences (including those of amplitude and phase) between the two stereo channels. Since out-of-phase "hall ambience" sound is a good part of the difference between the channels on many recordings, feeding it to separate speakers located toward the rear of the listening room provides a worthwhile listening enhancement at very low cost.

Keep in mind that the additional "ambience" speakers are silent when there is no difference between the channels—such as would occur if a mono signal were fec multaneously to the two channel a perfectly balanced stereo an fier.

At some point it occurrec Hafler that the ability to nullify ide cal signals by a "hot-to-hot" spe er connection could be usefu amplifier testing. A circuit (see 1) was devised that, in effect, e trically compares the signal g into the amp under test with signal coming out of it. After adj ment for level differences (using and phase shift, any residual so that's heard in the null speaker resents the difference between amplifier's input and output sig Because the signal (if any) at null speaker is always much low level than the normal program, normal speaker has to be mo out of listening range to kee output from overwhelming tha the null speaker.

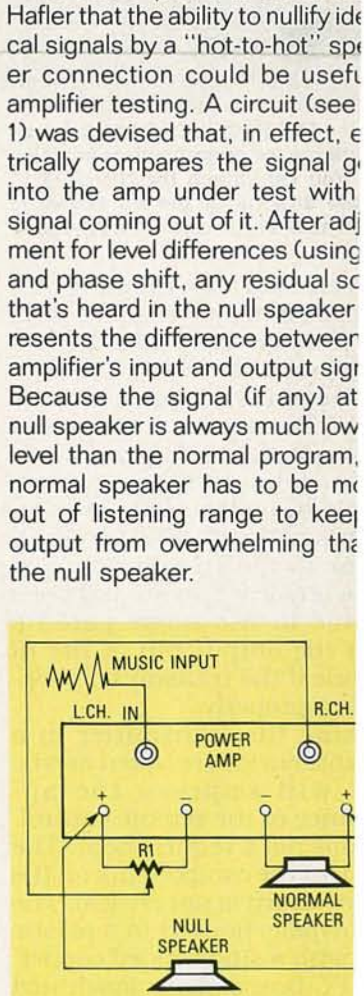


Fig. 1—Circuit for extracting wha audible differences exist between t put and output of an amplifier.

A perfect amplifier would pro zero signal at the null speak practice, the signal produced is ally low enough so that the e represents is totally masked c conventional playback by any designed conventional amplif ne wanted to test the virtues of a articular special speaker cable, it hould be used to feed the normal peaker. If the error signal heard om the null speaker is louder (or neasures higher) you know that the able is guilty of introducing un- vanted artifacts.

Carver Comparisons

A variant of the nulling technique used by Bob Carver of Carver Corporation to compare the elec- rical audio performance—and ence the sound—of two ampli- ers. Here, one channel of a refer- nce amplifier and a modified or est amp are connected conven- onally to a pair of speakers with a null" speaker connected across hem. (See Fig. 2.) Although not hown in the diagram, there needs o be, of course, a common ground etween the two amplifiers and the xact same mono music signal nust be fed to both amps. To the egree that the two channels have lentical performance, little or no

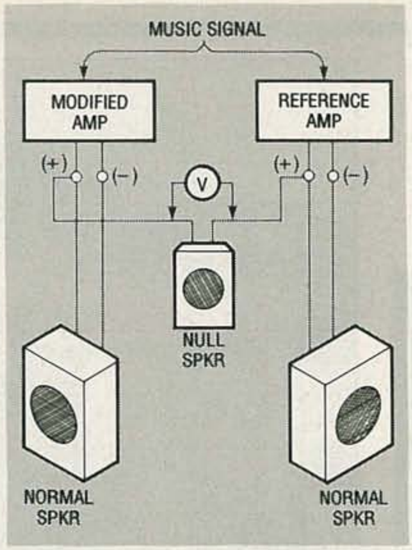


Fig. 2—Connection for comparing one channel of a reference amplifier to one channel of a modified or test amp. The normal speakers, whose purpose is to provide a typical load, are placed out of earshot. The null speaker plays only the difference between the two channels. Theoretically, two identical channels will produce no sound from the null speaker. A meter across the null speaker revealed nulls as low as −70 dB.

sound will be heard from the null speaker.

In tests where a low-cost ampli- fier was designed to sound like an amplifier costing thousands of dol- lars more, nulls as low as −70 dB were measured. Differences of −40 dB will be inaudible due to masking effects.

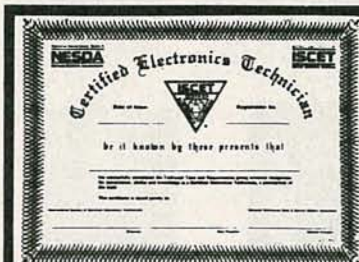
One would imagine that Hafler's and Carver's test would forever set to rest questions of whether ampli- fiers sound different, and to what degree. Hafler's test, in addition, would disclose whatever audible flaws exist in an amplifier without the need for a reference or com- parison unit. Sad to say, the test techniques have been ignored by testers for audiophile magazines who continues to judge equipment by whether or not it makes them "feel right." But why should we ex- pect any other reaction to tests that would essentially eliminate most or all of the arbitrary judgments and mysticism usually associated with audiophile product evaluations? **R-E**

You Need Tree City USA

City trees add the soft touch of nature to our busy lives. They cool our cities, fight pollu- tion, conserve energy, give wildlife a home, and make our neighborhoods more liveable.

Support Tree City USA where you live. For your free booklet, write: Tree City USA, The National Arbor Day Foundation, Nebraska City, NE 68410.

The National Arbor Day Foundation



ADMIT ONE

Your Ticket To

SUCCESS

Over 28,000 technicians have gained admit- tance worldwide as certified professionals. **Let your ticket start opening doors for you.**

ISCET offers Journeyman certification in Consumer Electronics, Industrial, Medical, Communications, Radar, Computer and Video. For more information, contact the **International Society of Certified Electro- nics Technicians, 2708 West Berry Street. Fort Worth, TX 76109; (817) 921-9101.**

Name ________
Address ________
City ________
State ________ Zip ________

____Send material about ISCET and becoming certified.

____Send one "Study Guide for the Associate Level CET Test." Enclosed is $10 (inc. postage).

BIG PROFITS IN VIDEO REPAIR!

WORK FROM HOME-EARN $85 HR!

With the tens of millions of VCRs and Camcorders in use, there currently is a **serious shortage** of trained techs to perform cleaning and repair jobs on these popular devices... Learn how you can start your own **highly profitable, Home-Based** video servicing business... And since up to 95% of all VCR and Camcorder malfunctions are due to a simple **mechanical** or **electro-mechanical** failure, you need not spend months or even years of complicated study before starting **paid, professional service work!**

Train at Home in your Spare Time!

Let Viejo's Training Program show you how!

CALL TOLL-FREE **1-800-537-0589** or mail coupon today!

VIEJO PUBLICATIONS, INC.
4470-107 Sunset Blvd., Suite 600
Dept. VK Los Angeles, CA 90027

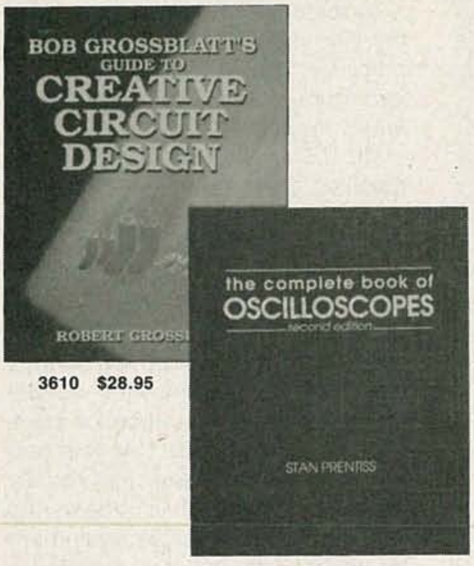
Yes! Rush me your FREE OPPORTUNITY KIT today!
(Check appropriate box)

- ❑ VCR Repair
- ❑ Camcorder Repair
- ❑ Advanced VCR Repair
- ❑ Fax Machine Repair

Name ________
Address ________
City/State ________ Zip ________

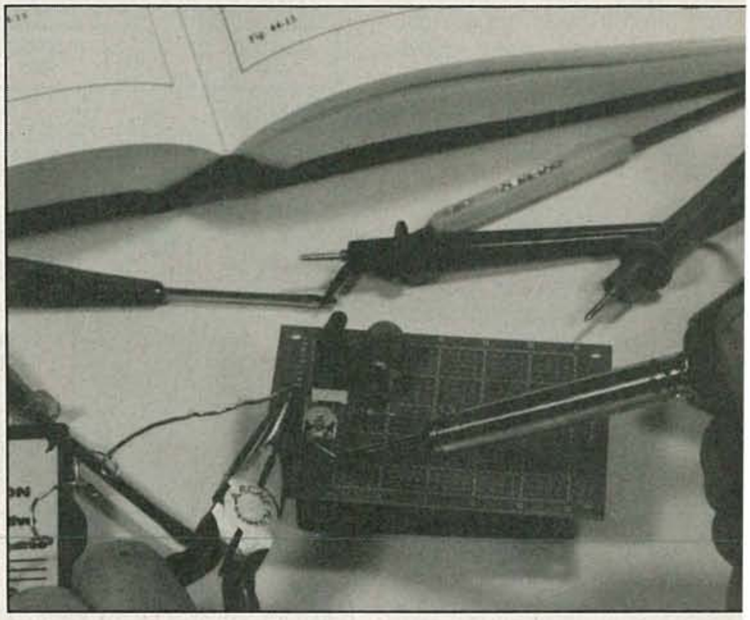
Dept. RE

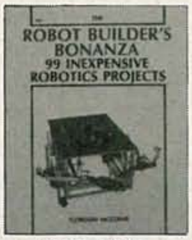
CIRCLE 191 ON FREE INFORMATION CARD



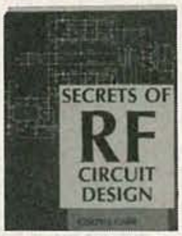
3610 $28.95

3825 $26.95





2800P $16.95
Softcover



3710-XX $32.95
Counts as 2

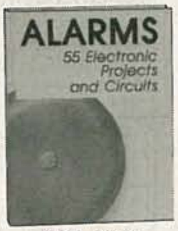
3671 $29.95

2883P $18.95
Softcover

1604P $17.95
Softcover

3345 $39

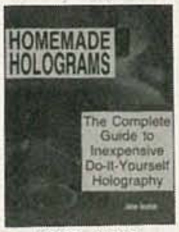
2613P $17.95
Softcover



2996P $14.95
Softcover

037504-XX $39.95
Counts as 2

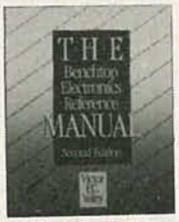
1367P $29.95
Softcover



3460P $14.95
Softcover

3669 $27.

3279-XX $36.95
Counts as 2



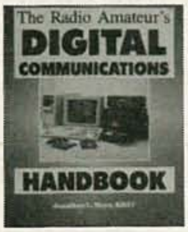
3414-XX $39.95
Counts as 2

3171P $19.95
Softcover

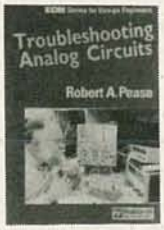
3550-XX $34.95
Counts as 2

3107P $18.95
Softcover

3700-XX $
Counts a



3362 $22.95



9410-XX $32.95
Counts as 2

3804P $19.95
Softcover

3778 $26.95

3475 $27.95

3627P $
Softcov

Select any 4 books for only $4.95

plus 1 FREE

when you join the **Electronics Book Club**[SM] **(values up to $158.75)**

3835P $14.95 Softcover
2925P $10.95 Softcover
3765 $29.95
3540 $26.95
2867P $18.95 Softcover
2985 $24.95
3672P $18.95 Softcover
3258 $28.95
3886 $22.95
3632P $10.95 Softcover
1938-XXX $60.00 Counts as 3
2980P $19.95 Softcover
2880P $14.95 Softcover
9370-XX $38.60 Counts as 2
3777-XX $32.95 Counts as 2

If coupon is missing, write to: Electronics Book Club, Blue Ridge Summit, PA 17294-0810

As a member of the Electronics Book Club . . .

. . . you'll enjoy receiving Club bulletins every 3-4 weeks containing exciting offers on the latest books in the field at savings of up to 50% off of regular publishers' prices. If you want the Main Selection do nothing and it will be shipped automatically. If you want another book, or no book at all, simply return the reply form to us by the date specified. You'll have at least 10 days to decide. And you'll be eligible for *FREE* books through the *NEW* Bonus Book Program. Your only obligation is to purchase 3 more books during the next 12 months, after which you may cancel your membership at any time. (Publishers' Prices Shown)

All books are hardcover unless otherwise noted. ©1992 EBC

A shipping/handling charge & sales tax will be added to all orders. If you select a book that counts as 2 choices, write the book number in one box and XX in the next. If you select a Counts as 3 choice, write the book number in one box and XXX in the next 2 boxes.

Your most complete and comprehensive source for the finest electronics books

ELECTRONICS BOOK CLUB[SM]

Blue Ridge Summit, PA 17294-0810

YES! Please rush me the books indicated below for just $4.95 plus $4.95 shipping/handling• & tax. Enroll me as a member of the **Electronics Book Club** according to the terms outlined in this ad. If not satisfied I may return the books within 10 days for a full refund and my membership will be cancelled. A shipping/handling charge & sales tax will be added to all orders.

FREE BOOK

Single selection only

If you select a book that counts as 2 choices, write the book number in one box and XX in the next. If you select a Counts as 3 choice, write the book number in one box and XXX in the next 2 boxes.

☐ Check or money order enclosed payable to: McGraw-Hill, Inc.

☐ Please charge my ☐ VISA ☐ MasterCard ☐ American Express

Acct.# ______ Exp. Date ______

PAYMENT MUST ACCOMPANY ORDER

Name ______ Signature ______ (required on all credit card orders)

Address ______ City ______

State/Zip ______ Phone ______

Offer valid for new members only, subject to acceptance by EBC. U.S. orders are shipped 4th Class Book Post. Canada *must* remit in U.S. funds. •Canadian orders are shipped International Book Post—add $10.00 shipping & handling. Applicants outside the U.S. and Canada will receive special ordering instructions. RE1192AC

DRAWING BOARD

Let's build our own video scrambler!

ROBERT GROSSBLATT

We haven't seen very much circuitry yet on our journey through videoland. That's to be expected, though, because video is a subject whose theory you should understand before you start building hardware. As I've already written countless times before, a video signal (shown in Fig. 1) is very complex, with many separate components that are mathematically related to one another.

If you look at a video signal on an oscilloscope, it will appear more or less like the lower waveform in Fig. 1. The most important component of the waveform is the horizontal sync pulse; if you do away with it, the TV won't have any reference for the beginning of a video line, and the resulting image will be misaligned vertically. (See our September column for more on the subject.) The color will also be messed up—without the horizontal sync pulse, the TV won't be able to find the color-burst signal.

Altering horizontal synch

Suppressing the horizontal sync is a simple, inexpensive, and relatively safe way to keep "unauthorized" viewers from receiving a coherent signal. So, to understand better how scrambling works, let's build a circuit that can alter the horizontal sync.

Because we're dealing with composite video, and we intend to play games with horizontal sync, the first thing we have to do is isolate the sync from the rest of the signal. That isn't very difficult—every TV in the universe can do it. Most modern TV's either use a discreet sync separator chip or have the needed circuitry buried in the innards of some custom silicon. That makes things cheaper for TV manufacturers, but it's murder for people like us who have a hard time buying the chip in single quantities.

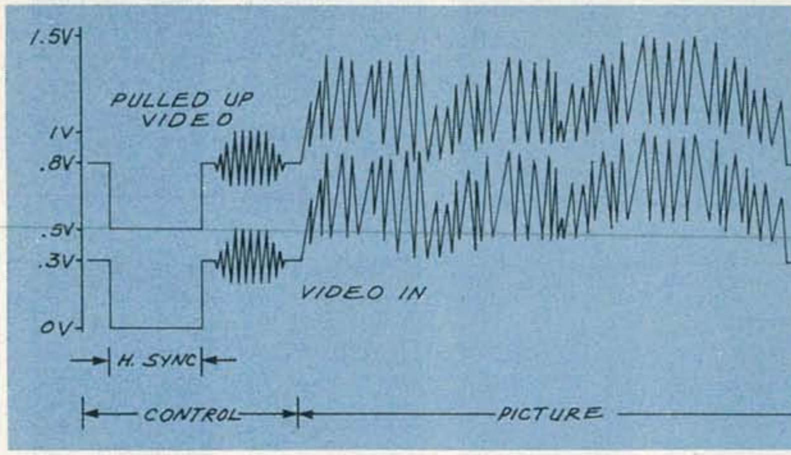


FIG. 1—A VIDEO SIGNAL is normally 1-volt peak-to-peak, but after buffering relative voltage level of the signal is raised by 0.5 volts. Then, the only part o pulled-up video signal that falls below the TTL threshold of 0.8 volts is the horiz sync signal.

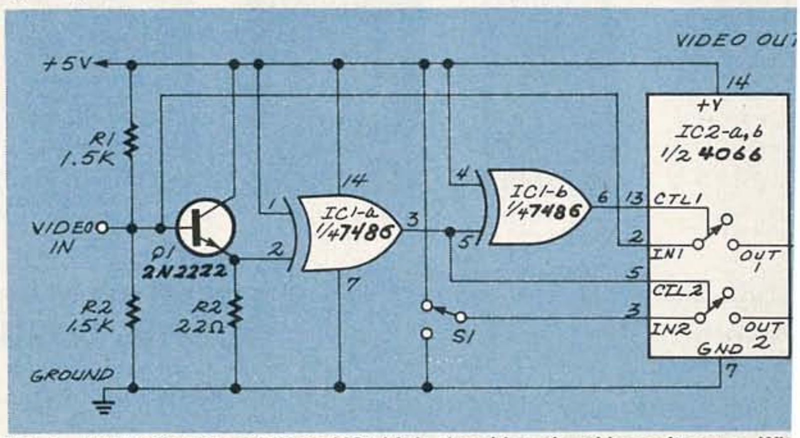


FIG. 2—WHEN S1 PULLS PIN 3 of IC2 high, the video signal loses its sync. Wh pulls pin 3 low, sync is restored.

Fortunately, there's always more than one way to get the job done. In this case, it means looking at the voltage definitions inherent in the video signal, and seeing what we can do with them. Standard video has very strict voltage divisions; everything above 0.3 volts is picture information and everything below 0.3 volts has to be a control signal. (We haven't talked about vertical sync yet, but you'll find that the same voltage levels apply to it,

When you have a 5-volt s and a signal voltage with a 0. knee, you should immediately about standard TTL logic. Ir family, everything below 0.8 v low, which is exactly what looking for. That might not be i diately obvious, so let's go th it.

A video signal is 1-volt pe peak but, by buffering it, the r voltage level of the signal is by 0.5 volts. So, instead of ra rom 0 to 1 volt, the signal ranges rom about 0.5 to 1.5 volts. The ranslated level of the control/pic- ure voltage point is now about 1 volt see the upper waveform in Fig. 1). 'ou can see that the only part of the ulled-up video signal that falls be- ow the TTL threshold of 0.8 volts is he horizontal sync signal.

The bottom line here is that we an build a sync separator from a tandard TTL gate—in this case ve'll use a 7486 exclusive-or (XOR) ate. All we have to do, as shown in ig. 2, is feed the translated and uffered video from Q1 to one input f the gate, and tie the other input of he gate high. (Q1 is part of the uffer that we put together in Sep- ember to keep your video gener- tor or VCR from being damaged.)

uppression circuit

If you work out the truth table for ourself, you'll see that the only ime the output of the gate is high is uring horizontal sync. The output t pin 3 of the 7486 is a TTL-level verted version of the horizontal ync. That output is fed to another OR gate, which inverts the signal nd gives us a negative-going sync ignal. Ability to provide both a ositive and negative sync signal is he key attribute of the suppression ircuit. We want to build a switch hat passes video during the picture ortion of the signal and be able to lter the signal during the horizontal ync period. That's what the rest of he circuit does.

The first part of the circuit is a icture/sync separator, and the last art is a picture/sync combiner— ort of. Even though we can put the ync back in, we also have the op- on of sticking in just about anything lse we want in place of horizontal ync.

The combiner uses half of a 4066 nalog switch as a double-pole, ouble-throw switch. (The analog witch contacts close when the ontrol voltage is high.) The outputs f the switch (pins 1 and 4) are com- ined, but because the control lines f the switches (pins 13 and 5) are onnected to mirror images of the orizontal sync signal, we can route he picture portion of the video sig- al to the switch output when sync s low (pin 6 of the 7486) and route horizontal sync to the switch output when sync is high (pin 3 of the 7486).

The single-pole, single-throw switch (S1) controls the input to pin 3 of the 4066. While it's neat to see the effect S1 has on the video signal when seen on an oscilloscope, this is one of those cases when you're better off seeing the effect on a TV.

Whenever S1 pulls pin 3 of the 4066 high (anything above the expected sync level), the video signal loses its sync and the picture on the TV goes totally haywire. If you've seen scrambled pictures before, you'll recognize it immediately. The left side of the picture will be on the right half of the screen, the right side of the picture will be on the left half. Down the middle of the screen will be the horizontal interval. When S1 pulls pin 3 low, sync is restored and so is the TV picture.

Putting it together

We are not ready to go into the details of the scrambling business just yet, though. A successful scrambler not only has to take the video apart, but it also has to put it back together again. That is quite a bit more difficult. There has to be a way to encode the video signal so that the horizontal sync signal is restored at the right time, and for the right length of time. One outdated way that this can be accomplished is to bury the information in the 31.5-kHz audio subcarrier.

That's not so surprising when you realize that half that frequency is 15.75 kHz—exactly the same as the scan rate of the video lines on a standard color TV. There's not much point in going through all the gory details of recovering suppressed-sync video since it's about as useful as presenting a full tutorial on repairing telegraph lines.

Since suppressed-sync scrambling was figured out by signal pirates about five minutes after it appeared, the people in the television signal scrambling business moved on to more complex methods of screwing up the video signal. The most common method now in use combines a variation on the suppressed-sync method, inverting the video, and performing a lot of weird other stuff. **R-E**

Learn VCR repair at home!

MAKE *GOOD* MONEY IN YOUR OWN FULL- OR PART-TIME JOB

Professional-level home study course. You will master easy-to-learn, high-profit repairs *without* investing in high-tech instruments or a costly workshop. Want more independence and higher income? Send or call today!

Free career kit: 800-223-4542

Name_____
Address_____
City_____ State____ Zip____

The School of VCR Repair
2245 Perimeter Park Drive
Dept.VM342 Atlanta, Georgia 30341

CIRCLE 183 ON FREE INFORMATION CARD

ADVANCE YOUR ELECTRONIC INTERESTS

WITH A NEW SUBSCRIPTION TO: *THE SPEC-COM JOURNAL!*

Getting your FCC Amateur Radio License is easier than ever before (NO-CODE requirement - see R.E. April 91 issue, pages 27-28). **SCj** is an 80-page per issue HAM RADIO magazine that covers ALL the specialized modes. Modes like HAM-TV, Radioteletype, Satellites, WXFAX and Computer Data Transmissions. Current issue - just $3.75 ppd.

Annual Subscriptions (6 issues):
$20 USA $25 Canada/Mexico
$30 Foreign (Surface)

The SPEC-COM Journal
P.O. Box 1002,
Dubuque, IA 52004-1002
(319) 557-8791
BBS (319) 582-3235

Enter A World Of Excitement with a Subscription to

Popular Electronics®

Get the latest electronic technology and information monthly!

Now you can subscribe to the magazine that plugs you into the exciting world of electronics. With every issue of Popular Electronics you'll find a wide variety of electronics projects you can build and enjoy.

Popular Electronics brings you informative new product and literature listings, feature articles on test equipment and tools—all designed to keep you tuned in to the latest developments in electronics. So if you love to build fascinating electronics, just fill out the subscription form below to subscribe to Popular Electronics...It's a power-house of fun for the electronics enthusiast.

EXCITING MONTHLY FEATURES LIKE:

- ❑ **CONSTRUCTION**—Building projects from crystal sets to electronic roulette
- ❑ **FEATURES**—Educational training on digital electronics, Ohm's Law, Antennas, Communications, Antique Radio, Simplified Theory
- ❑ **HANDS-ON-REPORTS**—User test comments on new and unusual consumer products
- ❑ **SPECIAL COLUMNS**—Think Tank, Circuit Circus, Computer Bits, DX Listening, Antique Radio, Amateur, Scanner Scene

PLUS: ALL OUR GREAT DEPARTMENTS!

You'll get 12 exciting and informative issues of Popular Electronics for only $18.95. That's a savings of $23.05 off the regular single copy price. Subscribe to Popular Electronics today! Just fill out the subscription order form below.

FOR FASTER SERVICE CALL TODAY

1-800-827-0383

(7:30AM-8:30PM)
EASTERN STANDARD TIME

ARE

Popular Electronics® SUBSCRIPTION ORDER FORM

P.O. Box 338, Mt. Morris IL. 61054

YES! I want to subscribe to Popular Electronics for 1 Full year (12 Issues) for only $18.95. That's a savings of $23.05 off the newstand price.
(Basic Subscription Rate—1 yr/$21.95)

❑ Payment Enclosed ❑ Bill me later

Please charge my: ❑ Visa ❑ Mastercard

Acct. # ______________________

Signature ______________ Exp. Date

PLEASE PRINT BELOW:

NAME

ADDRESS

CITY STATE ZIP

Allow 6 to 8 weeks for delivery of first issue. U.S. Funds only.
In Canada add $6.68 Postage (Includes G.S.T.). All Other Foreign add $7.50 Postage.

SUPER STROBE

continued from page 37

countering some trouble with false triggering by the sound of the shutter opening, we put the microphone on a tree limb to get it closer to the splash while being careful not to get it in the frame. We covered it with a plastic bag to keep it dry. The SENSITIVITY ended up being set about mid-range. Figure 15 shows one of our efforts at catching a stone skipping across water.

Exploding capacitors

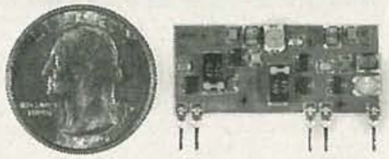
When the editor speculated on what an exploding capacitor might look like, we decided to find out... despite our better judgment. Do not try this at home! The fumes that are generated are noxious and toxic. A fire extinguisher, proper safety clothing and eye-protecting goggles are essential precautions.

We learned that there's not much more to be seen of an exploding capacitor with the strobe than without it. However, the picture that we chose to illustrate what happened (Fig. 16) is slightly more dramatic because the smoke, which would not have shown up otherwise, was illuminated by the strobe. To try to get a more interesting shot, we even piled a group of electronic components on top of the cap thinking we could get a picture of them flying into the air. That might have worked eventually, but when our eyes started to water from the smoke we decided to take a break, and we just never got back to this experiment.

Your turn

These photos and the explanations of how they were set up and shot should get you started. The only rule is that there are no rules; you really get to make them up as you go along. We have a standing bet about how much a golf ball deforms when it's hit. If you find out before we do, let us know. **Electronics Now** will be happy publish the best Freeze Frame pictures we receive. R-E

Electronics NOW® mini-ADS



TWO TRANSMITTERS IN ONE! 5 MINUTE ASSEMBLY! MONEYBACK GUARANTEE! New Law Enforcement grade device on a single chip is the most sensitive, powerful, stable room transmitter you can buy. Uses any 3V-12V battery. Or attach to telephone line to monitor all telephone conversations over 1 mile away without batteries! 100mW output! 80-130MHZ. Receive on any FM radio or wideband scanner. VT-75 microtransmitter. **$49.95 + 1.50** S&H. VISA, MC, MO. COD's add **$4.00. DECO INDUSTRIES, Box 607, Bedford Hills, NY 10507. 914-232-3878.**

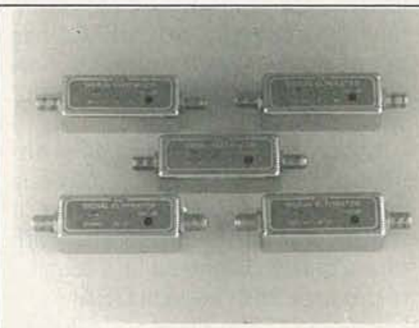
CIRCLE 127 ON FREE INFORMATION CARD

FREE CATALOG! ELECTRONIC TOOLS & TEST EQUIPMENT—Jensen's new Master Catalog, available free, presents major brand name electronics tools, tool kits, and test instruments, plus unique, hard-to-find products for assembly and repair and custom field service kits available only from Jensen. All fully described and illustrated. Enjoy free technical support and rapid, post-paid delivery anywhere in the Continental USA. **JENSEN TOOLS, INC., 7815 S. 46th St., Phoenix, AZ 85044. Phone: 602-968-6231; FAX 1-800-366-9662.**

CIRCLE 115 ON FREE INFORMATION CARD

CABLE TV CONVERTERS AND DESCRAMBLERS SB-3, TRI-BI, MLD, M35B, DRZ-DIC. Call for catalog and price list. Special combos available. We ship COD. Quantity discounts. Call for pricing on other products. Dealers wanted. FREE CATALOG. We stand behind our products where others fail. One year warranty. **ACE PRODUCTS, 1-800-234-0726.**

CIRCLE 75 ON FREE INFORMATION CARD



TUNABLE 50dB NOTCH FILTERS—for TV. Can be tuned precisely to required frequency. Model 23H-Ch's 2-3 (50-66 Mhz) Model 46FM-Ch's 4-6 plus FM (66-108 Mhz) Model 713-Ch's 7-13 (174-216 Mhz) Model 1417-Ch's 14-17 (120-144 Mhz) Model 1822-Ch's 18-22 (144-174 Mhz) **$30** each, includes shipping. Visa, MC, or check. (C.O.D. $5 extra). Fast delivery, 30 day money back. Quantity prices to **$16. STAR CIRCUITS, P.O. Box 94917, Las Vegas, Nevada 89193, 1-800-535-7827.**

CALL NOW AND
RESERVE YOUR SPACE

- 6 × rate $940.00 per each insertion.
- Fast reader service cycle.
- Short lead time for the placement of ads.
- We typeset and layout the ad at no additional charge.

Call 516-293-3000 to reserve space. Ask for Arline Fishman. Limited number of pages available. Mail materials to: mini-ADS, ELECTRONICS NOW, 500-B Bi-County Blvd., Farmingdale, NY 11735.

FAX: 516-293-3115

APPLIANCE REPAIR HANDBOOKS—13 volumes by service experts; easy-to-understand diagrams, illustrations. For major appliances (air conditioners, refrigerators, washers, dryers, microwaves, etc.), elec. housewares, personal-care appliances. Basics of solid state, setting up shop, test instruments. **$2.65 to $5.90 each.** Free brochure. **APPLIANCE SERVICE, PO Box 789, Lombard, IL 60148. 1-708-932-9550.**

CIRCLE 84 ON FREE INFORMATION CARD

COMPUTER CONNECTIONS

Gigabyte memory storage

JEFF HOLTZMAN

High-density is about to take on a whole new meaning for dynamic random-access memories. Hint: In the past RAM density always increased sequentially by powers of two (2, 4, 8, 16, . . .). Earlier this year, IBM introduced 16-megabit DRAM's for its AS/400 minicomputer. The next step for IBM should have been 32 megabits, but that's already old hat. As has been widely reported, IBM is now cooperating with Siemens to develop 64-megabit DRAM's.

More recently, Big Blue announced an even more ambitious international development effort: it will now pool its resources with those of both Siemens and Toshiba to produce 256-megabit DRAM's—bypassing 128 megabits—built with quarter-micron trace widths. It would take 400 of these lines to equal the width of a human hair!

Think about it. When many users are still moving up to 4-megabit DRAM's, nine of those babies to be developed would provide 256 mega *bytes* of memory! That is from 16 to 64 times better than the memory capacity that today's higher-end Windows-compatible workstations limp along on. Now consider a combination of a bank of 64-megabit DRAM's with an Intel P5 CPU and an XGA/DVI graphics subsystem, all on a single chunk of silicon. Soon the serial, parallel, and network port connectors of a computer will take up more space than the electronics!

Imagine the possibilities. We'll buy "dumb" highly stylistic display units with keyboard and stylu puts (DUKSI's). Each DUKSI have a socket that accepts a c plete computer-on-a-chip, in a n tude of styles. They'll customized performance fo ferent users, and permit easy grades. DUKSI's will be sold like Ralph Lauren brand-n clothes in a variety of styles to neers, technicians, executives dents, and even homemakers.

Neither the DUKSI nor the puter module will cost muc make; they'll be produced by ro and, unless there are dra changes in global business c tions, they won't be made in good old U.S of A. Large profi be generated from designing, ing, and reselling highly sty fashion-conscious DUKSI's. P would buy new DUKSI's from to time, not for technical upgr but for personal satisfaction buying new clothes.

The DUKSI will be part of schoolkid's lunch box, every ager's briefcase, every doc bag, and every technician's to Within ten years, they'll co without wires to all major tel munications services and pr on-demand connectivity t node on the networks. Within ty years, they could connect compatible electronic devi telephone, fax, copier, televis stereo.

If Microsoft has its way, Wi software will be an integrated this encroaching World Net. F reports suggest that Micro actively investigating ways to Windows for other environ Those could include envision vices called portable digi sistants (PDA's) and next-g tion video games (the "Win discussed here last time)

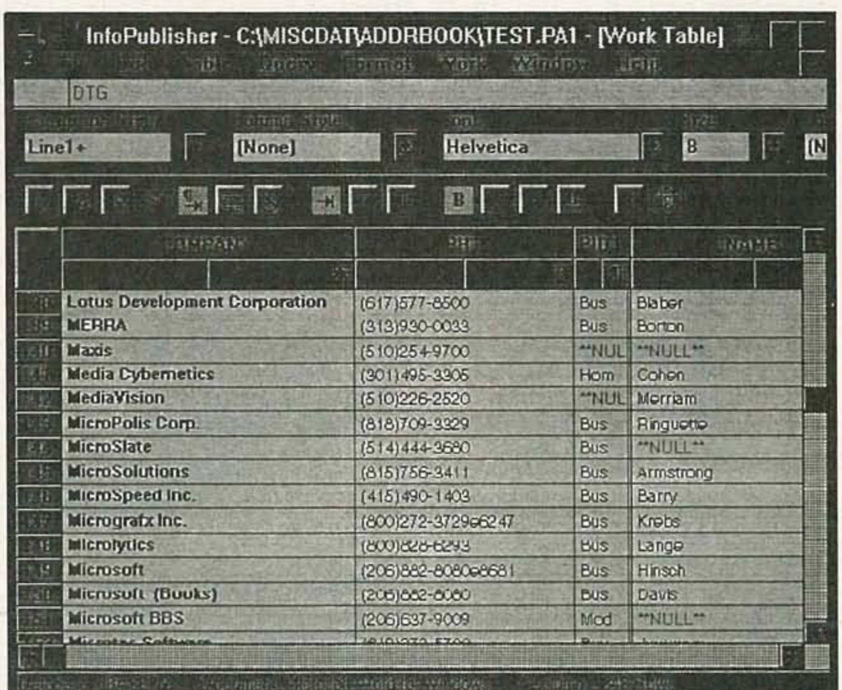


FIG. 1—DATABASE PUBLISHING is a snap with InfoPublisher. Extract the data from one or several joined dBASE, Paradox, Oracle, or SQL Server files, select desired rows and columns, apply formatting, and then export the data to popular DOS and Windows word processors and desktop publishing programs.

might also include office machines (faxes, photocopiers, and telephones), and personal telecommunications, which depend on computers to control access to news, sports, entertainment, and business information.

A chip in the hand

There's good and bad news about Intel's forthcoming P5 microprocessor, sometimes (erroneously) called the 586. The good news is that public hands-on demonstrations (including those for the press) prove it to be screaming fast. It makes smooth-scrolling 3-D animation possible, and it allows text scrolling under Windows almost as fast as character-based text on a 286 under DOS.

The bad news is that introduction of the chip has been delayed until early 1993. Intel apparently wants to make sure that there are no bugs in the P5 and that the company can meet high-volume production demand. That bad news is tempered by the possibility that its later introduction is likely to spur further price cutting in the active 486 microprocessor market.

As for its departure from its usual practice in naming microprocessors, Intel appears to be intent on distancing itself from the chip-clone companies (AMD, Chips & Technologies, Cyrix, NexGen, et al). It is holding an internal contest to develop a new name that does not contain the "86" moniker. It appears that marketing has become more important in selling microprocessors than we would have thought possible.

Intel has signed a deal with VLSI Technology under which VLSI gains rights to x86 technology. VLSI is expected to put that technology to work in building new devices that will be customized for handheld and other portable computers.

However, one recent study shows that the market for handheld and pen/tablet based PC's will not take off as rapidly as was initially expected. According to that study, laptops will gradually drop out of sight between now and 1996. Notebooks will pick up most of the slack and provide the largest share of new growth. Combination stylus/keyboard units are also expected to show significant growth. Pure pen-based systems will just be getting off the ground by then.

Product watch

InfoPublisher, an innovative niche product, functions as an interface between a database and a publishing system. It allows you to extract the information you need and publish it in a form that makes sense. On the database end, InfoPublisher can read dBASE, Paradox, and ASCII text files. It can also connect to SQL-based client-server databases including Oracle and SQL Server.

On the publishing end, InfoPublisher can connect to Word, WordPerfect, and Ami Pro for Windows, several versions of PageMaker, and DOS versions of Word and WordPerfect. InfoPublisher runs under Windows, so its operation is most efficient operating in that environment.

Why would you use InfoPublisher? A database manager allows you to sort and select data, and print reports based on them. Report formatting, however, typically leaves much to be desired. Of course, you could export a sorted and selected subset of your data as ASCII, import it into your word processor or desktop publisher, and format it there. But doing that typically involves a *lot* of grunt work. Imagine formatting each field of a 1000-record database manually. Then imagine having to repeat the whole process after updating your database!

Bridging the gap is where InfoPublisher comes in. It offers a friendly, spreadsheet-like user interface that allows you to query your database, apply formatting, and then export the results for fine-tuning and printing with your favorite printer. The best part is that you can save a query/formatting combina-

Products Discussed

• InfoPublisher ($795), PageAhead Software, 2125 Western Avenue, Suite 301, Seattle, WA 98121. (800) 967-9671, (206) 441-0340.
CIRCLE 000 ON FREE INFORMATION CARD

• NTSC ($25), ItWorks, P.O. Box 7403, Chico, CA 95927. (916) 893-1714.

FREE
Heathkit
Educational Systems
Electronics & Computer Software Education Catalog
*Fast-Track Individual Learning Programs
*State-of-the-Art Classroom Courses
*The Best Values in Electronics Education Today
New
Computer Aided Instruction
DC Electronics
AC Electronics
Semiconductors
Electronic Circuits
The stunning animations, hypertext glossary, and easy-to-understand text make learning the concepts of electronics a breeze...*and fun!*
Learn Electronics the easy and affordable way from the Masters in Electronics Training - Heathkit Educational Systems. From Basic Electricity and Electronics to Advanced Microprocessor Applications and much more, Heathkit will provide you with an unparalleled learning experience at a fraction of the cost of other programs.
For your FREE Catalog, call
Toll-Free 1-800-44-HEATH
please mention this code when calling 020-002
CIRCLE 86 ON FREE INFORMATION CARD

Choose from 45 Career Opportunities!
Get Your Specialized Associate Degree or Career Diploma at Home in Spare Time
Now without attending college classes and with no previous experience, you can train for a money-making career...even get a Degree. Send for free facts and color brochure on employment opportunities in the field that interests you most. See how easy it is to train at home for a great career or advancement in your present job.

CALL TOLL FREE **1-800-234-9070** Ext. 657
CALL ANYTIME—24 hours a day, 7 days a week.
OR MAIL COUPON TODAY!
281XB
ICS SINCE 1890 International Correspondence Schools
Dept. ADESA2S, 925 Oak Street, Scranton, PA 18515
Please send me free facts, color brochure and full information on how I can study at home for the career I have chosen. No obligation. **CHECK ONE BOX ONLY!**
ASSOCIATE IN SPECIALIZED BUSINESS DEGREE PROGRAMS
☐ Business Management
☐ Accounting
☐ Bus. Mgmt.—Finance Option
☐ Bus. Mgmt.—Marketing Option
☐ Applied Computer Science
☐ Hospitality Management
ASSOCIATE IN SPECIALIZED TECHNOLOGY DEGREE PROGRAMS
☐ Civil Engineering Technology
☐ Mechanical Engineering Technology
☐ Electrical Engineering Technology
☐ Industrial Engineering Technology
☐ Electronics Technology
CAREER DIPLOMA PROGRAMS
☐ High School
☐ Auto Mechanics
☐ Surveying and Mapping
☐ Drafting
☐ Air Conditioning & Refrigeration
☐ Wildlife/Forestry Conservation
☐ Police Sciences
☐ Private Security Officer
☐ Diesel Mechanics
☐ Electrician
☐ Small Business Management
☐ Gun Repair
☐ Electronics
☐ PC Repair
☐ Hotel/Restaurant Management
☐ Child Day Care
☐ Legal Assistant
☐ Interior Decorating
☐ Bookkeeping
☐ Art
☐ Motorcycle Repair
☐ Catering/Gourmet Cooking
☐ Computer Programming
☐ Computer Programming/COBOL
☐ Personal Computer Specialist
☐ Computer-Assisted Bookkeeping
☐ Fitness & Nutrition
☐ TV/VCR Repair
☐ Travel Agent
☐ Animal Care Specialist
☐ Photography
☐ Journalism/Short Story Writing
☐ Dressmaking and Design
☐ Florist
Name________ Age____
Address________ Apt. #____
City/State________ Zip____
Phone ( )________
CIRCLE 184 ON FREE INFORMATION CARD

tion and reuse it again after updating a database.

The program permits the creation of sophisticated database queries. Queries can be specified in a query-by-example (QBE) mode or by typing in SQL commands directly. You can begin in the QBE mode and then edit the SQL statement directly. Unfortunately, the process can't be reversed (you can't return to QBE from SQL). With simple commands you can select any or all columns (fields) of a database, sort rows (records) in ascending or descending order on as many as ten columns, and as an option, use easy-to-customize sort sequences.

You can also replace data (e.g., spell out abbreviations), create query expressions with arithmetic operators and create operators for a flock of functions: greater than, less than, equal, not equal, is null, is not null, is like, is not like, and more. In addition you can combine several expressions with Boolean operators (and, or), create calculated fields in the output table (e.g., price × 1.04 for inflation), and perform related relational joins between several tables.

After performing a query, InfoPublisher presents a work table in which you can rearrange columns, apply formatting (e.g. font, size, bold, and italics) on a row, column, or cell basis, sort the table, specify date and numeric formats, specify capitalization rules, and rearrange data. As an example you might want to change "The Hitchhiker's Guide to the Galaxy" to "Hitchhiker's Guide to the Galaxy.").

InfoPublisher simulates formatting by showing the proper font along with bold and italic attributes, but not point size. Each field can be preceded or followed by a tab, a "soft" return, a hard return, one or more spaces, and an arbitrary text string.

When everything looks right, you export the data. You can set up DDE links between InfoPublisher and, for example, Word for Windows. But performance (even on a 25-MHz 486DX) is pretty slow for a database of any size. You can also cut and paste data through the Windows clipboard, or export data to a separate file.

Let's assume you want to publish a customer database with name, address, and phone number. To separate entries in the printout you want the name to appear in boldface type, followed by the right-justified phone number, with the full address appearing on succeeding lines. In InfoPublisher's Work Table, click the column heading above the customer's name and press the "B" tool on the toolbar. Then click the line beneath the column heading and specify that that field will be followed by a tab.

Then click the corresponding point above the phone number field, and specify that it will be followed by a paragraph mark. When you bring the data into your word processor, set a right-justified tab stop, and voila. (Using styles makes the process even more efficient.)

I found one bug in the program: The fixed-length ASCII import filter caused a general program failure (GPF), and terminated the program. The vendor's technical personnel promised that the bug would be fixed in the next release, which is due to be released around the time you read this.

All in all, InfoPublisher is a pleasure to run. The QBE facility works like a charm, and its ability to save query/format specifications save a tremendous amount of time over traditional methods. The documentation is well written and well produced, but a quick reference guide to the multitude of query and format options is desperately needed. It has some bugs, and the user interface needs tuning, but even in version 1.2, InfoPublisher is a winner in our book.

SCSI hint

Having trouble interfacing two SCSI drives to the same system? I was when I was adding a second drive to my main system. The two drives were made by different manufacturers, and by themselves, both drives worked fine. But as soon as I connected them, things went crazy. The chief symptom was a disturbing clicking sound when I booted the system. Technical information provided by four vendors (drive A, drive B, the SCSI host adapter, and the distributor of the second drive) could suggest little more than n ing sure that the last drive on bus had proper terminating sistors. Also they said no two dr should have the same SCSI ID. help.

It turned out that the problem caused by EMI—with emphasi the *M*. The older drive, a large 5 inch model, was apparently gen ing a large magnetic field that i fered with the newer on compact 3.25-inch job. After s rating the drives by the distan several drive-bay positions, problem went away. Both d now function as advertised.

Shareware corner

Quick—what's the differenc tween RS-170 and RS-17 What's the delay in nanosec per foot of 75-ohm RG-59/U c cable? What color do you get green and blue phosphors on a are both active? How many line in n and what is the aspect ra the proposed American HDTV tem?

The answers, along with a v ble cornucopia of video and t sion-related data, are availabl DOS program called NTSC program was written by An Watts, a TV meteorologist an tems engineer who also de graphics systems for tele weathercasts.

NTSC has six sections: N signal parameters (e.g., sync back porch time, and horiz sync time), a glossary of ter calculator for calculating delay cable lengths, specs for num video formats (RGB, S RS-170, PAL, SECAM, and n test patterns, and a list of TV- nel frequencies. Mr. Watts packed more information int little $25 program than you get from half a dozen refe books. I'll post a copy on th BBS (516-293-2283). If you you can contact the address sidebar.

Answers (don't cheat): 1) R is the EIA standard that des NTSC composite black and video, and RS-170A is for colc foot = 1.540 nanosecon Green + Blue = Cyan; 4) 16:9

BUYER'S MART

PLANS AND KITS

FASCINATING electronic devices! Dazers! Lasers! Transmitters! Detectors! Free energy! Tesla! Kits/assembled! Catalog $4.00 (refundable). **QUANTUM RESEARCH,** 17919-77 Ave., Edmonton, AB. T5T 2S1.

DESCRAMBLING, new secret manual. Build your own descramblers for **cable and subscription TV.** Instructions, schematics for SSAVI, gated sync, Sinewave, (HBO, Cinemax, Showtime, UHF, Adult) $12.95, $2.00 postage. **CABLETRONICS,** Box 30502R, Bethesda, MD 20824.

CLASSIFIED AD ORDER FORM

To run your own classified ad, put one word on each of the lines below and send this form along with your check to:

Electronics Now Classified Ads, 500-B Bi-County Boulevard, Farmingdale, NY 11735

PLEASE INDICATE in which category of classified advertising you wish your ad to appear. For special headings, there is a surcharge of **$25.00.**

( ) Plans/Kits ( ) Business Opportunities ( ) For Sale
( ) Education/Instruction ( ) Wanted ( ) Satellite Television
( ) ______

Special Category: $25.00

PLEASE PRINT EACH WORD SEPARATELY, IN BLOCK LETTERS.
(No refunds or credits for typesetting errors can be made unless you clearly print or type your copy.) Rates indicated are for standard style classified ads only. See below for additional charges for special ads. **Minimum: 15 words.**

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15 ($46.50)
16 ($49.60)	17 ($52.70)	18 ($55.80)	19 ($58.90)	20 ($62.00)
21 ($65.10)	22 ($68.20)	23 ($71.30)	24 ($74.40)	25 ($77.50)
26 ($80.60)	27 ($83.70)	28 ($86.80)	29 ($89.90)	30 ($93.00)
31 ($96.10)	32 ($99.20)	33 ($102.30)	34 ($105.40)	35 ($108.50)

We accept MasterCard and Visa for payment of orders. If you wish to use your credit card to pay for your ad fill in the following additional information (Sorry, no telephone orders can be accepted.):

Card Number ______ Expiration Date ______

Please Print Name ______ / Signature ______

IF YOU USE A BOX NUMBER YOU MUST INCLUDE YOUR PERMANENT ADDRESS AND PHONE NUMBER FOR OUR FILES. ADS SUBMITTED WITHOUT THIS INFORMATION WILL NOT BE ACCEPTED.

CLASSIFIED COMMERCIAL RATE: (for firms or individuals offering commercial products or services) $3.10 per word prepaid (no charge for zip code)...**MINIMUM 15 WORDS.** 5% discount for same ad in 6 issues; 10% discount for same ad in 12 issues within one year; if prepaid. **NON-COMMERCIAL RATE:** (for individuals who want to buy or sell a personal item) $2.50 per word, prepaid....no minimum. **ONLY FIRST WORD AND NAME** set in bold caps at no extra charge. Additional bold face (not available as all caps) **55¢ per word additional.** Entire ad in boldface, $3.70 per word. **TINT SCREEN BEHIND ENTIRE AD: $3.85 per word. TINT SCREEN BEHIND ENTIRE AD PLUS ALL BOLD FACE AD:** $4.50 per word. **EXPANDED TYPE AD: $4.70 per word prepaid.** Entire ad in boldface, $5.60 per word. **TINT SCREEN BEHIND ENTIRE EXPANDED TYPE AD:** $5.90 per word. **TINT SCREEN BEHIND ENTIRE EXPANDED TYPE AD PLUS ALL BOLD FACE AD:** $6.80 per word. **DISPLAY ADS:** 1" × 2¼"—$410.00; 2" × 2¼"—$820.00; 3" × 2¼"—$1230.00. **General Information:** Frequency rates and prepayment discounts are available. **ALL COPY SUBJECT TO PUBLISHERS APPROVAL. ADVERTISEMENTS USING P.O. BOX ADDRESS WILL NOT BE ACCEPTED UNTIL ADVERTISER SUPPLIES PUBLISHER WITH PERMANENT ADDRESS AND PHONE NUMBER.** Copy to be in our hands on the 5th of the third month preceding the date of the issue. (i.e., Aug. issue copy must be received by May 5th). When normal closing date falls on Saturday, Sunday or Holiday, issue closes on preceding working day. Send for the classified brochure. Circle Number 49 on the Free Information Card.

HOBBY/broadcasting/HAM/CB/surveillance transmitters, amplifiers, cable TV, science, bugs, other great projects! Catalog $1.00. **PANAXIS,** Box 130-F11, Paradise, CA 95967.

DESCRAMBLER kits. Complete cable kit $44.95. Complete satellite kit $49.95. Add $5.00 shipping. Free brochure. No New York sales. **SUMMIT** RE, Box 489, Bronx, NY 10465.

SURVEILLANCE transmitter kits tune from 65 to 305 MHz. Mains powered duplex, telephone, room, combination telephone/room. Catalog with **Popular Communications, Popular Electronics and Radio-Electronics** book reviews of **"Electronic Eavesdropping Equipment Design,"** $2.00. **SHEFFIELD ELECTRONICS,** PO Box 377785-C, Chicago, IL 60637-7785.

FREE! Exciting catalog of sensational kits. **LNS TECHNOLOGIES,** 20993 Foothill Blvd., Suite 307R, Hayward, CA 94541-1511.

REMOTE CONTROL KEYCHAIN

Complete w/mini-transmitter and +5 vdc RF receiver
Fully assembled including plans to build your own auto alarm
$24.95 Check, Visa or M/C Add $ 3 shipping
5 @ $19.95, 10 @ $14.95
Visitect Inc. Box 14156, Fremont, Ca. 94539
(510) 651-1425 Fax (510) 651-8454

STEREO amplifier. 300W RMS/channel. Complete plans $9.95. **STEVE FREEL,** 195 Ibis Drive, Melbourne, FL 32951. (407) 676-5933.

BOOST stereo transmitter kit output power! Super simple plans. $4.00. **X-TEK,** Box 521164, SLC, Utah 84152-1164.

60 SOLDERLESS Breadboard Projects in two easy-to-read pocket books. Complete with circuit descriptions, schematics, parts layouts, component listings, etc. Both books (BP107 & BP113) only $11.90 plus $3.50 for shipping. USA and Canada only. US funds. **ETT, INC.,** PO Box 240, Massapequa Park, NY 11762-0240.

CELLULAR hackers bible Theory — hacks — modifications — $53.95. **TELECODE,** PO Box 6426-RE, Yuma, AZ 85366-6426.

VIDEOCIPHER II/satellite/scanner/cable/amateur/cellular/repair manuals, modification books, software. Catalog — $3.00. **TELECODE,** PO Box 6426-RE, Yuma, AZ 85366-6426.

BUILD 0-50 volt regulated dual tracking power supply. Complete schematics and instructions, $5.95. **SMS ENGINEERING,** RE 5932 West Bell Road, Suite D106, Glendale, AZ 85308.

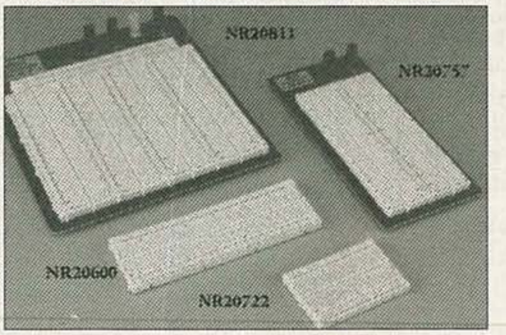
PROTOTYPING PC boards? Fast and easy from artwork to etched board in 30 minutes or less. Complete step by step plans and samples! $6.50 check or money order to **E.G.G.,** PO Box 11390, Bradenton, FL 34282.

GREAT Project. Silent Sam reminds you when you forget. SSTSR (Turn Signal Reminder) beeps 3 seconds after 15 seconds. Cycle repeats until cancelled. Unobtrusive, disabled when braking. Compact kit mounts atop flasher. Parts, case, PCB, schematic, instructions **$15** PPD; **2/$25; 3/$30.** Visa/MC. Free brochure **1-800-398-5605.** Prewired **$20** PPD; **2/$35; 3/$45 Silent Sam, 1627 Basil Dr., Columbus, OH 43227.**

1•800•831•4242 Your Resource f

Test/Measurement and Prototype Equipment

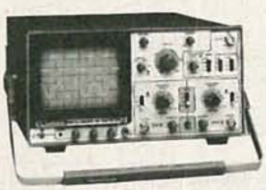
Jameco Solderless Breadboards



Jameco's long-lasting breadboards feature screen-printed color coordinates and are suitable for many kinds of prototyping and circuit design. Larger models feature a heavy-duty aluminum backing with voltage and grounding posts.

Part No.	Product No.	Dim. L" x W"	Contact Points	Binding Posts	Price
NR20600	JE21	3.25 x 2.125	400	0	$4.95
NR20722	JE23	6.50 x 2.125	830	0	6.95
NR20757	JE24	6.50 x 3.125	1,360	2	12.95
NR20773	JE25	6.500 x 4.25	1,660	3	17.95
NR20790	JE26	6.875 x 5.75	2,390	4	24.95
NR20811	JE27	7.250 x 7.50	3,220	4	32.95

GoldStar 20MHz Dual Trace Oscilloscope



The perfect unit for today's testing and measurement needs! Features include a 6" CRT display, and bandwidth from DC to 20 MHz. The GoldStar oscilloscope comes with two 40MHz probes, two fuses, power cord, operation manual, schematics and block and wiring diagram. It's lightweight and portable with a two-year warranty.

Part No.	Product No.	Description	Price
NR18551	GS7020	Oscilloscope	$399.95

Additional GoldStar Oscilloscopes

Part No.	Product No.	Description	Price
NR66051	GS904RD	40Mhz 2 channel oscilloscope	$799.95
NR66077	GS8100	100Mhz 3 channel oscilloscope	1379.95

Call for additional Goldstar test equipment

National and Intel Databooks

Part No.	Product No.	Description	Price
NR41224	400026	National General Purpose Linear Devices Databook	$19.95
NR41259	400039	National Logic Databook	19.95
NR41208	400015	National Data Acquisition Linear Devices Databook	11.95
NR41304	400104	National Special Purpose Linear Devices Databook	11.95
NR41275	400044	National LS/S/TTL Databook	14.95
NR39280	230843	Intel Memory Databook	24.95
NR39870	270645	Intel Embedded Controller Processors Databook	24.95

Additional databooks available!

JAMECO™
ELECTRONIC COMPONENTS
COMPUTER PRODUCTS

24 Hour Toll-Free Order Hotline
1•800•831•4242

Please refer to Mail Key NR2 when ordering

Metex Digital Multimeters

- Handheld, high accuracy • Measures AC/DC voltage, AC/DC current, resistance, diodes, continuity, and transistor current gain (except M3900)
- Manual ranging w/overload protection
- Comes with probes, batteries, case and manual

NR27086 & NR27158 only:

- Also measures frequency and capacitance

Part No.	Product No.	Description	Price
NR27115	M3800	3.5 digit multimeter	$39.95
NR27078	M3610	3.5 digit multimeter	59.95
NR27140	M3900	3.5 digit multimeter with tach/dwell	59.95
NR27086	M3650	3.5 digit multimeter w/frequency & capacitance	74.95
NR27158	M4650	4.5 digit w/ frequency & capacitance & data hold switch	99.95

24 Hour Toll-F
Order Hotlin
1•800•831•

Jameco IC Test Clip Series

- Test clips are designed for temporary connection
components
- Heavy-duty spring loaded hinge provides positiv

Part No.	Product No.	Description
NR22103	JTC16	16-pin (for 8, 14 & 16-pin I
NR22120	JTC20	20-pin (for 18 & 20-pin ICs
NR22146	JTC24	24-pin ....
NR22162	JTC28	28-pin ....
NR22189	JTC40	40-pin ....

EPROMs - for your programming nee

Part No.	Product No.	Price	Part No.	Product No.	Price	Part No.	Produc
NR33566	TMS2516	$4.25	NR40248	2764A-25	$3.49	NR65904	27C2
NR33603	TMS2564	5.95	NR39829	27C64-15	3.95	NR39714	27C2
NR33611	TMS2716	5.95	NR39845	27C64-25	3.49	NR39722	27C2
NR37647	1702A	3.95	NR39853	27C64-45	2.95	NR39731	27C2
NR39909	2708	4.95	NR39992	27128OTP	2.49	NR40184	2751
NR40002	2716	3.95	NR39925	27128-20	7.95	NR40150	2751
NR40011	2716-1	4.25	NR39933	27128-25	7.75	NR40168	2751
NR39706	27C16	4.25	NR39950	27128A-15	4.95	NR39773	27C5
NR40096	2732	4.95	NR39968	27128A-20	4.75	NR39781	27C5
NR40109	2732A-20	4.49	NR39984	27128A-25	3.75	NR39790	27C5
NR40125	2732A-25	3.49	NR39677	27C128-15	5.75	NR39802	27C5
NR40133	2732A-45	2.95	NR39685	27C128-25	7.95	NR39651	27C
NR39765	27C32	4.95	NR40070	27256OTP	4.19	NR65699	27C
NR40192	2764-20	3.95	NR40037	27256-15	5.49	NR65681	27C
NR40205	2764-25	3.75	NR40045	27256-20	5.29	NR43692	6876
NR40230	2764A-20	3.75	NR40061	27256-25	4.89		

A.R.T. EPROM Programmer

- Programs all current EPROMs in the 2716 to 27512 range plus the X2864 EEPROM
- RS232 port
- Software included

Part No.	Product No.	Description	Price
NR16686	EPP	Programmer	$179.95

UVP EPROM E

- Erases all EPROMs
- DE4 erases 8 chips every 21 min
- DE1 erases 1 chip every 7 minut

Part No.	Product No.	Descri
NR15712	DE4	Eraser.
NR66042	DE1	Portabl

• Partial Listing • Over 5000 Electronic and Computer Components in Stock! • Call for
• Please specify part no. when ordering

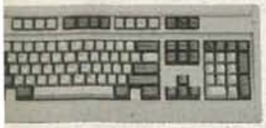
CIRCLE 114 ON FREE INFORMATION CARD

'alue. Only a Phone Call Away.

Computer Upgrade Products and Electronic Components

Upgrade your existing computer system! Jameco will help you upgrade easily and economically.

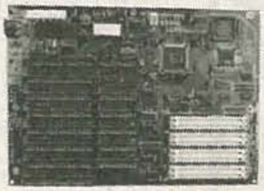
101-Key Enhanced Keyboard



This keyboard features 12 function keys, separate cursor and numeric keys.
- IBM PC/XT/AT and compatible computers
- Automatically switches between XT or AT
- LED Indicators for Num, Caps,and Scroll lock keys.

.	Product No.	Description	Price
32	K101	Keyboard	$49.95

Jameco 80386SX Motherboard



- 16MHz processing speed
- Baby motherboard (8.5"x13")
- Zero or one wait state operation
- Supports up to 16MB of RAM
- Intel 80387SX/compatible math coprocessor socket
- AMI BIOS
- Six 16-bit and two 8-bit expansion bus slots
- One-year warranty

Part No.	Product No.	Description	Price
NR53882	JE3616SN	Motherboard	$209.95

Toshiba 1.44MB 3.5" Internal Floppy Disk Drive

C/XT/AT and compatibles
atible with DOS versions 3.3 or higher
es all necessary installation hardware
B formatted high density mode
formatted low density mode
"H x 4"W x 5.9"D (actual drive size)
ar warranty

.	Product No.	Description	Price
74	356KU	Disk drive	$99.95

Many more upgrade products available!

Jameco IBM Compatible Power Supplies

NR19465:
- Output: +5V @ 15A, -5V @ 0.5A, +12V @ 5.5A, -12V @ 0.5A
- 150 watts output power
- Switchable between 110/220V
- Built-in fan
- Size: 9.5"L x 5.5"W x 4.625"H
- One-year warranty
- CSA approved

NR19545:
- Output: +5V @ 20A, -5V @ 0.5A,+12V @ 8A, -12V @0.5A
- 200 watts output power
- Switchable between 110/220V
- Built-in fan
- Size: 6.5"L x 5.88"W x 6"H
- One-year warranty
- CSA approved

NR19465

Part No.	Product No.	Description	Price
NR19465	JE1030	150 watt PC/XT power supply	$69.95
NR19545	JE1036	200 watt AT power supply	89.95

Additional power supplies available!

egrated Circuits*

	Product No.	1-9	10+
9	7400	$.29	$.19
5	7402	.29	.19
)	7404	.29	.19
1	7406	.35	.25
)	7407	.35	.25
5	7408	.35	.25
9	7410	.29	.19
3	7417	.35	.25
3	7420	.29	.19
5	7432	.35	.25
)	7447	.89	.79
1	7474	.39	.29
3	7476	.45	.35
5	7486	.45	.35
1	7489	2.95	2.75
)	7490	.59	.49
2	74121	.49	.39
2	74192	.79	.69
)	74193	.79	.69

Linear ICs*

Product No.	1-9
TL082CP	$.59
LM317T	.59
LM324N	.35
LM336Z	1.09
LM339N	.45
NE555V	.29
LM556N	.49
LM723CN	.49
LM741CN	.29
LM1458N	.39
LM1488N	.45
LM1489N	.45
ULN2003A	.69
LM3914N	2.49
NE5532	1.19
7805T	.45
7812T	.45

* *Name brand IC's in stock*

IC Sockets

Part No.	Product No.	Description	Price
NR51570	8LP	8-pin low profile	$.10
NR37161	14LP	14-pin low profile	.11
NR37372	16LP	16-pin low profile	.12
NR39335	24LP	24-pin low profile	.19
NR40301	28LP	28-pin low profile	.22
NR41110	40LP	40-pin low profile	.28

Connectors

Part No.	Product No.	Description	Price
NR15114	DB25P	Male, 25-pin	$.65
NR15157	DB25S	Female, 25-pin	.75
NR15085	DB25H	Hood	.39
NR15106	DB25MH	Metal Hood	1.35

Miscellaneous Components*

Transistors And Diodes

Part No.	Product No.	Description	Price
NR28628	PN2222	TO-92 case	$.12
NR28644	PN2907	TO-92 case	.12
NR35991	1N4004	DO-41 case	.10
NR38236	2N2222A	TO-18 case	.25
NR36126	1N4735	DO-41 case	.25
NR38359	2N3904	TO-92 case	.12
NR36290	1N751	DO-35 case	.15
NR38421	2N4401	TO-92 case	.15
NR36038	1N4148	DO-35 case	.07
NR38308	2N3055	TO-3 case	.69

Switches

Part No.	Product No.	Description	Price
NR21936	JMT123	SPDT, on-on (toggle)	$1.15
NR38842	206-8	SPST, 16-pin (DIP)	1.09
NR26622	MS102	SPST, momentary (push-button)	.39

**Additional components available*

Memory

Part No.	Product No.	Function		Price
NR41398	41256-120	256K DIP	120ns	$1.69
NR42251	511000P-80	1MB DIP	80ns	5.99
NR41523	41256A9B-80	256K SIMM	80ns	16.95
NR41718	421000A9A-80	1MB SIPP	80ns	54.95
NR41769	421000A9B-80	1MB SIMM	80ns	54.95

LEDs

Part No.	Product No.	Description	Price
NR34761	XC556G	T1 3/4, (green)	$.16
NR34796	XC556R	T1 3/4, (red)	.12
NR34825	XC556Y	T1 3/4, (yellow)	.16

Call or write for your
1993 Annual Catalog:
1•800•637•8471

Mention Mail Key NR2

24-Hour Toll-Free Order Hotline:
1•800•831•4242

JAMECO™
ELECTRONIC COMPONENTS
COMPUTER PRODUCTS
1355 Shoreway Road
Belmont, CA 94002

$30.00 Minimum Order
FAX: 1•800•237•6948 (Domestic)
FAX: 415•592•2503 (International)
Jameco ServiceLine™ :
1•800•831•8020 (Computer Repair)
Technical Support: 1•800•831•0084
BBS Support: 415•637•9025

For International Sales, Customer Service, Credit Department and all other inquiries: Call 415•592•8097 between 7AM-5PM P.S.T.

CA Residents please add applicable sales tax.

Federal Express UPS Shipping, handling and insurance are additional.

Terms: Prices subject to change without notice. Items subject to availability and prior sale. Complete list of terms/warranties is available upon request.

© *1992 Jameco 11/92* All trademarks are registered trademarks of their respective companies.

CIRCLE 114 ON FREE INFORMATION CARD

Cable TV DESCRAMBLERS

30-day Money Back Guarantee

➤ The Most Complete Line of Descramblers
➤ Friendly, professional service
➤ FREE Catalog

ORDER NOW!

VISA DISCOVER C.O.D

1-800-228-7404

Go to the Source

NU-TEK ELECTRONICS
3250 Hatch RD
Cedar Park TEXAS 78613

FOR SALE

TUBES: "oldest," "latest." Parts and schematics. SASE for lists. **STEINMETZ,** 7519 Maplewood Ave., Hammond, IN 46324.

RESTRICTED technical information: Electronic surveillance, schematics, locksmithing, covert sciences, hacking, etc. **Huge selection. Free brochures. MENTOR-Z,** Drawer 1549, Asbury Park, NJ 07712.

TUBES, new, up to 90% off, SASE, **KIRBY,** 298 West Carmel Drive, Carmel, IN 46032.

T.V. notch filters, phone recording equipment, brochure $1.00. **MICRO THinc.** Box 63/6025, Margate, FL 33063. (305) 752-9202.

SPEAKER repair. All makes — models. Stereo & professional. Kits available. Refoaming $18.00. **ATLANTA AUDIO LABS,** 1 (800) 568-6971.

ENGINEERING software and hardware, PC/MSDOS. Circuit design and drawing, PCB layout, FFT analysis, mathematics, circuit analysis, etc. Data acquisition, generation, I/O PCB's, etc. Call or write for free catalog. (614) 491-0832, **BSOFT SOFTWARE, INC.,** 444 Colton Rd., Columbus, OH 43207.

CABLE TV Equipment. Most type available. Special: Oak M35B $39.95. No catalog. COD orders only. **1 (800) 822-9955.**

80C52-Basic microcontroller board. Basic interpreter, 32K RAM, 16K Eprom, Eprom programmer, RS232, expansion connector. Bare board with manual, schematics $22.95. 80C52-Basic microprocessor chip $25.95. Assembled and tested $124.95. **PROLOGIC DESIGNS,** PO Box 19026, Baltimore, MD 21204.

JERROLD, Tocom and Zenith "test" chips. Fully activates unit. $50.00. Cable descramblers from $40.00. Orders 1 (800) 452-7090. Information (310) 867-0081.

TOCOM-Jerrold Impulse-Scientific Atlanta Converters, two year warranties, also **test modules** for your converters. Contact **NATIONAL CABLE,** (219) 935-4128 full details.

CABLE descramblers! Build your own descrambler for **less** than $12.00 in seven **easy** steps. Complete instructions $10.00. Radio Shack parts list and **free** descrambling methods that cost nothing to try included. **HARRYWHITE,** PO Box 1790, Baytown, TX 77520.

PROTECT yourself and equipment from electrical shocks. Complete unit $98.95. **SAFETY-UNLIMITED,** 1743 Baldwin Road, Yorktown, NY 10598. S/H $5.00.

FREE CATALOG

FAMOUS "FIRESTIK" BRAND CB ANTENNAS AND ACCESSORIES. QUALITY PRODUCTS FOR THE SERIOUS CB'er. SINCE 1962
FIRESTIK ANTENNA COMPANY
2614 EAST ADAMS
PHOENIX, ARIZONA 85034

CONVERTERS — Descramblers, Jerrold Starcom 6, S.A. 85XX, Oak RTC, Tocom VIP, Zenith, all bullet proof, lowest prices, best warranty, C.O.D. orders welcome. **ULTIMATE CABLE PRODUCTS,** (702) 646-6952.

PCB: Printed circuit board art work made to your specifications plotted on transparency. Multi layer and surface component capable. Circuit board production available, free estimate send schematic to **NEGRON ENGINEERING,** 159 Garfield Place, Brooklyn, NY 11215. Fax (718) 768-4028.

PLATED thru hole printed circuits. $25.00 minimum. Fast turnaround. For more information call **A.P. CIRCUITS,** (403) 250-3406 or BBS (403) 291-9342 (8,n,1).

IS it true... Jeeps for $44.00 through the U.S. gov't? Call for facts (504) 649-5745 ext. S-5192.

CABLE TV DESCRAMBLERS
★ CONVERTERS ★
and ACCESSORIES.

SAVE MONEY. DON'T RENT!

PANASONIC, JERROLD, OAK, PIONEER, SCIENTIFIC ATLANTA
AND MORE. LOWEST PRICES. FREE CATALOG.
CABLE READY COMPANY **(800) 234-1006**

DESCRAMBLERS-Converters, 1 piece combos, 85XX $189.00, DPV-5 $179.00, Tocom VIP $250.00, Zenith $199.00, full warranty, bullet proof. S.A.C. 1 (800) 622-3799.

CABLE converters, Oak RTC-56 $99.00, Jerrold DPV-5 $189.00, Zenith 1086 $225.00, Tocom-VIP $250.00, S.A. 85 — $179.00, Hamlin CRX-66003M $99.00, Sylvania 4040-DIC $79.00, all makes in stock, fully bullet proof. **MOUNT HOOD ELECTRONICS** (206) 260-0107.

BULLET proof descramblers-converters, all makes, best prices, examples Starcom 6 $179.00, Oak RTC-56 $109.00 Tocoms, Zenith, Scientific Atlanta, in stock, full warranty. **KABLE KONNECTION** (702) 433-6959.

JERROLD Impulse digital converter. Upgrade your 400 450 unit to this latest system. (212) 898-8819.

TEST equipment pre-owned now at affordable prices. Signal generators from $50.00, oscilloscopes from $50.00. Other equipment including manuals available. Send $2.00 U.S. for catalog refunded on first order. **J.B. ELECTRONICS,** 3446 Dempster, Skokie, IL 60076. (708) 982-1973.

GENERAL Instrument DPV-7's $250.00 tific Atlanta 8500's $150.00, Tocom's $1 $250.00. **CABLE WORLD,** 1 (800) 234-

CABLE TV converters. Jerrold, Zenith, Oak, Scientific Atlanta, and many more. experience gives us the **advantage.** Amex COD **ADVANTAGE ELECTRONIC 1 (800) 952-3916** 1125 Riverwood Dr., Bu MN 55337.

Dish System
LIFETIME WARRANTY

Quality Microwave TV A
WIRELESS CABLE - IFTS - MMDS -
Ultra High Gain 50db(+) • Tuneable 1.
• 55-Channel Dish System $1
• 36-Channel Dish System $1
• 20-Channel Dish System $1
• Optional Commercial Grid Antenna (not sho
• Yagi Antennas, Components, Custom Tun
• Call or write (SASE) for "FREE" Catalog
PHILLIPS-TECH ELECTRONICS
P.O. Box 8533 • Scottsdale, AZ 8
(602) 947-7700 ($3.00 Credit all p
MasterCard • Visa • American Express • COD's •

CB RADIO OWNE

We specialize in a wide variety of information, parts and services for C 10-Meter and FM conversion kits, rep plans, high-performance accessories. T of satisfied customers since 1976! Catal
CBC INTERNATIONA
P.O. BOX 31500RE, PHOENIX, A

RECEIVING TU
OVER 3000 TYPES I
Also hard-to-find transfor tors and parts for tube eq
Send $2.00 for our 32 pag
ANTIQUE ELECTRONIC S
6221 S. Maple Ave.•Tempe, AZ 85283•6

WIRELESS CABLE RECEIVERS 1.9 T

VISA/MC/AMEX

30 CH PARABOLIC DISH SYS
30 CH ROD ANTENNA SYSTE
30 CH CRYSTAL CONTROLLE
SUN MICROWAVE INT'L. INC.
P.O. BOX #34522
PHOENIX, AZ. 85067
(602) 230-1245
QUANTITY DISCOUNTS
ORDERS ONLY 1-800-484-4190 C

REMOVE LEAD VOCALS
From Records & CD's

Build this kit which vocals from standard CD's, tapes or FM b along with the bac Use with any ho stereo. Additional ki your voice, then mix **Pre-assembled** b able. Write fo **Weeder Technolo 421, Batavia, Ohi**

CABLE TV DESCRAMBLERS

*** VIDEO STABILIZERS AVAILABLE & Bullet Protectors ***
MULTI-VISION ELECTRONICS 2730 SO 123RD CT.STE #126 OMAHA, NE. 68144

1-800-835-2330
1-800-327-8544

BEST BUYS BEST SERVICE STARTS WITH A FREE CATALOG
TECH LINE (402) 331-3228

BY PURCHASING CABLE EQUIPMENT FROM MULTI-VISION ELECTRONICS THE PURCHASER AGREES TO COMPLY WITH STATE & FEDERAL LAWS REGARDING PRIVATE OWNERSHIP OF CABLE TV EQUIPMENT, IF YOU ARE UNSURE OF THESE LAWS CHECK WITH YOUR LOCAL OFFICIALS

((FEAT
1. Call
2. Pow
3. Min
4. Wire Rec 1.9
5. Stu
6. Sur
7. Dua

WHY RENT?
$AVE! $AVE!

CABLE TV DESCRAMBLERS

JERROLD • OAK • HAMLIN • ZENITH
PIONEER • SCIENTIFIC ATLANTA

READY-TO -SHIP!

6 MONTH WARRANTY! ABSOLUTELY LOWEST WHOLESALE / RETAIL PRICES!

MASTERCARD • VISA • AMEX • C.O.D.

FREE COLOR CATALOG!
1 (800) 950-9145

JP VIDEO
1470 OLD COUNTRY ROAD
SUITE 315-PE
PLAINVIEW, NY 11803
NO NY SALES

The Time Has Come...

...to send for the latest copy of the free Consumer Information Catalog. It lists more than 200 free or low-cost government publications. Send your name and address to:

Consumer Information Center
Department TH, Pueblo, Colorado 81009

U.S. General Services Administration.

REACH FOR THE POWER. TEACH.

No other profession has this power. The power to wake up young minds. The power to wake up the world. Teachers have that power. Reach for it. Teach. For information call:

1-800-45-TEACH.

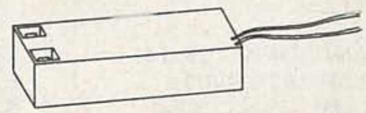
Ad Council

Recruiting New Teachers, Inc.

Courteous Service • Discount Prices • Fast Shipping

ALL ELECTRONICS CORP.
Mail Order Electronic Parts And Supplies
P.O. Box 567 • Van Nuys, CA 91408

LASER POWER SUPPLY

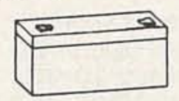


Epoxy encapsulated power supply for up to 2 mW lasers. 4 1/2" X 1 1/2" X 1 7/16". Input: 9 Vdc @ 1 amp. Output starting voltage: 7 to 8 kV. Operating voltage: 1.1 to 1.5 kV Operating current: 4 to 5 mA. Recessed 0.250 quick connect terminals for output. Color coded wire leads for input.
CAT # LPS-1 $35.00 each

RECHARGEABLE Gell Cell Batteries

Maintenance free, rechargeable batteries. Ideal for portable power or back-up power for communications, video, alarms etc. Useable in any position.

6 VOLTS @ 1.2 AMP/HOURS

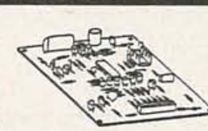


Size: 3.81" X 1" X 2" high.
CAT# GC-612
$6.50 each

12 VOLTS @ 10 AMP/HOURS

Two 6 volt 10 A/H batteries, assembled as a single 12 volt package.Package size: 6" X 3.94" X 3.75"
CAT# GC-1210 $35.00 each

MOTOR SPEED CONTROL AND TIMER



With a minimum of external wiring, this PC board will control the speed and duration of a 120 Vac motor or other load up to 300 watts. When activated, motor will operate for 10, 20 or 40 minutes or continuously at high, medium or low speed. To simplify hook-up we recommend using our membrane keypad, CAT# KPM-12 ($1.25 each) which, with slight modification, works well with this device. Instructions included.
CAT# MSC-5 $3.00 each

FLASH UNITS

NEW compact flash assemblies from a camera manufacturer. Operates on 3 Vdc. Measures 2 1/2" X 1 1/4". Ideal for use as a strobe, warning light or attention getter. Includes a hook-up diagram.
CAT# FSH-1 $3.75 each • 10 for $35.00
100 for $325.00

TOLL FREE ORDER LINES
1-800-826-5432
CHARGE ORDERS to Visa, MasterCard or Discover

TERMS: Minimum order $10.00.Shipping and handling for the 48 continental U.S.A. $3.50 per order. All others including AK, HI, PR or Canada must pay full shipping. All orders delivered in CALIFORNIA must include state sales tax (7 .25%, 7.5%, 7.75%, 8 .25% 8.5%) .Quantities Limited. NO C.O.D. Prices subject to change w/out notice.

Call or Write For Our FREE 64 Page Catalog
(Outside The U.S.A. Send $2.00 Postage)
ALL ELECTRONICS CORP.
P.O. Box 567 • Van Nuys, CA • 91408

CABLETRONICS

CONVERTERS

	1-4Units	5 Units	10 Units
PANASONIC TZP 145	$88.00	$75.00	$70.00
STARGATE 2000	$79.00	$69.00	$65.00
*HAMLIN MCC 3000	$25.00	$19.00	$15.00

ADD-ON DECODERS

SB-3 (NEW)	$50.00	$45.00	$43.00
*SB-3 FACTORY	$45.00	$39.00	$35.00
SA-3	$56.00	$50.00	$45.00
DTB-3	$65.00	$55.00	$50.00
KNI2A-2 or 3	$49.00	$45.00	$40.00
*HAMILIN MLD 1200-3	$49.00	$40.00	$35.00
*ZENITH SSAVI	$165.00	$149.00	$125.00
SA-DF	$159.00	$139.00	$125.00

COMBOS

JERROLD DPV7	$299.00	$249.00	$239.00
JERROLD DPBB	$319.00	$259.00	$249.00
SA8580 COMBO	$299.00	$225.00	$215.00
*JERROLD DRX-3-DIC	$165.00	$105.00	$89.00
JERROLD DRZ-3-DIC	$175.00	$115.00	$99.00
*OAK M35B	$45.00	$35.00	$30.00
HAMLIN SPC 4000 3M	$50.00	$44.00	$44.00

ADD $10.00 FOR VARISYNCH

***Refurbished as New**

QTY	ITEM	OUTPUT CHANNEL	PRICE EACH	TOTAL PRICE

California Penal Code #593-D Forbids us from shipping any cable descrambling unit to anyone residing in the state of california. Prices subject to change without notice.

SUB TOTAL	
Shipping Add 5.00 Per unit	
COD/CreditCard Add 5%	
TOTAL	

Please Print

Name____

Address_________________________City____________

State________Zip________Tel:(   )____________

☐ Cashier's Check ☐ Money order ☐ COD

☐ Visa ☐ MC CC#____________________ Exp. Date______

DECLARATION OF AUTHORIZED USE- I, the undersigned, do hereby declare under penalty of perjury that all products purchased, now and in the future, will only be used on TV systems with all applicable federal and state laws. FEDERAL AND VARIOUS STATE LAWS PROVIDE FOR SUBSTANTIAL CRIMINAL AND CIVIL PENALTIES FOR UNAUTHORIZED USE.

Date__________________Signed____________________

Cabletronics
9800 D Topanga Canyon Blvd., Suite 323,
Chatsworth, CA 91311
For Free Catalog, or to place an order call
(800) 433-2011 • FAX (818) 709-7565

One tree can make 3,000,000 matches.

One match can burn 3,000,000 trees.

A Public Service of This Magazine & The Advertising Council

New solid-state and digital TV sets, stereos, and videorecorders are tougher to repair than old-fashioned tube type sets and require special training for the service technician who works on them.

Only a few states have laws requiring competency tests for licensing technicians who repair consumer electronics, but fifteen years ago the International Society of Certified Electronic Technicians (CET) began its own certification program to qualify these technicians and those in industry. To carry the CET designation, technicians must have four years experience and pass a rigid examination on general electronics and a specific area of expertise such as audio or radio-TV.

Many consumers look for a Certified Electronic Technician in the shop when they need any electronic item repaired.

Free Consumer Checklist

A consumer checklist for selecting a service shop is av-

Modern electronic equipment such as digital TVs or stereos should be repaired by specially trained people.

ailable free by sending a stamped, self-addressed envelope to: Checklist, ISCET, 2708 West Berry, Fort Worth, TX 76109. The list reminds consumers to check such items as "Does the business have the parts for your particular brand?", "Did you get an estimated price?", and "Did you check this company with the Better Business Bureau?"

MC / COD / VISA
NO FLORIDA SALES

CABLE TV DESCRAMBLERS

WORLDWIDE CABLE

- BASE BAND
- TOCOM
- SCIENTIFIC ATLANTA
- JERROLD
- PIONEER
- ZENITH
- OAK
- HAMLIN

1 800-772-3233

1291 A POWERLINE ROAD, SUITE 10
POMPANO BEACH, FL 33069

ELECTECH
CABLE T.V. DESCRAMBL
• All quality brand names •
• All fully guaranteed • All the ti
Knowledgeable Sales Service Depart
FOR FREE CATALOG 800-253-

CABLE TV filters, cylinder type. The best All channels available. Low prices. Quant counts. Call 1 (800) 643-9170 ext. 170.

DESCRAMBLERS and turn-on kits, no 80 catalog; just the best prices! We'll beat an mate price — call for details. (407) 852-9

300 Experimenters Circuits — Comple practical books using diodes, relays, LED's, IC 555's, and IC CA3130's for b blocks. Only $33.00 plus $5.50 for shippin and Canada only. US funds. **ETT, INC.,** 240, Massapequa Park, NY 11762-0240.

ANTIQUE RADIO CLASS
Free Sample!
Antique Radio's
Largest Circulation Monthly.
Articles, Ads & Classifieds.

6-Month Trial: $15. 1-Yr: $27 ($40-1s
A.R.C., P.O. Box 802-L9, Carlisle, M

CABLE TV converters: Jerrold, Oak, Atlantic, Zenith & many others. "New MT add-on: mute & volume. Ideal for 400 owners! 1 (800) 826-7623, Amex, Visa, cepted. **B & B INC.,** 4030 Beau-D-R Eagan, MN 55122.

ELECTRONIC test equipment and pa catalog. **EF ELECTRONICS,** Box 326, 60507.

CABLE TEST CHIPS. S-A 8550, S-A 310, 311, 320, 321 (specify) — $33 8580/338 — $69.95. TOCOM 5503/0 $33.95. Starcom 6 — $33.95. Starc $49.95. **TELECODE,** PO Box 6426-R AZ 85366-6426.

CABLE TV descramblers! Absolutely t prices! All major brands. Nobody beats **CABLE PRICE CLUB,** 1 (800) 377-974

PREVENT descrambler damage. Don bullet!! Snooper Stopper Data Puls $33.95, with Surge Protection $44.95. Video Sender $54.95. **VCI,** 1 (800) 925

FREE CATALOG!
1-800-648-7938
ERROLD HAMLIN OAK ETC
CABLE TV DESCRAMBLERS
- *Special Dealer Prices!*
- *Compare our Low Retail Prices!*
- *Guaranteed Prices & Warranties!*
- *Orders Shipped Immediately!*

REPUBLIC CABLE PRODUCTS, INC.
4080 Paradise Rd. #15, Dept RE1192
Las Vegas, NV 89109
For all other information (702) 362-9026

PAY TV AND SATELLITE DESCRAMBLING
ALL NEW 1992 EDITION ALL NEW
992 Edition updates latest Circuits, Turn-ons, Bypasses, Bullets, Bags, Blackphers, VCII Plus and B-Mac Fixes. Only $15.95. VCII Wizzard Hacker's Bible cludes Plus. Tells All. $15.95. Pay TV and Satellite Descrambling Vol. 1 (Bacs), 1989, 1991 Editions are all different. $14.95 each. MDS Handbook $9.95. atellite Systems under $600. $12.95 (52). Any 3/$29.95 or 5/$49.95. Scraming News Monthly will keep you up to date on Plus breaks. $24.95/yr. special. verything we have including video, $109.95 New Catalog $1.
Scrambling News, 1552 Hertel Ave.,
Buffalo, NY, 14216. Voice/Fax (716) 874-2088
COD'S ARE OK. ADD $6

SATELLITE TV

REE catalog — Lowest prices worldwide. **SKY-SION,** 1012 Frontier, Fergus Falls, MN 56537. 1 00) 334-6455. See full page ad the Shopper ction.

ATELLITE TV — Do it yourself — major brands scounted, we'll beat everyone's price. **DIS-OUNT LARRY** (609) 596-0656.

DEOCIPHER II, descrambling manual. Schematics, video, and audio. Explains DES, Eprom, oneMaster, 3Musketeer, Pay-per-view (HBO, nemax, Showtime, Adult, etc.) $16.95, $2.00 ostage. Schematics for Videocypher Plus, 0.00. Schematics for Videocypher 032, $15.00. ollection of software to copy and alter Eprom des, $25.00. **CABLETRONICS,** Box 30502R, ethesda, MD 20824.

UPER low satellite prices. Free U.S. and International catalog. **SATMAN,** (309) 692-4140 (Int'l), 800) 472-8626 in U.S.

BUSINESS OPPORTUNITIES

OUR own radio station! Licensed/unlicensed M, FM, TV, cable. Information $1.00. **BROAD-ASTING,** Box 130-F11, Paradise, CA 95967.

T the government finance your small business. ants/loans to $500,000. Free recorded message: **(707) 449-8600.** (KS1).

CABLE TV DESCRAMBLERS
1-800-582-1114
FREE CATALOG
ARANTEED BEST PRICES • IMMEDIATE SHIPPING
M.K. ELECTRONICS
8362 Pines Blvd. Suite 276
Pembroke Pines, Fl 33024

CABLE TV SCRAMBLER LIQUIDATION!
FREE CATALOG!
lin Combos $44, Oak M35B $60 (min. 5), etc.
EST COAST ELECTRONICS
For Information: 818-709-1758
Catalogs & Orders: 800-628-9656

FREE CATALOG
• CABLE T.V. BOXES - ALL TYPES •
• LOW PRICES - DEALER PRICES •

ACE PRODUCTS
1-800-234-0726

EASY work! Excellent pay! Assemble products at home. Call toll free **1 (800) 467-5566** Ext. 5192.

HOME assembly work available! Guaranteed easy money! Free details! **HOMEWORK-R,** Box 520, Danville, NH 03819.

MONEYMAKERS! Easy! One man CRT rebuilding machinery. $6,900.00 rebuilt. $15,900.00 new. **CRT,** 1909 Louise, Crystalake, IL 60014. (815) 477-8655. FAX (815) 477-7013.

MAKE $75,000.00 to $250,000.00 yearly or more fixing IBM color monitors. No investment, start doing it from your home (a telephone required). Information, USA, Canada $2.00 cash for brochure, other countries $10.00 US funds. **RANDALL DISPLAY,** Box 2168-R, Van Nuys, CA 91404 USA. FAX (818) 990-7803.

★★★★PRESENTING★★★★
CABLE TV DESCRAMBLERS
★★★★★ STARRING ★★★★★
JERROLD, HAMLIN, OAK
AND OTHER FAMOUS MANUFACTURERS
- FINEST WARRANTY PROGRAM AVAILABLE
- LOWEST RETAIL/WHOLESALE PRICES IN U.S.
- ORDERS SHIPPED FROM STOCK WITHIN 24 HRS.
- ALL MAJOR CREDIT CARDS ACCEPTED

FOR ALL INFORMATION
1-800-345-8927

PACIFIC CABLE CO., INC.
7325½ Reseda Blvd., Dept 2120
Reseda, CA 91335

BEST BY MAIL
Rates: Write National, Box 5, Sarasota, FL 34230

OF INTEREST TO ALL

MONITOR CORDLESS TELEPHONE Conversations from your home or car. For details send $10.00 to: Bennett Distributors, 824 EA. Rand Road, Suite 186, Arlington Heights, IL 60004.

FREE HOME POSSIBLE! Sensible mortgage system reveals! Just $3.00: JENRON, Box 447-(RE), Batavia, NY 14021.

FREE PROFITABLE INFORMATION: Team, 1505-(RE) Avenue G, Fort Madison, IA 52627.

HERBS & SPICES

HERBS, SPICES, SASE: Herb Sense, 1032 Irving St., Box 446-(RE), San Francisco, CA 94122.

LEARN gold, silver, platinum scrap recycling business. (Free) information. Write: **RECYCLING,** Box 11216PE, Reno, NV 89510-1216.

ELECTRONICS dealers: Expand your product line. **Make $$$!** Become an **AMERICAN ELECTRONICS** dealer! Profit opportunities since 1965. Call Scott Pruett, 1 (800) 872-1373.

SATELLITE Television. A new money making business. A 4 hour install makes approximately $500.00 and service rates average $50.00/hr. Excellent part or full time income. Get started, send for your training kits today. Home Satellite Television kit $39.95. Commercial Satellite kit $49.95. Order both to receive your free video and supplies list. **S.B.G. ENTERPRISES,** Box 76051 Shawville Blvd. SW, Calgary, Alberta, Canada T2Y-2Z9.

EDUCATION & INSTRUCTION

F.C.C. Commercial General Radiotelephone license. Electronics home study. Fast, inexpensive! "Free" details. **COMMAND,** D-176, Box 2824, San Francisco, CA 94126.

ELECTRONIC engineering. 8 volumes complete. $109.95. No prior knowledge required. Free brochure. **BANNER TECHNICAL BOOKS,** 1203 Grant Avenue, Rockford, IL 61103.

LEARN electronics and digital basics. Programmed courses. $17.00 each, both $29.00. Satisfaction guaranteed. **TEK SOURCES,** 6050 NW 68th St., Parkland, FL 33067.

BUILDING A Robot: A Straightforward Approach. 152 pages fully illustrated. Instructions how you can easily construct a robot. Check or money order. $19.95 plus $3.00 shipping. **HUMANFORM ROBOTICS,** PO Box 158486, Nashville, TN 37215.

WHY Buy expensive batteries? Learn how to: salvage virtually free rechargeable nicad batteries from defunct battery packs. Use these cells in radios, flashlights, etc. SASE brings details. **DAY BY DAY PUBLISHING,** Box 490, Overton, NV 89040.

MINIATURE gambling computer. Play perfect blackjack, clock roulette wheels, etc. Free information. **RLT ENTERPRISES,** Box 424, Portland, OR 97207.

LEARN COMPUTERS!
Home study: become an expert with the personal computer for home or business use. Free literature: call 800-223-4542.
Name
Address
City State Zip
School of Computer Training, Dept. KM342
2245 Perimeter Pk., Atlanta, Georgia 30341

WANTED

INVENTORS: We submit ideas to industry. Find out what we can do for you. **1 (800) 288-IDEA.**

INVENTORS

INVENTORS! Can you patent and profit from your idea? Call **AMERICAN INVENTORS CORP.** for free information. Serving inventors since 1975. 1 (800) 338-5656.

SINGERS! REMOVE VOCALS!
Unlimited Backgrounds™
From Standard Records & CD's with the Thompson Vocal Eliminator™ Call for Free Catalog & Demo Record.
Phone: (404)482-4189 Ext 72
Singer's Supply, Dept RL-1
7987 Hightower Trail
Lithonia, GA 30058
24 Hour Demo/Info Request Line (404)482-2485 Ext 72
Singer's Supply - We Have Anything & Everything For Singers

MASTERCARD AND VISA are now accepted for payment of your advertising. Simply complete the form on the first page of the Market Center and we will bill.

BUY BONDS

THE ELECTRONIC GOLDMINE

The Electronic Goldmine has one of the greatest selections of unique electronic kits available in the world! We have over 65 kits and over 1,400 unique, bargain priced, components in our catalog!

FREE CATALOG with OVER 1400 DIFFERENT ITEMS INCLUDING 60 KITS! REQUEST YOUR COPY TODAY!

INFRARED DETECTOR KIT
Great for testing and verification of infrared output. 9V battery not included.
C6441 $5.95

LCD WATCH MODULE
These were the heart of a high quality LCD watch. They are brand new and are shipped with a good battery. You must remove a tiny screw (with a jeweler's screwdriver) to remove the protective plastic covering the battery compartment. These can display date, time, and even have an alarm; but if you wish to make use of the alarm feature you have to connect any 2 lead piezo (you supply the piezo) to the tiny gold springs on the back of the module. Size 1 1/8" diameter. Complete ready to use - but no case.
G2741 $1.25

INEXPENSIVE GEIGER COUNTER KIT
Detects both Beta and Gamma Rays. 9V battery not included.
C6447 $39.95

MUSIC MODULE NEW
Tiny flat music module made for a greeting card company. These are brand new and play a pleasant tune each time activated. The song is "Let me call you Sweetheart". Features large flat piezo disk, actuater lever, music IC and battery holder all on a small "PC board". Battery not included but operates from any 1.3V tiny hearing aid cell. (You can just about choose any cell and it will work.)
G2744 89¢

PRECISION HIGH SPEED MOTOR
Great for Robots, miniature fans, etc. Size 1 1/8" x 9/16". Operates from 1.0VDC up to 9VDC.
G2846 1.00 ea 10/8.00

BURGLAR/FIRE ALARM KEYBOARD CONTROL PANEL NEW
These are actual late model control-panels made for use on home/ Business, burglar/ fire alarms. They contain 6 bright LEDS, a 12 key control keypad with 2' cable and connector. These are brand new and the LEDS can be lighted with just the addition of a 9V battery to several points on the connector (we show you which ones) to provide you with the most realistic looking "fake" burglar alarm. The average burglar is going to think that you have a very sophisticated alarm system installed! Size 4 9/16" square 1/2" thick with 3 molded standoffs under panel. These are a great flea market items that can be sold for $10.00 or more! Order fast to avoid dissapointment!
G2904 $3.00 ea 10 FOR $25.00 100 FOR $230.00

MINIMUM ORDER: $10.00 plus $3.50 shipping and handling.
We accept MC, Visa and Money Orders.
SEND ORDERS TO: The Electronic Goldmine
P.O. Box 5408 Scottsdale, AZ 85261
PHONE ORDERS (602) 451-7454 FAX ORDERS (602) 451-9495

CIRCLE 194 ON FREE INFORMATION CARD

CABLE DESCRAMBLERS

Converters, Remote Controls, Descramblers, more

#EX192

All major brands carried
*JERROLD, *TOCOM, *ZENITH
*GENERAL INSTRUMENTS
*SCIENTIFIC ATLANTA, *OAK
*HAMLIN, *EAGLE, *PIONEER

7th Year in business. Thank You
Member of Omaha Chamber of Commerce
1 Year warranty on new equipment
30 Day money back guarantee
Orders shipped from stock within 24 hours

CALL TODAY FOR A FREE CATALOG
1-800-624-1150
VISA MasterCard AMERICAN EXPRESS C.O.D.

M.D. ELECTRONICS
875 SO. 72nd St.
Omaha, NE 68114

CIRCLE 53 ON FREE INFORMATION CARD

ADVERTISING INDEX

Electronics Now does not assume any responsibility for errors that may appear i[n the]
index below.

ADVERTISING SALES OFFI[CE]

Gernsback Publications, Inc.
500-B Bi-County Blvd.
Farmingdale, NY 11735
1-(516) 293-3000
President: **Larry Steckler**

For Advertising ONLY
516-293-3000
Fax 1-516-293-3115

Larry Steckler
publisher
Christina Estrada
assistant to the President
Arline Fishman
advertising director
Denise Mullen
advertising assistant
Kelly McQuade
credit manager

Subscriber Customer Service
1-800-288-0652
Order Entry for New Subscriber[s]
1-800-999-7139
7:00 AM - 6:00 PM M-F MST

ADVERTISING SALES OFFICES
EAST/SOUTHEAST
Stanley Levitan, Eastern Advertisin[g]
Manager
Electronics Now
1 Overlook Ave.
Great Neck, NY 11021
1-516-487-9357, 1-516-293-3000
Fax 1-516-487-8402

MIDWEST/Texas/Arkansas/Okl[a.]
Ralph Bergen, Midwest Advertising
Manager
Electronics Now
One Northfield Plaza, Suite 300
Northfield, IL 60093-1214
1-708-446-1444
Fax 1-708-559-0562

PACIFIC COAST/Mountain Sta[tes]
Electronics Now Magazine
Pamela Kuster
Pattis/3M
1800 North Highland Avenue
Suite 717
Hollywood, CA 90028

EN Shopper
Joe Shere, National Representativ[e]
P.O. Box 169
Idyllwild, CA 92549
1-714-659-9743
Fax 1-714-659-2469

Countersurveillance

/er before has so much /fessional information on the art detecting and eliminating ctronic snooping devices—and v to defend against experienced ormation thieves—been placed one VHS video. If you are a tune 500 CEO, an executive in / hi-tech industry, or a novice eking entry into an honorable, varding field of work in untersurveillance, you must w this video presentation again d again.

CALL NOW!

1-516-293-3751

HAVE YOUR VISA or MC CARD AVAILABLE

Vake up! You may be the victim of en words—precious ideas that would e made you very wealthy! Yes, profes- ıals, even rank amateurs, may be lis- ing to your most private con- ;ations.

Vake up! If you are not the victim, n you are surrounded by countless vic- s who need your help if you know how liscover telephone taps, locate bugs, or eep" a room clean.

There is a thriving professional service :ped in high-tech techniques that you become a part of! But first, you must ɔw and understand Countersurveilance hnology. Your very first insight into s highly rewarding field is made possi- by a video VHS presentation that you ınot view on broadcast television, sat- te, or cable. It presents an informative gram prepared by professionals in the d who know their industry, its tech- ques, kinks and loopholes. Men who ı tell you more in 45 minutes in a aightforward, exclusive talk than was :r attempted before.

Foiling Information Thieves

Discover the targets professional ɔopers seek out! The prey are stock ɔkers, arbitrage firms, manufacturers, gh-tech companies, any competitive lustry, or even small businesses in the ne community. The valuable informa- n they filch may be marketing strat- ies, customer lists, product formulas, ınufacturing techniques, even adver- ing plans. Information thieves eaves- op on court decisions, bidding formation, financial data. The list is limited in the mind of man—es- cially if he is a thief!

You know that the Russians secretly stalled countless microphones in the ncrete work of the American Embassy uilding in Moscow. They converted what was to be an embassy and private residence into the most sophisticated recording studio the world had ever known. The building had to be torn down in order to remove all the bugs.

Stolen Information

The open taps from where the information pours out may be from FAX's, computer communications, telephone calls, and everyday business meetings and lunchtime encounters. Businessmen need counselling on how to eliminate this information drain. Basic telephone use coupled with the user's understanding that someone may be listening or recording vital data and information greatly reduces the opportunity for others to purloin meaningful information.

CLAGGK INC. EN
P.O. Box 4099 • Farmingdale, NY 11735

Please rush my copy of the Countersurveillance Techniques Video VHS Cassette for a total cost of $53.95 each (which includes $4.00 postage and handling).

No. of Cassettes ordered ________
Amount of payment $________
Sales tax (N.Y.S. only) ________
Total enclosed ________
Bill my ☐ VISA ☐ MasterCard
Card No. ________
Expire Date ____/____

Signature ________
Name ________
Address ________
City ________ State ______ ZIP ______

All payments in U.S.A. funds. Canadians add $4.00 per VHS cassette. No foreign orders.

The professional discussions seen on the TV screen in your home reveals how to detect and disable wiretaps, midget radio-frequency transmitters, and other bugs, plus when to use disinformation to confuse the unwanted listener, and the technique of voice scrambling telephone communications. In fact, do you know how to look for a bug, where to look for a bug, and what to do when you find it?

Bugs of a very small size are easy to build and they can be placed quickly in a matter of seconds, in any object or room. Today you may have used a telephone handset that was bugged. It probably contained three bugs. One was a phony bug to fool you into believing you found a bug and secured the telephone. The second bug placates the investigator when he finds the real thing! And the third bug is found only by the professional, who continued to search just in case there were more bugs.

The professional is not without his tools. Special equipment has been designed so that the professional can sweep a room so that he can detect voice-activated (VOX) and remote-activated bugs. Some of this equipment can be operated by novices, others require a trained countersurveillance professional.

The professionals viewed on your television screen reveal information on the latest technological advances like laser-beam snoopers that are installed hundreds of feet away from the room they snoop on. The professionals disclose that computers yield information too easily.

This advertisement was not written by a countersurveillance professional, but by a beginner whose only experience came from viewing the video tape in the privacy of his home. After you review the video carefully and understand its contents, you have taken the first important step in either acquiring professional help with your surveillance problems, or you may very well consider a career as a countersurveillance professional.

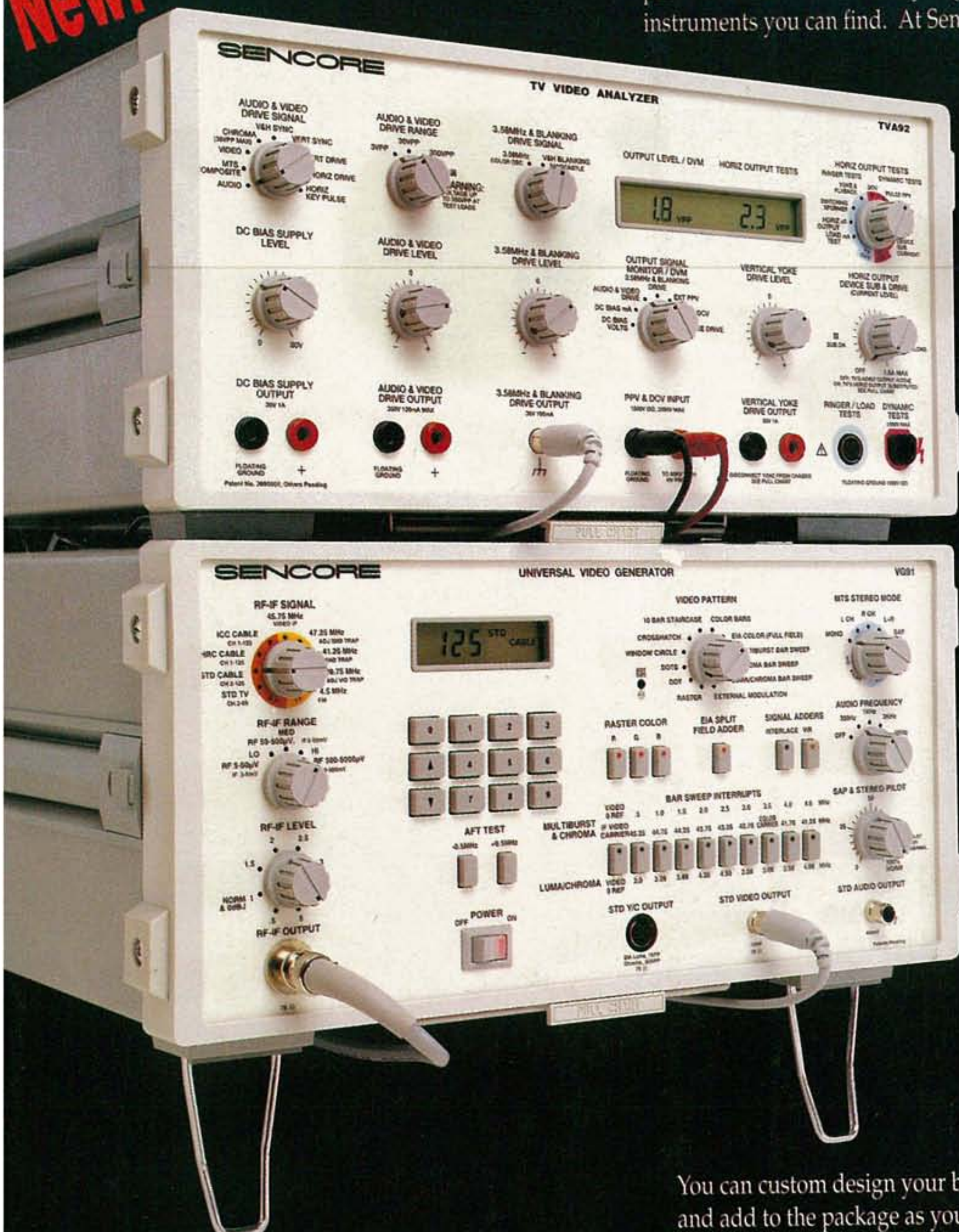
The Dollars You Save

To obtain the information contained in the video VHS cassette, you would attend a professional seminar costing $350-750 and possibly pay hundreds of dollars more if you had to travel to a distant city to attend. Now, for only $49.95 (plus $4.00 P&H) you can view ***Countersurveillance Techniques*** at home and take refresher views often. To obtain your copy, complete the coupon or call.

Twice The Power In One Video Analyzing Syst

New!

Finally, there is a full featured, compatible, and complementary ana
system specially designed by servicers for servicers. This new syste
provides over twice the analyzing power of any combination of no
instruments you can find. At Sencore, we call it the "Tech Choice S



Introducing T
TVA92 TV Vi
Analyzer

Now Everything You N
Isolate TV Defects, Tro
Start-up/Shut-down Pr
And Test Expensive Co
Plus, Accurately Estima
Repair Cost .

And,
Introducing T
VG91 Univer
Video Gener

A Complete All Chan
RF/IF/MTS Universal
Generator Designed T
Performance Test And
Defects In Any NTSC
System!

You can custom design your bench to fit your individual analyz
and add to the package as your business needs grow. Plus, with
exclusive commitment to the service industry, you are assured t
system investment will protect your business with additional in
upcoming complementary instruments.

Call 1-800-SENCORE (736-2673) ext. 739

TECH CHO

CIRCLE 193 ON FREE INFORMATION CARD

SENCORE