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POPULAR ELECTRONICS

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1954
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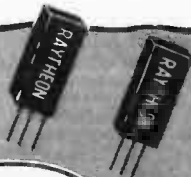
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COVER PHOTO: This young experimenter, shown testing the Heathkit A-7B audio amplifier, is not only acquiring valuable "know-how" by assembling and testing such a unit but is adding to his hi-fi system at low cost. This is only one of a wide variety of kits available to experimenters. Such kits offer the twin benefits of practical experience with electronic circuitry and a carefully-engineered unit which makes a professional addition to the workshop or home music system. See article on page 30 for details on this amplifier. (Ektachrome by John Deejen)

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NOVEMBER
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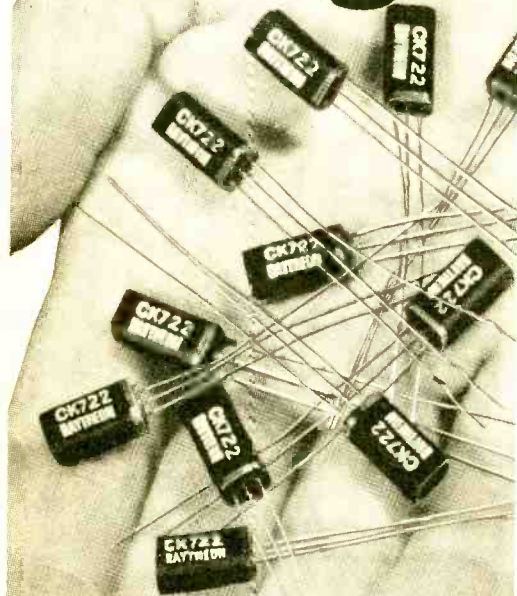
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(November)

Choosing Your Hi-Fi Loudspeaker
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The Practical Switchless Intercom
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Servicing Record Changers
Transistor Amplifier for Meters
All-Purpose Enclosure for 12" Speakers

POPULAR ELECTRONICS

DECEMBER
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VOL. I - NUMBER 3

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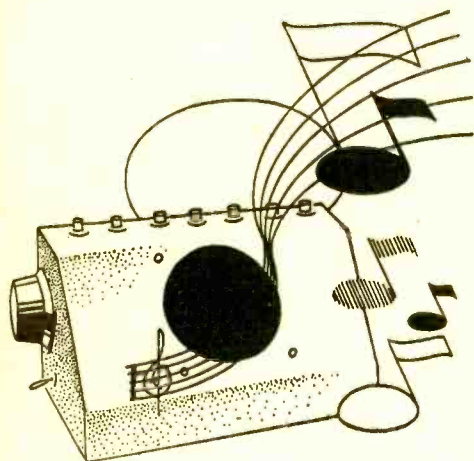
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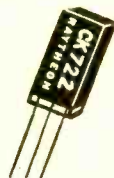
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COMING NEXT MONTH POPULAR ELECTRONICS

Fun with a Geiger Counter
Photoelectric Rifle Range
Two-Tube Broadcast Receiver
A Deluxe Photographic Timer
Novice C. W. Transmitter
"Two-Way" Electronic Metronome
Safford R/C Receiver

Plus More On

High-Fidelity Audio • Kits • Radio Control • Short-Wave Listening • What's New • How It Works • How to Make It • How to Use It • Carl & Jerry

IN THIS MONTH'S RADIO & TELEVISION NEWS

(December)

Build Your Own TV Color Converter
Midget FM Tuner
Choosing Your Hi-Fi Speaker Enclosure
Compact 100-Watt Bandswitching Transmitter
Servicing Printed Wiring TV Sets
A Single-Sideband Audio Test Oscillator
Transistor Vibration Amplifier

POPULAR ELECTRONICS

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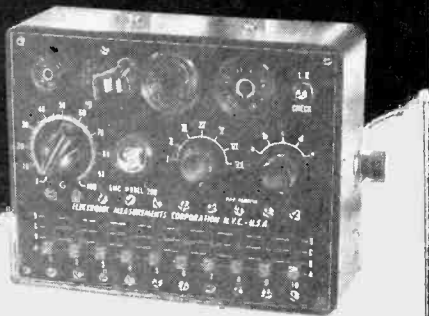
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- Checks completely for quality as well as shorts, leakages, filament continuity or opens between any two tube elements
- Visual line voltage check with adjustable control assures accurate quality testing
- Matches and checks Hi-Fi tubes such as 1614, KT 66, and 5881
- Space saving, high impact case, 5 1/4 x 6 3/4 x 2 7/8"
- Comes complete with detailed instruction book and tube listings

An invaluable tool for: Servicemen, radio hams, Hi-Fi fans, students, hobbyists.

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380 LAFAYETTE STREET
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COMING NEXT MONTH POPULAR ELECTRONICS

- "R/C Garage Door Opener"
- "Novice CW Transmitter"
- "Broadcast Band Receiver"
- "How Vacuum Tube Amplifiers Work"
- "How Tapes Are Made"
- "Servo R/C Escapements"

Plus More On

- High-Fidelity Audio • Kits • Radio Control
- Control • Short-Wave Listening • What's New • How It Works • How to Make It • How to Use It • Carl & Jerry

IN THIS MONTH'S RADIO & TELEVISION NEWS

(January)

- "High-Fidelity the Easy Way"
- "Six-Meter Emergency Transmitter and Power Supply"
- "A New Pocket Radio"
- "Frequency Standard for the Novice"
- "A Beat-Frequency Audio Oscillator"

POPULAR ELECTRONICS

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1955
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A Frequency Meter Monitor for Ham Stations
Power Supply
What We Hear
How to Add Extension Speaker
Plus More On
High-Fidelity Audio • Kits • Radio Control • Short-Wave Listening • What's New • How It Works • How to Make It • How to Use It • Carl & Jerry

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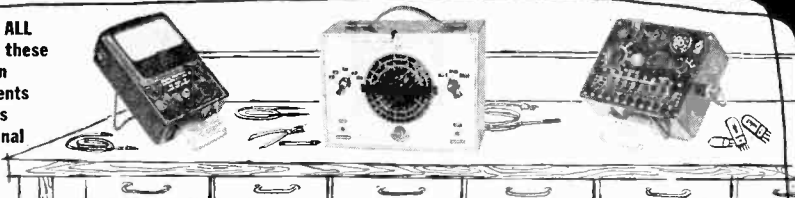
(February)

A Preselector for the SWL
"Mobile Meter" of Many Uses
A 60-watt "Ultra-Linear" Amplifier
Radio Licensing and the FCC
A "Universal" Counter
Intermodulation Distortion Tester

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You get ALL three of these precision instruments ... in this sensational offer!



EMC model 106 VTVM

Price of this individual unit
Model 106 (wired and tested) \$35.90
Model 106 (in kit form) \$23.90
Accessory probes available

EMC model 500 R.F. Signal Generator

Price of this individual unit
Model 500 (wired and tested) \$29.75
Model 500 (in kit form) \$19.75

EMC model 208 Tube Tester

Price of this individual unit
Model 208 (wired and tested) \$24.90
Picture tube adapter available

HOW TO GET IN ON THIS SENSATIONAL OFFER!

Start your own service shop with professional precision test equipment at solid savings plus the free Picture Tube Adaptor and Instrument Stands given in this special EMC offer.

Go to your favorite local jobber, purchase the above three instruments (Models 106, 500, 208), mail the three enclosed guarantee cards to EMC and receive by return mail your free \$6.46 worth of valuable accessories. This is a limited offer so act TODAY!

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Note these instruments can be purchased individually.

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COMING NEXT MONTH POPULAR ELECTRONICS

Electronic Music With The Theremin
Compact AM Tuner
Transistor Push-Pull Oscillator
20 Watt Novice Transmitter
Simple Power Supply for the Experimenter
Project Cyclone

Plus More On

High-Fidelity Audio ■ Kits ■ Radio Control
■ Short-Wave Listening ■ What's New ■
How It Works ■ How to Make It ■ How to Use It ■ Carl & Jerry

IN THIS MONTH'S RADIO & TELEVISION NEWS

(March)

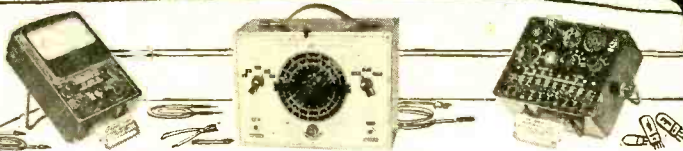
Audio Noise Check List
TV Stations on the Air
Loudspeakers—The Weakest Audio Link
New British Power Amplifier
Narrow-Band Speech Unit
The Audio Squelcher
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Total retail cost if purchased **\$6.46**

You get ALL three of these precision instruments ...in this sensational offer!



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Price of this individual unit
Model 106 (wired and tested) \$35.90
Model 106 (in kit form) \$23.90
Accessory probes available

EMC model 500 R.F. Signal Generator
Price of this individual unit
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COMING NEXT MONTH POPULAR ELECTRONICS

A Simple Lie Detector
First Experiments With Thyrafrons
Checking Your Portable Radio for Summer Fun
Heat Without Flame
A Dime Oscillator
Stereophonic Sound
The Boom in Radio-Controlled Boats
Project Tinkertoy
A Precision Photographic Timer
Plus More on
High-Fidelity Audio ■ Kits ■ Radio Control
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How It Works ■ How to Make It ■ How to
Use It ■ Carl & Jerry

IN THIS MONTH'S RADIO & TELEVISION NEWS

(April)

A Portable Scintillation Counter
Make Ready for Transistors
An Electronic Combination Lock
Erasing Troubles in Tape Recorders
Are You Ready for Conelrad?



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• 5 DB ranges —4 to +67 • 3 AC current ranges, 0-600 ma. • 4 DC current ranges, 0-1.2 amps.
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- Picking Your Pickup
- Talking With a Light Beam
- Distortion in Your Hi-Fi System
- Transistor Sine Wave Generator
- Heat Without Flame
- Our R/C Monster

Plus More on

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- Kits
- Radio Control
- Short-Wave Listening
- What's New
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JUNE 1955

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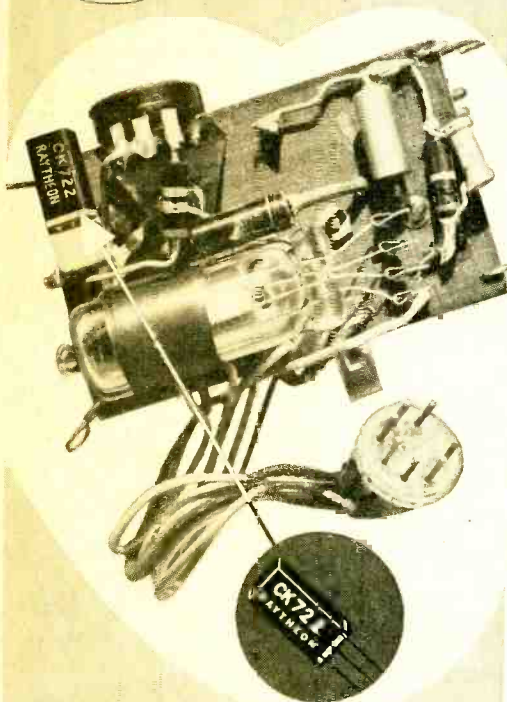
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- Light Beam Transmitter for Voice Communication
- Audio Frequency Meter
- Checking Out Clock Radios
- Easily Built Chassis Rack
- Transistor Pocket Radio Receiver

- High-Fidelity Audio ■ Kits ■ Radio Control
- Short-Wave Listening ■ What's New ■
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- Carl & Jerry ■ Tips & Techniques

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Line Voltage Booster

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connection isn't easy to determine while you're doing the wiring, so the best way to proceed is to do all the wiring but make the transformer primary connections temporary. Then set switch *S3* to the 12.6-volt position, *S1* to *line*, and plug the booster into an a.c. outlet. Note the meter reading.

Now switch *S1* to *boost*. The meter reading should increase, indicating that the transformer secondary voltage is being added to the line. If the meter reading decreases when *S1* is set to *boost*, unplug the booster and reverse the two transformer primary (black) leads.

An "economy" booster will be sufficient in a large number of applications, since 6.3 volts of boost is all that is required. The circuit is shown in wiring diagram (B). In this particular model, the transformer has a 3-amp., 6.3-volt secondary and can be used to boost the line voltage to any device requiring up to 300 watts of power.

The transformer may be phased in exactly the same manner described for the de luxe model using a TV set plugged into the receptacle and phasing the transformer for maximum picture size when the booster switch is set in the *boost* position.

Other uses for line boosters are almost as great as the number of appliances designed to be plugged into an a.c. outlet. A booster is especially effective when used with voltage-sensitive appliances, such as electric food mixers, sewing machine motors, electric fans, hand power drills, etc. Photographic darkroom enthusiasts will find a booster just what the doctor ordered for keeping the enlarger or contact printer lamp up to full brilliance.—*B. W. Blackford.*

METAL LOCATOR QUIZ

(Questions on page 88)

1. Beat-frequency locators indicate the presence of metal by a change in pitch; the field-distortion type reacts by changing the loudness of the tone and also, as a rule, by a visual meter indication. 2. If a non-ferrous metal causes a rise in pitch, a ferrous metal will produce a falling pitch, and vice-versa. 3. The field-distortion type. See cost chart. 4. Although rain water alone is a poor electrical conductor, it dissolves minerals in the soil to form electrolytes, or current-carrying liquids. These react on both forms of metal locators by producing spurious indications. 5. This orientation minimizes the direct pickup from transmitter to receiver so that the initial balancing adjustment may be made sensitive to small distortions of the field by metals or ores.

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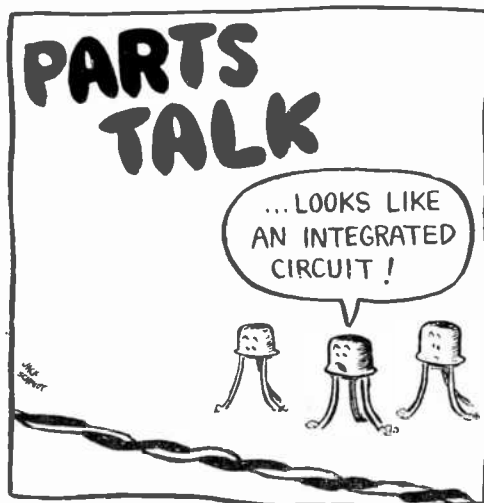
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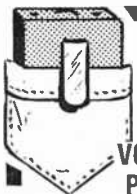
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ANSWERS ELECTRONICS IQ QUIZ

(On page 65)

- Answer: A. The bulbs correspond as follows: 1-C, 2-B, 3-E, 4-F, 5-A, 6-D.
- Answer: A. The combined resistance of resistances in parallel is always less than the smallest one in the group.
- Answer: C. All of the diodes are reverse-biased except C which is forward-biased.
- Answer: 7 A. The sum of the currents entering a junction must equal the sum of the currents leaving it. With 25 amperes flowing toward the center and 18 A flowing away, current G must be 7 A.
- Answer: D. All of the resistor combinations have an equivalent resistance of 12 ohms except D.
- Answer: C. Drawing C is upside down. Drawing B is reversed and rightside up, but one of the holes has been moved.
- Answer: 5864. A kilowatt-hour meter is read from left to right.
- Answer: 1-B, 2-C, 3-A.
- Answer: C. All of the components have the names of animals except C. A: crocodile clip; B: pigtailed; C: banana plug; D: rabbit ears.
- Answer: 24. A = 6, add 3; B = 9, add 4; C = 13, add 5; D = 18, add 6; E = 24.

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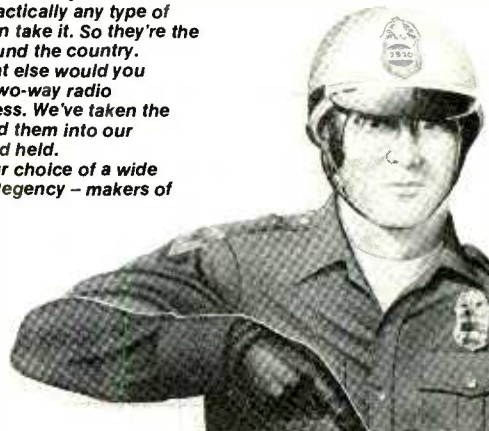
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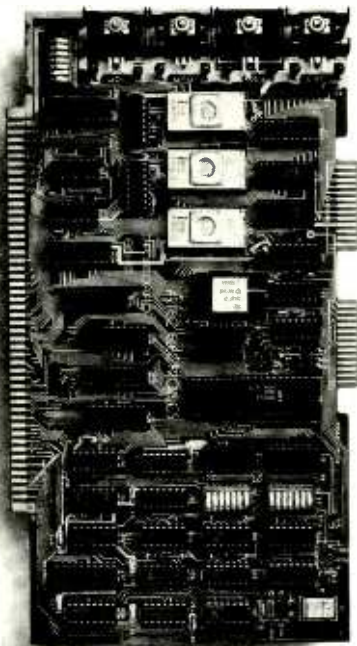
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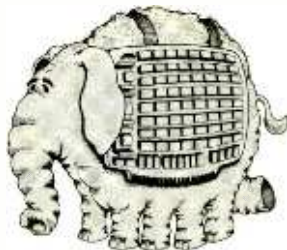
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Supreme, Inc. Model 655 oscilloscope. Need .5 mfd-1500 VDC capacitor and schematic. George Karastas, 3701 Mt. Aladin Ave., San Diego, CA 92111.

Atari CS-2600. Need schematic and specific information on the I/O port. Paul Yoes, 245 Koy Rd., Bellville, TX 77418.

Crosley Radio Corp. U.S. Army radio receiver and transmitter #3C-654A, Serial #46716. Need repair manual, operations manual and schematic. Michael J. Cedek, 2903 Gene Lane, Arlington, TX 76010.

Hallcrafters Model PC-210F radio. Need schematics. Narciso R. Villafane, Lemay 108 Ramey Base, Aguadilla, PR 00604.

Weston Model 983 oscilloscope. Need schematic and operation manual. Bill Allen, 35 Eagle St., Terryville, CT 06786.

Zenith Model G4541W Chromcolor II TV. Need schematic or service manual. C. G. Malseed, 331 Penny St., McKeesport, PA 15132.

General Electric Model #GEL-740 radio. Need schematic, instructions, alignment information and service manual. Richard R. Eggers, 191 N. Park Victoria Dr., Milpitas, CA 95035.

Craig Model 6408 videotape receiver. Need manual, parts list and schematic. T. Langley, 52 Sarles Lane, Pleasantville, NY 10570.

Hammarlund Model HQ100 receiver. Need manual, parts list and schematic. T. Langley, 52 Sarles Lane, Pleasantville, NY 10570.

Hickock Model OSK-4 teaching systems oscilloscope Model OSK-4. Need manual and schematic. Mark Abrams, 79 Nichol Ave., New Brunswick, NJ 08901.

Mercury Model 880 picture tube tester. Need instruction book. James E. Stewart, 1607R NE 15th Ave., Fort Lauderdale, FL 33305.

Precision Model ES-500A oscillograph. Need schematic and parts list and/or service manual. Jon M. Sobel, Box 7282, St. Petersburg, FL 33714.

Dumont Model TO-100 television camera. Need schematic and/or service manual. Gary Montgomery, 1011 Westwood Drive, Elkview, WV 25071.

Electrodata Co. Model AG-1 audio generator. Need schematic. R.H. Klapheke, 4113 Sunflower Dr., Louisville, KY 40216.

Conair Model 224 tube tester. Need CRT testing chart and adapter description(s). Jim Vassil, Box 4691, Redding, CA 96099.

Elco Model 625 tube tester. Need schematic and operating manual. John O. Tjebban, 5008 Will-O-Dean Rd., Raleigh, NC 27604.

Hallcrafters Model SX96 receiver. Need schematic, alignment data and operating manual. George Zintak, 8617 S. Karlov, Chicago, IL 60652.

Lafayette HA-800 Receiver. Need schematic and alignment manual. Robert W. Halcro, U.S. Army Element Alfsee, Box 2195, APO NY, NY 09224.

Tequipment oscilloscope Model D61A. Need service manual or schematic. M. Repouic, Box 403, Boston, MA 64080.

General Electric Model M-81 receiver. Need schematic. George Henley, 502 N. Armstrong, Pleasant Hill, MO 64080.

Texas Instruments Model PHP 1700. Need accessories interface. Rober Fein, 48 Pratt St., Allston, MA 02134.

Educational microcomputer systems Model M68K. Need schematics and documentation. **Motorola** Macsbug monitor. Need assembly language source listing. Joseph R. Stewart, 586 Plain St., Stoughton, MA 02072.

RCA Model TMV-97-B, r.f. oscillator. Need schematic and other available information. Russ Sandman, 560 Forest Hills Blvd., Waverly, OH 45690.

Digicom Data Products Modem Model AC-312. Need manual and schematics. Harold Wright, 7144 Center St., Highland, CA 92346.

EMC Model 502. Need schematic and NTS construction manual and parts list. M.M. Zamir, Box 1253, NY, NY 10451.

Philco Model 37-640 multiband radio and **Lear** model G511 phono and wire-recorder with model WC311A radio. Need schematics, service manuals and source of replacement parts. Mike Miller, Box 105, Bethel CT 06801.

Tennelec memory scan Model MS-1 monitor. Need schematic. Ernest Clark, R.D. 3, Box 426, Homer City, PA 15748.

Hallcrafters SX-4Z. Need schematic, parts list and operating manual. William F. Chapman, Lakeside Village, Wales, MA 01081.

Scott Model 99-C amplifier and **Sinclair** Model X-20 Class-D hi-fi amplifier. Need schematics. Patrick E. Chung, 11 Faulkner Avenue, Duhane Park, P.A. Washington Blvd. Jamaica, West Indies.

YORX Model M2601 stereo. Need technical manual, schematic, or owner's manual. Roman Budek, 65 Dover Dr., Des Plaines, IL 60018.

Advent VB225 projection T.V. Need schematics and parts list. Waldo Senechal, 2727 Pacific 141, Highland, CA 92346.

Video Systems Corp. Model 2000 video terminal. Need schematic, operating manual and service data. Don Morar, 3663 Hipsley Mill Road, Woodbine, MD 21797.

Mercury Model 204 tube tester. Need meter, charts and schematic. **Philco** 10L43 T.V. Need schematic and picture tube 17DRP4. Tom Schenk, c/o Ed Knapstein, 105 Bradford LN, Madison, WI 53714.

Realistic Model 150-A receiver. Need service manual and schematic. Jesus Pulgar, Box 11243, Santurce, PR 00910.

Precision Apparatus ES 500A oscilloscope. Power transformer needed. Vincent Werdein, 2517 Wehrle Dr., Williamsville, NY 14221.

Automatic Radio Phone Secretary Model TPS-3173. Need instruction manual and schematic. Gary Cook, Box 5, Centerville, MO 63633.

RCA Model 96K2 radio. Need schematic and parts list B. Murray, Route 1, Box 658, Capshaw Road, Harvest, AL 35749.

Analab dual trace scope Type 1120. Need any available information. Peter J. McManus, Box 38, Porter, ME 04068.

Micro-Q Z-80 based controller. Need schematic and operating manual. K.W. Keck, 9201 Hooker, Westminster, CO 80030.

Elco VTVM Model 221. Waterman Products industrial and television pocketoscope Model S-11-A. **Precision Apparatus Co. Inc.** tube tester Model 912, Serial No. 16479. Need owners or service manuals and tube charts. Edward Skirel, Wickham Ave., Box 339, Mattituck, NY 11952.

Precision Apparatus Co. Series E-200 C signal generator. Need schematic, operating instructions and service manual. Rustan R. Crespo, 440 59th St., West New York, NJ 07093.

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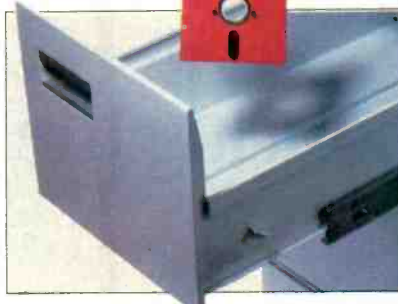
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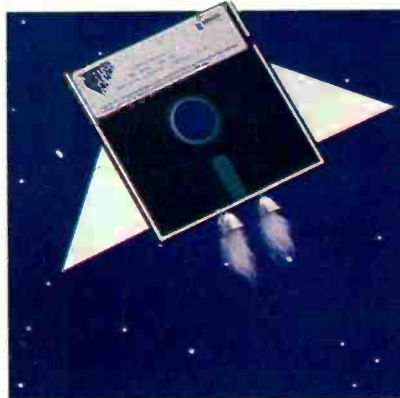
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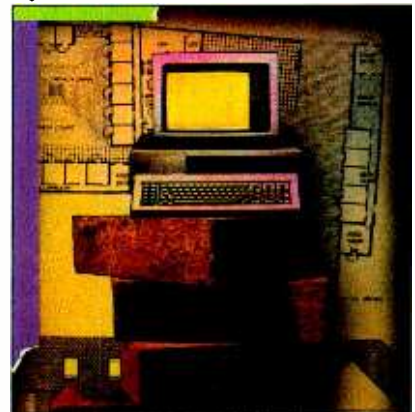
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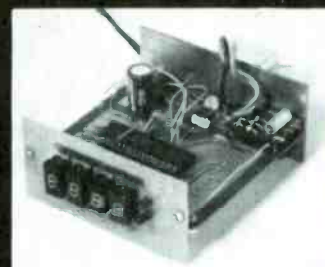
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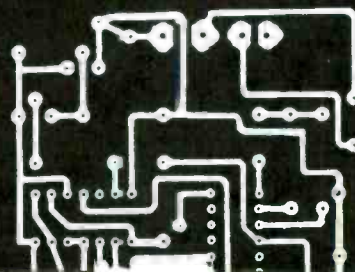
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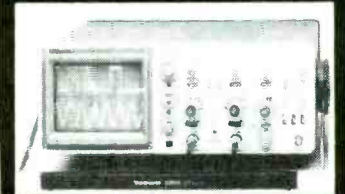
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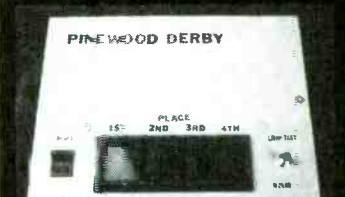
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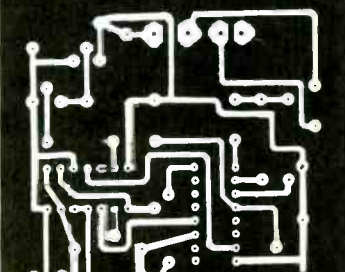
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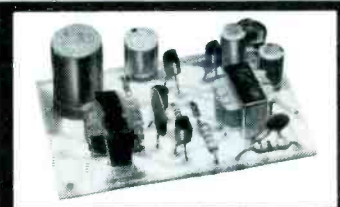
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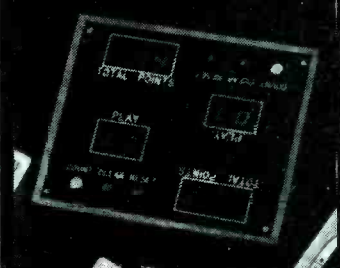
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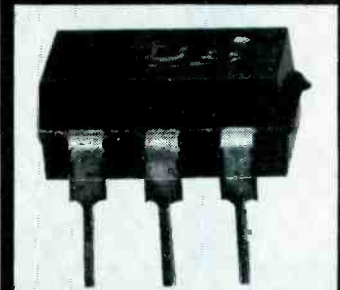
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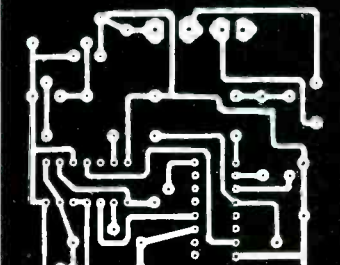
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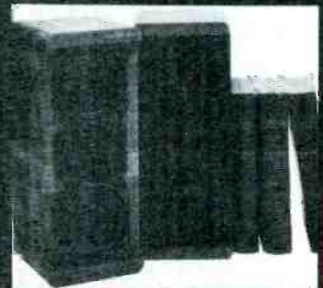
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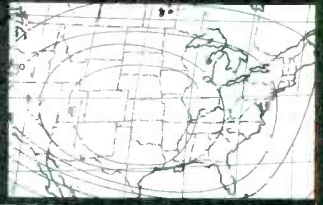
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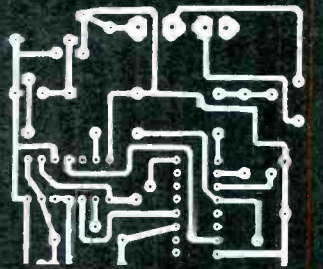
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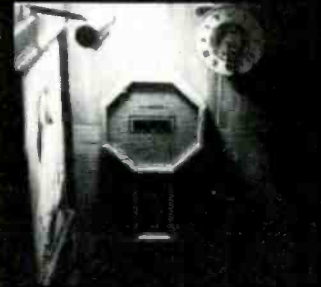
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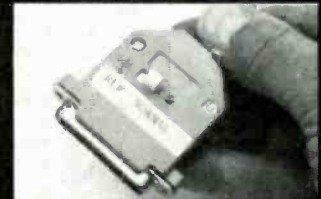
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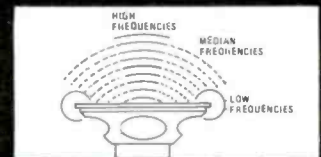
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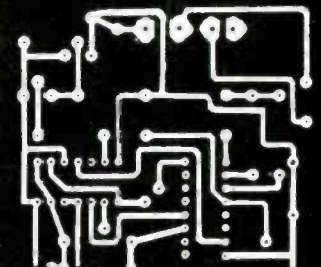
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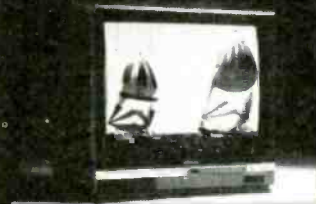
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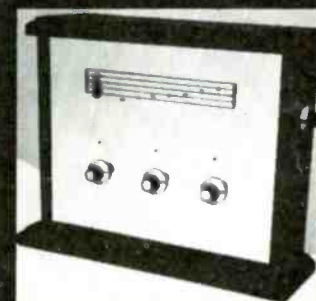
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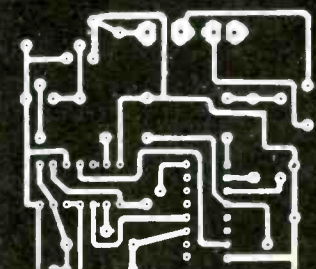
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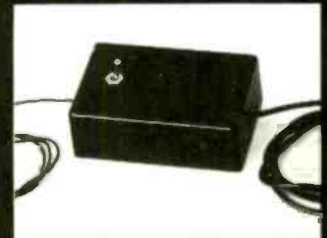
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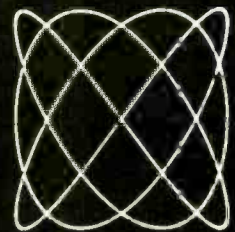
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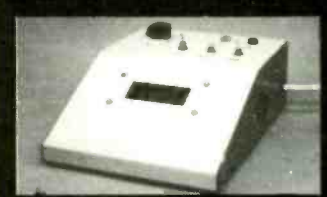
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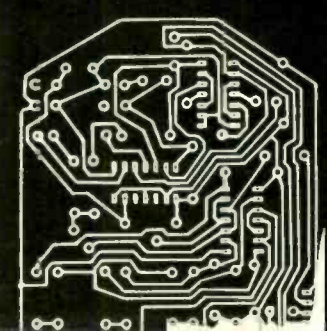
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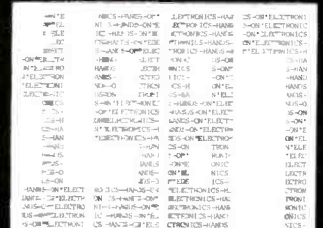
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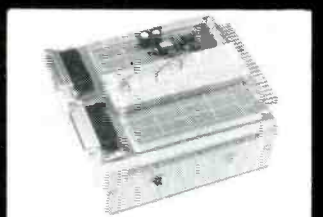
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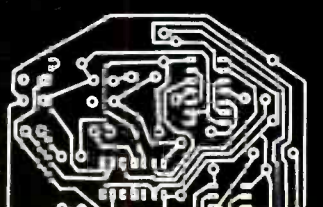
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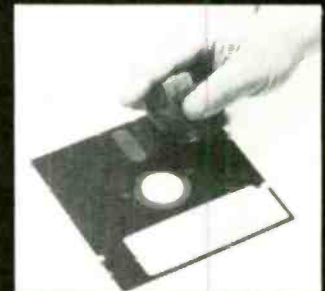
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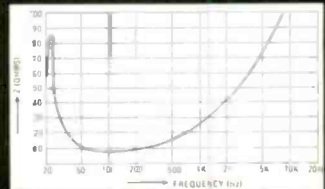
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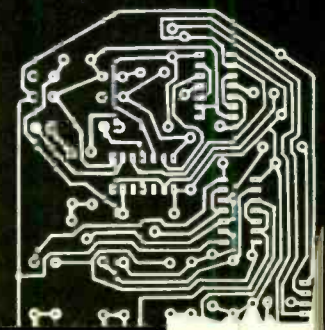
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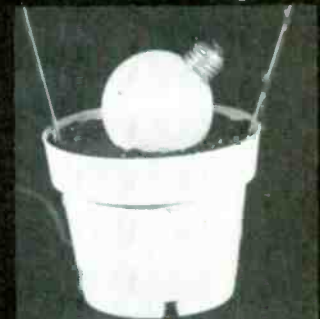
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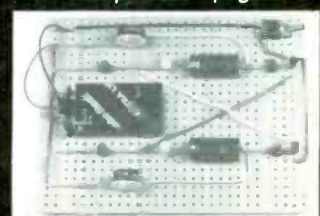
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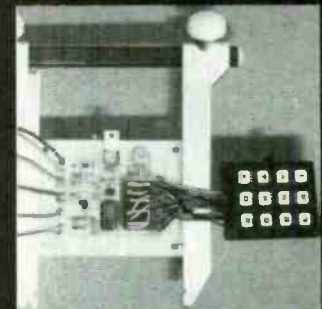
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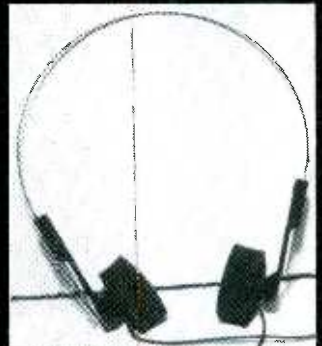
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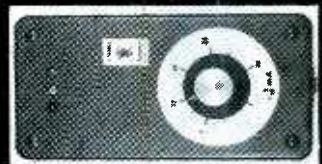
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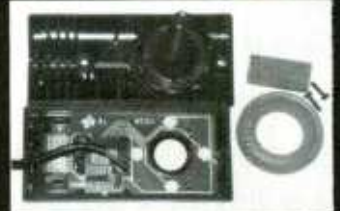
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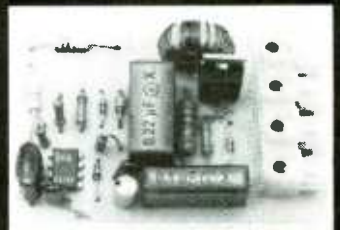
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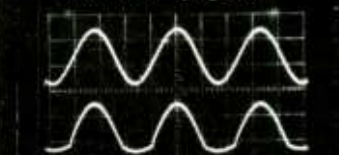
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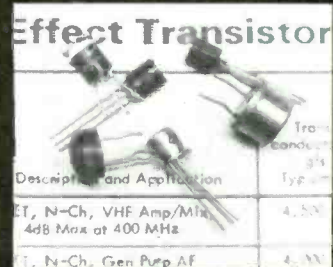
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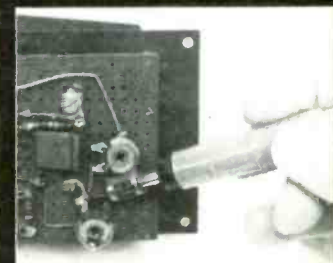
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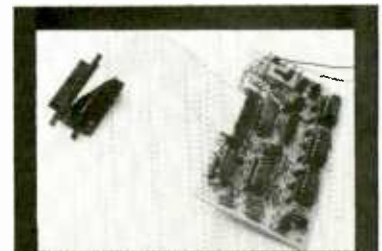
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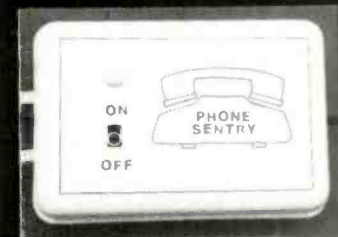
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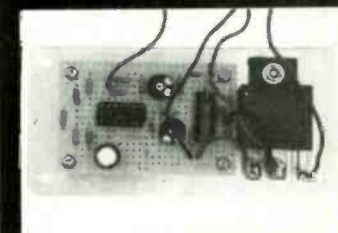
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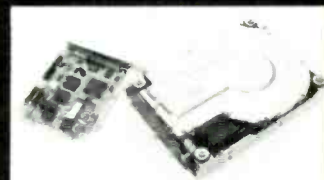
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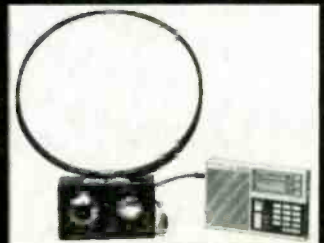
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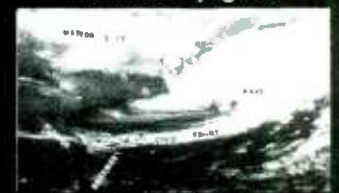
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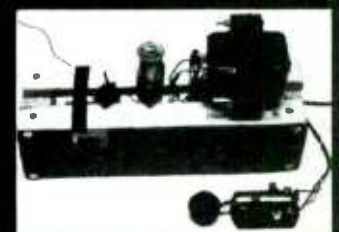
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- 73 **Digital Logic Probe**—the kit that you can build in only one evening and use for a lifetime

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- 78 **How To Replace Rechargeable Batteries**—you can locate and replace wired-in NiCd cells and repair the gadgetry they power
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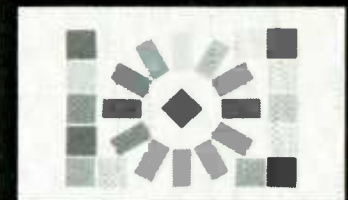
- 22 **Jensen on DX'ing**—the year in review; we prepare for the new year by reviewing the old
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- 41 **Night-Light Controller**—automate your porch, driveway, or outdoor lights, without RF interference
- 45 **Build the MOSFET Voltmeter**—measure voltage without skimping on the readout or interrupting the test circuit's operation
- 49 **Experimenter's Powered Solderless Bread/Clip Board**—put schematic diagram, notes, power supply, breadboard, and parts on one board.
- 52 **Tachometer Tester**—lets you gauge the accuracy of your tachometer
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- 65 **E-Z Math**—you can't design without it, but how can you avoid useless theorems?

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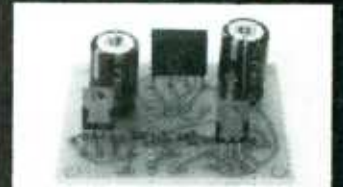
- 39 **Digital Voice Recorder**—electronic memory stores your voice
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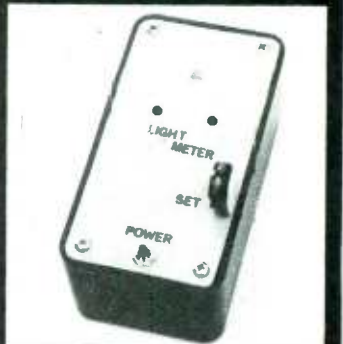
- 2 **Editorial**—wait 'til next issue
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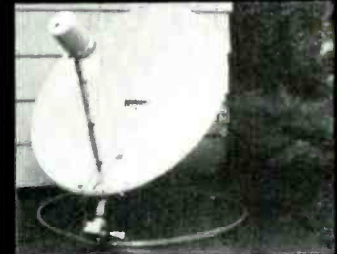
- 34 **Date Calculation Software**—gives the day of the week that a particular date has fallen, or will fall, on
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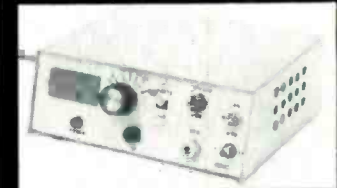
- 2 **Editorial**—The HOE PC give-away; the votes have been tallied and the winner rewarded
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- 8 **New Product Showcase**—where you'll find stocking-stuffers for the technically oriented
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GIZMO/BYTES—Blaupunkt Dallas Car Stereo: Panasonic VHS Camcorder: Shinton VCRs: Polaroid PhotoMagic System: Canon VM-E2N 8-mm Camcorder: Panasonic Bread Bakery: Healthcheck Blood Pressure Monitor: Sonin Ultrasonic Measuring Device: UPS Shutdown/Electronic Specialists, Inc: Oster Four-cup Coffeemaker: Hewlett-Packard Business Consultant II: Nakamichi CA-5A II Control Amplifier: Adjustable Exercise-Bike Reading Stand: Olympia USA, Inc. Paper Shredders: Career Navigator: Zenith Home Satellite-Receiving Systems: Canon Cat Work Processor: Plus U.S.A. Halftime-Scissors: Onkyo CD Player with Changer
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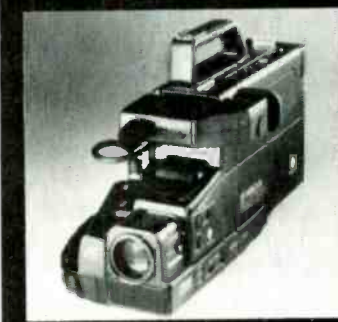
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- 37 **FactCards**—your desktop data source
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- 28 **The High-Voltage Pulse Generator**—build the fence charger or laboratory models and experiment with lighting, neon, or animal behavior
- 39 **The RGB Switch Box**—two computers but one monitor is no problem even with inversion
- 62 **Building Voltaic Cells**—you've built everything under the sun, but have you built a battery?
- 73 **Build a BCB Trap**—get rid of noise quick and easy with this simple one evening project

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- 75 **TAME the DOS Tiger**—unleash the power of the machine to do your bidding
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- 92 **Circuit Circus**—sequencers revisited; more power, but only a few IC's
- 94 **Friedman on Computers**—hot off the presses: color photos from your PC!

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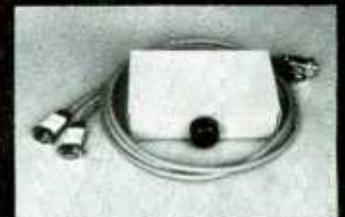
- 2 **Editorial**—Times Are Changing
- 4 **Letter Box**—free-flying information from readers and staff
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- 35 **The Frost Indicator**—detects ice before chilling accidents occur
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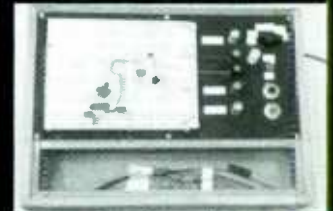
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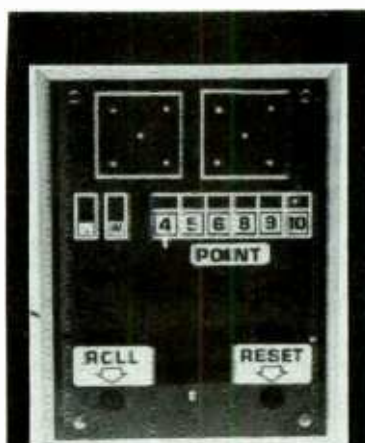
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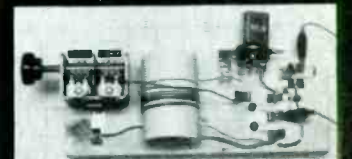
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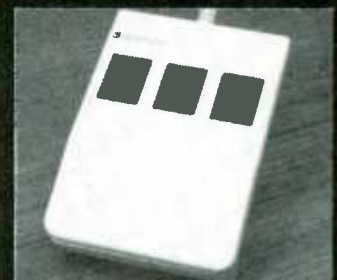
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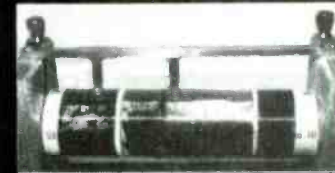
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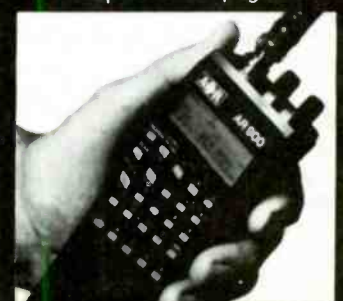
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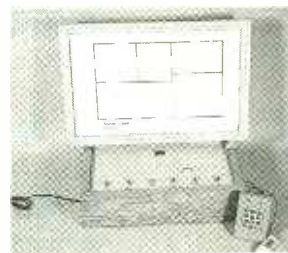
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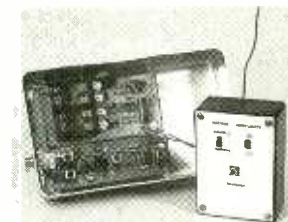
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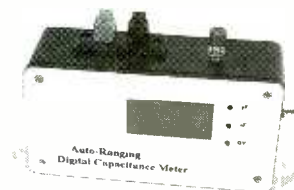
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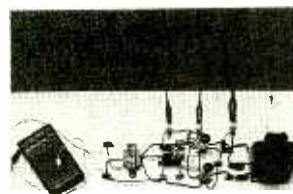
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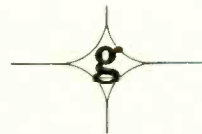


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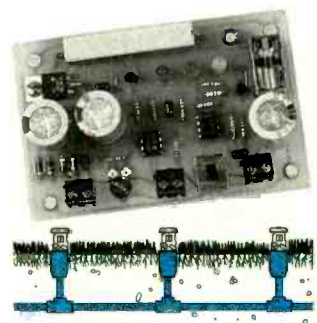
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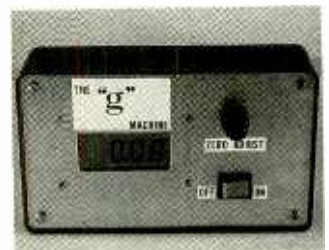
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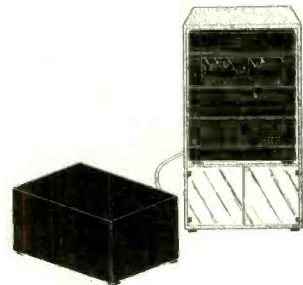
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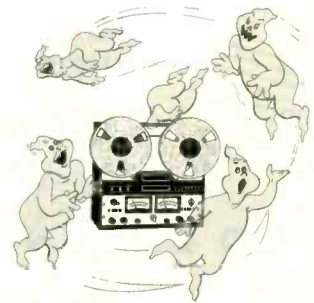
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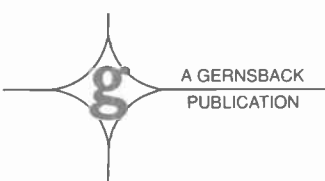


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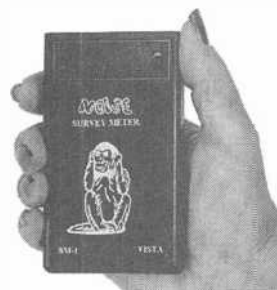
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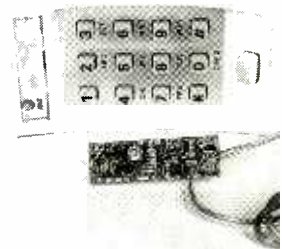
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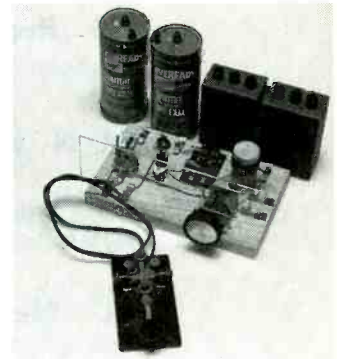
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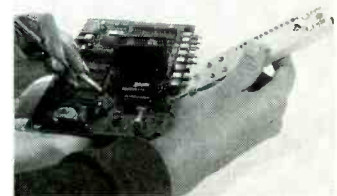
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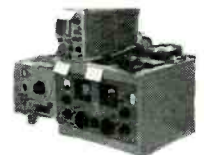
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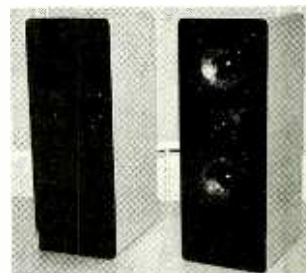
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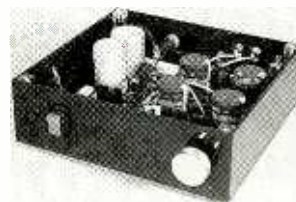
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Many swear by the therapeutic relief that acupuncture is reported to provide. If you want to find out for yourself if the treatment works, but are not keen on the idea of someone sticking needles into you, here's an electronic way of providing some of the effects of acupuncture without the use of needles —*Robert A. Heil*



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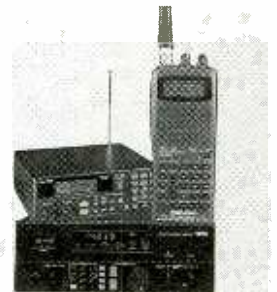
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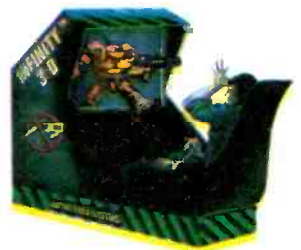
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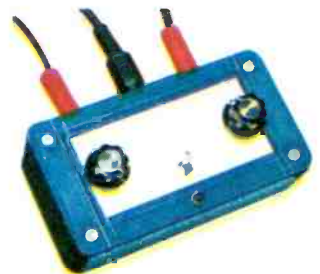
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Fight the forces of evil with this easy-to-build, easy-to-install circuit that protects your property from carjackers without placing yourself, or your loved ones, in any further danger. It can even be used to deter normal car theft—*Anthony J. Caristi*



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This fully programmable robot will have you believing in artificial intelligence in no time. It can move around your house without ever getting stuck in a corner, and could be modified to imitate many other types of thought—*Mike O'Connor*

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If your vehicle has doors that automatically lock when you turn on the ignition, this circuit will save you the trouble of having to manually unlock them when you turn the ignition off—*Josh Friedman*

51 Build a Solid-State Stroboscope

With this precision handheld unit you can make remote RPM measurements, view rotating devices in stop-action, and take some impressive photos of moving objects. Best of all, it costs much less than commercial units—*Skip Campisi*

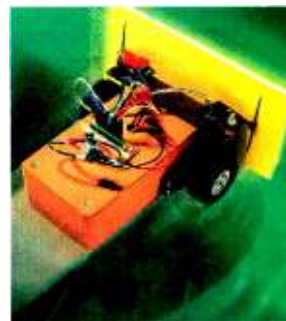
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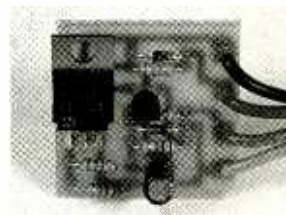
Want a way to get better performance from your VHF/UHF radio gear without spending a lot of money? Try these low-cost, easy-to-build antenna designs; with them, you'll see and hear results immediately—*Joseph J. Carr*

45 Toy Trains

Modern electronics have made this hobby more enjoyable than ever. Here's a look at toy trains of the past and present, and at what you can do to get started with your own setup—*Dennis Eichenberg*



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31 Build the Goblin Greeter

This Halloween, why not greet trick-or-treaters with a special treat of your own? With the Goblin Greeter installed, every time someone rings your doorbell, he or she will be welcomed to your abode by a spooky, hologram-like phantom and haunting noises. The circuit can also be used indoors to provide your next Halloween party with a frightfully fun host—*D. Derek Verner*

CONSTRUCTION

56 Build a Delayed Sweep Adapter

This simple, plug-in circuit will increase the capabilities and performance of your scope. For less than \$30, the Adapter lets you add a delayed sweep to just about any oscilloscope you choose. That saves you the added cost of buying an oscilloscope with the feature built-in—*Skip Campisi*

FEATURES

39 Using Digital Panel Meters

Here are some great applications for digital panel meters that you can use as stand-alone units or as springboards for your own circuit designs. Once you know how to work with DPMs, you'll be able to increase the accuracy of the next project of yours that requires a display, and give it a more attractive, professional look—*Bill Stiles*

45 Radio Amateurs

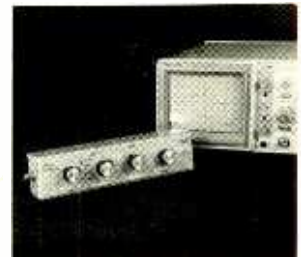
Just who are hams and what do they do? There seem to be more than a few misconceptions about the amateur-radio hobby and its practitioners. Learn the truth in this panoramic look at radio amateurs, and see just how easy it is to become a ham yourself—*Karl T. Thurber, Jr.*



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33 Build the Easyscope

Use this circuit to turn your PC into a dual-channel, digital storage oscilloscope. For about \$85 you can enjoy the features of a stand-alone unit that might cost \$1000 or more—*Robert G. Brown*

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This compact unit will greatly improve the accuracy of your DMM by eliminating the problem of circuit loading—*Skip Campisi*

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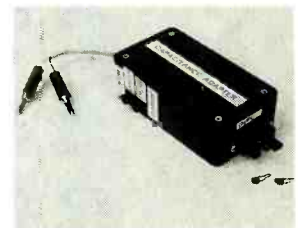
Here's an insider's view of the profession and what it takes to get started—*Lyle Russell Williams*

57 Learning About Simple Function Generators

No workbench is complete without a square- and triangle-wave-form generator. Here are the fundamentals of how these devices work—*Ron C. Johnson*



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23 A Holiday Gift Guide

Let us help you find the right electronic gifts for everyone on your shopping list. There's something in this guide that's sure to match just about every budget and interest—*Teri Scaduto and Christopher Scott*

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32 Build the Light Animator

If you want to add some motion and excitement to your Holiday lighting this year, this is the project for you. This circuit will control up to eight strings of lights, letting you create unique animated displays that will make your house the talk of the neighborhood—*Rodrick Seely*

43 Build the Color-Blind Illusion

Here's a neat little "magic" trick that will fool just about anyone. It's an electronic version of the old three-card Monte con game that will keep your friends puzzled for hours. Like those who witness any good illusion, those in your "audience" won't be able to believe their eyes—*Rick Duker*

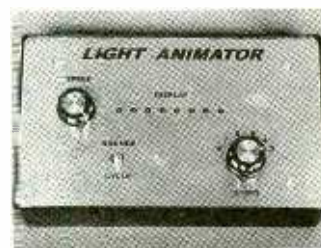
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39 High-Tech Electronic Building Security

What can technology do to prevent terrorism and crime? You'll find some answers to that and other questions here as we explore how electronics help provide public safety by detecting guns, explosives, and bad guys before they get a chance to enter a building—*Bill Siuru*



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COVER STORY

37 Build a Multimedia Subwoofer

If you're tired of the tinny audio coming from your computer's speakers, and are not at all impressed with the weak and lifeless sound effects those speakers produce, this project is for you. For under \$80, you can add powerful bass to all of your favorite multimedia games and audio CDs with this easy-to-build subwoofer—*Rodrick Seely*

CONSTRUCTION

41 Build a Multi-Chrome Projector

Sit and watch this unit's changing color patterns for just a few minutes and it will provide you with some biofeedback-type stress relief. Or just use it any time you need a light source of various colors. Either way you apply it, it's hard to look away from this device once it's on—*Skip Campisi*

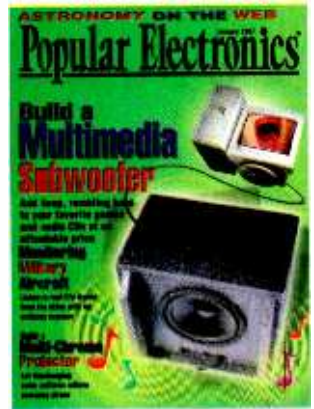
48 Build a Temperature Adapter

Just how cold is it around your workbench this winter? How hot is that IC really getting? Now you can find the answers to all of your temperature questions by connecting this simple circuit to your DMM—*Marc Spiwak*

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45 Monitoring Military Aircraft

Every day there are several real-life dramas unfolding over the skies of the United States. If you'd like to listen in on the exciting transmissions of our nation's military pilots, you're in luck. With an ordinary scanner and the listening tips given in this article, you'll feel as if you're part of the action in no time —*Laura Quarantiello*



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27 Build a 22-Watt Amplifier

Is the performance of your car stereo lacking in some areas? Are your road trips just not as entertaining as they could be? Put some real power into your vehicular audio system with this amplifier that looks small but actually sounds big. Best of all, it costs less than \$20 to build—*Gary Clifton*

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32 Build an Automatic Headlamp Control

In many states, if your car's windshield wipers are on, the law requires you to turn on the vehicle's headlamps too. With this circuit you'll never have to remember to do that again. Just switch on your vehicle's wipers and let the Control module do the rest for you—*Anthony J. Caristi*

49 Build an Infrared Remote Decoder

Use it to operate your computer from across the room with any TV or VCR remote control—*Stuart Ball*

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39 Cruising the Lowest Ham Bands

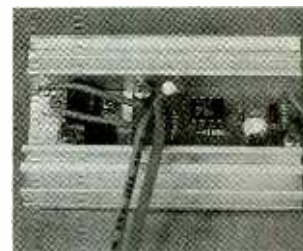
Join us for a look at LowFERS and MedFERS, the most unusual ham frequencies that you can explore. Learn what signals lurk in those regions of the spectrum, and what equipment you can use to hear them —*Karl T. Thurber, Jr.*



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39 Build an Alphanumeric Pager Decoder

This innovative device lets you view digital pager messages right off the airwaves. Just connect the circuit to a scanner radio and your computer, load up some special software, and you can be certain your beeper is grabbing all the messages that it should—*Alan D. Jones*

CONSTRUCTION

45 Build an Electronic Parrot

Having a parrot repeat what you say can be a lot of fun, but teaching one to talk can also take a lot of time. With this easy-to-build circuit you can have all the fun of an accurate mimic, in about an evening. Best of all, there's no cage to clean!—*David Williams*

52 Build an AC Line-Voltage Monitor

Just how safe are your expensive electronic devices? Find out if the AC outlets in your home or workshop are producing "clean" electricity with this inexpensive circuit—*Marc Spiwak*

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48 Cars That Can Call for Help

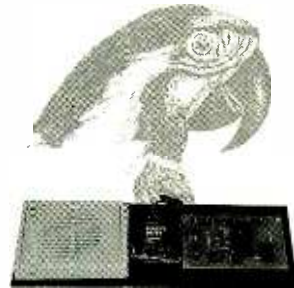
Learn how electronics can help roadside assistance get to you, even if you're lost. Also, find out what new technology makes it easy for police to get your stolen vehicle back—*Bill Siuru*

58 Intelligent Micromachines

Microscopic motors and machines have been around for a few years; however, now they can think for themselves. Join us for a look at the marriage of microminiature processors and motors that could result in some amazing applications—*Douglas Page*



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31 Build a Lie Detector

Find out who's telling the truth with this Galvanic Skin Resistance monitor. Just press two fingers on the Detector's "electrodes" and you're all set. It's great for parties or even classrooms. The Lie Detector can also be used as a biofeedback device by providing you with a visual and audible indication of how your skin's resistance is changing—*Skip Campisi*

CONSTRUCTION

42 Build a High-Efficiency Lighting System

Tired of high lighting bills? Quit wasting electricity on lights that don't work as efficiently as they could; here's a better option. With this system you'll save 90 percent on your monthly lighting bill—these are substantial savings you'll notice right away. Build these units for both home and office lights and save at both locations—*Stephen R. Rosenberg*

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39 Recharging Electric-Vehicle Batteries

Electric vehicles have finally hit the streets, but just how far can you travel in them before they run out of battery power? Join us for a look at the methods and systems being put in place to ensure EVs get you to and from your destinations—*Bill Siuru*

45 All About Amateur Communications Modes

The technology used by radio amateurs has certainly improved over the years; we've really come a long way. Here's a historical exploration of the many communications methods used by hams, past and present. From Morse code to computers, it's all right here—*Karl T. Thurber, Jr.*



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You can now take electrophotographs using fax machine paper in a rather unorthodox fashion, thereby eliminating the need for film developing—*Nick Cinquino*

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With just a handful of readily available components and a little patience, you can build a simple scope that uses several LED arrays to form the unit's 20 x 20 matrix display—*Carl J. Bergquist*

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COVER STORY

33 The DTMF Wire Tracer

Get a handle on those time-consuming wire sorting or installation jobs with an easy-to-build, two-piece, wire identification system! Using a DTMF tone generator (which produces 16 distinct tones) and a tone decoder (that identifies all 16 DTMF tones), this speedy tracer makes short work of your wiring worries—*Brian Pfler*

CONSTRUCTION

43 The Heartbeat Machine

This fascinating but simple circuit allows you to keep tabs on the rhythmic fluctuations of your heart, by detecting changes in the flow of blood through your finger! The pulsed blood-flow is used to determine heart rate—*Anthony J. Caristi*

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47 Electronics Help Clean Up The Air

Rather than forcing people to junk those old "smoke generators," electronics manufacturers are now producing retrofit emission-control systems to help older vehicles comply with the new clean-air standards!—*Bill Siuru*

51 Technological Arts ADAPT-11 Microcontroller Starter Package

This "foxy" little portable microcontroller, which generates Morse code at variable time intervals, is perfect for learning electronics, computer fundamentals, hardware and software microcontroller design, and can be incorporated as the core of custom or new product design—*Larry R. Antonuk*

57 Stretching Rechargeable Battery Technology

Tailoring a synthetic carbon fiber commonly found in socks, scientists at Sandia National Laboratory in Livermore, California, have created safer, lighter, longer-lasting, and less-expensive rechargeable batteries, using a lithium-ion technology—*Douglas Page*

58 Computers—They're Taking Control

—*Cartoon Fun*



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59 The Ultimate Electronic Ruler

Government researchers at the National Institute of Standards and Technology in Gaithersburg, Maryland, have developed a ruler that will be hard to measure up to! Dubbed the Molecular Measuring Machine, it has a range that is 250,000 times greater than that of most scanning tunneling microscopes (STM)—*Douglas Page*

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COVER STORY

33 The Hall-Effect Electronic Compass

If you do much traveling outside of your home state or even your neighborhood, for that matter, eventually you are going to get lost. But with the easy-to-assemble electromagnetic direction locator described in this article, staying on the right course will be a cake walk—*David Williams*

CONSTRUCTION

48 A 100-kHz–30-MHz Active Antenna

If you've encountered any of the drawbacks usually associated with the ham or SWling hobby, then just maybe the low-cost solution presented here will be of interest to you. Our active antenna gives your ham rig or DX station the pull it needs to catch the communications that you most want to hear!—*William Sheets, K2MQJ, and Rudolf F. Graf, KA2CWL*

54 DTMF Frequency Counter

Put that old inoperative tone telephone back in service with the aid of this easy-to-build frequency detection circuit—*William K. McKellips*

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39 The New/Old Autodyne

Over the years, many different receiver designs have been tried, some of which were immediately found wanting, and others achieved popularity for a while but fell out of favor when superior designs came along. But the direct-conversion receiver is a design that has come and gone, and is now being resurrected using the new generation of electronics components—*Joseph J. Carr*

44 The Laser Fridge

Learn how scientists have found a way to manipulate a device that's been shown to generate extreme heat to produce cold—*Douglas Page*

45 Computers Are Helping The Blind And Deaf

Here's a look at some new sophisticated software technology, which enables persons with minimal vision or profound hearing loss to see and hear again—*Bili Siuru*



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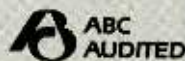
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COVER STORY

33 Build The Time-Off

Armed with this simple count-down timer, you can cut your electric bills, keeping a greater share of your hard-earned money, even if you fall asleep with the lights on or rush off to work each morning, leaving all sorts of appliances on until the evening—*D. Derek Verner*

CONSTRUCTION

45 The PC Parallel-Port Relay

Home automation can help free you from some of those repetitive tasks around your home. All you need is an old PC and the PC Parallel-Port Relay board, which we'll show you how to build, and your home will practically take care of itself—*Marc Spiwak*

50 The Electronic Garage Door Opener

A simple four-digit code along with the easy-to-build circuit presented here can take the place of your "emergency key." Now you won't lock yourself out of the house, and you can allow friends and relatives to enter when you can't be there—*James E. Tarchinski, N8PTG*

FEATURES

31 Smart Airbags

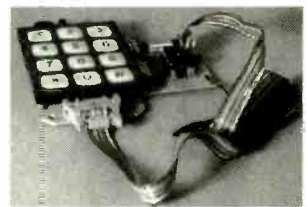
While airbags save lives and reduce injuries, they can also be extremely dangerous to small children riding in rear-facing infant seats. Read how new technology is making airbags less of a hazard to your vehicle's smaller passengers—*Bill Siuru*

40 Radio Resources of the Information Superhighway

Bring a cyberworld of radio information to your radio shack with these handy resource listings. This article shows how to find and access amateur radio, shortwave, and scanning information and resources on BBSs, the online services, the Internet, and the World Wide Web—*Karl T. Thurber, Jr.*



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39 Low-Power DC UPS

Uninterruptible power supplies have been around for a long time helping to keep vital business- and defense- related instruments on-line and ready to go at a moment's notice. Now you can ensure continued operation of your critical electronic equipment during a power failure with the Low-Power DC UPS presented in this article—*Philip Kane*

CONSTRUCTION

42 A Cheap Slave Driver

Build a simple controller circuit that allows you to remotely operate servo-motors to control surveillance cameras, aim your outdoor antenna, actuate robotic arms, and more!—*D. Derek Verner*

44 Ham Radio Code Filter

Here's an interesting "first" project for the budding ham radio operator—an audio filter for making the Morse code station you want to hear stand out from those you don't—*Larry Lisle, K9ZT*

FEATURES

46 All the Time in the World

Some 20,000 years ago, ice age hunters scratched lines in sticks and bones to keep track of the passage of time. Since then the methods have changed, but the need to chart the time of day, day of the week, etc., has not diminished. In this article we'll take a look at the evolution of timekeeping devices, and see how that task is handled in the United States and Canada—*Karl T. Thurber, Jr.*

55 Safety For Electronic Hobbyists

Electrical safety is not just a personal matter. All members of your household should at least be acquainted with some aspects of electrical safety. Your life or that of a family member could depend on it!—*Joseph J. Carr*



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Use this circuit-breaker-like electronic fuse substitute when testing electronic equipment that have operating currents ranging from 0.5 to 5 amps. It will spare you some of the frustration of finding replacement fuses, while safeguarding the equipment's overworked internal fuses—*Larry Ball*

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46 Charge-It!

This dual-regulated charger for NiCd and gel-cell rechargeable batteries can save you a bundle of cash by eliminating the need to buy batteries by the truck load—*Bill Stiles, CET*

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42 Leonid Meteors: Celestial Fireworks, Satellite Killers—or Both?

Will the impending fall meteor shower destroy Earth's satellites and space stations? Because of the tremendous impact velocities involved, highly charged plasma clouds created by the impacts of even remarkably small particles may be powerful enough to destroy our orbiting structures—*Kirk A. Kleinschmidt, NTØZ*



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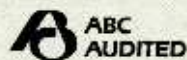
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33 Guitar Amplifier

Build the "Chrome Classic 50," which features a 50-watt amplifier, "clean" and "crunch" channels, adjustable tone and distortion controls, and a 10-inch, aluminum-cone speaker, for under 200 bucks!—*Rodrick Seely*

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Prevent those unpleasant conversations with your neighbors by giving your car phone a more pleasant way to announce that you have an incoming call—*Curt Jenó*

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Learn how analog optical coupling is accomplished by building your own optocoupler devices, and by conducting experiments with them. Perhaps, incorporate one or two of these useful little gadgets into your next project—*Dennis Eichenberg*

51 Monitor Clean-Up

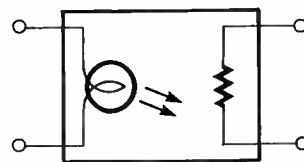
Extend the usability and life of your computer monitor, while maintaining its like-new appearance with these easy-to-follow instructions and a little elbow grease—*Marty Knight*



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Keep your home or apartment at comfortable temperature levels all round, without constant human intervention with this easy to assemble circuit - Sandeep Bagchi

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Get a handle on all those hard -to -make decisions with this easy -to- assemble, updated version, of this classic electronic decision maker - Lewis J. Newmire, K5KXM

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40 The Beverage Antenna

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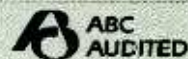
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COVER STORY

31 A Hands-on Approach to Op-Amp Basics

Learn how op-amps operate and how to use them in your own design, while building one or more of this trio of op-amp-based circuits

—Fred Nachbaur

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45 Heated Pet Pad

Be kind to your four-footed friend by furnishing it with a warm spot to rest on those cold winter nights—Walter W. Schopp

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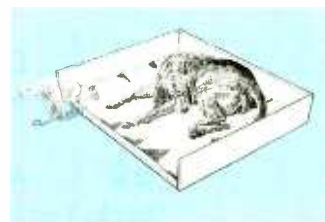
Home-theater design continues. In this issue, we take a look at the latest in receivers, large-screen TVs, video projectors, DVD players, and more!

50 Experimenting with the 4093 NAND Schmitt Trigger

Explore some of the possibilities offered by the 4093 CMOS NAND Schmitt trigger. The circuits outlined in this article are not only educational, but fun to build—Newton C. Braga



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COVER STORY

33 Build a Digital Capacitance Meter

Whether you are an electronics circuit designer, technician, or a hobbyist, our Digital Capacitance Meter can go a long way to taking the guesswork out of your construction or repair projects—*Patrick Bunker*

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41 Build the Telephone HangUp Module

Rid yourself of unwanted telephone solicitations and sales pitches with an easy-to-build circuit that quickly terminates the conversation, disconnects the line, and gets you off the hook—*Anthony J. Caristi*

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Home-theater design concludes. In this issue, we look at a speaker system, DVD/LD/CD player, A/V test DVD disc, interactive educational software, and more!

45 Before Their Time

While some electronic pioneers received acclaim for their work, others were largely forgotten. Here is your chance to get acquainted with some of the unsung heroes of the electronics age—*Larry Lisle, K9KZT*

53 You'll Never Be Lost Again

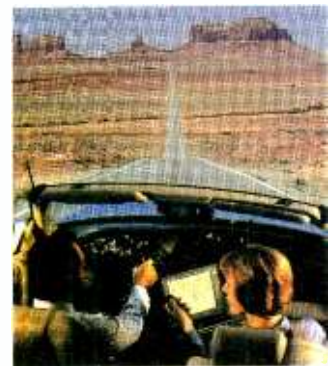
Stay on course as you traverse the countryside with the aid of one of several guidance packages that turn your laptop computer into an on-board navigation system!—*Bill Siuru*



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Melding GPS technologies with dead-reckoning capabilities allows urban mass-transit systems to offer riders a new level of convenience, while enabling both dispatchers and drivers to perform their duties more efficiently—*Bill Siuru*

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If you are concerned about the quality of the electric power delivered to your home by the local utility, perhaps this analyzer will help to ease some of your concerns—*Charles Hansen*

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This project gives all of the convenience provided by the phone company's automated redialing system, without incurring extra charges on your monthly telephone bill—*Anthony J. Caristi*

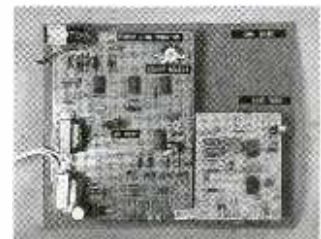
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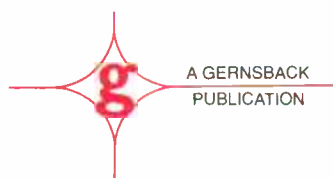


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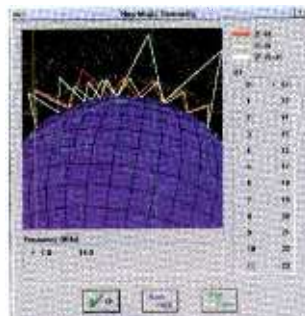
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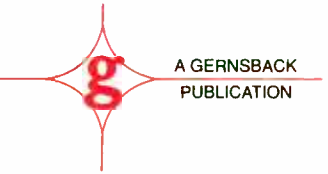


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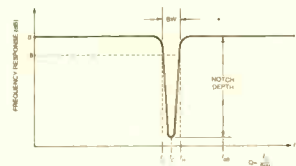
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Modernize your warm-air system with this easy-to-build circuit, which allows maximum heat to be extracted from your furnace

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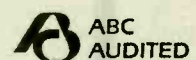
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31 Putting Together Your Own PC— from ATX to ZIP

There is nothing like building your own PC. Here is some advice on determining the selection of each major component in your computer, as well as some of the pros and cons of the many decisions you must make —*Rafael Avila*

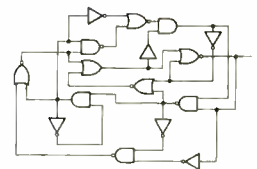


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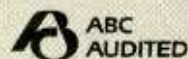
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Poptronics

THE MAGAZINE FOR THE HANDS-ON ELECTRONICS ACTIVIST!

FEATURES

15 CALLER-ID ALARM SYSTEM

With this complete setup, you'll always know when there's trouble at home or the office. It calls you at any Caller ID-equipped phone number you select—even a cell phone—if someone breaks in.

— Dennis Hewett



23 THE WATCHDOG

Protect your vehicle with this easy-to-install alarm circuit.

— Anthony J. Caristi

30 ELECTRONIC PADLOCK

Forget about keys you can lose. Use this cutting-edge digital lock instead. — Jon Varteresian

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4 GIZMO®

Mini DV Viewcam, scaled-down WEGA TV, affordable surround sound, and more

6 HANDS-ON REPORT

Digital Video Recorders—Head to Head

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8 PROTOTYPE

Time-reversal waves, bacteria biosensors, electronic nose technology, optical networks, and more

61 ROBOTICS WORKSHOP

Using and Hacking Robots with Lego Mindstorms

63 AMAZING SCIENCE

Speech-Recognition Interface Circuit

66 TECH MUSINGS

PostScript Integration, X-ray Fluorescence, Preventing CD-R Blowups, and more

73 BASIC CIRCUITRY

Receiver and Detector Circuits

77 SERVICE CLINIC

VCRs

HANDS-ON COMPUTING

43 COMPUTER SECURITY IN THE HACKER AGE

Our look at hardware and software that can help you keep your files and data safe from invasion.

— Konstantinos Karagiannis

39 PC TECH®

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Free Web Access Options

PC Gizmo®

Putting a Scanner to Work

Sony Vaio Slimtop PCV-L620

CD-R Expands



AND MORE

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FEATURES

15 CUT YOUR PHONE BILL WITH THE MONEYSAVER

Find all those 10-10 long-distance codes difficult to remember and annoying to dial? Why not let this device take care of all that for you and make a noticeable change in your monthly phone bill.

— Anthony J. Caristi



21 TELEPHONE HOLD AND LINE IN-USE PROJECT

This two-feature wizard takes away the hassle of shared lines.

— Bill Green

24 THE CALL DIRECTOR: A DISTINCTIVE-RING DECODER

Automatically route calls in your home or office.

— John Taylor, Jr.

PRODUCT REVIEWS

4 GIZMO®

Executive-style sound system, senior-friendly VCR, pedestal speakers, and more

6 HANDS-ON REPORT

Sega Dreamcast

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8 PROTOTYPE

Using Light for Brain Tumor Surgery, Luminescent Biosensors, Supercomputers, and more

36 SERVICE CLINIC

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55 ROBOTICS WORKSHOP

Watch out BASIC Stamp ... Here Comes the OOPic

58 AMAZING SCIENCE

Piezo-Film Transducers

61 TECH MUSINGS

Temperature Measurements, Thermocouple Fundamentals, Gambling Simulation, Working with Newsgroups, and more

67 BASIC CIRCUITRY

555 Applications

HANDS-ON COMPUTING

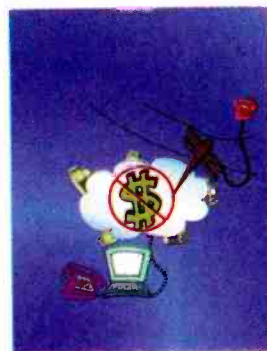
43 INTERNET TELEPHONY—THE NEXT GENERATION

The new breed of Net-phone products has arrived, bringing with it better quality and ease of use.

— Selina Kyle

39 PC TECH®

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Apple's Wireless Breakthrough
Finding Anyone Online
PC Gizmo®
Home Phonenumber Networking
Compaq Presario 5868
An Affordable Backup Solution



AND MORE

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FEATURES

19 CUSTOM LIQUID-CRYSTAL DISPLAYS

Two articles that will help you add visual spice to future projects:

20 LCDs FOR PCs

Build an interface to display PC data on liquid-crystal panels.

— Michael Chan

27 PROGRAMMING LCD GRAPHICS

Use your new PC interface to bring images to life.

— Michael Chan



76 CURING RECEIVER OVERLOAD

Circuits and other solutions to a radio buff's common problem.

— Julian Kerr

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4 GIZMO®

Compact home theater, PC-free photo printer, speaking GPS, and more

6 HANDS-ON REPORT

Escient TuneBase 100 CD-Management System

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8 PROTOTYPE

Bottled Water in a Box, Acoustic Holograms, Medical History on a "Chip," and more

33 SERVICE CLINIC

Keeping your VCR Happy

57 AMAZING SCIENCE

Geiger Counter

62 ROBOTICS WORKSHOP

Hands On: Using the OOPic Microcontroller

67 TECH MUSINGS

Fitting Bezier Curves, Machine-Tool Interface Details, PIC and Basic Stamp Books, and more

72 BASIC CIRCUITRY

Non-Mechanical Switch Circuits

HANDS-ON COMPUTING

39 UPGRADING A CPU

Squeeze extra life out of that old desktop computer. We look at two affordable, easy upgrades that will have your system buzzing through new applications.

— Ted Needleman

35 PC TECH®

This Month Featuring:

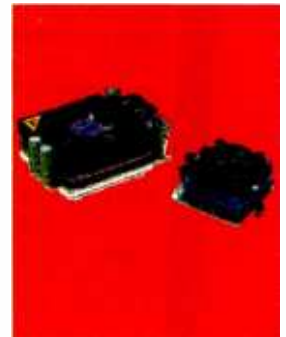
An MPEG-2/TV AGP Card

PC Gizmo®

Micron Millennia Max 533B

Ink Stamps from Graphics

Browser Timesavers



AND MORE

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16	NEW LITERATURE
81	NEW GEAR

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FEATURES

19 AUDIO PROJECTS YOU CAN BUILD

20 AUDIO SIGNAL GENERATOR

Why use generic oscillators to troubleshoot audio gear? Use our custom device that's fine-tuned for this specific task and get better results every time.

— Gary McClellan

24 PC MICROPHONE SWAPPER

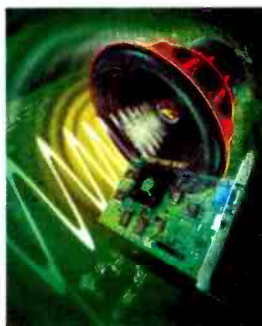
Forget about using little "throw-away" mics ever again. This interface lets you connect a quality microphone to your computer.

— Robert Olds

29 AUDIO CABLE TESTER

That noise creeping into your sound system may be a faulty cable. Use the Tester to ensure only healthy signal paths exist between pieces of your equipment.

— Gary McClellan



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6 PROTOTYPE

Saving Victims of Terrorism, Cars as Communications Centers, Nanotechnology, Free Net Access On the Go, World's Fastest Encryptor, and more

15 SERVICE CLINIC

VCR Cleanup Problems

49 AMAZING SCIENCE

Telepresence

52 ROBOTICS WORKSHOP

Using "Not Quite C" to Program LEGO Mindstorms

60 TECH MUSINGS

Pulse Electrolysis Myths, Extracting Acrobat .PDF URLs, Versatile Capacitor Switching, Contactless Charger Update, and More

66 BASIC CIRCUITRY

"More Power, Igor!" Working with High Voltage

HANDS-ON COMPUTING

37 MAKING MUSIC ON A PC

These killer applications will let you create CD-ready songs from scratch, or you can simply enjoy yourself by playing around with beats and melodies.

— Konstantinos Karagiannis

33 PC TECH®

This Month Featuring:

A Studio-Quality Sound Card

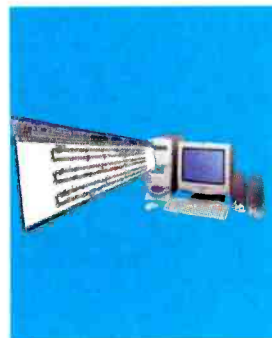
PC Gizmo®

Aqcess Qbe Personal

Computing Tablet

MP3 Secrets

Converting LPs to CDs



PRODUCT REVIEWS

4 GIZMO®

Camcorder Plus, "Big-Screen" Pager, Workout Music, Two-Channel Tuner/Preamp, and more

AND MORE

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18	NEW LITERATURE
70	NEW GEAR

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FEATURES

29 BUILD A PIC REPLICATOR
Here's a PIC programmer that doesn't require a programmer to build. Best of all, software can be updated to take advantage of future PIC technological developments.

—Peter Best



25 NOCTURNAL FLAME
This solar-powered night light is a fun project that you can build. It stores the sun's energy during the day and turns it into soft "lantern-type" light to guide you through the night.

—Jon J. Varteresian

41 TWO SIMPLE ZENER-DIODE TESTERS
Zener diodes can be tough to test. Here are two simple testers that you can build. They solve that problem once and for all.

—Fred Blechman

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4 GIZMO®
Eight-Channel Home Theater, DVD Lifestyle, Scanning in a Snap, Stereo Headset for Your PC, Diagnostics Software, iPhone the World, HDTV-Ready Direct-View TV, Progressive Scan DVD Player, Desktop Stereo, MP3 and Images to Go.

19 HANDS-ON REPORT
The Pioneer PDV-LV10 portable DVD player helps make the time pass much more pleasantly.

PR1 ProService Review—follows page 104
Future of digital electronics. Comments from the FCC Chairman. And more.

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7 COMPUTER BITS
Plastic to Plastic, The Final Chapter. How to make your own professional-looking CDs.

10 PEAK COMPUTING
Which Windows to Do? What comes next? Windows 2000? Windows Millenium? Pros and cons for PC users.

12 NET WATCH
Finding MP3s. How to find and acquire these files from the Internet.

15 AMAZING SCIENCE
Kirlian Photography does not require a camera and produces some amazing and dramatic effects. You really need to try it.

21 PROTOTYPE
How your home can phone for help. Electric motorcycle this year. Really high-speed freeze-frame photos. Non-invasive blood monitor. And more.

45 Q&A
You've got questions? Michael Covington has the answers.

47 SERVICE CLINIC
Common VCR problems and how you can solve them with some practical technical help from Sam Goldwasser.

49 ROBOTICS WORKSHOP
Tilt sensors are a must if your robot is going to stay erect. Here's a look at how they function.

58 BASIC CIRCUITRY
Wall-mounted power supplies. Plug in, turn on, and power up. How to use them to power your experiments.

61 TECH MUSINGS
Synchros, Selsyns, and accelerometers. Listening to bats. Avoiding 404 errors.

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FEATURES

29 INTERNET APPLIANCE DEVELOPMENT BOARD

Take some "free" emWare and Microchip software and integrate it with inexpensive and tricky electronics to build your own development system for controlling appliances in your home from remote locations.

—Fred Eady



41 APPLIANCES ON THE INTERNET

Utilities can now "talk" to appliances through the information superhighway, allowing your utility company to measure demand, forecast load growth, and more. Learn how they do it.

—Bill Siuru

45 NON-LINEAR CONFIGURATIONS

Linear integrated circuits do not have to be limited to linear applications; there are a variety of non-linear services that these useful devices can perform.—Joseph J. Carr

51 HIGH-VOLTAGE GENERATION

How to turn low-voltage AC into very high DC voltages. All it takes are a few readily available components and some technical know-how.

—Bill Cody

PRODUCT REVIEWS

4 GIZMO®

Portable LCD Photo Album; Wireless Inter-tainment System; CD Recorder; e-Mail Traveler; Mobile Scanner; In-Dash MiniDisc Receiver; DVD Player; Human/Solar-Powered Radio; New Desktop Computers.

7 HANDS-ON REPORT

Night Owl Optics Explorer NOX3, a night-vision scope that combines starlight amplification with an infrared illuminator.

PR1 ProService Review—follows page 112. *Electronic Service Survival Solutions; Schemes Against Your Business; Define Your Market.*

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9 COMPUTER BITS

Graphics on the cheap: How to get the graphics you need and how to process them to get the results you want.

13 PROTOTYPE

Spinning Gold into Electronics; Holographic Optical Data Storage; Clues to Astronomical Mysteries; Liquid-Crystal Display Panels.

20 AMAZING SCIENCE

Making exposures with our Kirlian photography equipment using sheet film and cameras.

23 SERVICE CLINIC

Solving the most common VCR play and record mechanical problems with some practical technical help from Sam Goldwasser.

57 Q&A

You've got questions? Michael Covington has the answers.

61 ROBOTICS WORKSHOP

More on the BasicX-24 microcontroller and using it with radio-control servos.

66 TECH MUSINGS

Using transfer functions; lithium polymer batteries; understanding non-linearity; algae hydrogen source; and more.

72 BASIC CIRCUITRY

Experiments with infrared LEDs, transistors, and phototransistors.

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FEATURES

29 A HIGH-POWERED TESLA COIL

Everyone loves high-voltage equipment! The sheer excitement of man-made lightning and the smell of ozone instill awe and wonder in anyone who has witnessed this equipment in operation. Our Tesla coil is large enough to throw 30-inch sparks.

—Robert Iannini and Chester H. Lawrence



43 CALL ALERT

Unsolicited telephone calls can be very frustrating. One solution is to turn off your phone's ringer when you don't want to be disturbed. Give your friends a secret code, and they can let you know when they are calling.

—Raymond C. Buck III

48 PC KEYBOARD

Learn how the IBM AT keyboard works. With that knowledge, you can recycle old keyboards into a new project, add one to an existing device, or even build an input device that can take the place of a keyboard.

—Craig Peacock

PRODUCT REVIEWS

3 GIZMO®

Digital-audio player, wireless modem, voice-controlled car stereo, two-way family radio with weather reports, laptop carry case/desk, all-in-one boombox, digital-video camcorder, Internet streaming-audio broadcaster, high-definition receiver/computer monitor, signature digitizer.

PR1 ProService Review—follows page 103.

The 2000 National Professional Service Convention, building great Web sites, and more.

DEPARTMENTS

6 COMPUTER BITS

Film at 11. Ted Needleman scans and digitizes film slides to store them on a disk.

9 NET WATCH

Joe Black takes a look at various services for making free or low-cost telephone calls over the Internet.

15 PROTOTYPE

Neural-network avionics, quantum computers, high-performance search-engine chips, microgravity-generated optical fibers, computer-security protocols, and thunderstorm detectors.

20 AMAZING SCIENCE

Learn the basics of superconductors from John Iovine in preparation for some super-cold experiments.

24 Q&A

You've got questions? Michael Covington has the answers.

59 SERVICE CLINIC

Sam Goldwasser discusses VCR sensors.

62 ROBOTICS WORKSHOP

Gordon McComb shows you how to use DC motors.

65 BASIC CIRCUITRY

LEDs for fun and "prophet" with Charles Rakes

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FEATURES

29 TRAIN YOUR PETS WITH THE SCATCAT

Although you might love the four-footed, fur-covered members of your household, they sometimes decide that they're allowed to go wherever they want—even if it's a "no-no" area like the kitchen counter, the dining-room table, the living-room sofa, or if Kitty likes to play "Godzilla" on the toy-train layout! Animals aren't dumb; they're clever enough to realize that they can "get away with it" if you're not around—especially at night. This month's cover story describes a training device that will sound a high-pitched alarm and flash a light whenever an animal enters a "forbidden zone." After a few startling episodes, even the most stubborn pet will "get the hint!"—Russ Shumaker



39 SOLAR-CELL INVERTER

Solar cells are a wonderful, non-polluting source of electricity, but the voltage that they put out is too low for most transistor-based circuits. With this device, you can boost the voltage level of any solar cell to usable levels.—Fred Nachbaur

42 ALL ABOUT ELECTRONICALLY-TUNABLE ACTIVE FILTERS

Active filters, being one of the fundamental circuits in electronics, are even more valuable if you can change their response with a control voltage. Learn how they are designed and work with this "hands-on" approach using tested designs.—Ron Tipton

PRODUCT REVIEWS

3 GIZMO®

Network Walkman, direct-view HDTV, wireless e-mail, clock radio, still/motion digital camera, THX-certified speakers, music software, portable tablet computer.

DEPARTMENTS

6 NET WATCH

Joe Black uses the Net to buy cellular-telephone service.

8 SURVEYING THE DIGITAL DOMAIN

This new column by Reid Goldsborough touches on the subjects that affect every computer user, neophyte and power user alike. This month he takes a quick look at computer viruses and alternative operating systems to the one that came on your computer.

14 PEAK COMPUTING

Ted Needleman sets your machine on FireWire as he explores high-speed data-transfer busses.

17 PROTOTYPE

Polymers for high-speed communication, new-generation batteries for an electric motorcycle, "intelligent" robot competitions, medical imaging technology, and atom traps.

22 Q&A

Michael Covington answers your most perplexing questions.

25 SERVICE CLINIC

Sam Goldwasser digs deeper into VCR control problems.

60 BASIC CIRCUITRY

Charles Rakes races to the finish line with this marathon of simple circuits.

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THE MAGAZINE FOR THE HANDS-ON ELECTRONICS ACTIVIST!

FEATURES

36 VIDEO-SIGNAL GENERATOR FOR NTSC OR PAL

Working with video equipment can mean the occasional readjustment to your equipment to be sure that everything is in top-notch condition. With this simple circuit, aligning a television for proper color reproduction is a snap. What's more, the same circuit can output NTSC- or PAL-format signals by changing a handful of simple parts.
—Thomas Gould



43 LOOKING FORWARD TO DTV

In just a few short years, your television set is going to explode! While that description is more figurative than literal, the day is fast approaching where today's TVs will stop working, never to display a soap opera or newscast again. What we're referring to is the coming of digital television, or DTV. With all of the controversy surrounding the rollout of the new broadcast standard, we take a look behind the scenes at the technology that gives DTV its edge. After all, aren't you curious how they plan to squeeze a high-definition picture and 6-channel surround sound into the same bandwidth of today's television signals? In this first of two parts, we discuss video and audio encryption and compression.
—Geophrey McComis

51 A COLORBURST-BASED FREQUENCY REFERENCE

How many times have you tried to set up a frequency counter or an oscilloscope only to be frustrated by a lack of a stable, accurate frequency standard? With this circuit, such a reference standard is no farther away than the closest television-broadcast signal.
—Thomas Gould

PRODUCT REVIEWS

3 GIZMO®

Indoor/outdoor speakers, electronic spelling dictionary, home-theater transmitter, USB-to-printer adapter, PCMCIA adapter for desktop PCs, Minidisc player, radar-detector/compass/safety-alert system, interactive television, inkjet printer, home-theater bundle.

DEPARTMENTS

6 PEAK COMPUTING

Ted Needleman digs deep into an old Celeron-based system in an attempt to breathe new life into an aging warhorse.

9 COMPUTER BITS

On the home front, Ted Needleman gets around to squeezing tons of papers onto CD-Rs.

12 SURVEYING THE DIGITAL DOMAIN

Reid Goldsborough strikes it rich with free Web-design services and free on-line encyclopedias.

17 PROTOTYPE

Detecting smashed atoms, detecting land mines, detecting nuclear weapons, detecting cholera outbreaks from space, cockpit retrofit, kiddy phones, and network-service standards.

21 Q&A

Michael Covington offers answers to the latest batch of perplexing questions.

55 AMAZING SCIENCE

Experience chills and thrills as John Iovine performs some cool superconductor experiments.

58 ROBOTICS WORKSHOP

In this "lost episode," Gordon McComb reveals the hidden secrets of the BasicX microcontroller.

62 SERVICE CLINIC

Sam Goldwasser takes control of VCR control-system problems.

65 BASIC CIRCUITRY

All aboard with Charles Rakes as he builds simple circuits to test components. Download the circuits from www.electronicworkbench.com/poptronics and play with a "virtual workbench" on your computer.

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FEATURES

29 AN FM/TV AUDIO RECEIVER

How many times have you missed a favorite television program because you just couldn't get to a screen? Perhaps you were in the kitchen or garage or working outside. You couldn't (or didn't want to) stop what you were doing, but the task was mindless enough to make television a welcome distraction. Now you no longer need to worry that you set the VCR properly. This small, battery-powered receiver can fit in a shirt pocket with the right case. By changing a few select components, you can tune in different TV or FM-radio bands. What better way to pass the afternoon than listening to soap operas while weeding the garden?—Anthony J. Caristi



37 LOOKING AHEAD TO DTV: PART 2

The first part of this technological look behind the scenes of the digital-television standard took the video and audio signals, digitized them, compressed them, and squeezed them down to a fraction of their original size. This month, we chop them up, pack them together, and send them out over the airwaves to appear soon on a digital television near you.—Geophrey McCormis

45 GETTING INSIDE AN NCO

Numerically-controlled oscillators are usually "unsung heroes" when it comes to generating an accurate waveform over a wide frequency range. Not only do we tell you all about how NCOs are designed, you get your hands dirty by building an actual NCO from discrete parts—a learning experience much more valuable than buying a single-chip device off the shelf.—Tom Napier

PRODUCT REVIEWS

3 GIZMO®

"Top-end" CD Player, mood lights, handheld GPS system, flat-screen monitor, digital-audio jukebox, wireless GyroMouse, emergency batteries, multi-channel speaker system, TV/VCR combination, Internet privacy software.

DEPARTMENTS

6 NET WATCH

Kick tires, peek under hoods, and "test" shocks as Joe Black shops for a new car on line.

8 SURVEYING THE DIGITAL DOMAIN

Before Reid Goldsborough tries out Web-based applications, he tells you how your PC is out to get you—physically.

11 COMPUTER BITS

Ted Needleman ties every computer in the house together with a "network in a box" kit.

13 PEAK COMPUTING

When Ted Needleman gets tired of crawling around the back of his computer to access the ports, he brings them "up close and personal" with some handy port-replication hardware.

17 PROTOTYPE

Telescope mirrors, compressing medical images, rewritable DVDs, right- and left-handed nanoclusters, software for "designer genes," a history of "green" chemistry.

21 Q&A

Problems and their solutions from Michael Covington, the Poptronics "Answer Man."

51 ROBOTICS WORKSHOP

Gordon McComb's position on servomotors in robotics...depends on the size and accuracy of the unit! After he shows you how to work with them, you can choose a position of your own—or make them free-wheeling.

55 AMAZING SCIENCE

John Iovine "wrecks a nice beach" with a circuit to "recognize speech."

60 SERVICE CLINIC

Sam Goldwasser takes control of your VCR's play and record problems.

63 BASIC CIRCUITRY

Turn off those sirens! Charles Rakes is alerting us about alarm circuits!

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FEATURES

25 ELECTROSURGERY

When we think of "electronics in the operating room," the usual impressions are of sophisticated monitoring devices that keep track of the patient's vital signs, alerting the doctors if any reading deviates from the "norm." Surprisingly, one of the most basic electronic/electrical inventions to assist the surgeon is an "electric scalpel" that cuts flesh by means of a high-voltage, high-frequency signal. What's more, this device has been used in hospitals for longer than you might think! Learn the "hows and whys" behind electrosurgical units in this fascinating peek behind the sterile curtain.—Albert Lozano-Nieto, Ph.D.



29 AF/RF SIGNAL CHASER

When the "weak link" breaks in a chain of audio or RF circuits, it can be difficult and frustrating to find the spot where traffic stops. Instead of chasing your tail, you can use this device to sniff out any audio or radio-frequency signal, giving you a great advantage in the "fox and hound" game that has plagued repair technicians through the years.—Newton C. Braga.

38 TUBE AMPLIFIER BIAS CHECKER

The vacuum-tube-based amplifier has been a staple of musical instruments since the development of amplified instruments. The venerable tube has also enjoyed a resurgence in the home-stereo market over the past few years owing to its "warm-sounding" distortion characteristics when driven to its limits. One problem with tube rigs is setting the bias and balance of the output circuit. If that isn't set correctly, the amp will sound horrible and the output tubes will burn out faster. Here is a fast and—more importantly—safe way to read the bias current of any standard amplifier. Not only is it easy to get an accurate reading of the bias setting, the procedure doesn't expose you to dangerous high voltages.—Gary McClellan

PRODUCT REVIEWS

7 GIZMO®

Digital camera, VHF/UHF antenna, CD recording deck, home-theater projector, multimedia monitor/receiver, DVD development system, portable media player, camcorder tote bag, Hi8 camcorder, surge protector.

AND MORE

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11 PROTOTYPE

Airborne laser mapping, virtual medical system, molten-glass measurement system, high-speed fiber-optic laser, judicial video-conference system, and tracking the Los Alamos fire aftermath.

15 COMPUTER BITS

A starry-eyed Ted Needleman examines some heavenly bodies with computer-controlled telescopes.

20 SURVEYING THE DIGITAL DOMAIN

The Web helps those who help themselves. Reid Goldsborough shows you how to help yourself to knowledge about the Internet in order to build a better Web site.

33 NET WATCH

Joe Black buys toys ... and then tries to get them fixed.

43 Q&A

Go on, ask away; Michael Covington has the answer to your most puzzling dilemmas.

49 AMAZING SCIENCE

John Iovine muscles his way into the world of air muscles.

53 ROBOTICS WORKSHOP

Exploring the basics of robot "brains" with our resident electro-mechanical reanimator, Gordon McComb.

57 SERVICE CLINIC

Sam Goldwasser mops up last month's battle by tackling video recording and playback problems in VCRs.

61 BASIC CIRCUITRY

Spoil a would-be burglar's "party" with more of Charles Flakes' alarm circuits. Download the circuits from www.electronicworkbench.com/poptronics and play with a "virtual workbench."

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FEATURES

25 A TALKING TOY-TRAIN STATION

Sound and animation have been a part of toy trains since the technology advanced far enough to make such enhancements possible. Unfortunately, the early attempts, while very effective, were not always practical. Here's a way to update an American Flyer concept from its pre-WWII record format ("Daddy, what's a 'record'?") to modern solid-state voice-recording-and-playback chips.

—Dennis Eichenberg



27 INSIDE A FURBY

Who would have thought that a simple electronic toy that does little more than act "cute" (or annoy as the case may be) would take the world by storm? That's just what the Furbys have done. You can get them in a range of colors and special editions. Come with us as we peel back the fur and expose their secret inner workings.—Julian Edgar

32 THE GAME ENHANCER

Don't you hate finding out that board games are frequently dull and boring compared to the television game shows that spawned them? If you're the "MC" in a game, how can you make a fair judgement call as to who raised their hand/shouted out/squeezed their "clicker" first? The GameEnhancer takes the guesswork out when determining who goes first—and includes programmable background songs you can code yourself. What's more, it makes a great PIC programmer as well!—Steve Henry

PRODUCT REVIEWS

7 GIZMO®

PlayStation 2, MP3 player, MP3 carrying case, underwater camera system, flat-panel monitor/TV, handheld personal two-way communicator, Microsoft games, satellite dish for RVs, and a color eBook.

AND MORE

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5 PEAK COMPUTING

Ted Needleman sheds some light on optical-drive upgrades.

10 NET WATCH

Chris Lamorte gets root privileges as he shows you how to get a top-level domain of your own.

13 SURVEYING THE DIGITAL DOMAIN

Scrap your PC for a Net Appliance or replace it with the "latest and greatest?" Reid Goldsborough gazes into the next millenium of computing and reports his opinions on the matter.

21 PROTOTYPE

Off-the-shelf supercomputer clusters, next-generation planetary rovers, back-up warning devices, self-synchronizing pendulums, and piracy-resistant digital-video systems.

46 Q&A

Michael Covington serves up a cornucopia of solutions to some of our readers' "real stumbers."

49 AMAZING SCIENCE

John Iovine plays with "the world's smartest metal."

53 ROBOTICS WORKSHOP

Instead of stumbling around in the dark, let Gordon McComb show you how to add collision-avoidance and detection circuits to your robot.

57 BASIC CIRCUITRY

Charles Rakes combines last month's alarm circuits into a full-fledged security system. Download the circuits from www.electronicsworkbench.com/poptronics and test them on a "virtual workbench."

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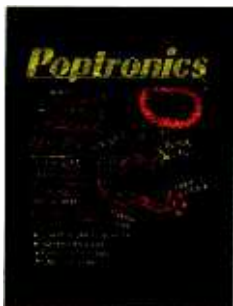
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25 ULTRASONIC MOTORS

Everyone knows that electric motors turn electricity into magnetism that turns the rotor, right? Well...not really. If your motor turned electricity into a pulsing surface at ultrasonic frequencies, you'd have an ultrasonic motor, of course! Learn about these fascinating devices and how they just might play an important part in your future. There's even enough general advice provided to build your own USM.—Jim Van Laarhoven



31 VIRTUAL RETINAL DISPLAYS

Small portable displays have gone from helmet-based units made famous in the video arcades to small cubes suspended in front of one eye. The next generation now being tested is built into a pair of glasses—the ultimate “stealth” display (short of the yet-to-be-invented biological implants popular in science fiction and movies) that doesn't block your vision.—William Siuru

33 AN RF FIELD-STRENGTH METER

Electromagnetic fields are all around us. Study after study is starting to suggest that there is some danger in the higher frequencies that are increasingly found in our latest gadgets. Find out how strong a radiated field can be with this simple hand-held unit.—Rudolf F. Graf and William Sheets

PRODUCT REVIEWS

9 GIZMO®

High-resolution digital camera, dual-tray CD recorder, digital vehicle compass, hands-free adapter for cell phones, thunderstorm detector, in-wall home-theater speakers, ultra-tiny .MP3 player, DVD-RAM drive, reusable CD labels, plasma flat-panel display, and a computer-free Internet audio player.

14 HANDS-ON REPORT

Aqcess Technologies Qbe Cirrus tablet computer.

DEPARTMENTS

5 NET WATCH

Get ready for some “death and destruction” fun as Chris LaMorte looks into the world of BattleBots.

12 PEAK COMPUTING

Ted Needleman offers guidance on whether to keep riding the upgrade merry-go-round.

21 PROTOTYPE

Self-driving vehicles, full-scale airport simulator, environmentally-friendly batteries, new micromachining methods, and finding a new type of greenhouse pollution.

41 Q&A

Michael Covington's final curtain call of Qs and As.

44 COMPUTER BITS

Join Ted Needleman as he uses software and hardware to gaze at the night sky.

47 AMAZING SCIENCE

John Iovine designs and builds some neat Nitinol-based toys.

51 ROBOTICS WORKSHOP

If friends describe your robot as a “bull in a china shop,” Gordon McComb can help fit some collision-avoidance sensors to your pride and joy.

55 BASIC CIRCUITRY

If you're in the area, Charles Rakes' proximity sensors will find you.

58 SURVEYING THE DIGITAL DOMAIN

Looking to spend your money on-line? Reid Goldsborough has some good advice on both e-tailing and auctions.

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29 THE ALTA PRO 2000

One secret to adding more features to projects while keeping parts count and size small is to use programmable microcontrollers and microprocessors. But there's another way to keep things small: programmable-logic devices. How do you program them? Our PLD programmer can handle the task, now or in the future. It's versatile, expandable, and obsolescence-proof.—Robert G. Brown



25 FILTERING AGAINST EMI/RFI

There are times when simple shielding is not enough to protect sensitive circuitry. How do you protect your project when you must have wires connected to it? We take a look at the different paths electromagnetic interference uses to sneak into the "inner sanctum" and spoil the party and how to protect against those intrusions.—Joseph J. Carr

37 ANALOG MEMORY MODULE

If you've tried troubleshooting ultra-fine circuit traces or twisted yourself into a knot to reach that test point deep in the heart of your TV, you know the frustration of watching where your test probes are while trying to read your meter's display. This simple add-on device grabs and holds the voltage for reading at the test site or back at the bench.—Stanley J. York

PRODUCT REVIEWS

13 GIZMO®

FSR radios, DVD/MP3 player, Game Boy holster, outdoor plant pot/speaker system, ultimate electronics carry bag, translucent "boombox," wireless modem phone jack, easy Internet-access mouse, report-writing software, magnesium-chassis notebook computer, and an all-in-one office machine.

DEPARTMENTS

8 PROTOTYPE

Cars with 42-volt automotive electrical systems, fuel cells, and other energy innovations. Also, a look at the latest research from university and private industry research labs.

17 NET WATCH

If you surf the Web, you never have enough bandwidth. Chris La Morte looks at some wideband alternatives to the "antique" analog modem.

19 SURVEYING THE DIGITAL DOMAIN

Plug into the "world community" with Reid Goldsborough's advice, including how not to spam!

21 COMPUTER BITS

When Ted Needleman's house lights go out, he can bask in the glow of his CRTs with the aid of UPSs.

23 PEAK COMPUTING

Get the "big picture" as Ted Needleman checks out the scanner scene... flatbed image scanners, that is.

45 Q&A

Introducing the "new kid on the block," Dean Huster.

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John Iovine juices up some fuel cells.

54 SERVICE CLINIC

Tired of watching "silent" movies on your VCR? Listen to Sam Goldwasser's advice on VCR audio problems.

57 BASIC CIRCUITRY

Charles Rakes gets "up close and personal" with some more proximity sensors.

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THE MAGAZINE FOR THE HANDS-ON ELECTRONICS ACTIVIST!

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