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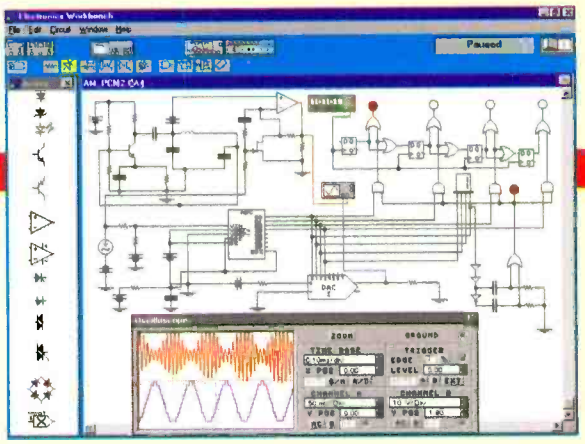

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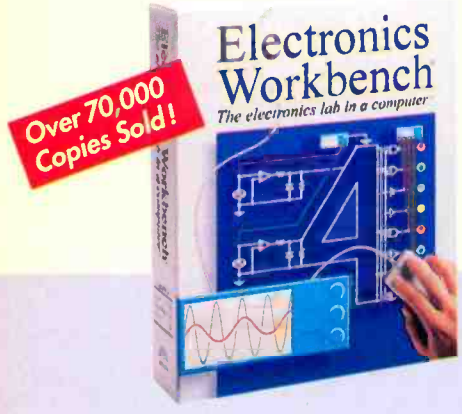

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AUGUST 1996
Vol. 13, No.8

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Editorial

Changes

As you might have guessed from the title of this month's editorial, changes are afoot. First and foremost, this will be my last issue as Editor of **Popular Electronics**.

That leaves me more than a little sad. **Popular Electronics** has been an important part of my life for a long time: I have been with the magazine since the title was re-acquired by Gernsback Publications in the late 1980s, and merged with **Hands-on Electronics**. It helps me to know that the magazine will be in good hands. Dan Karagiannis, who has been my associate editor for nearly two years, will be taking my place.

What's to become of me? Not to worry—I'm not going far. In fact, I am just moving next door, where I'll be taking the helm of our sister magazine, **Electronics Now**. When I first started with Gernsback, some 16 years ago, it was as an assistant editor with that magazine (which then was known as **Radio-Electronics**). It will be nice to be re-united with an old friend.

In closing, I want to thank everyone that has made my time at **Popular Electronics** so enjoyable. That includes a group of the finest electronics writers and columnists in the industry; a bunch of wonderful colleagues, both past and present; and, most of all, each and every **Popular Electronics** reader—you have all made my time and efforts here meaningful and worthwhile.

Carl Laron
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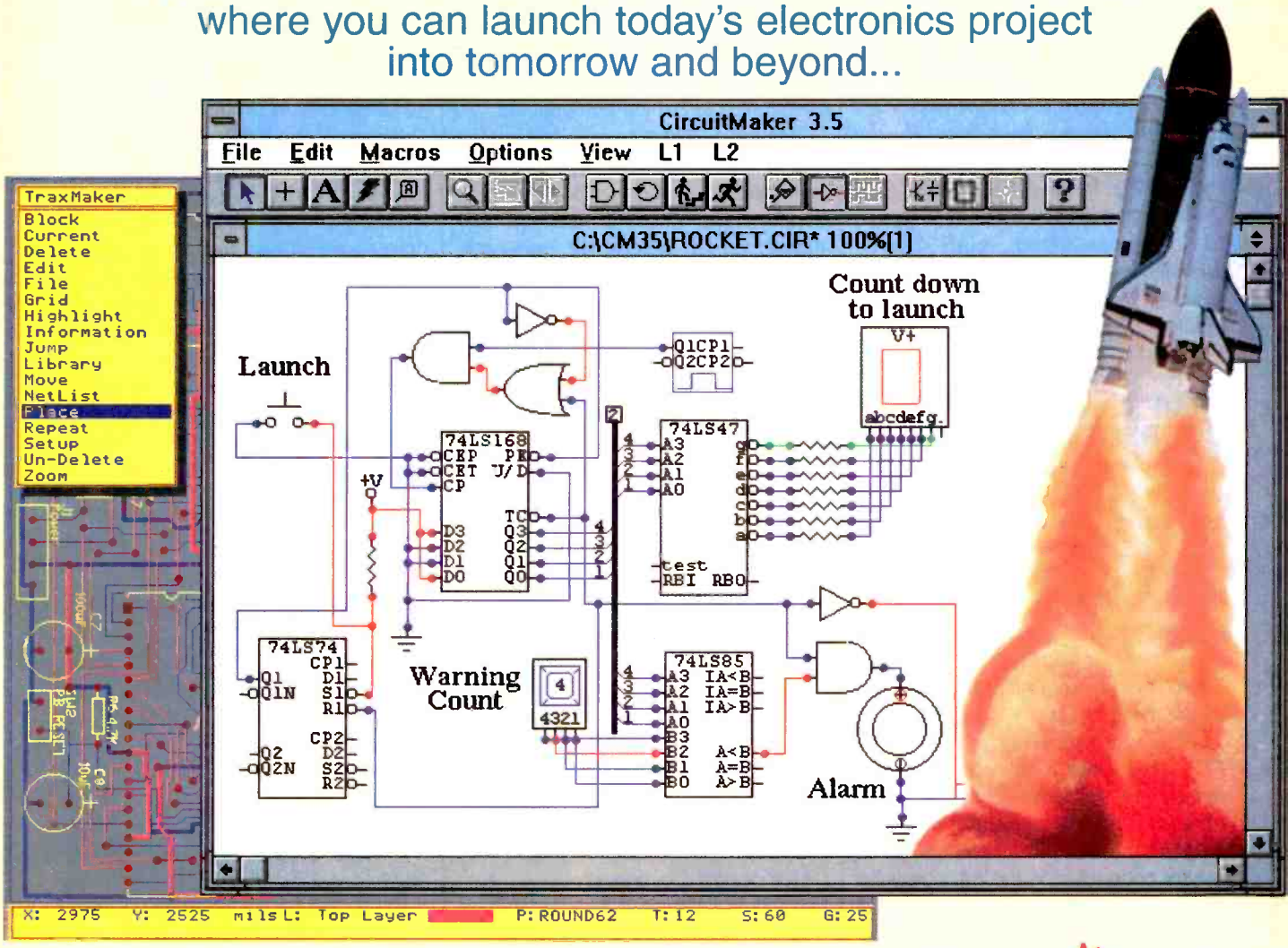

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LETTERS

A Stimulating Correction

BIO-STIMULATOR CORRECTION

*It was brought to my attention that I made two errors in my article, "Build a Bio-Stimulator" (**Popular Electronics**, June 1996): Transistor Q1 should be a 2N4401 unit, and capacitor C5 should be a non-polarized, 1-μF, 50-volt monolithic unit. Sorry for any inconvenience those errors might have caused.*

—Robert A. Heil

DTMF TONE PAD CORRECTIONS

*It appears that my article, "Build a Versatile DTMF Tone Pad," which appears in the June 1996 issue of **Popular Electronics**, contains a few errors. On the schematic diagram, the connection labeled "-12V" should be labeled "Ground" with a ground symbol connected to the junction of C1 and D2. There should also be a ground connection at the junction of R7 and R9.*

Also, due to printing problems, the PC board looks a little blurry, which means that the following might not be clear: On the PC board, the pad connected to pin 8 of IC1 for XTAL1 should not be connected to the trace running to R7. And the pads associated with C5 and C9 should not be connected to the ground trace running between their respective pads. On a different note, another possible source for a suitable keypad is Circuit Specialists, Inc., P.O. Box 3047, Scottsdale, AZ 85271-3047.—Brian Pliler

HOW MINE TURNED OUT

As a copier technician, finding squeaks and rattles is an everyday battle. So when I saw Charles Hansen's article, "Build the Auto Stethoscope," in the April 1995 issue of **Popular Electronics,** I knew there was hope.

Although I have an EET degree, I had never built an electronic project before. However, the Stethoscope plans looked so good, I was sure it would work. I went to Gateway Electronics to get the components.

I found a PC-board-making process where the artwork is copied onto a transparency, ironed onto a piece of copper-clad PC-board material, and etched off. It took about one hour. Except it was a mirror of the art! Oops! Turning over the transparency solved the problem.

I drilled the board and stuffed the components. The soldering went quickly and there were no problems. I put it in a Radio Shack box and used a Radio Shack 4-pin connector for the microphone connection.

The plans called for a 3-wire microphone, but Radio Shack was out, so I had to use a 2-wire microphone. A 20-μF capacitor wired between signal and power for the microphone solved that problem.

When I powered it up, the Stethoscope gave a lot of feedback at high volume. So instead of using walkman headphones, I mounted a pair of 8-ohm B speakers wired in series into a set of shooting ear muffs. That solved the feedback problem.

No design is ever really done. But I can't think of another way to improve this one. The proof of that is that my boss borrowed my Stethoscope and hasn't given it back yet. So I might have to build another one. By the way, it also makes a great shop amp.

D. M. W.
Lakewood, CO

HAVES & NEEDS

I'm interested in obtaining any information, including instruction booklets, service manuals, schematics, theory of operation, parts lists, and general information regarding two different items that I am trying to restore. The first is a 1959 "King of Diamonds" pinball machine, manufactured by D. Gottlieb & Co. The second is a Kellogg hand-crank wall telephone. I also need an ear-piece cord for the phone.

LOUIS M. IANNUZZELLI
1315 West 53rd Street
Davenport, IA 52806

I saved from the trash heap an AC/DC instrument calibration standard manufactured by Radio Frequency Laboratory Inc. of Boonton, New Jersey (P/O Model 829B, Stock No. 6625-804-4993, Contract No. AF 33(604)38770, 115V 10 50 to 400cy).

Now I am trying to figure out what to do with it! I have no manuals. Can someone out there help me with information on this device?

MICHAEL PEARCE
811 East 7th
Superior, NE 68978

I am looking for copies of the manuals for a Dynakit FM-1 Dynatuner FM tuner and an EICO HF-22 power amplifier. I will gladly reimburse copying and postage costs. Thank you.

ALAN JOHNSON
2490 Sharon Way
Reno, NV 89509

I have a radio-detector-type S.E. 183A, serial number 2611, which was made for the Navy Department Bureau of S.E. by Wireless Specialty App. Co. of Boston, Massachusetts. It has three crystal contacts.

I hope that some of my fellow **Popular Electronics** readers can tell me about it, including the year it was used on ships.

KENT MUELLER
30 Hamilton Avenue
Clifton, NJ 07011

A few years ago, **Popular Electronics** offered free Fact Cards. I need a copy of the guitar preamplifier circuit. I would appreciate it if someone could send me a copy.

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PRODUCT TEST REPORT

JVC GR-SV7 Camcorder

BY STEPHEN A. BOOTH

Like its predecessor, the *GR-SV3*—the first Compact-VHS (VHS-C) camcorder with a color, LCD monitor-viewfinder—JVC's new *GR-SV7* takes a two-fisted approach to video moviemaking. It's styled like a 35mm film camera—two hands even for pros. Moreover, the multi-angle versatility of the LCD screen lends itself to use as a waist-level or over-the-head viewfinder—even as a face-forward monitor for those times when the director gets out from behind the lens to get into the picture.

JVC's new GR-SV7 S-VHS camcorder features both a color LCD screen and a conventional viewfinder

That's not to say that there are not some important differences. Besides sporting a 4-inch (diagonal) color LCD (compared to the previous model's 3-inch screen), the new entry also offers S-VHS video recording with Hi-Fi stereo sound. And while it retains auto-everything, point-and-shoot simplicity, this upgrade's feature-trim adds myriad customizable functions and special effects. If the GR-SV3 was the film-camera equivalent of a snapshooter, the GR-SV7 is an SLR with a lazy-man's mode.

On the test-bench in the lab, the camcorder exhibited fine performance overall. Although some measurements could have been better, those usually represented a tradeoff with others that were stellar. Regardless, the appeal of the GR-SV7 will largely be its big LCD monitor and other convenience features, not its test scores.

FEATURES

A 3.25-pound camcorder seems heavy these days, but the weight's irrelevant in a two-hand model—more so considering the additional functionality of the LCD monitor. In combination with the built-in speaker and headphone jacks, the color display makes this type of camcorder a mobile entertainment center. Sure, you may use it to view your raw camcorder footage as you go. But families traveling with young kids will probably appreciate the ability to play prerecorded entertainment even more.

By the way, you don't have to use the color LCD as a viewfinder, convenient though that might be. The GR-SV7 retains a traditional, black-and-white CRT of the peep-hole type. Using that alone, without the LCD, will buy you an additional ten minutes of power using the standard battery.

You needn't use the LCD only as a viewfinder, either. It swivels around to face forward, so that subjects can see themselves as others will see them—as they're being taped. That probably isn't as vital to the cast as it is to the director (poor-old Mom or Dad), who might occasionally want to get into the action. The option to monitor the scene from in front of the lens—and change zoom-lens through the included, wireless remote control—is another factor in this camcorder's appeal.

In the front-facing mode, the LCD can be used as a Video Message center—families can leave sight-and-sound notes on the GR-SV7 instead of Post-It notes on the refrigerator (a blinking light alerts you to "mail"). Additionally, in this "interface" position the GR-SV7 functions as a playback monitor for videos.

Of course, prerecorded programs generally don't come on VHS-C cassettes—you'll have to make your own (from TV, or by dubbing from other tapes). Usually, line-in recording to a camcorder is a pain, but not with the GR-SV7.

It comes with a clever "junction box" that acts as a docking station for the camcorder, and offers multiple audio/video inputs and outputs (including S-Video) for easy hookup to TVs or other video devices. Since this is an S-VHS camcorder, with about two-thirds greater resolution than standard VHS, you could use the EP mode to stretch a 40-minute VHS-C cassette to hold two hours' worth of cartoons—and still have a really fine picture (instead of EP fuzz).

For sedentary entertainment, you'll run the GR-SV7 off AC with the included adapter/battery charger. For vehicular viewing, though, you'll want the optional 12-volt DC powercord, if only to spare your camcorder battery.

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The downside of monitor-style color LCD viewfinders is power consumption. In moviemaking, the supplied BN-V12U NiCd (nickel-cadmium) battery is rated for 30 minutes when using both the color LCD and eye-level monochrome viewfinder—or 40 minutes with the LCD off. Those times reflect typical hands-on use—zooming, pausing, multiple starts and stops. The battery needs 70 minutes to take a charge. JVC offers two other batteries good for 65 and 90 minutes under high-load conditions.

As a camcorder, the GR-SV7 has a huge bag of tricks. Focus and white-balance are automatic (or color-temperature setting), but manual options abound for these and other moviemaking functions. The lens itself is a 10X power zoom in its optical form, the photographic equivalent of a 32mm semi-wideangle through 324mm telephoto. Digital signal processing extends your reach further. For example, 20X magnification is instantly available in the full-auto mode—and 100X "digital zoom" in the preset mode (which contains other custom settings for more advanced videography). Such extreme telephoto settings aren't the province of hand-holding—even two-handed. But in lieu of a tripod, the GR-SV7 has digital image stabilization to quell operator shake.

Though the image might remain steady, JVC candidly points out that image quality does deteriorate in the digital-zoom modes. Those merely enlarge a smaller portion of the optical image, so sharpness is sacrificed because fewer lines of resolution appear on your TV screen. At extreme magnifications, images bear the tell-tale pixelization of the CCD image sensor.

As you'd expect in a full-featured camcorder, the GR-SV7 provides multiple special-effects to entertain your audience, and others to either improve or embellish your home movies. The fun stuff includes snapshot, motor-drive, slow-shutter, and classic-film modes. Snapshot yields video stills—with photoprint-like white borders—while motor drive records a succession of those. Slow shutter is the by-now cliché, MTV-style, disjointed music-video look. Classic film emulates the syncopated look of 24-frames-per-second film when played without speed-compensation at NTSC-video's 30-frame-per-second rate.

As for embellishment, the GR-SV7 has several built-in fades, wipes, and dissolves. And regarding the automated functions that just make any movie look better, there are back-lit and sports modes. The former handles tricky lighting-situations such as sunsets and fireworks. The latter shifts gears to faster shutter-speeds to record clear images for slow-motion playback—for all you folks who want to study the mechanics of your tennis backhand or golf swing. This mode's high shutter-speeds require very bright light for optimal recording. Which gets us to the lab . . . .

Fig. 1. This vectorscope photograph shows phase to be right on the mark, but chroma (red) to be a little oversaturated.

TEST RESULTS

Here's the tale-of-the-tape as measured by the Advanced Product Evaluation Laboratory (APEL), an independent testing facility located in Bethel, Connecticut. When you read APEL's electrical measurements in the Table 1, keep the following in mind.

Minimum illumination rates the camcorder's ability to record in low light and still capture a viewable image. It's measured in lux—the lower the number, the better—and most companies vie to advertise a camcorder with capabilities of a night-vision scope. Unfortunately, until there is a uniform way of measuring lux, comparing manufacturers' specs is meaningless.

A standardized rating for lux is in progress; in fact, APEL is among the parties developing the methodology with the Electronic Industries Association. For the time being, APEL's lux measurements as published here are at least consistent and comparable. Accordingly, you can compare the minimum illumination of competing camcorders tested here. JVC's 3.8-lux doesn't seem as good the 0.9-lux posted by a Sony's model in an earlier test—but lux, with modern camcorders (compared to the formative years), is an overhyped spec anyway.

You'll probably never shoot movies in sheer darkness. Average household lighting produces decent pictures—and an inexpensive accessory lamp will punch up colors. Actually, the GR-SV7 tested slightly better than the 4-lux minimum that JVC specified. It's encouraging to see that JVC didn't make claims to infrared-type light sensitivity. The company must feel that the GR-SV7 stands up on its other merits.

These include resolution, white balance and color contamination. At 380 lines of horizontal resolution recorded to tape at the video output, the GR-SV7 comes within a hair of the theoretical ceiling for S-VHS. Resolution means sharpness, and it is gauged by the number of image-making lines the camcorder records, in picket-fence fashion across your TV screen. By comparison, top resolution for standard VHS is 240 lines, and a live TV broadcast weighs in at 330. For your information, the resolution of the GR-SV7's camera measured 400 lines.

Usually, test reports don't fuss about camera resolution, because all that most people care about is the image that winds up on videotape. But with the popularity of home multimedia computers and the multitude of applications that invite input from video images, APEL and **Popular Electronics** believe camera resolution should be of concern to serious computer and video buffs.

White balance reveals a camcorder's ability to adjust to different temperatures of light (say, sunshine or indoor light-bulbs) to reproduce pure whites and therefore, correctly balanced colors. JVC's auto white-balance circuitry scores better than most—and it could be manually adjusted if you're a perfectionist.

Meanwhile, color contamination was an astoundingly perfect 0 IRE

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(that's zero). That test reveals the presence of unwanted color specks as found in a black-and-white test pattern. In other words, no color-speckles even when you're doing critical close-up stills in the macro-mode. You can focus to within a half-inch in the macro-mode of the GR-SV7—good news for videographers with coin, stamp, or butterfly collections.

The GR-SV7 posted only average numbers for signal-to-noise ratio—average, that is, for conventional VHS. But APEL measured the camcorder's S-VHS performance—why else would anyone be interested in this model (and its two-grand price tag)? This is measured under optimal lighting conditions and shows the amount of usable signal, for color (chroma AM) and brightness (luminance, black-and-white), above the threshold of electrical noise. By a rule-of-thumb, noise increases with picture-sharpness (resolution)—of which the GR-SV7 has plenty.

Oddly, color contamination too is often a tradeoff for resolution—but the GR-SV7 measures none. There must be something special about the 570,000-pixel 1/3-inch CCD that JVC is using here. Because in streaking/lag and image-retention, and in color quality, the camcorder produced excellent ratings. The test for streaking/lag and image retention looks for flares or tails of light and color that trail behind the highlights of a moving subject. Look for that during baseball games on TV, when light reflects off batting helmets or other shiny gear. It's virtually nonexistent in home camcorders.

With phase accuracy and chroma saturation, the color red is the test-case because it's the most difficult for video to handle correctly. Phase accuracy looks for deviation from true red, toward magenta or yellow. Chroma saturation gauges depth, or intensity of hue.

The bouncing ball in APEL's vectorscope photo (see Fig. 1) shows phase to be on the mark. And although chroma appears to be just a hair above the cross-hairs—and therefore a bit oversaturated—visual inspection shows that the GR-SV7 compensates for that in playback. (Some camcorders do record a bit "hotter" than needed, then fix it in the mix by showtime.) It wouldn't matter much anyway: If you were to find a deep-red too rich for your blood, you could always adjust to taste with the color controls of your TV.

For more information on the JVC GR-SV7 camcorder, contact the manufacturer directly at the address given below, or circle 120 on the Free Information Card. ■

TABLE 1—TEST RESULTS

The following test results were furnished by the Advanced Product Evaluation Laboratory, an independent testing facility located in Bethel, CT. Measurements were taken in the S-VHS format, standard-play mode, using JVC's ST-20 S-XG VHS-C (compact) videocassette. Mimimum illumination was measured using the "gain-up" feature of the full-auto mode.

Brand:	JVC
Model:	GR-SV7
Price:	$1,999.99
Video Measurements:	
Minimum Illumination	3.8 lux
Resolution	
Record/Play Video Out	380 lines
Camera	400 lines
Signal-to-Noise Ratio (Record/Play Video Out)	
Chroma AM	39.5 dB
Luminance	42.8 dB
Signal-to-Noise Ratio (Camera)	
Chroma AM	41.0 dB
Luminance	42.3 dB
Color Contamination	0 IRE
White Balance	4.0 IRE
Streaking/Lag, Image Retention	Excellent
Color Quality	
Phase Accuracy	Excellent
Chroma Saturation	Excellent
Minimum Focus Distance	
Normal	38 inches
Macro	0.5 inch
Audio Measurements:	
Signal-to-Noise Ratio	52.0 dB
Maximum Output (built-in mic)	0.4 volt
Input Sensitivity (external mic)	4.0 mV
Other Measurements:	
Power Requirements (with color LCD monitor on)	17 watts
Weight (including battery and cassette)	3.25 pounds
Dimensions (inches, H × W × D)	5.0625 × 7.625 × 4.25

FOR MORE INFORMATION

JVC Company of America
41 Slater Drive
Elmwood Park, NJ 07407
CIRCLE 120 ON FREE INFORMATION CARD

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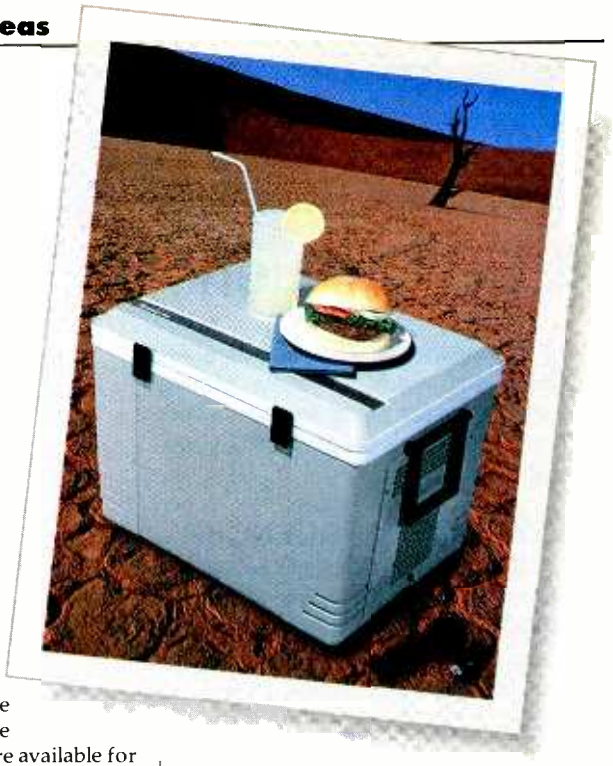
TECHNOLOGY UPDATE

500 miles from nowhere, it'll give you a cold drink or a warm burger...

NASA space flights inspired this portable fridge that outperforms conventional fridges, replaces the ice chest and alternates as a food warmer.



By Charles Anton

Recognize the ice cooler in this picture? Surprisingly enough, there isn't one. What you see instead is a Koolatron, an invention that replaces the traditional ice cooler, and its many limitations, with a technology even more sophisticated than your home fridge. And far better suited to travel.

What's more, the innocent looking box before you is not only a refrigerator, it's also a food warmer.

NASA inspired portable refrigerator. Because of space travel's tough demands, scientists had to find something more dependable and less bulky than traditional refrigeration coils and compressors. Their research led them to discover a miraculous solid state component called the thermo-electric module.

Aside from a small fan, this electronic fridge has no moving parts to wear out or break down. It's not affected by tilting, jarring or vibration (situations that cause home fridges to fail). The governing module, no bigger than a matchbook, actually delivers the cooling power of a 10 pound block of ice.

The refrigerator from outer space.

The secret of the Koolatron Cooler/Warmer is a miniature thermo-electric module that effectively replaces bulky piping coils, loud motors and compressors used in conventional refrigeration units. In the cool mode, the Koolatron reduces the outside temperature by 40 degrees F. At the switch of a plug, it becomes a food warmer, going up to 125 degrees.

From satellites to station wagons. Thermo-electric temperature control has now been proven with more than 25 years of use in some of the most rigorous space and laboratory applications. And Koolatron is the first manufacturer to make this technology available to families, fishermen, boaters, campers and hunters– in fact anyone on the move.

Home refrigeration has come a long way since the days of the ice box and the block of ice. But when we travel, we go back to the sloppy ice cooler with its soggy and sometimes spoiled food. No more! Now for the price of a good cooler and one or two seasons of buying ice, (or about five family restaurant meals), all the advantages of home cooling are available for you electronically and conveniently.

Think about your last trip. You just got away nicely on your long-awaited vacation. You're cruising comfortably in your car along a busy interstate with only a few rest stops or restaurants. You guessed it... the kids want to stop for a snack. But your Koolatron is stocked with fruit, sandwiches, cold drinks, fried chicken... fresh and cold. Everybody helps themselves and you have saved valuable vacation time and another expensive restaurant bill.

Hot or cold. With the switch of a plug, the Koolatron becomes a food warmer for a casserole, burger or baby's bottle. It can go up to 125 degrees.

And because there are no temperamental compressors or gasses, the Koolatron works perfectly under all circumstances, even upside down. Empty, the large model weighs only 12 pounds and the smaller one weighs just seven. Full, the large model holds up to 40 12-oz. cans and the smaller one holds six.

Just load it up and plug it in. On motor trips, plug your Koolatron into your cigarette lighter; it will use less power than a tail light. If you decide to carry it to a picnic place or a fishing hole, the Koolatron will hold its cooling capacity for 24 hours. If you leave it plugged into your battery with the engine off, it consumes only three amps of power.

Limited time offer. Because Comtrad is bringing this offer to you directly, you save the cost of middlemen and retail mark-ups. For a limited time only, you can get this advanced, portable Koolatron refrigerator at the introductory price of $99. Call today to take advantage of this special promotional pricing. Most orders are processed within 72 hours.

The versatile Koolatron is available in two sizes. The P24A holds 30 quarts and the smaller P9 holds seven quarts. An optional AC adaptor lets you use them in your rec room, patio or motel room. They plug into any regular outlet.

Try it risk free. We guarantee your satisfaction with any product from Comtrad Industries. With the Koolatron you get our complete "No Questions Asked" 30 day money-back guarantee. Plus you get a full one year manufacturer's limited warranty. If you are not satisfied for any reason, just return the product for a complete refund.

Koolatron (P24A) holds 30 quarts	**$99**	$16 S&H
Koolatron (P9) holds 7 quarts	**$79**	$8 S&H
Optional AC Adapter (AC 10)	**$49**	$6 S&H

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CIRCUIT CIRCUS

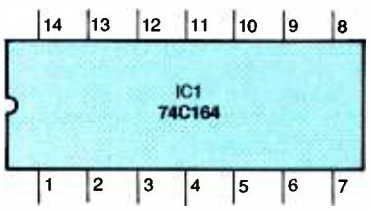
LED Sequencers, and More

BY CHARLES D. RAKES

Greetings, fellow circuiteers. Are you ready for some circuitry fun? If so, stay tuned and see what's happening here at the Circus this month.

LED LIGHT SEQUENCER

Our first entry places a 74C164 8-bit shift register IC in an LED light-string sequencer. But before we start plugging in parts, let's take a look at the register's input/output pins, as shown in Fig. 1.



PIN #	FUNCTION
1	SERIAL INPUTS
2	SERIAL INPUTS
3	OUTPUT 1
4	OUTPUT 2
5	OUTPUT 3
6	OUTPUT 4
7	GROUND; BATTERY NEGATIVE
8	CLOCK INPUT
9	CLEAR INPUT
10	OUTPUT 5
11	OUTPUT 6
12	OUTPUT 7
13	OUTPUT 8
14	+ POWER; 3 – 15V

Fig. 1. The 74C164 8-bit shift register is at the heart of the LED light sequencer. The pinout for that integrated circuit is shown here.

Input data goes to the serial inputs at pins 1 and 2. When pins 1 and 2 are high, data moves one step forward with each clock pulse. The IC's eight serial/parallel outputs are pins 3-6 and 10-13. The data flows from output 1 to 2 to 3 and sequentially on to 8 with each clock pulse. The data at the output register may be cleared to zero by taking the clear input (pin 9) momentarily low.

The shift register transfers data on the positive edge of the clock pulse. For glitch-free operation, the clock's output must produce only a single positive transition per clock pulse.

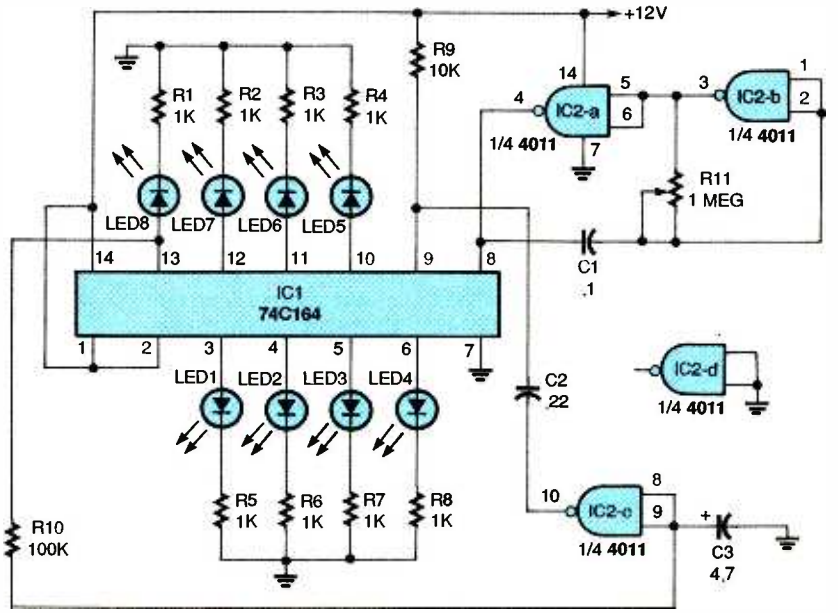


Fig. 2. Here is the complete schematic for the LED light sequencer. The circuit turns one of eight LEDs first on, then off, in order.

Now on to the sequencer circuit, which is shown in Fig. 2. Two gates, IC1-a and IC1-b, of a 4011 quad two-input NAND-gate IC are connected in a low-frequency, astable oscillator circuit with the operating frequency set by the values of C1 and R11. That circuit arrangement makes a good clock-pulse generator for the 74C164 shift register, IC1. The clock's positive output pulses, available at pin 4 of IC2, are fed to the shift register's clock input at pin 8 of IC1.

An LED is connected to each of the shift register's outputs. A 1000-ohm current-limiting resistor is placed in series with each LED.

The shift register's eighth output, at pin 13, connects through a time-delay RC network, made up of R10 and C3, to the input of gate IC2-c. That gate's output is capacitor coupled to the shift register's clear input at pin 9. When the eighth clock pulse turns on LED8, pin 13 of IC1 goes positive, charging C3. After a brief time period, IC2-c's output goes low clearing the shift register's outputs.

Here's how the LEDs light: The first clock pulse turns LED1 on, the second pulse turns LED2 on, and the process continues until all eight of the LEDs are lit. After the eighth LED turns on,

PARTS LIST FOR THE LED SEQUENCER (Fig. 2)

SEMICONDUCTORS
IC1—74C164, 8-bit shift register, integrated circuit
IC2—4011 quad 2-input NAND gate, integrated circuit
LED1-LED8—Light-emitting diode, any color

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1-R8—1000-ohm
R9—10,000-ohm
R10—100,000-ohm
R11—1-megohm potentiometer

CAPACITORS
C1—0.1-µF, ceramic-disc
C2—0.22-µF, ceramic-disc
C3—4.7-µF, 35-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS
IC socket, wire, solder, etc

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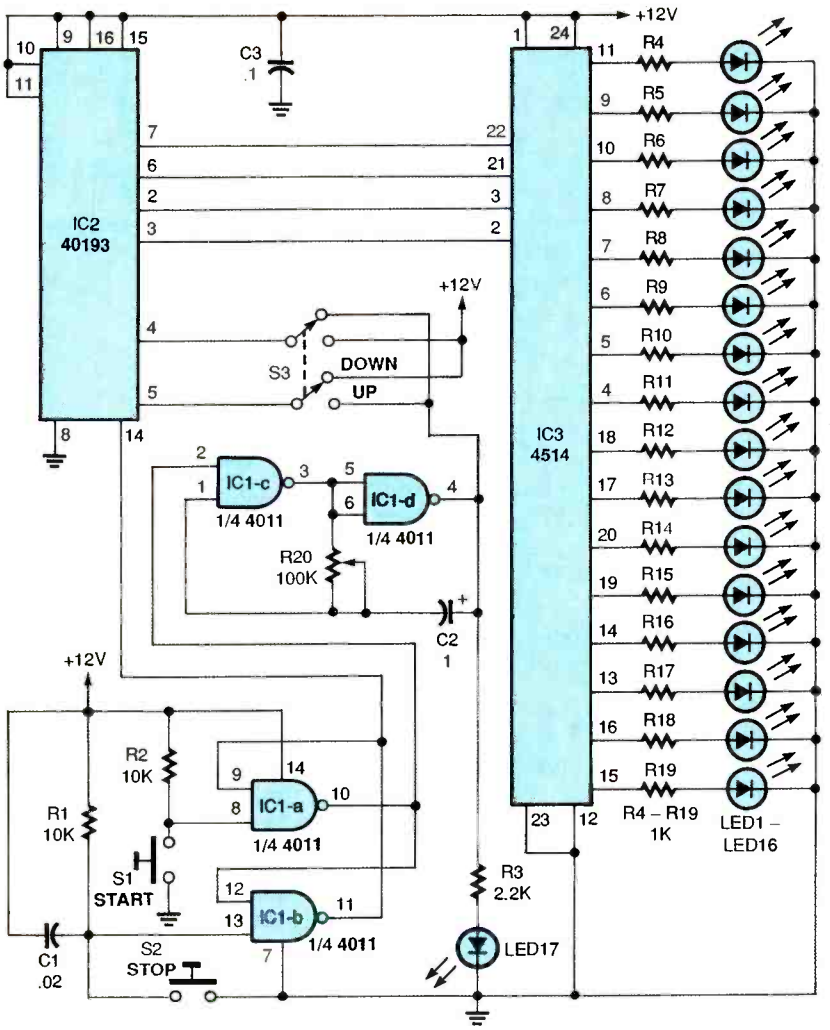

Fig. 3. This up/down sequencer will sequence the LEDs either up or down depending on the setting of S3.

PARTS LIST FOR THE UP/DOWN SEQUENCER (Fig. 3)

SEMICONDUCTORS

IC1—4011 quad 2-input NAND gate, integrated circuit
IC2—40193 binary up-down counter, integrated circuit
IC3—4514 1-of-16 decoder, integrated circuit
LED1-LED17—Light-emitting diode, any color

RESISTORS

(All fixed resistors are ¼-watt, 5% units.)
R1, R2—10,000-ohm
R3—2200-ohm
R4-R19—1000-ohm
R20—100,000-ohm potentiometer

ADDITIONAL PARTS AND MATERIALS

C1—0.02-μF, ceramic-disc capacitor
C2—1-μF, 35-WVDC, electrolytic capacitor
C3—0.1-μF, ceramic-disc capacitor
S1, S2—SPST pushbutton switch, normally open
S3—DPDT switch
IC sockets, wire, solder, etc.

the clear pulse from IC2-c turns off all of the LEDs and the sequence is repeated.

The values of R10 and C3 may be varied to allow LED8 to remain on for the same time period as each of the other LEDs. The RC time-delay circuit will need to be shorter for a faster sequence and longer for a slower sequence. The delay time may be increased by making the value of either R10 or C3 larger, and decreased by making the values smaller.

UP/DOWN LIGHT SEQUENCER

Our next LED circuit, shown in Fig. 3, uses a 24-pin 1-of-16 decoder IC to turn 16 LEDs on and off in a sequential order. The CMOS 4514 binary-to-decimal decoder, IC3, uses a four-bit binary input to select and turn on one of the sixteen outputs.

A 40193 binary up/down counter, IC2, supplies the binary input data to the 4514 decoder. Two gates of a 4011 quad 2-input NAND gate, IC1-c and IC1-d, are connected in a low-frequency, astable-oscillator clock circuit. The operating frequency is set by C2 and R20. The remaining two gates of the 4011, IC1-a and IC1-b, are configured in a set-reset flip-flop latching circuit. Switch S1 serves as the start switch, S2 as the stop switch, and S3 selects IC2's up/down counting feature.

The circuit operation goes like this: Pressing S1 latches IC1-a's output high at pin 10, starting the oscillator by taking pin 2 of IC1-c high. At the same instant, the reset input of IC2, at pin 14, is latched low, allowing the IC to count up or down depending on the position of S3. The LEDs (LED1 through LED16) turn on and off in a sequential manner, one at a time, as the clock operates. When the last LED in the sequence turns on and off, the sequence starts over and continues until the stop switch is activated.

When S3 is in the UP position, LED1

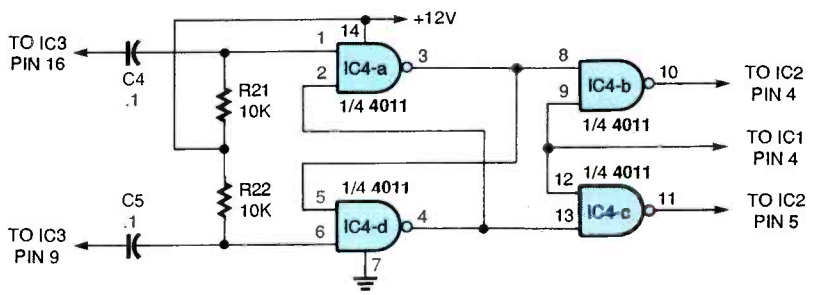

Fig. 4. This add-on circuit for the sequencer in Fig. 3 will cause that circuit to first sequence up, then down, and repeat until the circuit is manually stopped.

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starts the sequence and LED16 ends it. With S3 in the DOWN position, LED16 starts the sequence counting down to LED1.

UP/DOWN SEQUENCER ADD-ON

Because IC2 is an up/down counter why not use that feature to have the LEDs count up to LED16 and then back down to LED1? O.K., we can do that! Take a look at the circuit in Fig 4. That additional 4011 set-reset flip-flop latching circuit connects to the sequential circuit in Fig. 3 as shown. To make the modification, first remove the up/down selector, switch S3, in the circuit of Fig. 3, then connect the two circuits together.

PARTS LIST FOR THE ADD-ON CIRCUIT (Fig. 4)

R21, R22—10,000-ohm, ¼-watt, 5% resistor
C4, C5—0.1-µF, ceramic-disc capacitor
IC4—4011 quad 2-input NAND gate, integrated circuit

When the LED sequence reaches either end of its cycle, the set-reset state of IC4-a and IC4-b reverses causing IC1-b and IC1-c to direct the clock output from the up or down to the down or up input of IC2. The sequence continues on until S2 is pressed.

Those two circuits are great fun to play with, so why don't you see what neat applications you can find for them?

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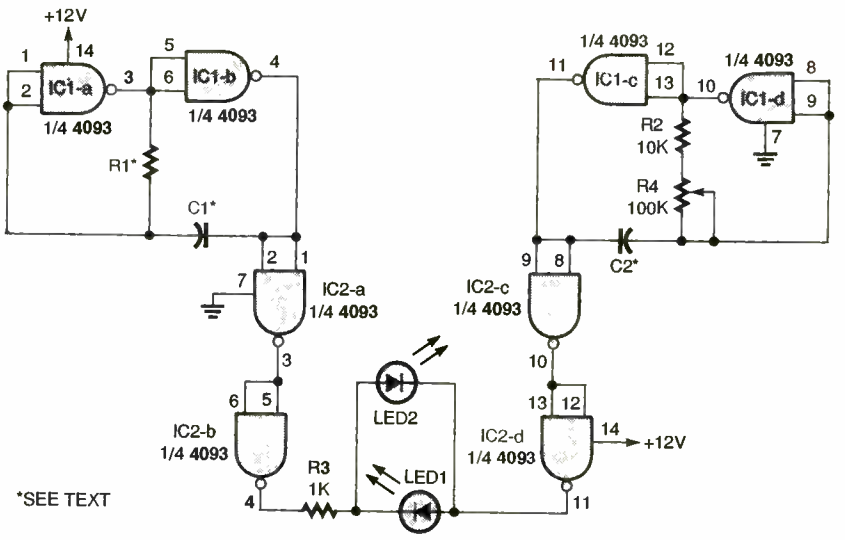

Fig. 5. This capacitor comparator will let you tell quickly if capacitors are close to each other in value.

CAPACITOR COMPARATOR

Our last item this go-a-round is a capacitor-comparator circuit that's shown in Fig. 5. Two 4093 quad 2-input NAND Schmitt-trigger IC's make up the active components in the circuit. The four gates of IC1 are connected in two similar astable oscillator circuits. The output of each oscillator connects to the inputs of a gate in IC2. The outputs at pin 4 of IC2-b and pin 11 of IC2-d are fed to two cross-coupled LEDs through a 1000-ohm current-limiting resistor.

When both oscillators are operating at the same frequency and phase, the output between pins 4 and 11 of IC2 will be zero and neither LED will light. If a 47,000-ohm resistor is selected for R1 and two matched capacitors are used for C1 and C2, the two oscillators can be set to the same frequency and phase by adjusting R4.

The comparator circuit can now be used to select matching capacitors by placing the desired value of capacitor in the C1 position and checking the matching values in the C2 location.

When the two capacitors are very close in value, the two LEDs will slowly flicker on and off, and with a perfect match both LEDs will go out. To find out how close two capacitors are that don't match, mark the original balance position of R4 and slowly rotate it back and forth until a match is found. If the balance point was very close to the marked position, the two capacitors are close in value. If a large change in R4's setting is necessary to acheive a balance, the two capacitors are not close in value.

PARTS LIST FOR THE CAPACITOR COMPARATOR (Fig. 5)

SEMICONDUCTORS
IC1, IC2—4093 quad, 2-input, NAND Schmitt trigger, integrated circuit
LED1, LED2—Light-emitting diode, any color

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1—See text
R2—10,000-ohm
R3—1000-ohm
R4—100,000-ohm potentiometer

ADDITIONAL PARTS AND MATERIALS
C1, C2—See text
IC socket, wire, solder, etc.

Well, we've reached the end of our space for this time so it's lights out time again for now. Until we meet here again next month, may all of your circuits perform as planned. ■

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Fifteen years of microelectronic research makes conventional antennas a thing of the past!

This little box uses your home's electrical wiring to give non-subscribers, cable subscribers and satellite users better TV reception!

by David Evans

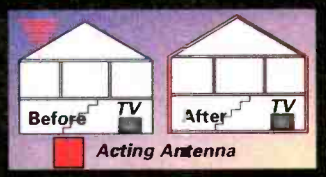
Technology corner

1. Why don't conventional antennas work as well as the Spectrum?

■ When TV signals are tuned at the TV channel's center frequency, optimum tuning has been achieved.

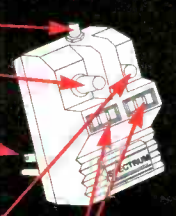
■ Other antennas can't offer center frequency tuning like the Spectrum Antenna can. They only offer such tuning up to the edge of the center frequency. As a result your TV picture remains snowy.

2. How does Spectrum use a home's electrical wiring as an antenna?



Believe it or not, the Spectrum Antenna simply "activates" the giant antenna that already exists in your home. Essentially, it uses all of the wiring throughout your home's walls and ceilings to make an antenna as large as your house for unbelievably clear reception of local broadcasting.

3. Spectrum antenna features



Parallel 75 ohm resistance
For minimum loss of signal

Signal search control
For selecting multiple antenna configurations

Polarized three-prong plug for grounding
For optimum signal grounding to eliminate noise and static

Resonant fine tuner control
For dialing in crisp, clear TV/stereo reception, eliminates ghosting

Dual AC outlets with built-in surge protection
For plugging in additional TV stereo equipment guarding against damage and electrical surges

Until recently, the only convenient way to guarantee great TV reception was to have cable installed or place an antenna on top of your TV. But who wants to pay a monthly cable fee just to get clear reception, or have rabbit-ear antennas that just don't work on all stations? Some people just aren't interested in subscribing to cable. Or they may live in an area where they can't get cable and TV-top antennas aren't powerful enough. And what about those people who have cable or satellite systems but still can't get certain local stations in clearly?

Now, thanks to fifteen years of microelectronics research, a new device has been developed that is so advanced, it actually makes conventional antennas a thing of the past. It's called the Spectrum Universal Antenna/Tuner.

Advanced technology. Just imagine watching TV and seeing a picture so clear that you'd almost swear you were there live. Just plug the Spectrum Antenna into a standard AC outlet and plug your TV into the Spectrum. You can remove the unsightly clutter of traditional TV-top devices gathering more dust than television signals. Get ready for great reception. Your TV will suddenly display a sharp, focused picture thanks to its advanced design "Signal Search" and "Fine Tuner" controls.

Uses your home's electrical wiring. The Spectrum Antenna is a highly sophisticated electronic device that connects into a standard wall outlet. The outlet interfaces the Spectrum Antenna with the huge antenna that is your home wiring network. It takes the electrical wiring in your house or apartment and turns it into a multi-tunable, giant TV reception station which will improve your TV's overall tuning capability. The results are incredible. Just think how much power runs through your home's AC wiring system—all that power will be used to receive your local broadcasting signals.

How it works. Broadcast TV signals are sent out from the local broadcast station (ABC, CBS, NBC, etc.). They interface with your home's AC power line system, a huge aerial antenna network of wiring as large as your home itself. When the Spectrum Antenna interfaces with the AC line, the signal is sent to its signal processing circuit. It then processes and separates the signal into 12 of the best antenna configurations. These specially processed signals route themselves into 12 separate circuits. The Spectrum Antenna includes a 12-position rotary tapping switch, the "Signal Switch" control, which gathers twelve of the best antenna configurations.

The "Signal Search" offers varying antenna configurations for the user to select from the best signals of all those being sent. The signal then passes through the Spectrum Antenna's special "Fine Tuner" circuit for producing crisp, clear reception.

Risk-free offer. The Spectrum Universal Antenna/Tuner comes with our exclusive 90-day risk-free home trial and a 90-day manufacturer's warranty. Try it, and if you're not satisfied, return it for a full "No Questions Asked" refund.

Who can use Spectrum?

- ***Cable users-You have cable but you can't get certain local stations in clearly.***
- ***Non-cable users-You don't have cable and want the stations to come in more clearly***
- ***Satellite users-You have a digital satellite system but can't get local stations in clearly***

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NET WATCH

Mapping The U.S.

BY DAN KARAGIANNIS

Virtually speaking, the Web is a big place. That's part of the reason why more and more search engines are appearing on it on a somewhat regular basis. Internauts need a way to navigate through all the twists and turns of the Net Information Superhighway.

Likewise, the United States is a big place with its own physical highways. This month, we'll take a look at a place that makes navigating those roads a bit easier. Also, for all you hobbyists who don't wish to ignore interests you picked up before the Net explosion, we'll take a look at a couple of antique-radio sites.

MapQuest lets you either access a street guide to the continental U.S., or get directions describing the shortest driving distance between two places.

MAPQUEST

If you're like me, you love a good road trip. And while you might know the route to your favorite getaway, eventually you'll want to go somewhere else. That's when a map of the country comes in handy. Of course, even with such a map, detailed street information of each city is not available. So what do you do?

Well, if you have a Net connection, and don't feel like ordering street atlases every time you plan on going somewhere, point your browser to MapQuest. It can make your travel planning easier in two unique ways.

First, the site contains a searchable and customizable Interactive Atlas. Simply enter a full address or some aspect of one, like a town, state, and/or zip code. The Atlas will search for a street map of the area and present it to you as a modifiable view. By that I mean you can zoom in and out to get the level of detail and area of coverage you require. Finding a map of the area around the Gernsback offices took about 30 seconds (including typing time).

The sizes of the maps and certain aspects of their appearance can be customized before you perform your first search. A great feature of the Interactive Atlas is that it remembers such customizations and even what you were looking for during your last visit. To take advantage of that feature, the site requests your name and e-mail information to open a free "user page" the first time you sign on. (Note: Be sure to bookmark the resulting page that will be created for you, or else you won't be able to access your stored user information.)

Even if you're not looking to get away by car, the maps come in handy when you're looking for a particular house or place of business. As I mentioned earlier, you can enter complete addresses, including street numbers. Just be careful; the little virtual pin that will appear on the map you retrieve does *not* correspond to where on the street the quest of your search lies. It simply indicates the center of your area of interest. However, knowing the streets around a destination make it easier to get to the correct street.

If you find that an area you brought up on screen is not exactly right, you have two options. You can either zoom out using the slide indicator to the left of the map, or you can use the four directional arrows to move your area of view over.

As you might be able to tell by my description, using this site is like owning an incredible street-atlas CD-ROM, without the strain such a disc would make on your wallet. If you drive, be prepared to spend a lot of time at MapQuest's Interactive Atlas.

But we're not done talking about the site yet. Remember, I said MapQuest can make your travel planning easier in two ways. Even if you downloaded a map of the complete state you wish to visit, that wouldn't necessarily tell you the shortest distance between two points. In the past, to figure that out you'd need an accurate scale of the map, a bit of string, and a lot of patience.

Now, with MapQuest's TripQuest, finding the shortest distance between two cities or towns is ridiculously simple. Just type in the name of your start-

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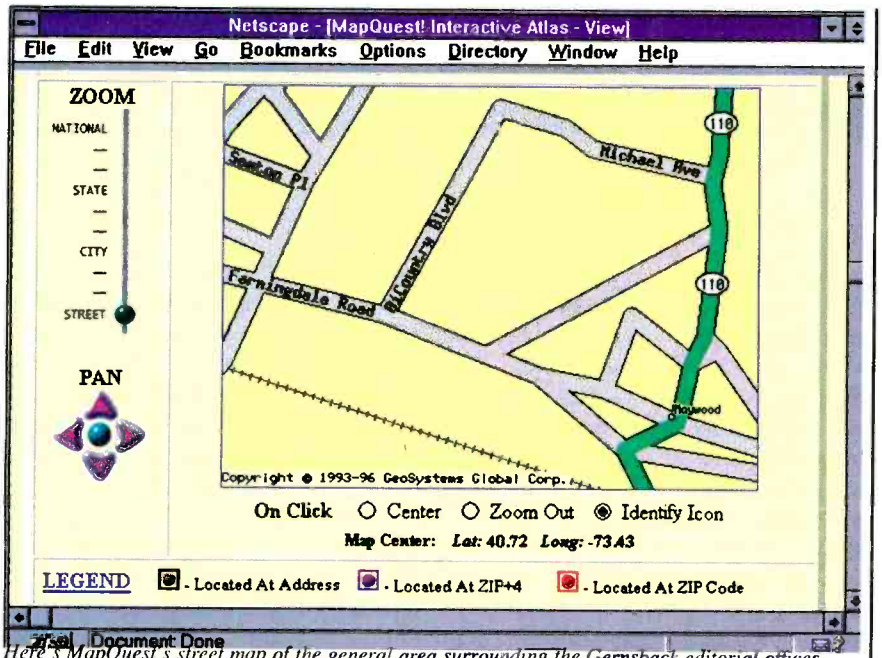

Here's MapQuest's street map of the general area surrounding the Gernsback editorial offices.

ing point, being as specific as possible; then do the same for your destination point. There are fields for city/town, state, and county. If you don't know the county, don't worry; TripQuest will give you choices if there is more than one town of the same name in the same state.

Once you enter the information you will only have to wait a few seconds before a complete itinerary appears on your screen. The directions you get will be clear and easy to understand. You should be able to follow them to your destination without a map; however, having one along (especially because this site can give you one free) never hurts.

Keep in mind that the shortest distance between two places is not always the quickest way. TripQuest seems to consider mileage when calculating its directions for you, but not how many traffic lights are on a particular road or if there is road work at this time of year. Only use TripQuest if you would like to be sure of preventing excess mileage during a trip.

A visually pleasing site, the Antique Radio Page lets you view photos and read descriptions of radios from the 1920s to the 1950s.

HOT SITES

MapQuest
http://www.mapquest.com

Antique Radio Page
http://members.aol.com/djadamson/arp.html

Bellingham Antique Radio Museum
http://www.pacificrim.net/~radio/old_html

ANTIQUE-RADIO SITES

Now, let's turn our attention to two spots on the Web where antique-radio information is made available using modern technology. If you have an interest in the radios of yesteryear, here are some places you should visit:

One of the most impressive sites is the Antique Radio Page. In the Galleries found there you can view radios from the 1920s to the 1950s, and read descriptions of each. You'll find early transistor, tube, and even novelty radios, all just a click away. Those who like visiting attractive sites will appreciate not only the quality of the pictures of the radios found here, but also the way they are laid out.

This site is also a great starting point for exploring antique-radio sites and information on the Net. You'll find plenty of links to general antique-radio pages, other online radio collections, sources for restoration and parts, and information about radio clubs in your area.

Also, if you're new to the hobby, there's a thorough bibliography of references in Books. For those who don't feel like running off to the library, there's a lot of information available in Articles.

As a final note, there's another particularly useful feature at this site. If you're looking to buy an old unit, or perhaps a part for one, read what others are selling in the Marketplace. You can even place an ad if there's an item you'd like to sell.

Our last hot spot is the Bellingham Antique Radio Museum site, which is the Web presence of the museum of the same name, located in downtown Bellingham, Washington. Like theAntique Radio Page, this site has images and descriptions of radios to explore as well, including one of the world's largest radio (which you have to see to believe).

continued on page 22

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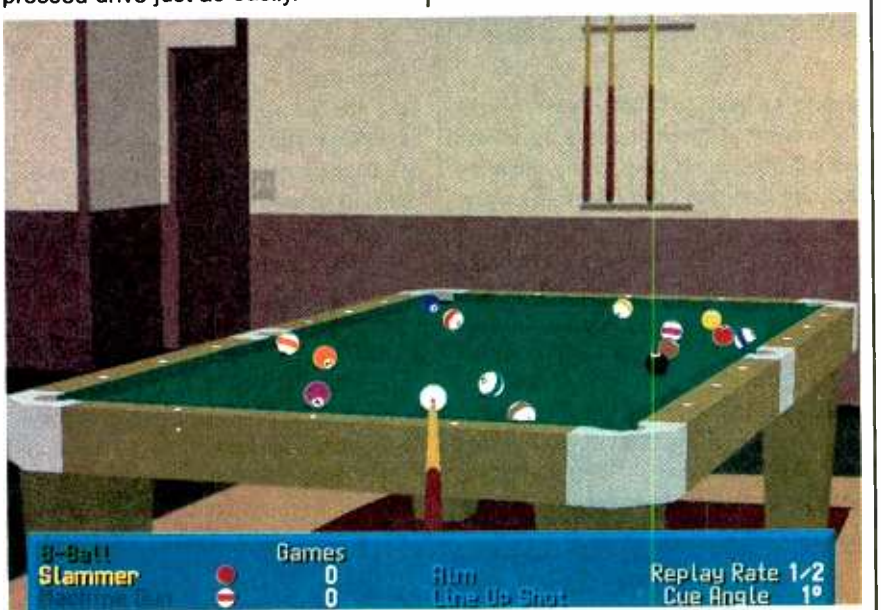
MULTIMEDIA WATCH

CD-R Drives

BY MARC SPIWAK
TECHNICAL EDITOR
WINDOWS MAGAZINE

It's amazing! No matter how big a hard drive I have, I always manage to get to the point where it's too full for comfort. I'm talking about 1-gigabyte drives and up here, so a larger drive isn't necessarily the answer. Sure I can always compress a drive, and I have never really had any trouble with drive compression, but it always introduces new hassles that I don't want to deal with. Besides, I can fill up a compressed drive just as easily.



Virtual Pool turns your PC into a pool table. You can walk around the table to eye up a shot, move back, get a different angle, and just play pool.

I suppose that part of my problem is due to all of the hardware and software I test. Almost every piece of hardware has its own software, and software is huge these days. Multimedia files and general junk off the Internet only add to the problem. But another part of my problem is that I often need huge amounts of free space on a hard drive. Things like video capture could swallow your hard drive whole!

I also need extra drive space for the CD-R drives I've been testing recently. CD-R drives can record on special blank CD-ROM discs, as well as read regular ones. Sometimes it's necessary—and it's always convenient—to have a whole CD's worth of free space on a hard drive to arrange the contents of a new disc that you want to record. Many hard drives can't hold 700 megabytes to begin with, let alone have that much free space. But not only does this CD-R dilemma contribute to the full hard-drive syndrome, it also helps solve it by allowing you to shove massive amounts of junk off your hard drive onto cheap read-anywhere discs.

CD-R drives are now available for under $1000. And I've seen the blank discs selling for less than $7 each. That's around a penny a megabyte! It's the cheapest storage in town when you get right down to it. So if you need to free up a CD's worth of space, one thing you can do is transfer stuff from your hard drive to a CD. Of course you can't put your working software there, at least not permanently. But they are great for archiving old software and for off-loading the junk that piles up on your drive that you just can't part with. And the discs you make can be read on any CD-ROM drive—at least in theory.

I've seen some strange problems with some of the discs I've made. For example, some CD-ROM drives can't read some of the discs (all very recent drives, by the way). Or some see only the first entry on a multi-session disc (portions recorded in separate sessions). A disc that was partially recorded on one drive couldn't be added to on another. But that's all part of the growing pains—the drives are getting better, faster, and cheaper all the time, and they will be standard soon on high-end systems. And if the discs are $7 now, they will probably be only a couple of dollars each a few years from now. How could they not become standard?

NEW STUFF

If you've always wanted to play pool, but can't afford your own table or don't have the room for one, or if you play pool all the time and just want to keep in practice, then you should check out *Virtual Pool* from Interplay Productions. That very realistic game turns your PC into a pool table—or as close as it's going to get to one. All of the physics and geometry of real pool are here. The game lets you walk around the table to eye up a shot, move back, get a different angle, or whatever. Anything you can do in real pool—except send a ball crashing through a window—you can do here. You can select the game variety you like (straight pool, 8 ball, etc.), play with a friend or computer opponent, and in general feel as though you are really playing pool. Realistic sound effects and pool-hall music put the finishing touches on this amazing game.

Activision's already excellent *MechWarrior 2* is available in a new version that's been designed exclusively for Windows 95 and a Pentium processor. You can get by with any Pentium processor, but you also need a minimum of 12 MB of RAM and VLB or PCI video. But hey, this is a serious piece of software, and any Pentium or

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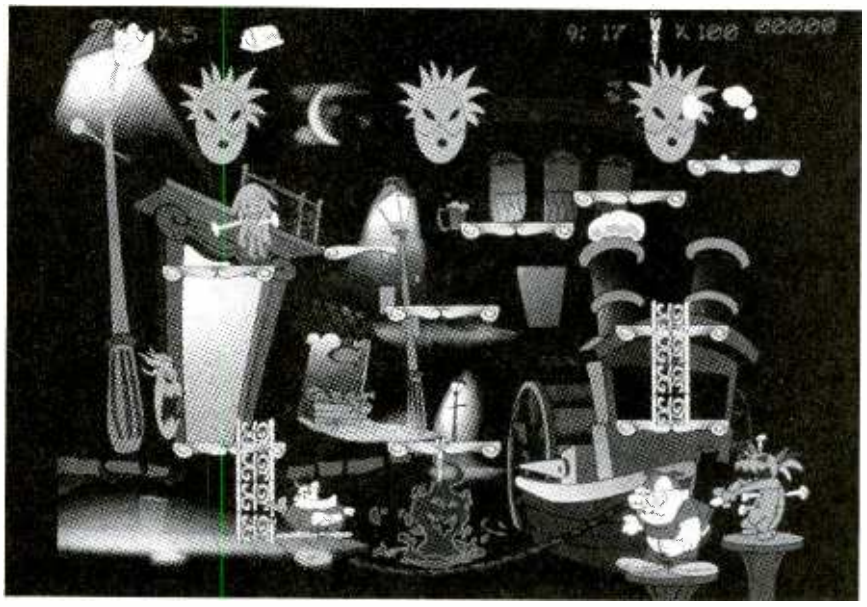
Win 95 system should really be equipped with at least 16 MB of RAM, anyway. So long, 486! Also new from Activision is the *Commodore 64 15 Pack*, which contains fifteen of the best selling games for that platform, but optimized to run in Windows 95. The disc includes *Beamrider, Decathlon, Hacker, Little Computer People, Portal, Zenji, Top Fuel Eliminator, Alcazar, Toy Bizarre, Zone Ranger, Rock N' Bolt, Park Patrol,*



7th Level's Arcade America stops in New Orleans.

Web Dimension, The Great American Cross-Country Road Race, and *Master of the Lamps.*

Creative Multimedia's *Travel & Leisure: Great Cities Europe* can help as a trip planner if you're planning a trip there. Or it can send you on a virtual trip to 15 major cities in Europe with its videos, slide shows, travel information, maps, and more, for around $29.95. *Consumer Reports Cars: The Essential Guide* contains the information you've trusted for years on cars from 1987 through 1996 on CD-ROM, which makes it easy to find what you're looking for. You can get this one for around $19.99.

ESPN Extreme Games! from Sony Interactive is a racing game based on the popular TV shows on ESPN. Players can compete on inline skates, skate board, mountain bike, or street luge, on courses located in San Francisco, Lake Tahoe, Utah, South America, and Rome. *Eastern Mind* is an adventure game based on an Oriental premise of reincarnation. The player, Rin, must travel to the island of Tong Nou to search for his lost soul.

Epic MegaGames' *Radix: Beyond the Void!* Is a 3D flying game that takes place in the alien-infested tunnels of the Theta-2 base, and deep into a huge alien ship. You must fly the Radix class experimental ship to save human hostages trapped beyond the void. You've got to avoid enemy ships, alien zombies, missiles, crushing floors and ceilings, steep slopes, and more.

The *V for Victory Commemorative Collection* from IntraCorp celebrates the 50th anniversary of the Allied victory in World War II. The CD-ROM contains all four *V For Victory* games. There's Utah Beach, Gold Juno Sword, Market Garden, and Velikiye Luki.

7th Level's *Arcade America* is a humorous adventure in which the hero, Joey, must travel across America in search of his pals and get to Woodstock for their musical debut. Players drive, run, and jump from Alcatraz to Las Vegas to the Alamo and New York. There are plenty of obstacles along the way, hidden objects you need to find, multiple game levels, and more.

The Memorex Software Series from Entertainment Technology is a new line of software to be distributed by mass merchants, drug chains, warehouse clubs, computer chains, and the like. *Battlefield Warriors* combines *Jetfighter II Advanced Tactical Fighter, Operation Combat II,* and *Project X* on one disc. *Mud Pies* is for younger kids with *Mario's Early Years Collection, Shelley Duvall's It's A Bird's Life,* and *Cardshop Plus!* on one disc.

One new disc this month is intended for video distributors and retailers. Republic Entertainment's interactive

WHERE TO GET IT

Activision
11601 Wilshire Blvd.
Suite 1000
Los Angeles, CA 90025
CIRCLE 50 ON FREE INFORMATION CARD

Creative Multimedia
225 SW Broadway
Suite 600
Portland, OR 97205
CIRCLE 51 ON FREE INFORMATION CARD

Entertainment Technology
18000 Studebaker Road
Suite 200
Cerritos, CA 90703
CIRCLE 52 ON FREE INFORMATION CARD

Epic MegaGames, Inc.
3204 Tower Oaks Blvd.
Suite 410
Rockville, MD 20852
CIRCLE 53 ON FREE INFORMATION CARD

Interplay Productions
17922 Fitch Avenue
Irvine, CA 92714
CIRCLE 54 ON FREE INFORMATION CARD

IntraCorp, Inc.
501 Brickell Key Drive, 6th Fl.
Miami, FL 33131
CIRCLE 55 ON FREE INFORMATION CARD

Republic Entertainment, Inc.
5700 Wilshire Blvd.
Suite 525 North
Los Angeles, CA 90036-3659
CIRCLE 56 ON FREE INFORMATION CARD

7th Level, Inc.
1110 E. Collins Blvd., #122
Richardson, TX 75081
CIRCLE 57 ON FREE INFORMATION CARD

Sony Interactive
919 East Hillside Blvd.
Foster City, CA 94404
CIRCLE 58 ON FREE INFORMATION CARD

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Home Video Catalog is basically a multimedia catalog of about 1200 movies, many of them familiar to me, produced over Republic's 60-year history. The CD-ROM includes trailers for many of the movies, as well as press kits, background information, and more. Video distributors can keep up to date on Republic's full product line, and learn of new releases with the disc being updated four times a year. Now what would be really neat is if the disc were given out free, say at Blockbuster. That way, people on their way out of the store could pick one up and spend some time at home researching movies of interest. Playing with this disc, I actually learned that two Stephen King TV movies I really enjoyed, *The Stand* and *The Langoliers*, are available on video through Republic. Perhaps I'll try to get copies of those for myself. ■

NET WATCH

(continued from page 19)

But the photos are not really this site's most interesting features. Believe it or not in this visual age, the most impressive aspect of the Bellingham Antique Radio Museum is the text. In particular, there are two sections, Explore the History of Radio and Explore the History of Broadcasting, which are quite valuable to information seekers. When you click one of those on, you are presented with a timeline covering important events. Further, several of the terms and names in those timelines provide links to definitions and biographical information.

The site claims to be a "work-in-progress," and promises to have sound bites of early significant radio broadcasts and, on occasion, a short film clip. Also, the Museum welcomes submissions from the Net, and will provide space for them. So be sure to check there often, and if you have something to submit, feel free to do so.

And while we're on the topic of submissions, please feel free to contact me with any sites you'd like to see covered or with any other comments you have. I can be reached via e-mail at peeditor @ aol.com and via snail-mail at *Net Watch*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

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New breakthrough clones TV signals and sends them to any other TV in your home

Recoton's new development duplicates cable, TV, VCR and satellite signals and transmits them...without any wires!

by Charles Anton

Today, television choices are virtually unlimited. Between cable, satellite TV, videos and network programming, it's almost a full-time job trying to keep up with all the alternatives. And it promises to get more complicated in the future. Breakthroughs in fiber optic technology will bring over 500 channels into your home.

Home broadcasting breakthrough. The problem with all this technology is the expense required to maintain your system and keep it up-to-date. Now, a wireless video broadcasting system from Recoton gives you the power to utilize this technology without the hassle and expense of re-wiring your entire home.

Today, Recoton introduces the next generation in wireless broadcasting. The wireless video broadcaster transmits (re-broadcasts) cable, TV, VCR or satellite programs to any other TV in your home...wirelessly!

Wave of the future. Never drag your VCR from room to room again: Recoton's wireless video broadcasting system transmits video or TV signals to any other TV in your home.

Because the system is totally wireless, you won't have to worry about running miles of wires. Besides, who wants to install cable in every room of their home? With Recoton's wireless video broadcasting system, you won't have to. You can even watch one program on your main TV while someone else watches something different on another TV. It's just like having a personal broadcasting system in your home—and it's legal in every state.

Hi-tech home broadcast. Recently, the *Federal Communications Commission* allocated a band of radio frequencies specifically for wireless, in-home product applications. Recoton took advantage of the FCC ruling by creating and introducing wireless equipment that can transmit within the prescribed frequency over distances of up to 150 feet.

Wireless Video Breakthrough...

Cable *Broadcast cable channels, even premium channels, to other TVs in your home that are not wired for cable.*

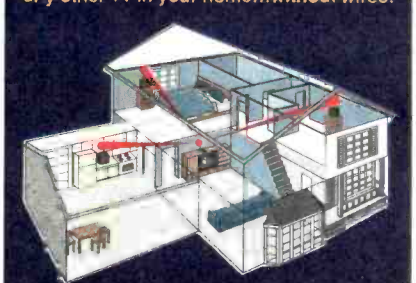
Videos *Transmit signals from one VCR to any room, even if someone is watching TV in the room that the VCR is in.*

Satellite programs *Watch satellite programs throughout your home without stringing miles of cable everywhere.*

Live video *View home videos as you film them or turn your camcorder into a security camera.*

Network programs *If the main TV is hooked up to an antenna, you can broadcast its clear signal to all the others.*

Recoton's video broadcasting system clones the accessories (cable, satellite, VCR, etc.) of one TV and broadcasts it to any other TV in your home...without wires!



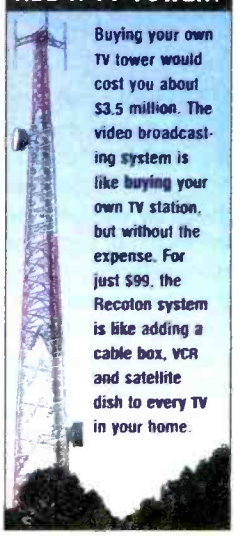
One transmitter, unlimited receivers. One transmitter will operate an unlimited number of receivers. This means that a transmitter in the den can send signals to a TV in the living room, kitchen, bedroom and anywhere else you may have a TV. Recoton puts your favorite programs where you want them most.

Unlimited choices. Since the broadcasting system uses the latest in 900 MHz frequency signals, there is no time-consuming or complicated wiring. The receiver can be easily moved from one television to another.

The transmitter will also broadcast to multiple receivers, so you can watch the same program on multiple TVs simultaneously. The transmitter connects to the source TV; the receivers simply connect to the others.

Exclusive factory-direct offer. With this breakthrough in home video broadcasting technology, you can have the convenience of your own personal wireless broadcasting system for a fraction of the cost of owning your own TV station. For a limited time only, we are offering Recoton's wireless video broadcasting system (one transmitter and one receiver) for the low price of $99. You can order additional receivers for other TVs for just $59 each.

ADD A TV TOWER?



Buying your own TV tower would cost you about $3.5 million. The video broadcasting system is like buying your own TV station, but without the expense. For just $99, the Recoton system is like adding a cable box, VCR and satellite dish to every TV in your home.

Risk-free offer. The wireless video broadcasting system by Recoton is backed by Comtrad's exclusive risk-free home trial. Try it, and if you are not completely satisfied, simply return it within 30 days for a full "No Questions Asked" refund. It also comes with a 90-day manufacturer's limited warranty. Most orders are processed within 72 hours and shipped UPS.

Video Broadcasting System . . . . . $99 $9 S&H
Includes one transmitter and one receiver.
Additional receivers (each) . . . . . $59 $7 S&H

Please mention promotional code 173-PL-6664 .

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Midlothian, Virginia 23113

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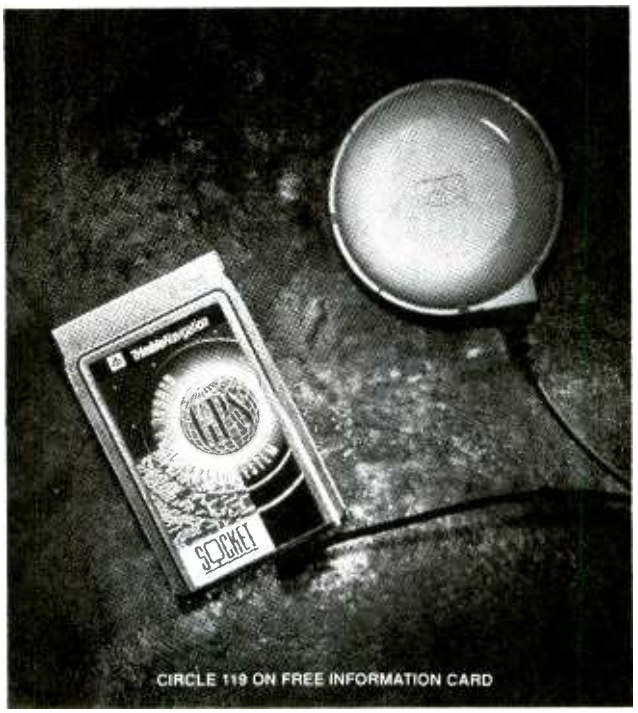
A Hands-on Electronics REPORT

SOCKET COMMUNICATIONS GPS CARD



CIRCLE 119 ON FREE INFORMATION CARD

The GPS Card is the best back-seat driver ever.

People are constantly on the move these days. Modern society relies on the transportation system to get the things it needs where they are needed. Food, clothing, medical supplies, and more are needed by all. Large trucks carry tons of merchandise from place to place so that stuff gets from the factory to your local store. Smaller shipments are transported in vans and cars. Sometimes it's just a skill that must be transported to where it's needed. For example, medical personnel must get to an accident scene as quickly as possible if lives are to be saved. No matter what is being transported, however, as long as it's staying on the ground, the shipment depends on the roads and highways to get through.

While we all depend on the intricate network of streets and highways to get what we need, we also depend on the drivers to know how to get from point A to point B. Unfortunately, no matter how skilled we are at reading maps and following directions, we are only human, and virtually everyone has gotten at least "a little lost" at one time or another. But if you own or have access to a laptop computer, a new accessory card could make getting lost a thing of the past.

The *GPS Card* from *Socket Communications, Inc.* is a miniature Type II GPS receiver that slides into an empty PCMCIA slot in a laptop computer and lets the computer tell you exactly where you are. With the GPS card up and running, you'll know exactly where you are on the globe with longitude and latitude readings. There's also altitude, speed, course, and time-of-fix indications.

But now for the best part: The GPS Card also works with *City Streets for Windows*, a mapping program from Road Scholar. City Streets lets you see in an instant where you are on a map by superimposing a little car on it that traces your route as you drive. City Streets can also run without the GPS, and it can provide you with distances, directions, and other travel information. But it's much more useful, and exciting, with the GPS.

The GPS Card is very easy to use. It installs in an empty PCMCIA slot, and, once installed, the laptop computer should instantly recognize what it is. There are steps you can take that will make the computer recognize the card if it does not do so automatically, but I had no problem with it in a fairly new Pentium 90 laptop. Note, however, that you do not need a Pentium to run any of this software. Anything that can run Windows will do. It's just that some do a better job of it than others.

The program that does all the dirty work is called WinMobile. That software interprets the GPS data coming from the GPS Card and displays it as longitude, latitude, altitude, speed, course, and time in a nice little window.

WinMobile also displays the relative signal strength of all satellites being received. If your GPS system is not locking on to your location, you can watch the progress in the WinMobile window to see which satellites are detected and how well data is being received. But watching longitude and latitude readings change in a text-based window isn't all that exciting. It's only when City Streets is running that you begin to feel like "James Bond" or "Buck Rogers" with your high-tech gear in hand.

The GPS Card comes with the PC Card receiver, a magnetic antenna for auto-roof mounting, and all necessary software including the basic City Streets program. You also get a coupon good for the free City Streets map of your choice. Maps of over 1600 U.S. cities and several cities in Europe are available. Additional city maps cost $29.95 (less if you buy more than one map). The city maps also cover much of the outlying area in case you're not interested in the main part of the city. Living on Long Island

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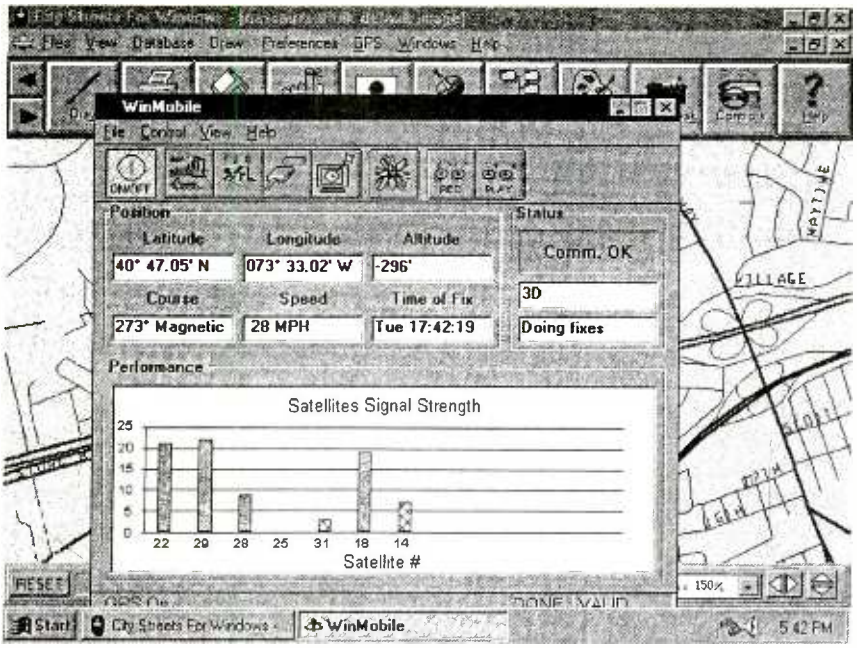
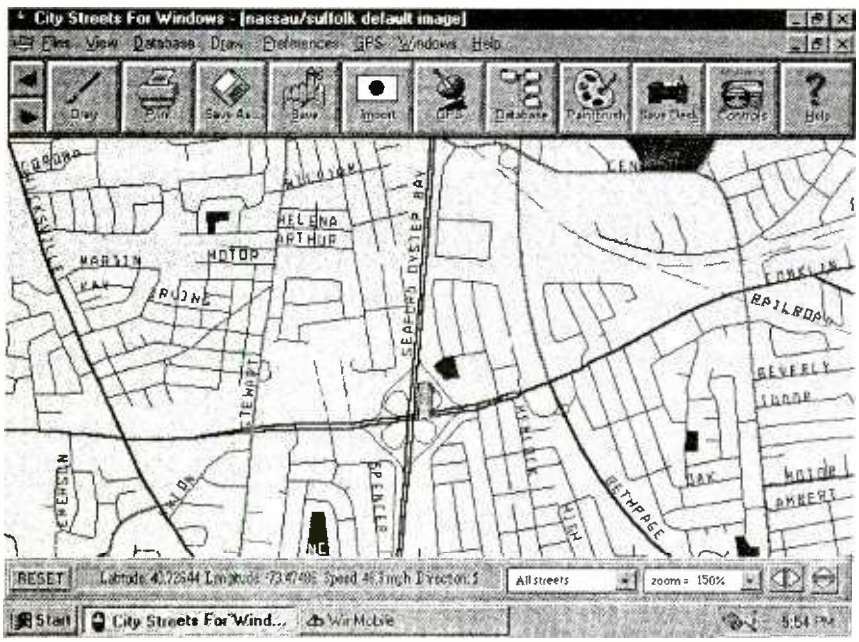


WinMobile displays satellite signal strength, longitude and latitude readings, altitude, speed, course, and time of fix.



Inch by inch, the little car will follow you home. The maps continuously flip to the next page as the little car leaves one section and enters another.

(that's in New York for those that don't know), we checked out the combination Nassau/Suffolk map.

By the way, the maps contained in City Streets are not just any old maps, they're Etak maps. Those electronic road maps, supplied by Etak, Inc., contain addresses, landmarks, bodies of water, and more. The digitally encoded maps are extremely accurate, which is necessary to work with a GPS system.

GPS. The Global Positioning System, or GPS, is a constellation of 24 Navstar satellites that orbit the earth in six orbital planes. There are four satellites in each plane, with circular 20,200-kilometer orbits at an inclination angle of 55 degrees and a period of 12 hours. Due to that configuration, the satellites appear in the same position at the same sidereal time each day (actually they appear four minutes earlier each day, but that's accounted for in software), and at least five satellites will be in "view" from anywhere in the world at any given time. If a GPS receiver can lock onto the signals from at least three of these satellites, a position fix can be maintained.

Positioning is determined by calculating the timing differences from at least three signals. The signals are encoded in such a way that a receiver can tell which satellite the signal is from. Accurate time-of-day signals from an atomic clock on board each satellite are also transmitted. Each satellite transmits a signal containing its orbital elements, clock behavior, system time, and status messages. An included almanac gives the approximate data for each active satellite and allows all satellites to be located once the first one has been successfully locked in.

Atomic time-keeping is very accurate. By examining a Navstar satellite signal and calculating the time it took for the signal to reach the receiver (there is a delay associated with each signal), the receiver knows how far it is from the satellite. With delays calculated for at least three signals, the receiver can triangulate an exact location on a map. The more valid signals received, the more accurate the positioning. Altitude can be calculated if the unit receives at least two signals.

Driving Home. When we first tested the GPS Card, it didn't seem to want to work. It said that it was working properly, but it wouldn't lock onto satellite signals. Later on, we determined that the GMT offset-time was set incorrectly. The offset time tells the GPS receiver which satellites to look for. However, even if the offset time is set incorrectly, the receiver will eventually lock onto one of the satellites and then figure everything out. If the GMT offset is set properly, though, the system works in a matter of minutes.

The magnetic antenna normally adheres itself to the roof of the car, but the car we were driving (a 1994 Camaro) didn't have a steel roof. Fortunately the antenna will also work on the dashboard at the base of the windshield. Glass is transparent to satellite signals, while steel and other building materials are not. The antenna is a small plastic-encased disc with a magnetic base. At the end of the

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antenna's cord is a small plug that fits into a mating socket on the GPS receiver PC Card.

With the antenna connected and Windows up and running, we brought up City Streets and started the GPS. WinMobile can be launched by itself, but starting GPS in City Streets automatically starts WinMobile in the background. WinMobile interprets the GPS data and passes it on to the City Streets program. WinMobile displays satellite signal strength, longitude and latitude readings, altitude, speed, course, and time of fix. If you get bored waiting for GPS to become active in City Streets, you can watch the signal reception progress in the WinMobile window to see which satellites are detected and how well data is being received.

With the GMT offset set properly, we didn't have to watch WinMobile for very long; City Streets popped a little car into place before we even got out of the office parking lot. And inch by inch, that little car traced our route home, right to our home street. As a matter of fact, City Streets can even indicate where a certain address is on a map, although it might stop a few houses off due to the accuracy (or inaccuracy) of the GPS system. But at least it will get you right near a home or business. The maps continuously flip to the next page as the little car leaves one section and enters another.

Sometimes the little car will appear slightly off the road you are traveling. That is usually due to inaccuracy introduced into the GPS signals by the government. The GPS signals are intended primarily for U.S. military use. That inaccuracy, or Selective Availability (SA), blocks full GPS accuracy by manipulating navigation data and/or satellite-clock frequency. That lessened accuracy is intended to foil use by enemies, and is the level of accuracy that is available to the general public.

The worst thing about the GPS Card is that it's distracting, or perhaps just a bit too entertaining, especially for new users. As a matter of fact, we actually passed our exit because we were paying more attention to the laptop than to our driving! However, at $799, it's probably a bit too expensive for the average gadget freak, plus you will need a laptop computer—a considerable additional expense for those who don't have one. But for those whose work involves a lot of traveling, the system could be a lifesaver. Emergency personnel, delivery men, and anyone else who works out in the field could spend a lot less time asking for directions and more time at the job site if only they had a GPS Card and laptop computer. Surely all cars will have something like this built right into the dashboard in the near future. Or at the very least it will be an option!

For more information on the GPS Card, contact Socket Communications directly at the address given below, or circle 119 on the Free Information Card. ■

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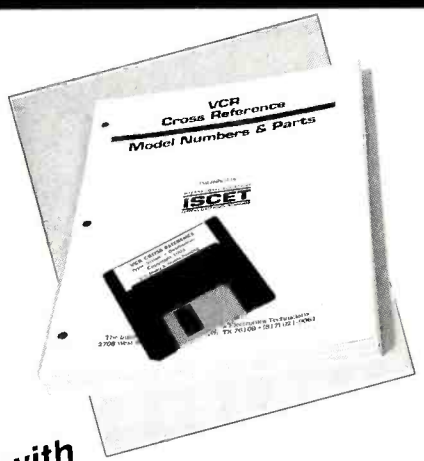

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BUILD AN Anti-Carjack MODULE

This easily concealed device will make sure no carjacker gets very far in your car.

BY ANTHONY J. CARISTI

Consider this scenario: You are driving your vehicle, and are stopped for a red light. A person approaches and demands the vehicle, which you quickly surrender. The thief drives away, but about 60 seconds later the engine stops and can't be restarted. Unable to use the dead vehicle, the perpetrator has no choice but to abandon it.

That story might raise a few questions. The most important of those being: How? Well, the exact form of theft prevention you just read about is possible with the *Anti-Carjack Module* described in this article. It's an automatic circuit that "knows" when a carjacking takes place. You might never need the protection it provides, but should the occasion ever arise, you could thank the day you decided to build this project.

The Anti-Carjack Module also provides additional benefits. It can help prevent a traditional theft—where an attempt is made to steal the vehicle while it is parked unattended, and the would-be thief unknowingly triggers the protection circuit. Additionally, this anti-theft system always gives you the option of purposely arming its disabling circuit when you must leave the vehicle parked in a high-crime-rate area. That feature alone is reason enough to install the Anti-Carjack Module.

Once installed, the Module is always on duty with no attention to it ever required; it is totally automatic in operation. The time-delay circuit that disables the engine is never activated until a door is opened while the ignition is turned on. Such a situation will almost certainly occur during a carjack attempt, or can be made to happen if you simply turn on the ignition switch (there's no need to actually start the car) before exiting the car.

The only requirement for you and other drivers and passengers in your family to remember is not to open a door while the engine is running. However, should the circuit be accidentally tripped, it is easily reset by a hidden pushbutton switch. The Module features two LED indicators that quietly notify you of the status of the system, but which mean nothing to a thief.

The Module itself can be built on a small printed-circuit board that can be concealed anywhere. It features a miniature heavy-duty relay that cuts power to the vehicle's ignition or fuel pump when the circuit is activated. Also, the Module is permanently powered by the vehicle's battery, and its negligible stand-by current drain of less than 100 microamperes will never cause the battery to run down. That means you can be sure of being protected all year round.

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Circuit Description. The schematic diagram for the Anti-Carjack Module is shown in Fig. 1. As mentioned, the 12-volt DC power source for the circuit is taken from the equipped vehicle's battery. Diode D1 provides protection against any possible reverse-voltage transients that might appear on the 12-volt line.

The "thinking components" of the circuit consist of a 4011 quad 2-input NAND gate, IC1, and a 555 timer chip, IC2. In addition to the connection to the vehicle's 12-volt line, two other logic connections to the circuit are required: one from any accessory-power line that is energized by the ignition switch, and the other from the line that connects the dome or courtesy lights to the door switch.

The door switches in the vehicle provide the ground return for the dome or courtesy lights when any of the doors are opened; the line connecting a door switch to the lamps is at a potential of +12 volts when the doors are closed, and at zero volts when any door is open. The logic level on that line is fed through D2 to pins 12 and 13 of IC1-d, which inverts it and drives pin 9 of IC1-c. At the same time, the accessory-power wire, which is at +12 volts only when the ignition switch is turned on, is connected to the other input of IC1-c through D3. Under normal driving conditions, when the ignition switch is on and the doors are closed, the output of IC1-c at pin 10 is high. However, should a door be opened, the logic output of IC1-c goes to zero volts.

The negative-going output waveform of IC1-c is coupled to the trigger input of IC2, which is connected as a one-shot multivibrator. That waveform causes the output of IC2 at pin 3 to go high for a period of time determined by R4 and C5. With the values shown, the RC time constant is about 60 seconds.

The two remaining sections of the 4011, IC1-a and IC1-b, are connected in a bistable-multivibrator configuration with two input terminals, pins 1 and 6. That configuration has two stable states, with the logic output levels at pins 3 and 4 always being opposite to each other. A negative transition at the input terminal of the gate that has a zero output-logic level will cause the multivibrator to change state.

When the timing period of IC2 is completed, its output at pin 3 goes to zero. That negative-going wavefront is coupled to the input of IC1-a, causing the bistable circuit to change state. As a result, pin 3 of IC1-a goes to +12 volts.

The positive output of IC1-a forward biases MOSFET Q2, causing relay RY1 to be energized. As a result the normally closed contacts of RY1 open, depriving power to the ignition or fuel-pump circuit, and thereby stalling the vehicle.

When reset-switch S1 is pressed, a negative transition is applied to pin 6 of IC1-b. That causes pin 3 of IC1-a to go to zero, releasing the relay and allowing the vehicle to be started.

A yellow LED, LED1, which is driven by Q1, alerts the driver of the vehicle if the timer has been activated, either by a carjack attempt or by inadvertently or purposely opening a door when the ignition is on. That gives the driver warning that the circuit has been triggered and a stall-out will occur in 60 seconds.

A red LED, LED2, will light whenever the system is set to the disable mode (more on that later). When purposely set to the disable mode, the circuit will draw about 40 milliamperes of current; however, there's no need to worry about discharging the vehicle's battery as that is still a very small load.

The circuit has been designed to be "fail safe." That is, the normally closed contacts of RY1 are used to control vehicle operation. The relay is never energized unless the circuit is powered and the timer triggered. In the unlikely event a component failure should cause the relay to be actuated, removing jumper JU1 will disable the relay coil circuit and RY1's contacts will remain closed.

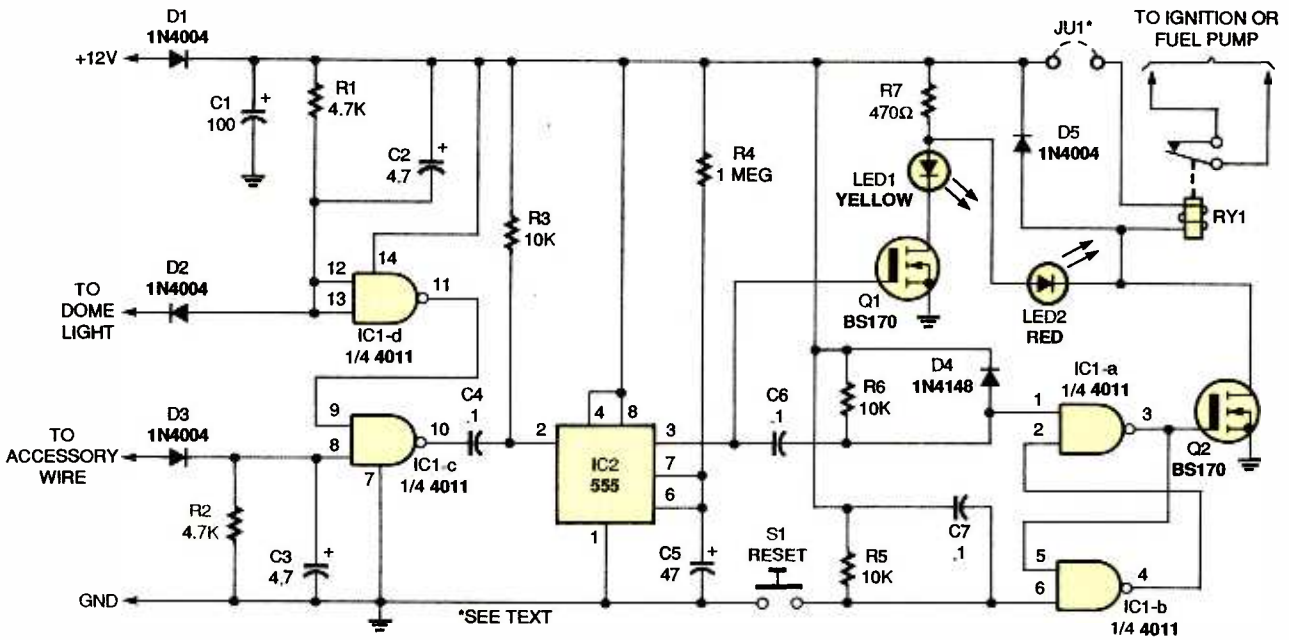

Fig. 1. Here's the schematic for the Anti-Carjack Module. When the circuit senses that a door is opened while the ignition is on, it will use relay RY1 to kill the ignition after 60 seconds.

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Construction. The author's prototype for the Anti-Carjack Module was built on a printed-circuit board. If you'd like to do the same, you can either etch your own board using the foil pattern shown in Fig. 2, or order one from the source mentioned in the Parts List. Alternatively, the circuit can be built on a perforated board using point-to-point wiring.

If you are using a PC board, refer to the parts-placement diagram shown in Fig. 3 when building the circuit. Begin assembly by installing all the resistors and capacitors; make sure to properly orient the polarized capacitors. Next, following the orientations shown in Fig. 3, mount the MOSFETs and diodes.

The relay you use for RY1 will determine how you orient the part. Check to make sure the relay-contact connections are made to the pads that lead to the vehicle's ignition or fuel pump (*i.e.*, the pads at the bottom of RY1 in Fig. 3).

Solder jumper JU1 in place next. If you'd like, you can use an SPST switch instead of the jumper. That way you won't have to cut the jumper in case of a circuit malfunction; you could just turn it off instead.

Go on to solder 16-gauge, stranded insulated wire to the pads for the ignition or fuel pump connections. The leads only have to be long enough to exit whatever enclosure you'll put the circuit within; you can attach longer wires later. Solder 18-gauge, stranded insulated wire to the pads for the accessory-wire, dome-light, +12V, and ground connections. Keep those wires just long enough to exit the enclosure as well.

As you can see from the parts-placement diagram, S1, LED1, and LED2 are mounted off-board. Use wire leads and connect those components to the circuit. When the circuit is mounted later (after it is tested) you will want to hide reset-switch S1.

To complete the board, directly solder the integrated circuits to it; do not use sockets, as the circuit will be subjected to the vibration and the harsh environment present in a vehicle. Before soldering the ICs, be absolutely sure that each is properly oriented as illustrated in Fig. 3. Be careful; it is difficult to remove an IC from the board once it has been soldered in place.

When the board is complete, examine it very carefully for any mistakes. It is far easier to correct problems at this stage rather than later on if you discover that the circuit does not work.

PARTS LIST FOR THE ANTI-CARJACK MODULE

SEMICONDUCTORS

IC1—4011 quad 2-input NAND gate, integrated circuit
IC2—555 timer, integrated circuit
Q1, Q2—BS170 or equivalent N-channel MOSFET transistor
D1–D3, D5—1N4004 silicon rectifier diode
D4—1N4148 silicon diode
LED1—Light-emitting diode, yellow
LED2—Light-emitting diode, red

RESISTORS

(All resistors are ¼-watt, 5% units.)
R1, R2—4700-ohm
R3, R5, R6—10,000-ohm
R4—1-megohm
R7—470-ohm

CAPACITORS

C1—100-µF, 25-WVDC, electrolytic
C2, C3—4.7-µF, 25-WVDC, electrolytic
C4, C6—0.1-µF, ceramic-disc
C5—47-µF, 25-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

RY1—12-volt SPDT relay, normally closed 7-amp contacts (Magnecraft 276XAXH-12DC or similar)
S1—SPST pushbutton switch, normally open
Printed-circuit materials, plastic enclosure, electrical tape, 16- and 18-gauge stranded hookup wire, solder, hardware, etc.

Note: The following parts are available from A. Caristi (69 White Pond Road, Waldwick, NJ 07463): etched and drilled PC board—$9.95; Q1 and Q2—$2.75 each; IC1—$2.50; IC2—$3.00; RY1—$12.75. Please add $5.00 postage and handling. NJ residents must add appropriate sales tax.

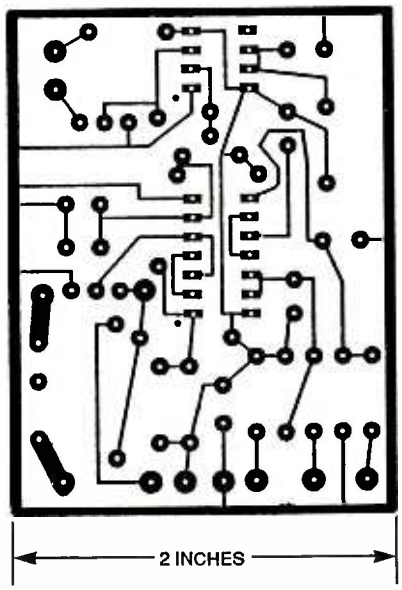

Fig. 2. If you'd like to etch your own PC board, use this full-size template.

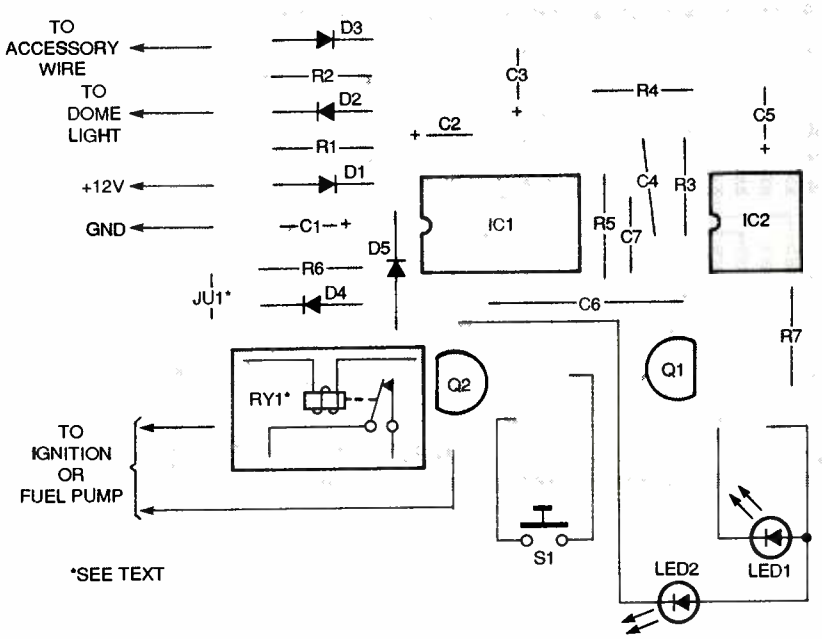

Fig. 3. Use this parts-placement diagram as a guide when building the Module. Reset-switch S1 should be mounted in a hidden location in the vehicle.

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It is recommended that you place the circuit board into a small, covered plastic enclosure to protect it from dirt and inadvertent short circuits. Drill holes in the sides of the enclosure for the wire leads.

That completes the Module's assembly; however, do not install it into a vehicle at this time. You have to first test it to ensure that it is working properly.

Preliminary Test. To perform the initial test, you will need to assemble the temporary test circuit shown in Fig. 4. As you can see, you will need a 12-volt DC source, two SPST switches, and an ohmmeter. Wire those components as shown. The open-circle connection points shown to the right of the diagram correspond to the matching arrow connection points on the PC board. Make those connections at this time.

Before applying power, check the resistance between the two wires that connect to the normally closed relay contacts (labeled "ignition"). Verify that the resistance reading is zero ohms.

Make sure that test-switches 1 and 2 are open, then turn power on. If the yellow LED is lit, allow at least 60 seconds for it to be extinguished, then momentarily press the reset button. If the red LED is illuminated press the reset button to extinguish it.

Close test-switch 1. Both LEDs should be extinguished. Open test-switch 1, then close test-switch 2. The LEDs should remain extinguished.

Close both test switches, then open them. The yellow LED should be illuminated and remain so for about 60 seconds. When it goes out, the red LED

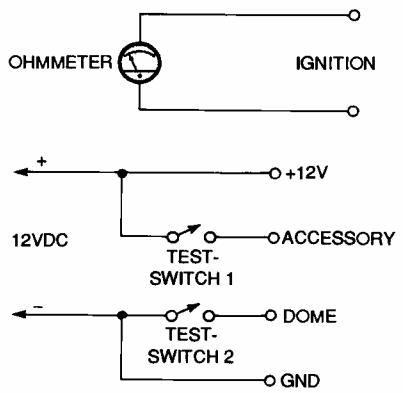

Fig. 4. This test circuit will help you figure out if the Module is working before you install the unit in your car.

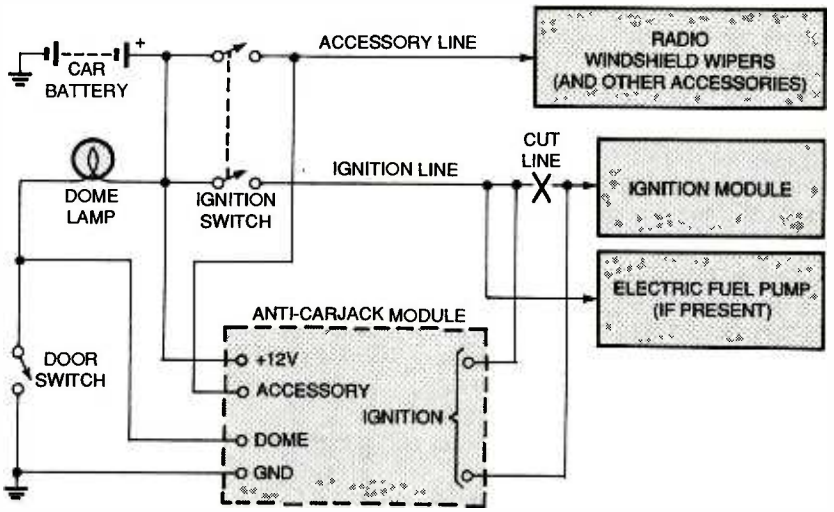

Fig. 5. Using this diagram should make installing the Module in your vehicle a little easier. Note that the connections to the ignition line are the only ones that require you to cut a wire. The rest of the connections are splices.

should light. Use an ohmmeter to verify that the resistance reading taken between the two wires connected to the relay contacts is infinite. Then press the reset switch; the red LED should be extinguished.

If the circuit performs as described, the preliminary test is complete and the Module may be installed in the vehicle. If not, troubleshoot the circuit to locate and fix the problem, which could be a short between closely spaced conductors or a bad solder joint. Also, double-check the orientation of all of polarized components in the circuit.

If you're having a difficult time locating a problem, try using a DVM to measure the voltage at various points in the circuit to determine logic levels. Ascertain that the output voltage at pin 11 of IC1-d is high (+12 volts) at all times except when both test switches are closed. Then, momentarily connect pin 2 of IC2 to circuit ground and measure the output voltage at pin 3, which should rise to +12 volts. If IC2 does not time out properly, check R4 and C5. You might need to replace the IC that is not responding properly.

If the yellow LED fails to light as described above, check the orientation of Q1 and the LED. If the relay or red LED does not energize, check the orientation of Q2, LED2, and D5. If those are correct, try a new transistor or LED.

When the board is operational as described, it is ready to be installed in the vehicle. Let's look at how to do that.

Installation. Before installing the Anti-Carjack Module in the vehicle, locate the wires that you will connect to the unit. Those include the door-switch wire that turns on the dome or courtesy lamps, any accessory wire that is powered by the battery only when the ignition switch is turned on, the power-feed wire to either the ignition module or electronic fuel pump (if so equipped), and the battery +12V terminal.

The choice of whether to disable the ignition or fuel pump is up to you. Disabling the ignition causes the engine to stop immediately; disabling the fuel pump allows the vehicle to sputter to a halt down the road a bit, making it seem more like a typical mechanical problem, somewhat masking the presence of the module.

There are literally thousands of models of vehicles on the road today, so it is not possible to address each one. However, Fig. 5 is a simplified schematic diagram showing a typical automotive electrical system. Note the wiring to the door switch, accessories, ignition module, and electric fuel pump. Just as in the test circuit, the open-circle connection points correspond to the arrow connection points in the circuit board.

The best way to locate the desired wires is to refer to the shop manual for your vehicle, which will provide information concerning the location and color of each wire. Alternatively you might want to consult the dealer, or an automotive technician, who is familiar

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with your vehicle's particular make and model.

After locating the necessary wires, use the voltmeter to verify the voltage levels of each. The door-switch wire should be at +12 volts with the door closed, and zero volts with it open. The accessory wire is at +12 volts only when the ignition switch is turned on. Also, the ignition module or fuel-pump power feed wire is energized only when the ignition switch is on.

After verifying the proper voltage levels, disconnect the ground (chassis) wire from the vehicle's battery. That will ensure that any inadvertent short circuit occurring during installation will cause no damage.

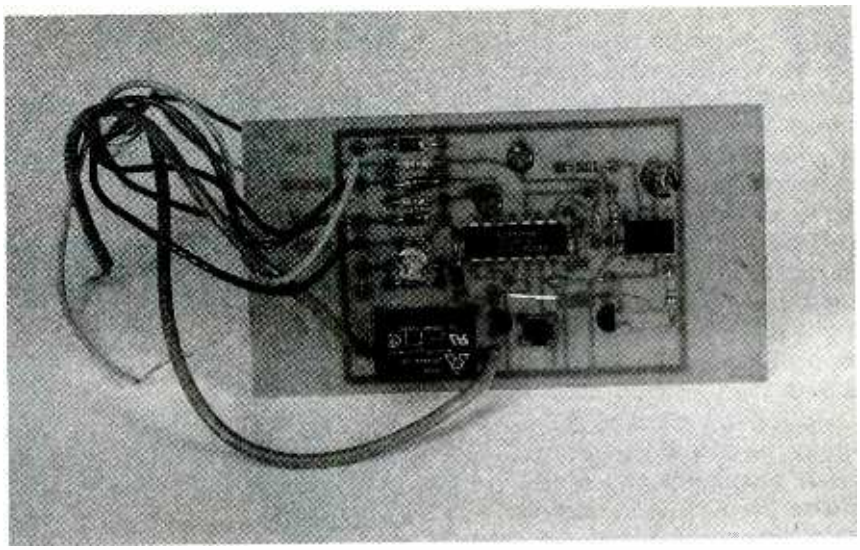
Determine the desired location of the Module in the vehicle, which could be in either the passenger or engine compartment. Then, estimate the required length of each wire necessary to connect to the Module. Measure carefully to avoid cutting the wires too short. Use the same gauge wire for each lead as you used for its matching connection on the board (match 16-gauge with 16-gauge and 18-gauge with 18-gauge wires). If possible, use several different wire colors to help avoid miswiring. Solder all connections and insulate them with electrical tape.

Secure the Anti-Carjack Module at the desired location, and then mount the LEDs and reset-switch S1. The LEDs should be visible to the driver, but the reset switch must be hidden. A good location for the reset switch is inside the glove compartment. You will probably need to cut the leads you already soldered for those parts and attach longer ones.

Find the lead labeled "to accessory wire" in Fig. 3. Take that long lead (you should have already attached the necessary added length) and splice it to the accessory-power wire of the vehicle. Do not cut the accessory wire; simply remove some insulation from it and solder the connection. Then insulate it properly with plastic electrical tape.

Repeat the procedure, this time using the wire labeled "to dome light" in Fig. 3. Splice it to the door-switch line, solder the connection, and insulate it with electrical tape.

Next, locate the power line that feeds either the ignition module or electric fuel pump. Cut that line at a suitable location and strip back each cut end about ½ inch. Then attach one of the relay contact wires (labeled "to ignition or fuel pump") to one cut end. Repeat for the other wire. Solder both connections carefully and insulate each with tape. Arrange the wires so that the modification will not be obvious to anyone looking at the electrical harness of the vehicle.



Here's the finished module prior to installation.

The next connection is to the positive side of the battery, using the wire labeled "+12V" in the parts-placement diagram. Many vehicles have two wires attached to the positive battery terminal—one for the starter and the other for the alternator and electrical system. Choose the smaller of the two wires, solder a connection to it carefully, and insulate the joint with tape.

Finally, connect the ground lead (labeled "GND") of the circuit to any metal part of the vehicle, such as under the head of a screw that threads into metal. Tighten the screw securely, but be careful not to strip the threads. Then reconnect the negative battery lead securely. That completes installation of the Anti-Carjack Module.

Final Test. When the installation is properly completed, verify that both LEDs are extinguished. If the red LED is illuminated, press the reset button to place the system into operation. Start the vehicle; it should run continuously with no stall-out.

Now, with the engine running, open and close the door. The yellow LED should be lit. After a minute or so the yellow LED will be extinguished and the red one illuminated. The engine will stall and you won't be able to restart it. Press the reset switch, verify that the LEDs are extinguished, and you should be able to restart the vehicle.

Using the Module. The Anti-Carjack Module is always on duty, completely automatic, and never in need of attention. Always remember to turn off the ignition switch before exiting the vehicle. If at any time the circuit is accidentally triggered, as indicated by the yellow LED, wait for the red LED to come on and then press the reset button to extinguish it.

The vehicle will always protect itself in the event of a carjack attempt while the ignition switch is on. However, should the ignition happen to be off, casually turn it on (remember, you don't need to actually start the engine) before leaving the vehicle.

If at any time you wish to take advantage of the disable feature before leaving the vehicle, open the door before turning off the ignition switch. The yellow LED will come on, indicating that the circuit has been activated. If you wish, wait 1 minute for the red LED to come on, indicating that the relay has been energized and the vehicle is disabled. Remember, you must press the reset button before starting the engine when you return.

We hope you will never need the protection of the Anti-Carjack Module. But it's a nice feeling to know that it's there, just in case. ■

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BUILD AN UNDERCOVER Scanner Antenna

It's a useful and unusual accessory for your handheld scanner.

BY JOHN R. SOMERS

Recently, while coordinating graduation ceremonies at a local university, I was forced to communicate with my coworkers on three different radio frequencies. When preparing for the assignment, I anticipated the situation, and decided to take my scanner along. However, before I could use my handheld in that situation there were a few problems I had to overcome—problems that the *Undercover Scanner Antenna* described in this article solved.

Originally, I planned on using the flexible "rubber ducky" antenna on my scanner. I knew it wasn't worth much for DX, but thought the antenna would work for reasonably close range, even though our radios would be using relatively low power. The antenna might have worked, too, had I wanted to hold the scanner in my hand all day. But I already had one hand occupied with a radio. I wanted to wear the scanner on my belt and monitor by means of an earphone.

Unfortunately, when I tried using the scanner with the antenna in close proximity to my body, I received next to nothing. I assumed my body was detuning the receiver, but whatever the cause, using a rubber ducky would never do.

My next idea was to use a quarter-wave, two-meter whip I had made. That worked quite well on the scanner—much better than the flexible antenna—but it had an irritating habit of poking me in the eye whenever I sat down. I realized I was going to have to use a longer antenna for more gain, but one with enough flexibility not to pose a problem when worn under a suit coat.

It dawned on me that my earphone's wire would make a fairly decent antenna if I could devise a method of connecting it to both the antenna connector and the earphone jack at the same time. That would have the advantage of eliminating the cumbersome whip or the ineffective rubber ducky, while at the same time the length would, with luck, improve reception.

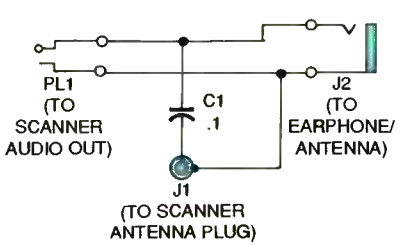

Fig. 1. Here's the schematic for the Undercover Scanner Antenna. As you can see, it contains only four common components.

Circuit Description. The schematic for the Antenna circuit is shown in Fig. 1. Because the circuit is passive, no power supply is needed.

Plug PL1 connects to the audio-output or earphone jack of a scanner. The audio signal is then fed to J2, the earphone/antenna jack of the circuit. A 0.1-µF capacitor, C1, connects the center ("hot") terminal of J2 to a BNC jack, J1.

When an earphone is plugged into J2, C1 feeds RF from the earphone wire to the front end of the scanner, through J1, without directly connecting the audio circuit to the receiver. An earphone connected to J2 will therefore both provide audio and act as an antenna.

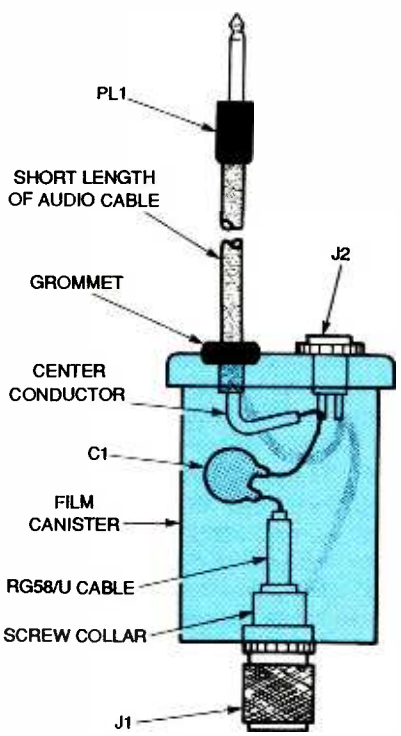

Fig. 2. When assembling the Antenna, use this wiring diagram as a guide.

Construction. Figure 2 is a simple connection diagram that should make wiring the project easier. My prototype was built in a 35-mm-film canister, primarily because it was handy. You can do the same, or find another suitable enclosure.

(Continued on page 70)

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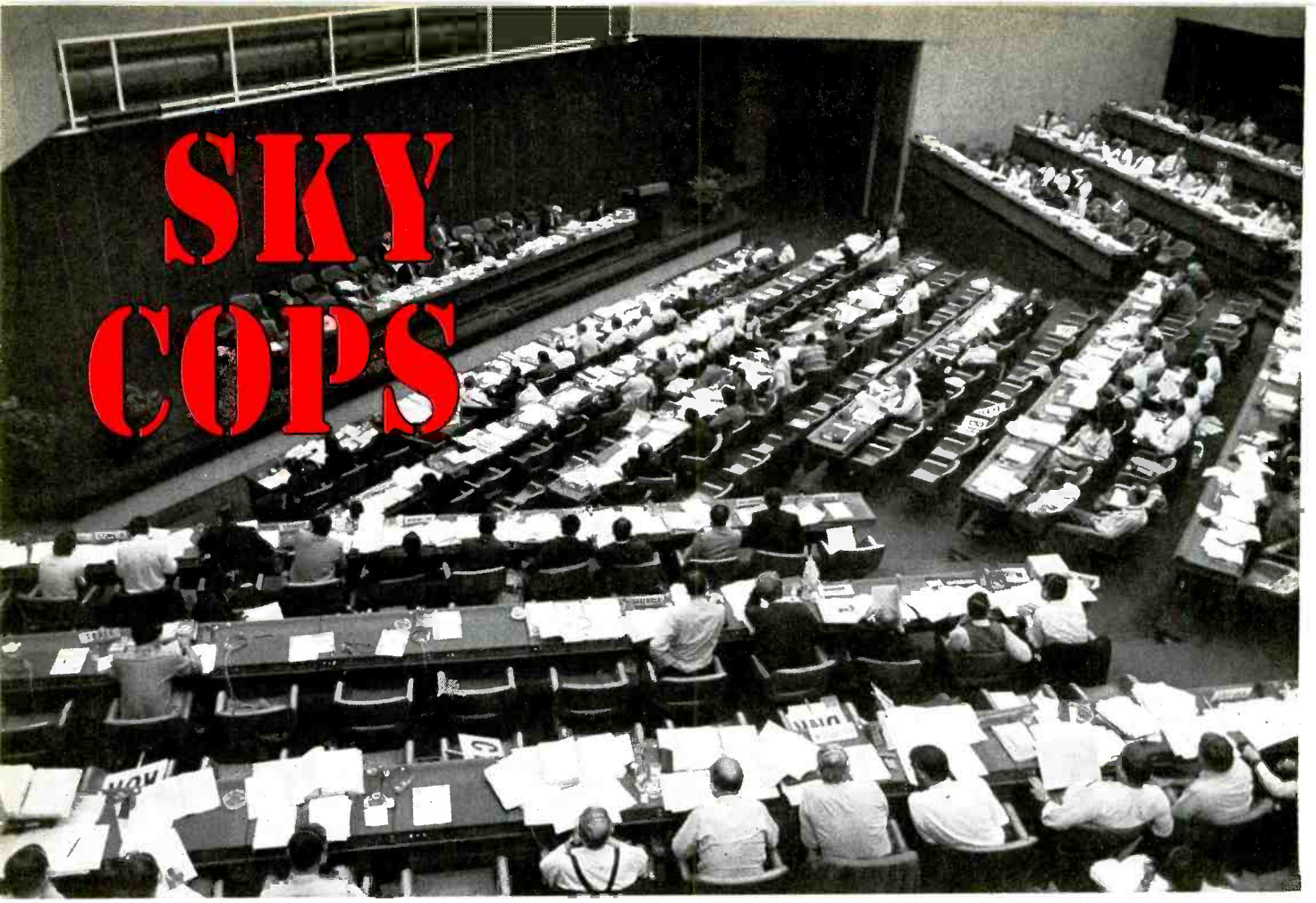

SKY COPS

Here's a look at those who guard the electromagnetic spectrum and keep it usable for all of us.

BY KARL T. THURBER, JR.

Most radio amateurs and shortwave listeners have heard of the FCC or Federal Communications Commission, which governs telecommunications in the U.S. But few know about the "other" regulators of the airwaves, such as the International Telecommunication Union (ITU) and other national and international organizations. Those "sky cops" are the radio peacekeepers that keep chaos out of an important global resource—the electromagnetic spectrum. And it's those protectors and their protected domain that we'll be looking at in the pages that follow.

The Electromagnetic Spectrum. Just what are sky cops protecting? Well, the part of the electromagnetic spectrum where radio communication can take place. That part of the spectrum generally is considered to extend from a few Hz to at least 300 GHz. Scientists break up that immense range of frequencies into ten smaller groupings or bands; most of the bands are ten times as high in frequency as a band lying just below them in the spectrum.

In the lowest band or range are those frequencies known as the ultra-low frequencies (ULF), from essentially zero to 3 Hz. Just above ULF lie the extremely low frequencies (ELF); they cover 3 Hz to 3 kHz. Above that, from 3 to 30 kHz, are the very low frequencies (VLF). Next are the low frequencies (LF), from 30 to 300 kHz. The medium frequencies (MF) extend from 300 to 3000 kHz (3 MHz).

From 3 MHz to 30 MHz are the high frequencies (HF). Above them are the very-high frequencies (VHF), from 30 to 300 MHz. The ultra-high frequencies (UHF) extend from 300 to 3000 MHz, or 3 GHz. From 3 GHz to 30 GHz are the super-high frequencies (SHF), and from 30 GHz to 300 GHz, the extremely high frequencies (EHF).

Spectrum Management Basics. If you want to communicate by radio, you have to cooperate to avoid interference problems. If other users operate on the same frequencies, at the same time and in the same area as you, you'll produce mutual interference, something to be avoided if possible.

For a moment, let's turn from electronics to economics. The radio spectrum has some of the properties of what economists call a "common good," which is a special kind of natural resource. Its use is essentially free. Users have no incentive to use the spectrum efficiently because there's no savings in doing so. Instead, they're motivated to secure the maximum amount of spectrum they can. The result is that everyone suffers from interference and new users are denied spectrum access.

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The spectrum is an unusual common good in that—unlike coal, oil, or iron—it's not depleted or destroyed by use; and when one user stops using a portion of it, another can use it. The spectrum is scarce, though, because at any time and place one use of a portion of the spectrum precludes other use of that portion.

Spectrum usage is regulated, access is controlled, and usage rules are enforced because of the possibilities of interference between users. All that requires some policing, both at home and internationally, because minimizing interference lies at the heart of effective spectrum management.

Spectrum Management: A History. The practical application of radio transmission and reception began in the last decade of the previous century, and it didn't take long for the U.S. government to step in. From 1902 to 1912, at least 28 bills dealing with radio regulation were introduced in Congress, and in 1910 a law was passed requiring certain ocean vessels to carry radio transmitting and receiving equipment. The Titanic passenger ship disaster of 1912 drew public attention to the use of radio on the high seas, especially for safety and rescue.

Ultimately, the clamor for regulation resulting from users experiencing interference caused by unchecked and uncoordinated transmissions resulted in passage of the Radio Act of 1912, which required registration of transmitters with the Department of Commerce. That act also relegated radio amateurs to wavelengths of 200 meters or shorter—wavelengths that at the time were considered to be practically worthless. Surprisingly, the act didn't control frequencies, operating times, and station power, so the government still had no real regulatory power.

In 1922, government spectrum users formed the Interdepartment Radio Advisory Committee (IRAC) under the Secretary of Commerce to coordinate their use of the spectrum. Of course, the government's own use of the spectrum was much more easily coordinated than that of the public, and federal users found that cooperation was mutually beneficial.

Then, the Radio Act of 1927 established the Federal Radio Commission (FRC). From 1927 until 1934, the FRC handled radio matters while the Department of Commerce regulated wireline telegraphy and telephones. The Communications Act of 1934 established the FCC, which nicely combined those two functions.

The 1934 Act gave the FCC broad regulatory powers in both wireline (telephone and telegraph) communications and radio communications. Under the 1934 Act, the President had the authority to assign frequencies to all federally owned or operated radio stations, assign frequencies to foreign embassies, and regulate the government's own radio equipment.

The Act served the country well for many years, and it still does. But the many dramatic changes in telecommunications over the past 10 to 20 years have put great pressure on Congress to overhaul the Act, which is now beginning to show its age.

The International Telecommunication Union's modern headquarters building, shown here, is located in Geneva, Switzerland.

Spectrum Management Today. The result of the 1934 Act overhaul was the Telecommunications Act of 1996. That new act reshaped the telephone, cable, and media industries, promoting competition. It also placed regulations on electronic publishing, particularly on the Internet (which resulted in much protest that is still ongoing). However, the new act still didn't change the radio spectrum. Rather, it left the way clear for possible follow-on legislation that could change spectrum allocations later this year or next.

So, spectrum usage remains pretty much the same. In the United States, the National Telecommunications and Information Administration (NTIA) manages the federal government's use of the spectrum, while the FCC manages all other uses—notably that of the public. The 1934 Act provides for developing different classes of radio service, allocating bands to the various services, and authorizing frequencies. However, the act doesn't specifically allocate bands for exclusive federal or nonfederal use. Such allocations stem from agreements between the FCC and NTIA rather than from the law itself; therefore, coordination between the two agencies is important.

As long as there's plenty of spectrum space available, merely assuring that multiple users don't operate in the same part of the spectrum in the same geographic area usually is sufficient. But as the spectrum becomes more crowded, ensuring that the spectrum is used efficiently becomes critical.

Fortunately—at least until recently—technology has kept ahead of spectrum demand. Now, however, the demand for spectrum is growing rapidly, especially for cellular radio, personal communications, digital-audio broadcasting, and high-resolution TV. The technical advances needed to meet the demand are pushing the envelope of practicality, at least in the short term.

Communication systems are more numerous today than they were in the past and they have become more complex. Also, there has been a rapid growth in the number of active frequency authorizations from both the FCC and NTIA.

The casual glance just provided of the twin guardians of spectrum management in this country should make it obvious how important their existence is. Now, let's look at each more closely.

The FCC. The FCC is an independent federal regulatory agency responsible for managing spectrum use by the public. Its commissioners are appointed by the President (who designates one as Chairman) and confirmed by the Senate; they serve five-year terms. The FCC's annual budget is about $100,000,000, although recent budget and personnel cuts are expected to adversely affect many FCC activities, particularly those of the field offices, which are expected to be cut back.

Under the 1934 Act, the FCC regulates the spectrum so as to make

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available rapid, efficient, worldwide wire- and radio-communication services. The Act authorizes the FCC to regulate the "channels of radio transmission," including radio-station licensing and operation, but the law provides few details on FCC spectrum-management objectives. The "public interest" is the primary criterion for non-federal spectrum management, although the 1934 Act doesn't define just what that is.

The FCC recently restructured and reinvented itself, resulting in an "alphabet soup" of acronyms with which we'll have to contend. The Common Carrier Bureau regulates interstate wireline "common-carrier" services such as telephone and telegraph companies, and it investigates complaints about them. The Mass Media Bureau regulates radio-and television-broadcasting stations and issues station licenses.

The Cable Services Bureau handles cable-television issues, while the International Bureau regulates international facilities and services and licenses satellite facilities. It also represents the FCC in international organizations.

The Compliance & Information Bureau (CIB) is the FCC's primary public point of contact, and it carries out various enforcement, public-service, and engineering programs. The CIB inspects stations, resolves interference problems, monitors the spectrum to make sure that channels remain usable and free from interference, and certifies radio-equipped ships. It also pursues administrative and criminal sanctions against those who violate the laws and FCC rules.

Finally, the FCC's sprawling Wireless Telecommunications Bureau (WTB) is of particular interest. It handles all FCC domestic wireless-telecommunications programs and policies, except those involving satellites. Included are cellular-telephone, paging, personal-communications, public-safety, and other commercial and private services.

Among the WTB's seven divisions, the Enforcement Division and the Private Radio Division are of special concern. The Enforcement Division ensures compliance with FCC rules, orders, and policies, and it responds to public inquiries regarding rates and practices. The Private Radio Division regulates the Public Safety, Industrial, Land Transportation, Aviation, Marine, Amateur, Broadcast Auxiliary, and Personal Radio Services.

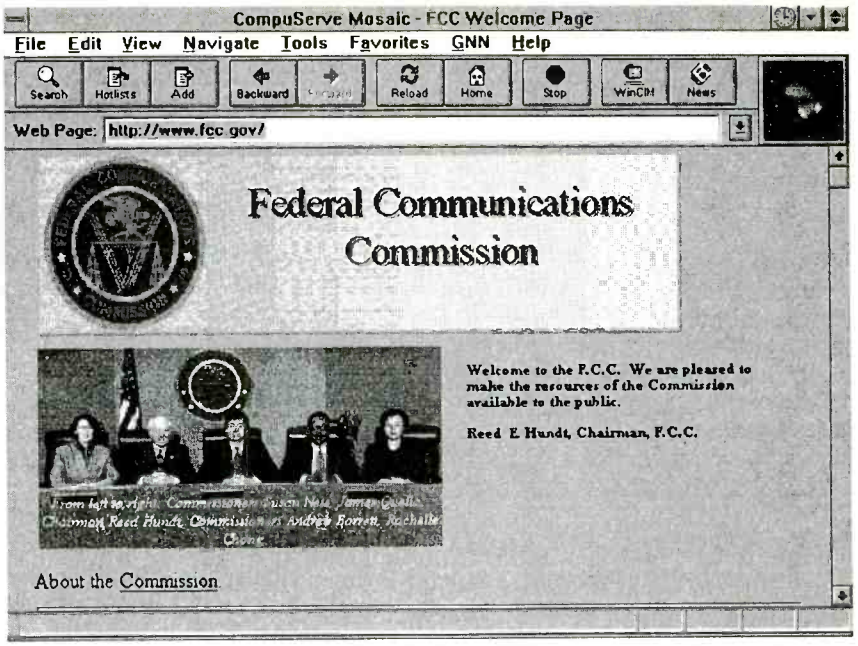

Fig. 1. If you'd like to learn more about the Federal Communications Commission, which oversees interstate and international communications, visit their Web site.

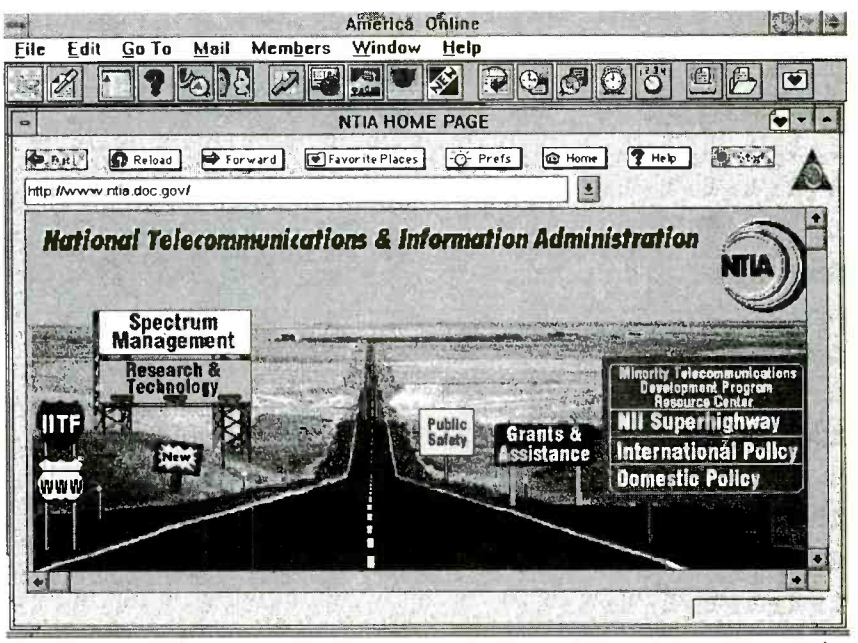

Fig. 2. As its Web page graphically suggests, the National Telecommunications and Information Administration is at the very heart of the "information superhighway."

If you have Internet access, and would like to learn more about the FCC, you could visit the organization's web site at http://www.fcc.gov (see Fig. 1).

The NTIA. A part of the Department of Commerce, the NTIA was established in 1978. Although the agency is little known outside the government, its importance shouldn't be underestimated. The NTIA is both the telecommunications policy advisor to the President and the manager of federal spectrum use. Like the FCC, the NTIA is experiencing deep budget and personnel cuts that might curtail many of its activities.

The NTIA has five major offices and three staff groups. The five offices are International Affairs, Spectrum Management, Telecommunication Ap-

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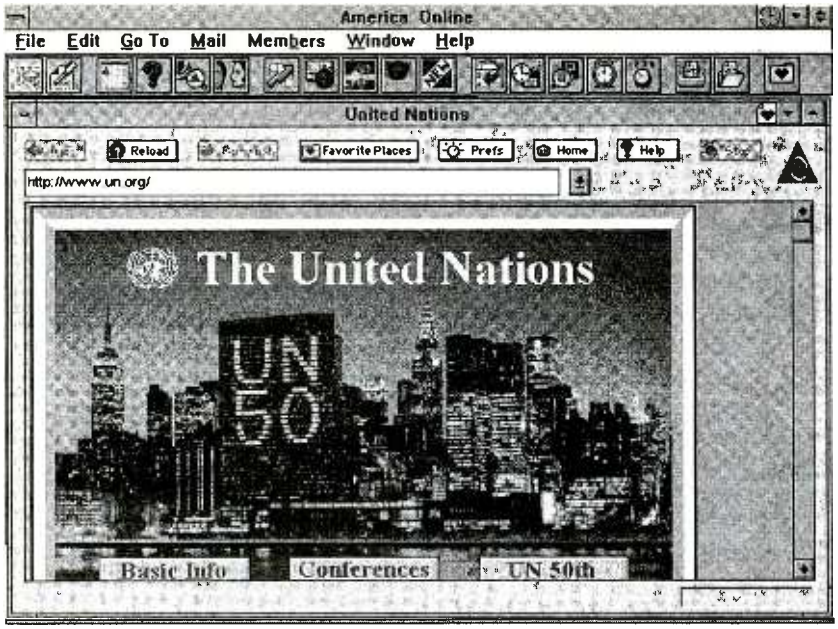

Fig. 3. On October 1995, the United Nations celebrated its golden anniversary. That was commemorated on their Web page, which also contains lots of useful information.

Telecommunication Sciences. Several of those offices are especially important to us. The Office of Internal Affairs, for example, provides technical guidance and recommendations that advance U.S. strategic interests and international competitiveness.

The Office of Spectrum Management establishes policy regarding allocations and regulations concerning federal spectrum use, prepares for international radio conferences, assigns frequencies, reviews federal agencies' new communications systems and certifies that spectrum will be available for them, assesses spectrum resources, and participates in emergency readiness activities.

An important NTIA staff group is the Interdepartment Radio Advisory Committee (IRAC). Created in 1922, the IRAC has advised, over the years, whoever has been responsible for exercising the President's powers under the 1934 Act. Today the powers are delegated to the Assistant Secretary of Commerce for Communications and Information, who is also the NTIA Administrator.

The IRAC assists in assigning frequencies to government radio stations and in developing policies, programs, procedures, and technical criteria relating to spectrum allocation, management, and use. It consists of a main committee, three subcommittees, a group for notifying the ITU of frequencies used, and several spectrum policy working groups.

To keep current on what the NTIA is up to, you can visit the agency's web site at http://www.ntia.doc.gov (see Fig. 2).

Now, let's turn our attention away from the United States. As hinted at earlier, there are also international conservators of the radio spectrum. But exactly what are those organizations, and just what do they do?

The United Nations. Established at the end of World-War II to promote international peace and security, the United Nations' (UN) main purpose was to "save succeeding generations from the scourge of war." It is headquartered in New York, and is the second such organization, having replaced the largely ineffective League of Nations, which was founded in the aftermath of World War I.

The UN has six major internal agencies: the Security Council, General Assembly, Economic and Social Council, Trusteeship Council, International Court of Justice, and Secretariat. Various specialized agencies also are attached to the UN to deal with specific international problems.

A group of UN specialized agencies we're particularly interested in has as its purpose broadening and promoting communications among nations. The group includes the Universal Postal Union, the International Civil Aviation Organization, and the International Telecommunication Union (ITU), among others. You can visit the UN's web site at http://www.un.org (see Fig. 3) if you'd like more information on that international organization.

The ITU. As an international intergovernmental organization, the ITU administers a system of frequency allocations to various regions of the world—a necessary undertaking because spectrum space is so scarce and valuable. Its mission includes technical, development, and policy domains. To those ends, the ITU holds periodic global meetings.

The ITU has three "sectors." The Radiocommunication Sector promotes efficient spectrum use by all Radiocommunication services; the Standardization Sector works toward standardizing telecommunications worldwide; and the Telecommunication Development Sector enhances planning, technical cooperation, and assistance. Other elements of the ITU's organization include a Plenipotentiary Conference, the ITU's supreme authority; a Council of members; periodic world conferences on international telecommunications; and a General Secretariat.

The ITU's organization provides for the convening of World Radiocommunication Conferences every two years to accommodate new technologies in a timely manner. Those conferences provide a vehicle to revise the ITU's radio regulations and associated frequency-assignment plans to accommodate such new and emerging technologies.

The ITU also is divided geographically into three regions. Region One is made up of Europe, Africa, and most of north Asia; Region Two contains North and South America; and Region Three consists of south and southeast Asia, including China and India, plus Australia and the Pacific.

Like the other organizations we've discussed so far, the ITU also has a web page. You can visit it at http://www.itu.ch (see Fig. 4).

Radio's Unofficial Guardians. So far, we've considered the roles of governmental and intergovernmental organizations. However, since the

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founding of the UN, non-governmental organizations (NGOs) have made valuable contributions to the international community. They draw attention to issues, suggest programs, disseminate information, and mobilize public opinion.

So, just what is an NGO? An NGO is a nonprofit, voluntary citizens' group organized on a local, national or international level. NGOs bring citizen concerns to governments, advocate and monitor policies, and encourage political participation. They also offer analysis and expertise, serve as "early-warning mechanisms" on developing problems, and help monitor and implement international agreements. At least 1,500 NGOs have programs on issues of concern to the UN. We'll look at some of them here, starting with the International Amateur Radio Union (IARU).

The IARU. In March 1924, recognizing the international implications of amateur radio, pioneering radio amateur and cofounder of the American Radio Relay League (ARRL), Hiram Percy Maxim, W1AW, met with a small group of amateurs in Paris to make plans for a new international organization. The organization became the IARU. On April 17, 1925, the IARU's constitution was adopted by 25 countries' representatives. The IARU's formation was confirmation of Maxim's idea that amateur radio had become truly international in scope.

Today, the IARU is a worldwide organization that represents the interests of more than 1.5-million radio amateurs, with over 125 national amateur-radio societies as members. It has consultative status with the UN as an NGO. As such, it's a member of two ITU sectors, Radiocommunication and Telecommunication Development, and it participates in the ITU's World Radiocommunication Conferences every two years.

The IARU's constitution spells out its goals and objectives in some detail. Those include representation of amateur radio at and between conferences and meetings of international organizations; encouragement of international goodwill and friendship; promotion of technical training of young people; use of amateur radio in natural disaster relief; development of amateur radio in countries not yet represented by member societies; and support of amateur radio as valuable national resources.

Also, the IARU operates the IARU Monitoring System. It's used to detect non-amateur stations causing harmful interference with amateurs, in coordination with the ARRL Monitoring System (ARRLMS), described below, as well as with the ITU.

The IARU has its international secretariat collocated with the ARRL headquarters in Newington, CT. Its central policy-making functions and management are carried out by an Administrative Council. But the IARU also is divided into three regional organizations, paralleling the three regions of the ITU. The regional organizations may levy dues and investigate applications for membership from prospective member societies.

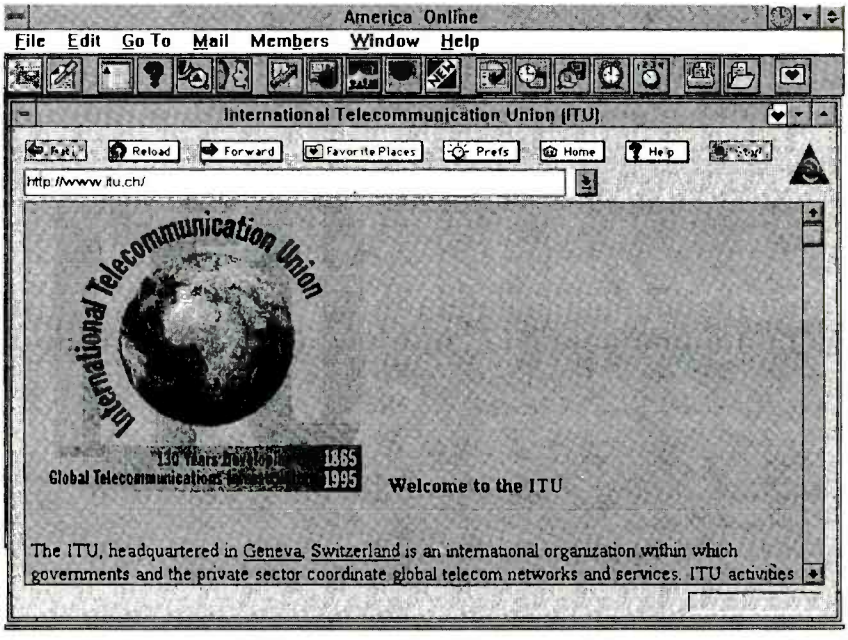

Fig. 4. The International Telecommunication Union is one of the numerous specialized agencies attached to the United Nations system. To keep up with the times, they've created an excellent Web page that's loaded with information.

SOURCES

Special thanks are due to Steve Mansfield, N1MZA, and Jennifer Hagy, N1TDY, of the ARRL Legislative and Public Affairs staff for their considerable assistance in preparing this article. The information and materials they supplied on ARRL and IARU programs were particularly helpful. Here are some other sources used by the author:

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American Radio Relay League. *The Amateur Auxiliary to the FCC's Compliance and Information Bureau and ARRL Official Observers.* An ARRL pamphlet; Newington, CT, June 1995.

Baldwin, Richard, W1RU. "The 60th Anniversary of ITU." IARU public news release reprinted from *QST*, April 1985.

Federal Communications Commission. Public historical, organizational, and policy information posted on the FCC World-Wide Web site, 1996.

International Telecommunication Union. "In Brief: 1995." A public report of the ITU; Geneva, Switzerland, 1995.

International Telecommunication Union. Public historical, organizational, and policy information posted on the ITU World-Wide Web site, 1995.

Kelleher, Jack, W4ZC. "FCC Highlights" column, *WORLDRADIO*, December 1995.

Mansfield, Steve, N1MZA. "DC Currents" column, *QST*, February 1996.

National Telecommunications and Information Administration. Public historical, organizational, and policy information posted on the NTIA World-Wide Web site, 1995.

United Nations. Public historical, organizational, and policy information posted on the UN World-Wide Web site, 1995.

World Radio TV Handbook. New York, Billboard Publications, 1992. ■

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HIRAM PERCY MAXIM

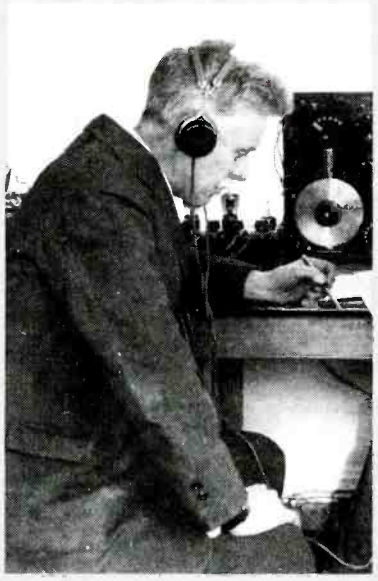
The formation of the International Amateur Radio Union (IARU) largely is credited to the efforts of radio pioneer and inventor Hiram Percy Maxim (1869–1936). Richard L. Baldwin, W1RU, IARU President, notes that Maxim's work has great significance for the international amateur-radio community. Indeed, it was Maxim who "got the ball rolling" towards formation of the IARU 72 years ago.

In March 1924, recognizing the international implications of amateur radio, Maxim met with a small, international group of radio amateurs in Paris to make plans for the new international organization, the IARU. On April 17, 1925, the IARU's constitution was unanimously adopted by some 25 countries' representatives.

Maxim, of course, is associated closely with the birth and early development of amateur radio. A long-standing tradition in amateur radio is that of "The Old Man," or "T.O.M." That refers to Maxim, who, with Clarence D. Tuska, co-founded the American Radio Relay League (ARRL) in 1914. He is recognized as the father of amateur radio, and he served as the League's president for 22 years until his death in 1936. Maxim, whose callsign, W1AW, later was awarded by the FCC to the ARRL for its headquarters station in his memory, was an imaginative engineer and inventor who pioneered in the development of the automobile and who also invented the Maxim silencer for firearms.

T.O.M. was known as a feisty standards-setter who was revered highly in the amateur community. Many T.O.M. stories grew up around his accomplishments, principles, and philosophies. Even today, some older amateurs might judge controversial developments in the hobby by asking themselves, "What would the Old Man (OM) think about that?"

Maxim also is associated with the tradition and symbols of the Wouff Hong, long a part of amateur radio lore. Not merely a silly spontaneous word invention, the Wouff Hong was a mythical creation of a then-anonymous writer using the name "The Old Man," found after his death to be Maxim. From that mythical, mystical symbol emerged the Royal Order of the Wouff Hong, a sort of radio-amateur secret society intended to symbolize an honorary inner circle of the ARRL.



Hiram Percy Maxim, a true amateur-radio pioneer, co-founded the American Radio Relay League in 1914 and also helped form the International Amateur Radio Union in 1925.

The Wouff Hong first was mentioned in a series of humorous stories in Maxim's "Rotten Radio" series in the ARRL's journal *QST*. In the January 1917 issue, T.O.M. referred to the Wouff Hong for the first time, discussing it in his article "Rotter QRM," in which he referred to unnecessary interference by crummy operators—who amateurs of the present era would call "lids."

Actually, the Wouff Hong was just one of three mythical instruments of torture or strangulation designed by T.O.M. It, along with his two other nonsense-word creations, the Rettysnitch and the Uggerumph, were used to attack poor operating practices and ensure good radio-operating techniques. ■

Broadcasting Organizations. There also are a number of international organizations involved with the ITU's work; those organizations represent the interests of international broadcasters. The objectives of such organizations include promoting cooperation among member broadcasting organizations; fostering program exchanges; and representing the international interests of its members in the legal, technical, and programming aspects of broadcasting.

Most of those communications- and broadcasting-oriented organizations have specialized memberships. Regional organizations predominate, such as the European Broadcasting Union, Asia-Pacific Broadcasting Union, Caribbean Broadcasting Union, and North American National Broadcasters Association. Others serve specialized geopolitical and research interests, such as the Commonwealth Broadcasting Association, International Institute of Communications, and International Broadcasting Society.

With the growth in international shortwave religious broadcasting, you'll also find numerous organizations that serve similar purposes for religious broadcasters. Some of those include the National Religious Broadcasters; World Association for Christian Communication; and International Catholic Association for Radio, Television, and Audiovisuals.

ARRL Monitoring System. Protecting the spectrum largely is the job of governments and other international organizations. However, in the U.S., the ARRL sponsors two programs that promote spectrum discipline, one of which is the ARRL Monitoring System (ARRLMS).

The ARRLMS grew out of the old Intruder Watch that also supported IARU monitoring efforts. The Intruder Watch was formed in the 1960s by the ARRL to provide a mechanism for doing something about the many commercial and foreign broadcasting stations that operated (and still operate) illegally in the amateur bands—especially on the 40-meter band. The ARRL took action because many of those stations—radio poachers—thought that appropriating amateur frequencies would pose little problem.

The ARRLMS now consists of a relatively small group of amateurs—membership is strictly limited by the ARRL to those who have the right combination of radio equipment and experience. It has three objectives. Those are to: (1) report non-amateur stations causing harmful interference to hams to the government, so that it can take steps to have the interfering stations removed; (2) establish a record of vigilant protection of the amateur bands (especially on frequencies allocated exclusively to amateurs) so that other countries at international conferences can be apprised of their out-of-band operations; and (3) develop band-occupancy data and conduct special studies, such as spectrum-occupancy studies.

ARRLMS activities stress finding interference that seriously degrades,

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obstructs, or repeatedly interrupts communications. There's judgment involved in reporting intruders; the mere existence of a non-amateur station on the amateur bands, or a one-time occurrence, doesn't constitute harmful interference and so isn't reported. Nor is amateur-to-amateur interference such as jamming or deliberate QRM (interference) reported through the ARRLMS.

ARRL Official Observers. The other ARRL volunteer group is the Official Observer (OO) program, which is affiliated with the FCC Amateur Auxiliary. Members of the OO (called, naturally enough, OOs) are amateurs who help fellow hams maintain their equipment and operating procedures to be in compliance with FCC regulations through an energetic on-the-air monitoring program.

The OO program has been sponsored by the ARRL for over 50 years to help amateurs help each other. Their objectives include notifying amateurs by mail of operating or technical irregularities before they come to the attention of the FCC, fostering wider knowledge of and better compliance with FCC rules, extending amateur self-regulation, and helping the FCC better use its very limited manpower and resources.

The affiliated FCC Amateur Auxiliary consists of about 700 volunteer ARRL OO appointees. While OOs monitor the amateur bands and notify amateurs of technical and operating discrepancies as a service to them, they're not radio police, and they don't directly enforce FCC rules. But they're trained to help the FCC, if need be, in enforcement.

In rare, hard-core rules violations, OOs refer problems to the higher echelons of the Amateur Auxiliary and might be requested to gather evidence for possible FCC enforcement actions. OOs might even be called on—deputized, if you will—to assist the FCC as members of the Amateur Auxiliary.

The OOs do their job by listening rather than transmitting. They keep an ear cocked for frequency instability, harmonics, hum, key clicks, broad signals, distorted audio, overdeviation, out-of-band operation, and the like. OOs also look for amateur-repeater jamming, malicious interference, rude on-the-air remarks, racial slurs, and obscene or indecent words.

But OOs don't resolve radio frequency interference (RFI) problems. Nor do they handle non-amateur HF intruders (those are the business of the ARRLMS). Cases involving unlicensed, on-the-air "bootleggers" are simply turned over to the FCC for follow-up.

OOs complete their task once they send a notification postcard. The postcard isn't an official FCC citation; rather, it's a friendly note to alert the recipient to possible equipment factors or operating practices that might have contributed to a departure from FCC rules or good operating practice. No reply is required, but if you receive one you should take steps to determine what caused the problem and fix it.

On the other side of the OO coin, there are "Good Operator Report Cards." Those all-smiles reports are sent to operators noted by OOs whose on-the-air signals and/or operating practices stand out as being consistent with the highest standards and thus are a model for newcomers to follow.

OOs must be trained and certified. They use an extensive training manual and pass a comprehensive examination before issuing notifications. They also must be full ARRL members and have been licensed at the Technician Class or higher for at least four years. OO applications are handled through the ARRL's field organization.

If you're interested in the public service aspects of amateur radio, the ARRL offers several other field appointments. Those include Official Relay Station, Official Emergency Station, Official Bulletin Station, Technical Specialist, Public Information Officer, and Local Government Liaison. All require ARRL membership, and some require a particular class of license or other experience. ■

NAMES AND ADDRESSES

American Radio Relay League
225 Main St.
Newington, CT 06111-1494

Asia-Pacific Broadcasting Union
P.O. Box 1164
Jalan Pantai Bahru
59700 Kuala Lumpur
Malaysia

Broadcasting Research Institute
39c Highbury Place
London N5 1QP
England

Caribbean Broadcasting Union
Wilkins Lodge
Two Mile Hill
St. Michael
Barbados, W.I.

Commonwealth Broadcasting Association
Broadcasting House
London W1A 1AA
England

European Broadcasting Union
Ancienne Route, 17A
Case Postale 67
CH-1218 Grand-Saconnex (GE)
Switzerland

Federal Communications Commission
1919 M Street N.W.
Washington, DC 20015

International Amateur Radio Union
International Secretariat
P.O. Box 310905
Newington, CT 06131-0905

International Catholic Association for Radio, Television, and Audiovisuals
12 rue de l'Orme
B-1040 Brussels
Belgium

International Institute of Communications
Tavistock House South
Tavistock Square
London WC1H 9LF
England

International Telecommunication Union
Place des Nations
CH-1211 Geneva 20
Switzerland

National Religious Broadcasters
299 Webro Rd.
Parsippany, NJ 07054

National Telecommunications and Information Administration
2100 Wisconsin Ave.
Washington, DC 20007

North American National Broadcasters Association
1500 Bronson Ave.
Ottawa, Ontario
Canada K1G 3J5

United Nations (UN)
1st Ave. and 46th St.
New York, NY 10017

World Association for Christian Communication
357 Kennington Lane
London SE11 5QY
England

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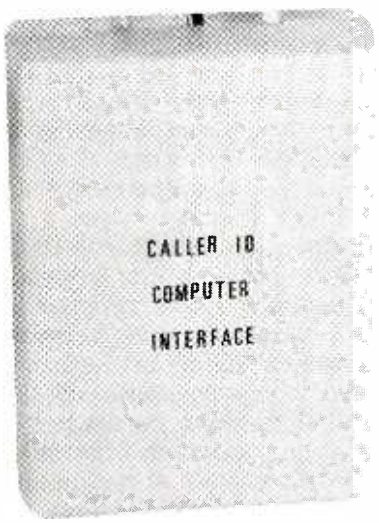

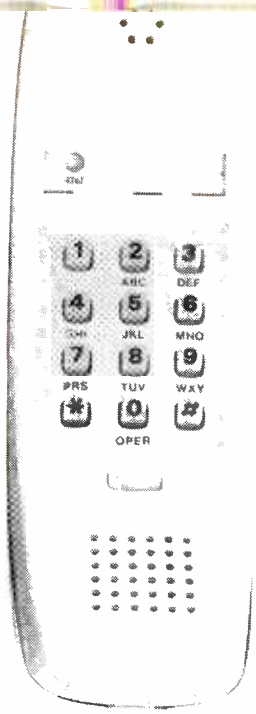

Build A Caller-ID COMPUTER Interface

Use it to keep track on your PC of who's been calling.

BY TERRY J. WEEDER

Since the early 1990s, telephone accessories have been appearing on the market that, when plugged into the phone line, will display the number and/or name of the calling party of each incoming call. Those caller-ID devices tap into the data stream sent down the phone lines and use it to identify the origin of the call. However, such units do not usually provide any way for you to implement the data received: You can see who's calling, and that's about it.

The *Caller-ID Computer Interface* described in this article changes all that. It's a device that directly links your computer to caller-ID information, and enables you to create programs that can import and use the data. Your computer can keep a running log of all incoming calls, automatically retrieve information from a database related to a caller, or verify a caller's name and phone number if, for example, he or she wished to gain access to your BBS or other modem applications.

All decoding and processing of the caller-ID data is handled by the onboard microcontroller. That chip converts the data to a one-line, formatted ASCII string that can be easily imported by your PC with very little programming. The serial communications interface used on the Caller ID was specifically designed to share the same RS-232 port with other projects of its kind. Multiple units can be piggybacked on the same port and plugged into different phone lines, thus allowing one computer to manage calls received from several telephones.

About Caller ID. There are a number of features now offered by local telephone companies that are part of Custom Local Area Signaling Services (CLASS), which include distinctive ringing, call forwarding, etc. Among the CLASS features are two services that deliver information pertaining to the calling party: Calling Number Delivery (CND) and Calling Name Delivery (CNAM). Both CND and CNAM are part of a subscriber feature that transmits data (date, time, number, and name) of the calling party during the silent period between the first and second ring. You must subscribe to those services or no data will be sent, but once subscribed, you will receive the data on calls whether the caller subscribes or not.

The date and time information is sent on all calls, but the actual calling party's name or number might not always be available. If the caller wishes to be anonymous, a special code is sent instead of the name and number indicating that the call is private. Also, though in the very near future all areas of the U.S. will be connected to the system, at the time of this writing there are still gaps in the data link, such as calls originating from some very rural areas and/or some calls received via long-distance lines. In those cases, a code is sent indicating that the call is coming from out of the area.

Data Message Format. Caller-ID data is transmitted serially (least-significant bit first) at 1200 bits per second. Each 8-bit word is preceded by a start bit (space) and followed by a stop bit (mark), with 1200 Hz being a logical 1 (mark) and 2200 Hz being a logical 0 (space). In addition, up to 10 mark bits could be added between words. That data is delivered to your home using one of two different formats: Single Data Message Format (SDMF) and Multiple Date Message Format (MDMF).

Figure 1 shows the order in which the data is sent when using SDMF. The portion of the message that contains the calling number is preceded by a "type code" of 04 (hex). Following that is a "length" word that is the number of words in the message, then the date

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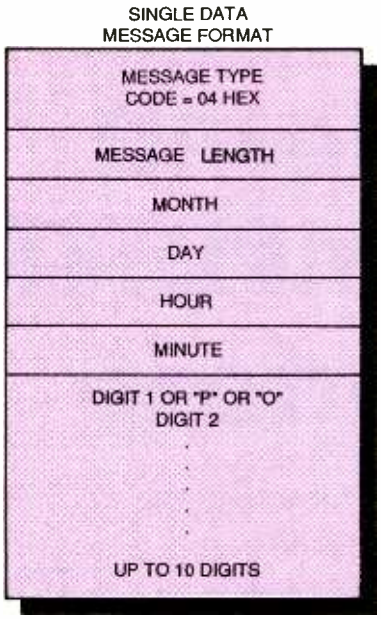

Fig. 1. This diagram shows the order in which caller-ID data is sent when using Single Data Message Format.

time and number followed by a "checksum" word.

For example, 07-31-93 1:30 pm 513-555-1212 would be sent as follows: {type}{length} 073193133051 35551212{checksum}. Note that the time is in 24-hour format. The message type and length are sent in binary, while each character of the month, day, hour, minute, and telephone number are sent in standard, 8-bit ASCII codes.

If for some reason a calling party's number is not available (*i.e.* if it's outside your service area, or originating from a phone where CND is not supported), the letter "O" is sent instead of a telephone number. If the calling party is deliberately blocking the delivery of his or her number (that can be done, in most areas, by pressing *67 on your touch-tone phone prior to making a call), the letter "P" will be sent instead of the telephone number.

In order to provide for future additions to the data stream sent over the phone line, MDMF was created, which allows for transmissions of multiple blocks of data (messages), not necessarily related to each other. Bell Communications Research group (Bellcore) has hinted that in the future SDMF might eventually be phased out in favor of MDMF.

The structures of the two different formats are rather incongruous with each other. In addition to being able to deliver multiple messages (other then just caller-ID information), the data associated with each message in the MDMF is broken up into separate parameters. In the case of the CND information, for example, the date and time are delivered in a completely separate parameter than that of the calling number. The message might contain different parameters in various order, depending on the services subscribed to. In either format, the last word to be transmitted is a checksum word, which is the complement of the sum of the bits in all words in the data transmission, and is used to ensure that the data was received correctly.

When using MDMF, the message-type word that indicates delivery of CND and/or CNAM is 80 (hex). That is followed by a message-length word that is the sum of all the words in all the different parameters associated with the message. Figure 2 shows each parameter that could be included, and the type code that identifies it. Note that each parameter has its own length word also. That word is important when designing a program that will decode the message. For example, if you want your program to look for just the name of the calling party, you would want it to ignore those parameters that have the wrong type code. When receiving each type code, the length word can be used to indicate how many words your program will have to skip before the beginning of the next parameter.

Whether you subscribe to CND, CNAM, or both determines which parameters will be included in the message. In all cases, either the "number" parameter or "reason for absence of number" parameter will be sent, but not both. The same applies to the "name" and "reason for absence of name" parameters. At the present time, the maximum number of characters in the name parameter will not exceed 15. That number is expected to increase in the future.

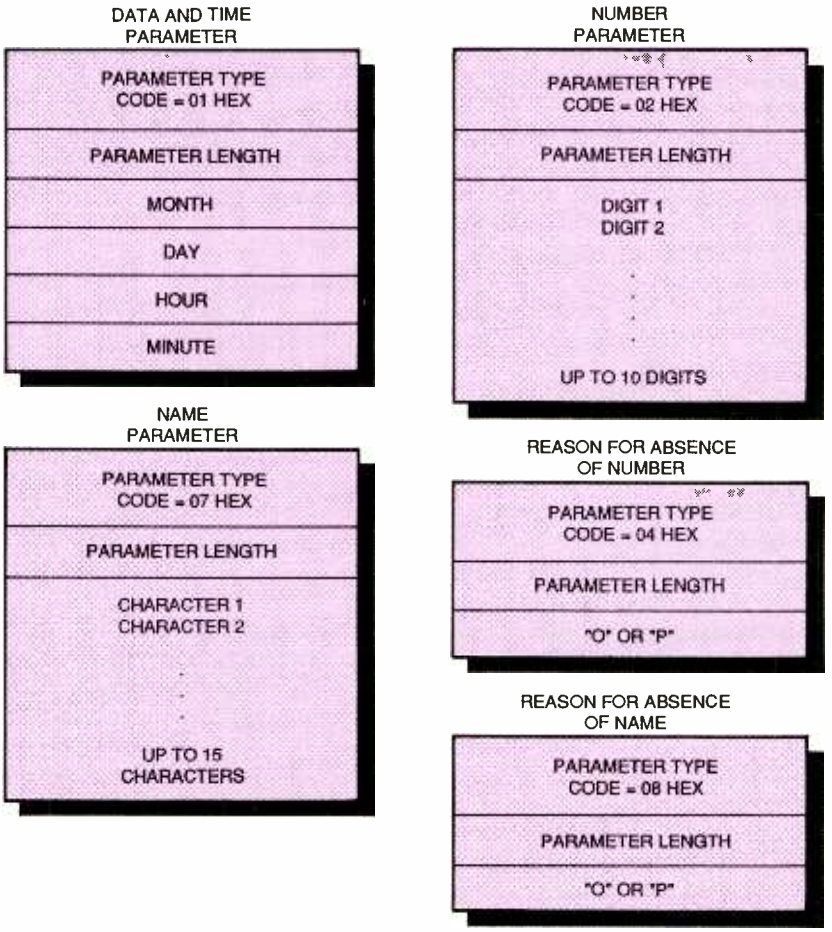

Fig. 2. Here are the parameters and parameter-type codes that might be included in a caller-ID data stream when Multiple Data Message Format is used.

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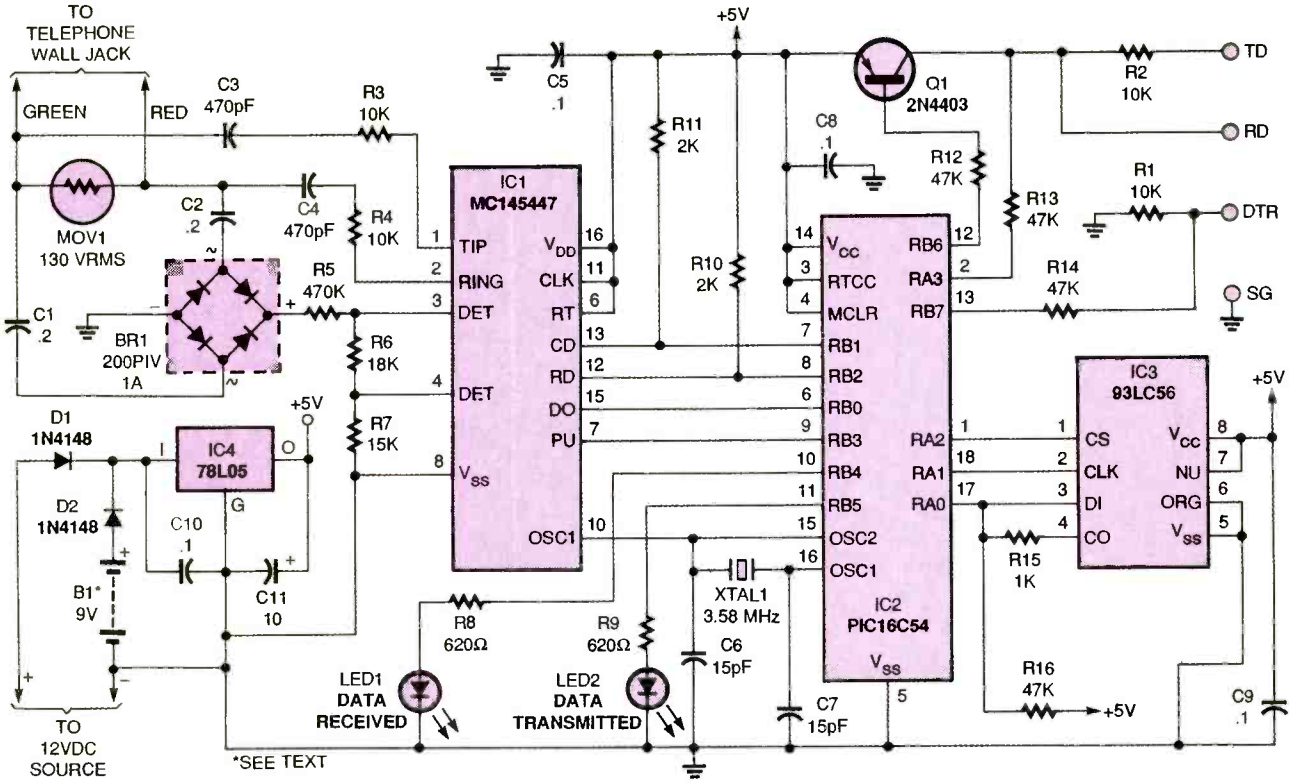

Fig. 3. In the Caller-ID Computer Interface, microcontroller IC2 handles all the decoding and processing of incoming caller-ID data, which is then stored in EEPROM IC3 until it can be transmitted to a connected computer.

PARTS LIST FOR THE CALLER-ID COMPUTER INTERFACE

SEMICONDUCTORS

IC1—MC145447 calling-line identification receiver, integrated circuit
IC2—PIC16C54 (preprogrammed) 8-bit microcontroller, integrated circuit
IC3—93LC56 serial EEPROM, integrated circuit
IC4—78L05 low-power 5-volt regulator
Q1—2N4403 general-purpose PNP silicon transistor
BR1—1-amp, 200-PIV, full-wave bridge rectifier
D1, D2—1N4148 general-purpose silicon diode
LED1—Light-emitting diode, yellow
LED2—Light-emitting diode, red

RESISTORS

(All resistors are ¼-watt, 5% units.)
R1–R4—10,000-ohm
R5—470,000-ohm
R6—18,000-ohm
R7—15,000-ohm
R8, R9—620-ohm
R10, R11—2000-ohm
R12–R14, R16—47,000-ohm
R15—1000-ohm

CAPACITORS

C1, C2—0.2-μF, Mylar
C3, C4—470-pF, ceramic-disc
C5, C8–C10—0.1-μF, Mylar
C6, C7—15-pF, ceramic-disc
C11—10-μF, 35-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

MOV1—130-VRMS metal-oxide varistor
XTAL1—3.58-MHz, TV-colorburst crystal
B1—9-volt alkaline battery (optional, see text)
Printed-circuit materials, suitable enclosure, IC sockets, 12-VDC wall adapter, telephone cord with modular plug, RS-232 connector (see text), four-conductor cable, wire, solder, hardware, etc.

Note: The following items are available from Weeder Technologies (P.O. Box 421, Batavia, OH 45103; Tel. 513-752-0279): double-sided etched and drilled PC board (WTCCI-B)—$9.50; kit of parts including all on-board components and pre-programmed PIC16C54 (WTCCI-C)—$25.00; pre-programmed PIC16C54 (PIC-CCI)—$16.00. All orders must include an additional $4.00 for shipping and handling. Ohio residents please add 6% sales tax.

Circuit Description. The schematic diagram for the Caller ID is shown in Fig. 3. Power is supplied by a 12-volt-DC wall transformer or other fixed supply. A 78L05 regulator, IC4, then converts that supply to 5-volts DC for use by the circuit; that output is filtered by C11, and C10 stabilizes IC4. A 9-volt battery, B1, can be used with switching diodes D1 and D2 as a back-up at times when there is a loss of AC line current.

An MC145447 calling-line identification receiver, IC1, strips the FSK tones from the telephone line and converts them to TTL-level data. The tones are coupled through C3, C4, R3, and R4 to input-pins 1 and 2 of IC1. Bridge-rectifier BR1 converts the ring voltage to DC and applies it, through an attenuator made of R5–R7, to ring-detect-pins 3 and 4 of IC1.

The heart of the circuit is IC2, a PIC16C54 EPROM-based 8-bit CMOS microcontroller. That chip has one 8-bit I/O port, one 4-bit I/O port, and internal EPROM memory that holds the program used for decoding the data being output by IC1, reading and writing data to and from a 93LC56 EEPROM (IC3), and sending serial data to a connected PC's

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RS-232 port. A detailed description of IC2's firmware is presented later.

The voltage levels used for serial communications on an RS-232 port are +3V to +25V for a logic 0, and −3V to −25V for a logic 1. Most RS-232 devices use +12V and −12V, respectively. Bit 6 (pin 12) of IC2 is used to send data to the serial port. A logic 1 is generated when bit 6 is at a high level; that turns off Q1, allowing the −12V from the transmit-data (TD) pin of the RS-232 to be applied to the receive-data (RD) pin through resistor R2. When bit 6 is sent low, it produces a logic 0 that turns on Q1, thereby pulling the RD pin to +5V. Because the TD pin of an RS-232 port is normally at a marking level (−12V), it provides the negative voltage needed for communications at RS-232 levels.

Bit 7 (pin 13) of IC2 is tied to the data-terminal-ready (DTR) pin through R14 and determines when the Caller ID is plugged into an active RS-232 port. Bit 3 (pin 2) of IC2 is tied to the RD pin through R13 and is used to verify an idle RS-232 state prior to sending any serial data. That will avoid a collision with the data sent from an adjacent Caller-ID Computer Interface unit, or any other projects that are sharing the same RS-232 port.

A 93LC56 2K serial EEPROM (IC3) is used as a 256-character buffer to store all caller-ID data until it has the chance to be sent to the computer. The chip-select (pin 1), data-in/out (pins 3 and 4), and clock (pin 2) of the EEPROM connect to pins 1, 17, and 18 of IC2, respectively. Because the data in/out pins of IC3 share the same I/O pin of IC2, resistor R15 is used to limit the current flow during those transition times between write and read functions when there are conflicting logic levels.

Here's how IC2 communicates with the EEPROM: First, the microcontroller places a high on the chip-select pin of IC3. Data is then transferred serially to and from the EEPROM on the positive transition of the clock pin. Each read or write function is preceded by a start bit, an opcode (identifying the function to be performed—read, write, etc.), then an 8-bit address, which is followed by the 8 bits of data that are being written to, or read from, that address.

The PIC Firmware. As mentioned, microcontroller IC2 must be programmed with the Caller-ID Computer Interface firmware in order to work with the circuit. If you have the equipment and can program your own PIC, the source and object code files are available on the Gernsback BBS (516-293-2283). Otherwise, you can order a pre-programmed microcontroller from the source mentioned in the Parts List.

Here's how the firmware works: At power-up, and after the microcontroller initializes several of its internal registers and sends a series of commands to the EEPROM that enables the write function, IC2 monitors ring-detect-pin 12 of IC1. When a ring is detected by IC1, and verified for at least 2.3 ms, IC2 waits for the end of the ring then looks for the presence of the caller-ID carrier by watching the carrier-detect pin (pin 13) of IC1. If a carrier is detected within 2 seconds, IC2 reads the first word that is transmitted serially from IC1's data-out pin (pin 15). That word represents the type code of the message. If the type is found to be 04h (SDMF) or 80h (MDMF), IC2 retrieves all subsequent words in the message and stores the complete string in the EEPROM.

Following the retrieval of the caller-ID data, IC2 checks the DTR pin of the RS-232 interface to determine if it is connected to an active serial port. If so, the data stored in the EEPROM is transmitted to the RS-232 port in the following format: "12/31 08:45 513-752-0279 Weeder,Terry"; that's including all spaces and separators. That string is preceded by an "I" (identifying it as an incoming call) and followed by a carriage return.

The ASCII string is stored in the computer's internal RS-232 buffer ready for input into a program (for example, a QuickBASIC program with a "line input #" command). If the DTR shows an inactive serial port (*i.e.* the program is not running, the computer is turned off, etc.) IC2 returns and watches for

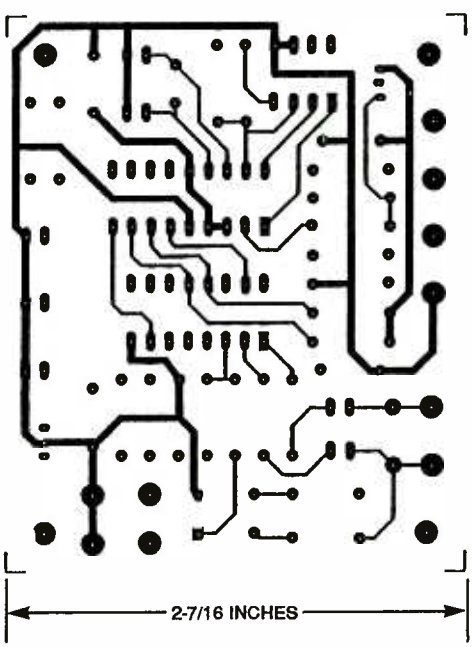

Fig. 4. The PC pattern for the solder side of the Caller-ID board.

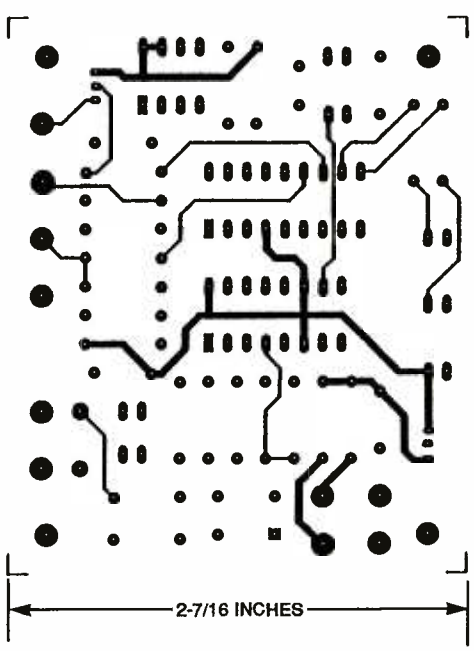

Fig. 5. Here's the pattern for the component side of the board.

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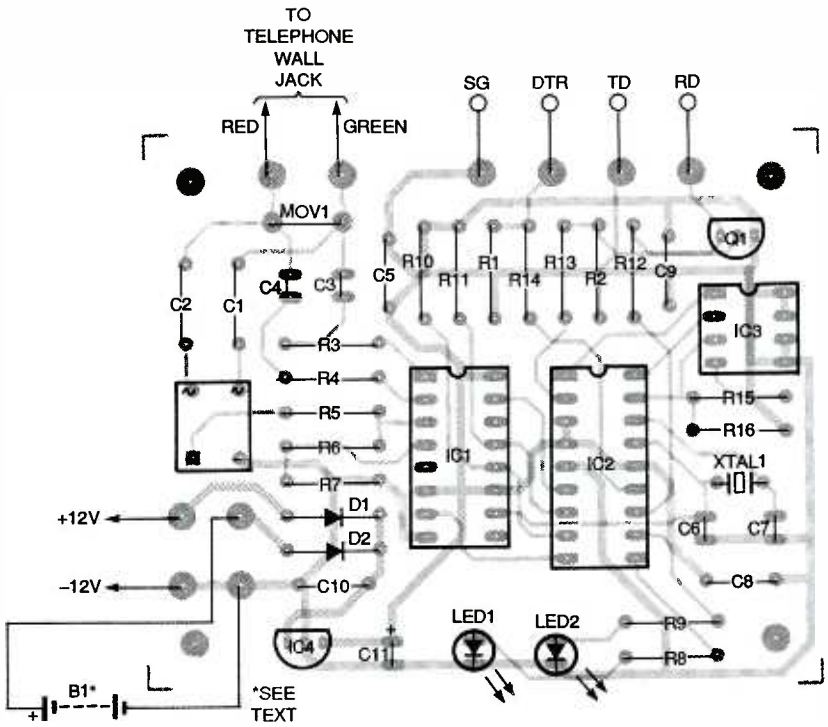

Fig. 6. Use this parts-placement diagram as a guide when you're assembling the Caller-ID PC board. Battery B1 should only be connected if you wish to have a backup power source.

another ring detect, taking the data from any subsequent call and adding it to the EEPROM, then dumping all data to the RS-232 port as soon as the latter is active.

Construction. The author's prototype for the Caller ID was built on a double-sided PC board. If you would like to do the same, you can either etch your own board using the solder- and component-side templates shown in Figs. 4 and 5, respectively, or order a pre-etched and drilled board from the source mentioned in the Parts List.

Refer to the parts-placement diagram shown in Fig. 6 and begin assembly as follows. Solder sockets to the board for IC1–IC3, being sure they are oriented properly. Next, install all resistors and capacitors, paying attention to the polarity of capacitor C11. Go on to mount D1, D2, LED1, and LED2, positioning them as shown in Fig. 6.

Solder the bridge rectifier (note BR1's polarity) and metal-oxide varistor (MOV1) to the board. Then, install the transistor (Q1) and regulator (IC4), positioning them as shown; be sure to avoid creating a solder bridge between those closely spaced pads. Mount XTAL1 next, leaving a small gap between the bottom of the crystal and the PC board to avoid the chance of its metal case shorting the two pads together.

Obtain a piece of 4-conductor telephone modular cord (available from Radio Shack and other sources), cut off one of the connectors, strip and tin the red and green wires, and solder them to the terminals marked "red" and "green" in Fig. 6. The yellow and black wires are not used.

Use another piece of 4-conductor telephone cord to run between the PC board to an RS-232 connector. To make sure the Caller ID is compatible with all PCs, hook-up diagrams for both 9- and 25-pin RS-232 connectors are shown in Fig. 7. Simply match the DTR, RD, TD, and SG connections on the board with their corresponding pins on the connector you are using. Then, solder a jumper wire on the RS-232 connector between RTS and CTS pins, and between the DTR, DSR, and DCD pins, as shown.

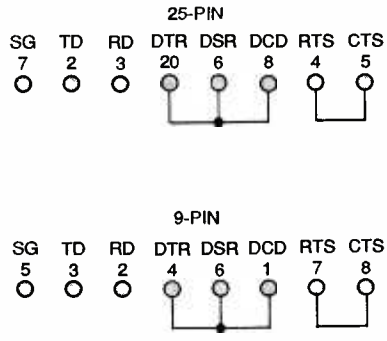

Fig. 7. The Caller ID unit can be used with either a 9- or 25-pin RS-232 connector. Just make the connections shown here to the four appropriately labeled leads from the circuit.

You will now need to make the necessary power connections to the circuit. If you have a 12-VDC wall transformer you wouldn't mind dedicating to use with the Caller ID, cut off the connector at the end of the wires, use a voltmeter to determine which lead is positive and which is negative, and solder those wires to the appropriate pads on the PC board. Alternatively, you could add a power jack that matches the power adapter you have.

Note that B1 is listed as being optional. That battery can be used as back-up during a power outage. If you want to use it, solder a 9-volt-battery clip to the terminals shown in Fig. 6. Note, if you're not using a battery for backup, a 9-VDC wall transformer can be substituted for the 12-VDC one.

After all components and wires have been soldered, closely examine both sides of the PC board for any mistakes. Then, carefully plug IC1–IC3 into their sockets using the orientations shown in Fig. 6. If you can't find IC1 locally, you can order it from Newark Electronics (Tel. 516-567-4200) and other Motorola distributors.

Mount the board in a plastic enclosure and cut three notches in the seam of the box for the cords to exit. Tie a knot in each cord for strain relief, then assemble the two halves of the box, placing the knots on the inside.

Operation. The Caller-ID Computer Interface can share the same RS-232 serial port with other units of its kind if you wire each in parallel to the same RS-232 connector. You must, however, remove R1 and R2 on any subsequent unit; in other words, of all the units paralleled on the same port, only one should have R1 and R2 installed. Doing that will allow you to piggyback additional units for monitoring multiple lines.

You must call your phone company and subscribe to the Caller-ID service

(Continued on page 76)

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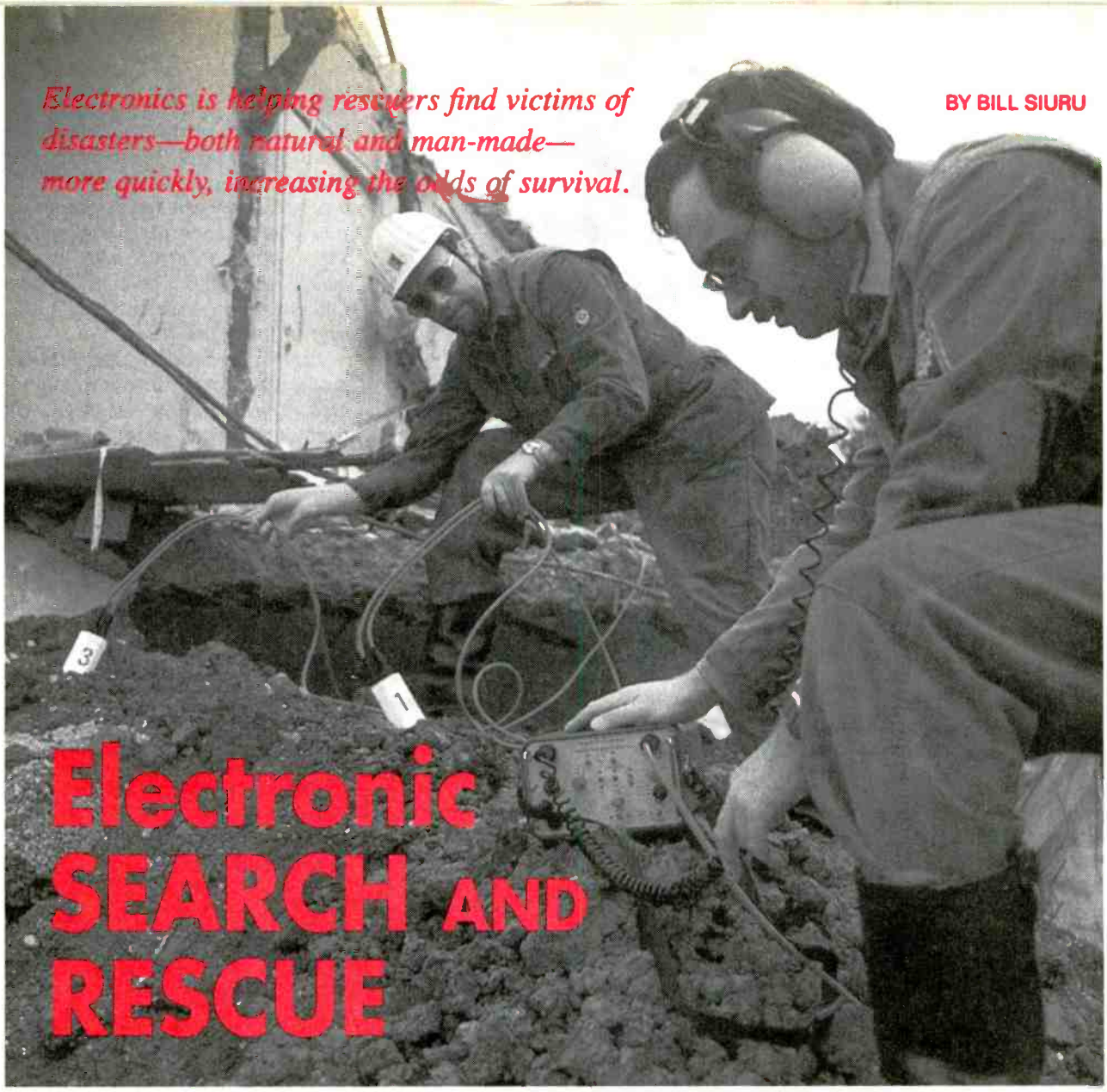

Electronics is helping rescuers find victims of disasters—both natural and man-made—more quickly, increasing the odds of survival.

BY BILL SIURU

Electronic SEARCH AND RESCUE

Many of us have watched on television as search-and-rescue teams frantically attempted to locate survivors of the Oklahoma City bombing; the collapsed department store in Seoul, Korea; the earthquake in Kobe, Japan; and other man-made and natural disasters that were equally devastating. While people have been found days, even weeks, after some of those disasters, every second counts during search-and-rescue operations.

Trained search dogs are usually the first alternative in search-and-rescue situations. Dogs can cover an area to detect victims more quickly than humans. Also, they can often reach areas that are inaccessible or too dangerous for human searchers. A dog can find victims who cannot communicate.

But there are drawbacks to using dogs. For one, dogs are a scarce resource that require a highly trained handler. Further, winds, layers of concrete, elevator shafts, and so forth can redirect smells making the dog's job difficult, if not impossible.

That's where today's high-tech electronic gear comes into play. Such gear is not designed to replace trained search dogs; for one thing, electronic listening devices, for example, usually require a cooperative victim who can produce a sound to make his or her presence known. Instead, the technology is used to complement search dogs in searching for survivors.

Listening For Victims. In their fight for life, trapped victims will cry, knock, scratch, or make other sounds as they struggle to be heard and subsequently rescued. Sometimes body motion or mere breathing can be used in locating survivors. Most of the time, those sounds are barely audible because of the victim's weakened condition and often confined position beneath mounds of rubble, dirt, mud, or snow. The problem is further compounded by the general din of equipment and vehicles, as well as radio communications during a major rescue operation. Because the feeble sounds made by victims will probably not be heard by the unaided ear, high-tech sensing systems have been developed.

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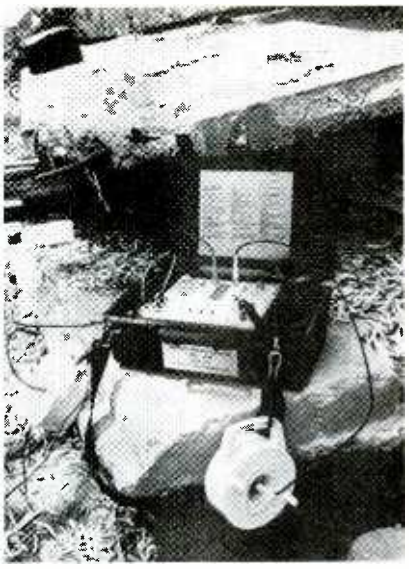
One of those is the TPL 310 Trapped Person Locator offered by Mistral Inc., located in Bethesda, MD. The Trapped Person Locator was developed by Elpam Technologies in Tel Aviv, Israel to find survivors in collapsed buildings caused by terrorist bombings. The TPL-310 uses a combination of four acoustic and seismic sensors—typically one acoustic and three seismic sensors, though four of the latter can be used. The sensors are lowered into the site at the end of a cable. Covering the entire acoustic and seismic spectrum, that combination of sensors can detect audible sounds as well as vibrations such as victims' tapping and scratching. Sound detection is especially important for locating babies or small children who are much more likely to cry than knock or tap.

Various listening strategies can be used to pinpoint the precise location of a victim, or to determine if there is more than one survivor. For instance, several sensors can be placed at different locations for triangulating the location. Or, by simultaneously listening to two signals with two separate display units, the presence of two sources, and thus two victims, can be determined. The TPL 310 system can be used in the aftermath of earthquakes, collapsed buildings, avalanches, land slides, mud slides, and mine disasters.

Frequency-band filters are used to eliminate noise from rescue machinery and vehicles, as well as nearby radio-frequency transmitters. If a survivor is found, the acoustic sensor can be replaced by a sensor/speaker unit so the operator can have two-way communications with the survivor using a handheld microphone. Typically, the TPL 310 with four sensor inputs requires three people—an operator and two assistants. The system is battery operated, either a 12-volt car battery, 12-volt commercial battery, or a dozen C-cell batteries. There is also a simpler TPL-310 C/Mini system with only one acoustic and one seismic sensor. It operates on four 9-volt batteries.

The German-made Wandel & Goltermann Life Detector (offered in North America by Delsar, Inc. of Chapel Hill, NC) is another system that detects survivors using vibrations transmitted through solid media. The



The Trapped Person Locator lets rescuers locate and communicate with survivors. It was successfully used after earthquakes in Armenia and the Philippines.

seismic oscillations excite a mass inside the sensor, which is connected to a piezoelectric cable. The movement of the mass generates a voltage that is converted into an audio signal by the Life Detector. Headphones are used to listen to that audio signal or the signal can be displayed on the Life Detector control unit. The sensor is sensitive to motion in all three axes, so position, for instance, on the rubble heap is not critical. The signals can be summed or listened to one at a time so you can more accurately locate the source of the signal.

Accessory magnetic clamps are used to attach the sensor to steel structures. Spikes are used to penetrate soil or concrete. Each sensor can detect infrasonic frequencies down to 1 Hz. Frequencies in that range propagate particularly well in earth, sand, and rubble. The upper limit is 3000 Hz. Filters are used to suppress extraneous outside noise.

Delsar offers another important rescue tool—the AC Hot Stick. While not a sensing device, the AC Hot Stick uses a high-sensitivity AC amplifier to detect downed high-voltage AC wires, a constant danger to rescue workers. If a "hot" wire is detected, the AC Hot Sticks sounds an audible alarm.

Visual Searches. The latest, smaller, lighter, and better-performing video technology allows remote, visual searches for trapped victims. For instance, Search Systems of Bakersfield, CA is offering its Search Cam, which consists of a sensor package on a 12-foot-long, rigid, telescoping pole. At its tip, the 1.75-inch-diameter head contains a video camera, microphone, speaker, and lights so rescue workers can see, hear and communicate with survivors in voids of collapsed buildings.

The video monitor is worn on the operator's chest so it can be viewed while extending the probe. The video camera at the end of the probe can swing through 180-degrees using a gear-motor mounted inside the head. The 12-foot probe length allows

The WG Life Detector with three of the six sensors that can be used to locate survivors. Signals from two sensors can be compared visually using the display, or audibly in the earphones.

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searching even in pancaked concrete flooring at depths of up to 10-foot thickness.

The Search Cam has already proven itself in a major disaster. One unit had been purchased by the Seoul Fire Department only four months before the collapse of the five-story department store. The Federal Emergency Management Agency (FEMA) has acquired Search Cams for all its 26 search-and-rescue teams.

Another system, the Mini-Portable Integrated Video System (MiniPIVS), was developed by Sandia National Laboratories in Albuquerque, New Mexico for use in nuclear weapons accidents. Now MiniPIVS is being commercialized for use by rescue workers in disasters ranging from earthquakes to terrorist attacks. MiniPIVS is a fully portable, self-contained unit that provides one-way video and two-way audio communications between a remote on-scene disaster location and a base station some distance away. The portable video/audio unit, or camcorder, can be mounted on a tripod and operated by remote control. Or it can be used in a handheld mode with auxiliary equipment carried in a field vest. The system allows rescuers to keep in constant communication with a team of disaster and medical experts who can observe the rescue operation and provide advice from a safer, more secure base station.

The MiniPIVS technology has been turned over to two Native-American-owned companies located in the Navajo Nation for commercialization—They are First American Cooperative Engineering of Leupp, AZ and SunMart Inc. of Window Rock, AZ. They are combining the MiniPIVS with the Personal Medical Interpreter (PMI) developed by both companies. The PMI uses a CD-ROM and is capable of translating 1900 medical phrases into 43 languages to make the system useful virtual anywhere in the world. With MiniPIVS and PMI, if a rescuer found a disaster victim who spoke only a foreign language, the rescuer could program the PMI to communicate vital information to the victim.

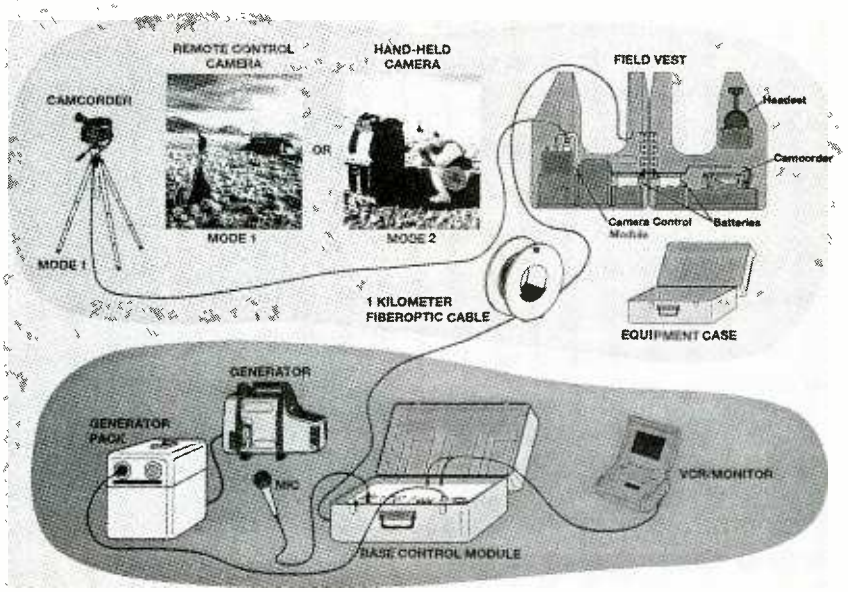
Fire-Rescue Gear. Building collapses, earthquakes, and other similar disasters are not the only search-and-rescue situations to benefit from modern technology. Firemen frequently have to make rescues in complete darkness and in dense smoke, moving on hands and knees, searching essentially blind for people who might be unconscious or hiding under beds or behind obstructions. Sometimes an unseen fire can be raging under the floor on which rescuers are crawling; if undetected, that could place both victims and rescuers in further jeopardy.

Cairns & Brother Inc. in Clifton, NJ with the assistance of GEC-Marconi Avionics Inc. in Britain has combined the latest in infrared-imaging, virtual-reality, and microprocessor technology so firefighters can see even in total darkness or in the densest blinding smoke. The CairnsIRIS Infrared Imaging System consists of three main parts. The IRIS sensor and tiltable helmet-mounted display (HMD), both mounted on the firefighter's helmet shell, allow completely hands-off operation. The processor/power module (PPM) is located on the fireman's belt, well protected inside a thermally insulated pouch.

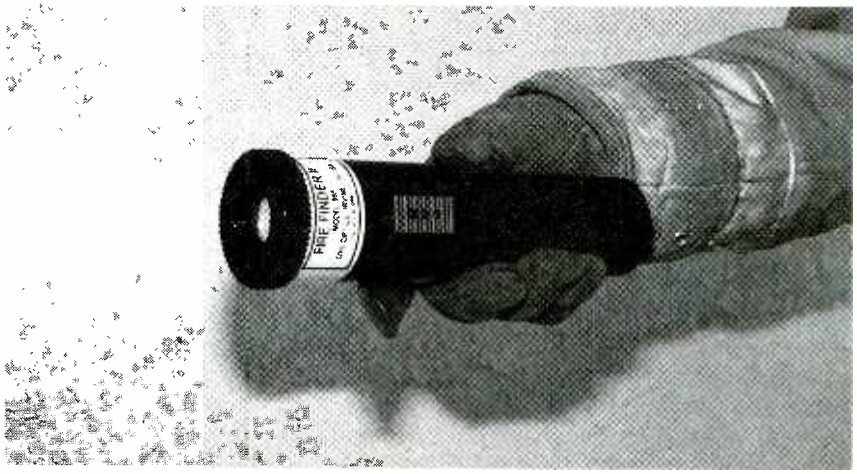
The totally self-contained infrared sensor weighs 1.4 pounds. Inside there is a latest-technology germanium lens and heat-sensitive, miniature CCD sensing chip operating in the

(Continued on page 70)

Mini-Portable Integrated Video System (MiniPIVS)



The MiniPIVS, developed by Sandia National Laboratories, can be used to communicate with victims of disasters.



The Fire Finder II looks and operates like a flashlight, but it can quickly spot hidden hot spots that can further endanger both victims and rescuers.

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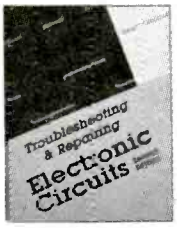

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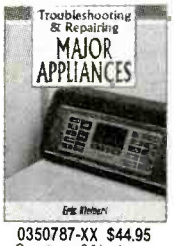

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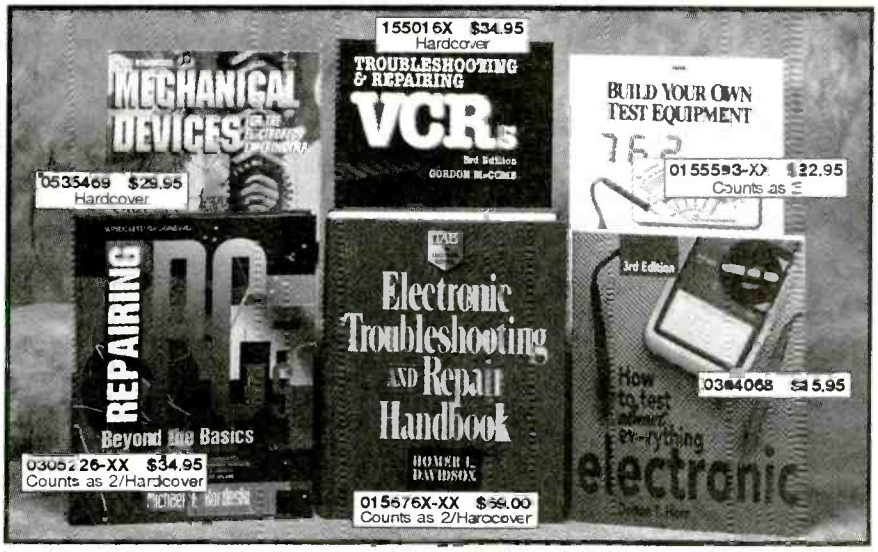

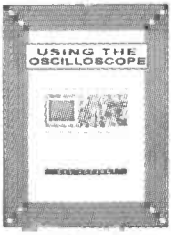

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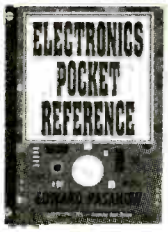

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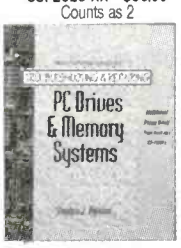

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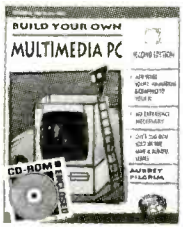

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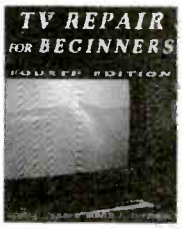

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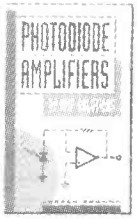

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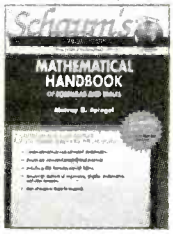

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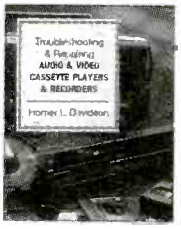

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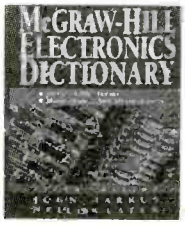

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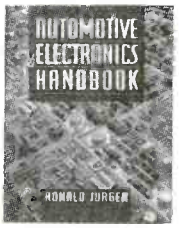

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Twin-Lead Antennas

BY JOSEPH J. CARR, K4IPV

One of the things that has interested me over the years is cheap antennas that work well. By "well" I mean with reference to a dipole—I tend to judge every antenna against a resonant half-wavelength dipole on the same frequency. While not as "scientific" as comparing the antenna to a theoretical construct called an "isotropic source" (which is how professional antenna engineers define antennas), it works in the real world—after all, I don't know how to build an isotropic radiator, so, to me, comparisons made to one are little more than a dreary figure on paper. By "cheap" I mean something that I can build for less than $25 given a little ingenuity and a well-stocked junk box (or, if you ask my wife, "junk room").

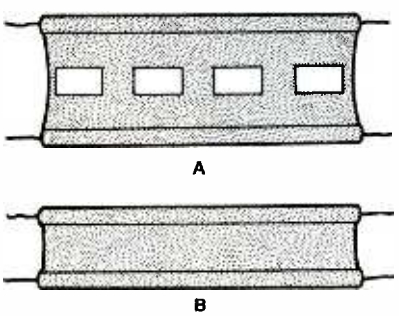

Fig. 1. Before coax became as popular as it is today, twin-lead was the most popular type of TV-antenna transmission line. a section of 450-ohm twin-lead is shown in A, and 300-ohm twin-lead is shown in B.

Not long ago I was in a Radio Shack store and they were offering some old stock for sale at a tremendous discount, and among the items were several 100-foot rolls of 300-ohm television twin-lead. "Hmmmmmmm . . . ," I wondered, "how many different antennas can I build with this stuff?" Because I also have about 65 feet of 450-ohm twin-lead, left over from my experiments with the G5RV antenna not long after I assumed the writing of this column, I also wondered what could be done with that material.

TWIN-LEAD

Before tackling twin-lead antennas let's first look at what this stuff called "twin-lead" really is—after all, readers raised in the cable-TV generation might not recognize this older form of TV transmission line. Two basic forms of twin-lead transmission line are shown in Fig. 1. Both forms are basically parallel-conductor transmission lines, but with an insulator material between the wires (as opposed to open line, which uses air dielectric and spacers). The form in Fig. 1A is representative of 450-ohm twin-lead. It is heavier than 300-ohm twin-lead (Fig. 1B), and usually has square holes punched in it to beat down losses (and also raise the velocity factor a little bit). The smaller and more flexible 300-ohm twin-lead once was the most common form of television-antenna transmission line. Some 300-ohm line has holes punched in it, and the holes might be squared (as in Fig. 1A), round, or elongated with rounded ends. The effect of those holes is, as above, to reduce losses on higher frequencies (UHF), and raise the velocity factor from about 0.82 to about 0.87.

TWIN-LEAD ANTENNAS

Antennas come in two basic flavors: Marconi designs and Hertzian designs. Marconi antennas are unbalanced with respect to ground, so one side of the transmission line is grounded at the antenna end. Examples of the Marconi form are the end-fed, single, random-length wire and the quarter-wavelength vertical.

Hertzian antennas are balanced with respect to ground. Examples of those antennas are dipoles and doublets of all forms.

TWIN-LEAD MARCONI ANTENNA

Figure 2 shows the basic Marconi form of antenna made with 300-ohm twin-lead. The overall length of the radiator is quarter wavelength, but because the transmission line used for the element has a velocity factor less than 1.00, the overall length is a tad shorter than the free-space quarter wavelength. To find the proper length (in feet) divide 234 by the frequency in megahertz: $L_{FT} = 234/f_{MHz}$.

Note that at the far end of the twin-lead Marconi antenna the two conductors of the twin-lead are shorted

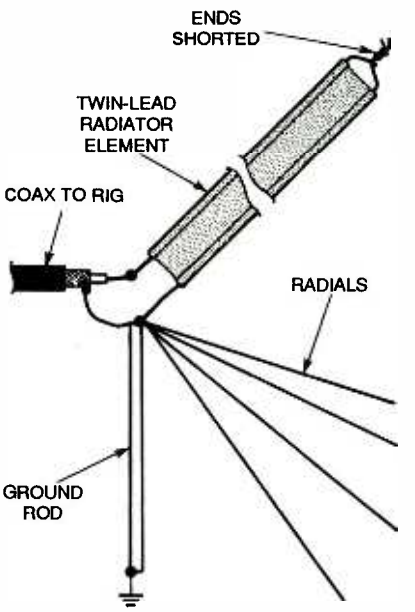

Fig. 2. A twin-lead Marconi antenna is shown here. Note that the conductors are shorted at the far end and that a good ground is required.

together. Because the radiator is a quarter-wavelength long, a short circuit at the far end reflects a high impedance to the feedpoint.

The feedline end of the radiator is connected directly to a length of 52-ohm coaxial cable, which goes to the rig. The shield of the coaxial cable is connected to one conductor of the twin-lead, while the center conductor is connected to the other.

As is true of all Marconi antennas, this one needs a really good ground connection. The shield of the coaxial cable is connected not just to the twin-

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lead, but also to either an 8-foot copper-clad steel or copper ground rod, a set of four or more quarter-wavelength wire radials, or both.

FOLDED DIPOLE

Perhaps the most common form of twin-lead antenna is the folded dipole (Fig. 3). This Hertzian-form antenna is made using a length of 300-ohm twin-lead that is a half-wavelength long. The overall length of the antenna radiator element is: $L_{FT} = 468/f_{MHz}$. The ends of the transmission line are stripped back about 1 inch and then soldered together. One of the wires of the twin-lead is cut in the center to form the feedpoint. A second piece of twin-lead is connected to the feedpoint on one end and the rig or receiver at the other.

The antenna of Fig. 3 requires an antenna tuner or other matching system that has a balanced output. Most radio transmitters and receivers today

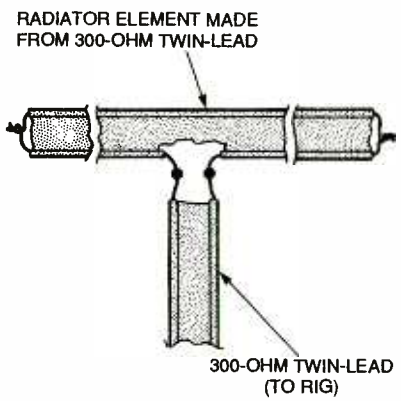

Fig. 3. A good old-fashioned folded dipole is the most common type of twin-lead antenna. If you want to use standard coax as a transmission line, a 4:1 BALUN must be used at the feedpoint.

have a coaxial antenna connector, and not a balanced connector. To use coaxial cable with this antenna, replace the transmission line with 75-ohm coaxial cable and use a 4:1 BALUN transformer at the feedpoint to the antenna.

WIDEBAND FOLDED DIPOLE

All resonant antennas are bandwidth limited . . . that's what "resonant" implies, after all. In "the old days," this wasn't too much of a problem because

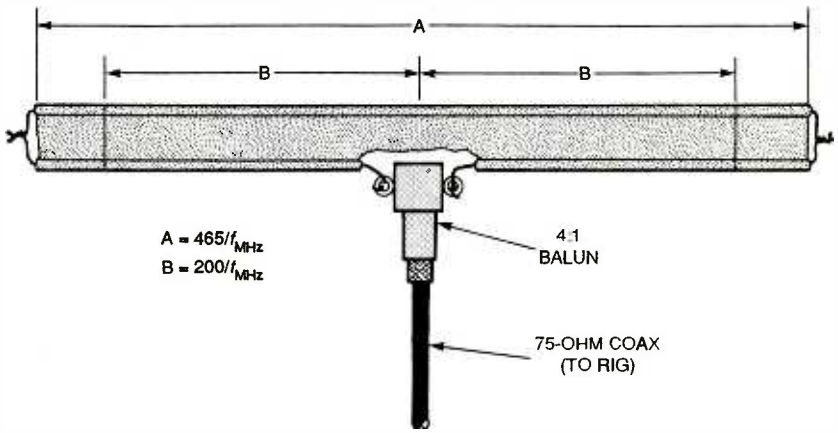

Fig. 4. To get an acceptable VSWR across an entire band, use this wideband folded dipole.

transmitters in those days had either an adjustable loop coupling or pi-network that could be used to match a wider range of impedances than the untuned outputs used on today's ham rigs. The rigs we use today usually have a VSWR shutdown circuit that limits RF power when VSWR reaches 1.5:1 and shuts off the transmitter altogether when the VSWR reaches some magic figure above 2:1. Most resonant dipoles designed for the middle of an HF band will reach a VSWR in the shutdown region at the ends of the band. As a result, most of us either tolerate poor performance, or use a line-flattener form of antenna tuner to tune out the impedance difference. There is a better way.

Figure 4 shows a wideband folded dipole. It is very much like the regular folded dipole, although a tad shorter. The radiator element is shorted on both far ends, as is true of all folded dipoles. But it is also shorted at two points at about 86 percent of the distance from the center-feed point and the ends. A 4:1 BALUN transformer is used at the feedpoint to allow a coaxial cable to be used as the transmission line back to the rig. One way to look at this antenna is that it is actually two folded dipoles (one longer at a lower frequency, and the other shorter at a higher frequency), built so that their VSWR curves overlap.

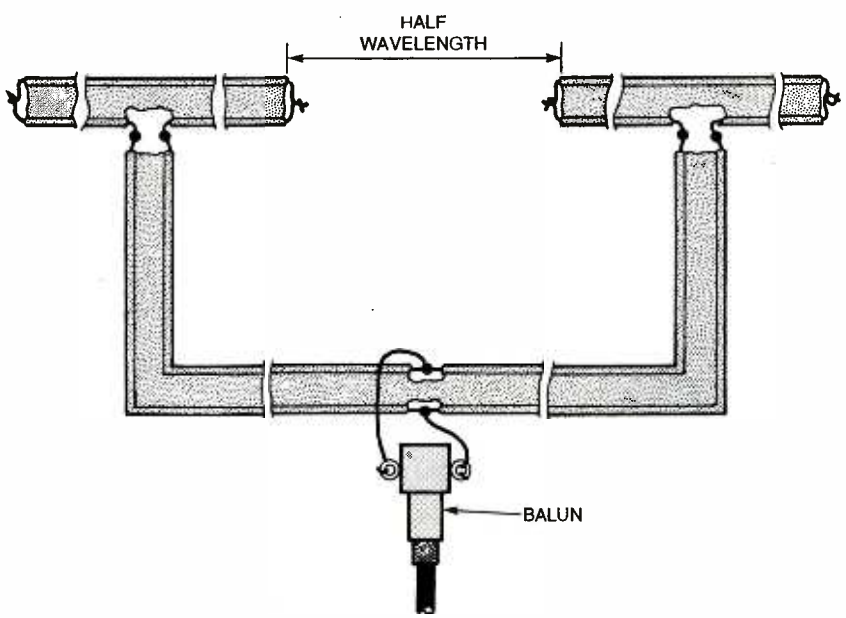

Fig. 5. These stacked folded dipoles provide 3 dB gain over a conventional dipole. The two antennas are spaced a half-wavelength apart.

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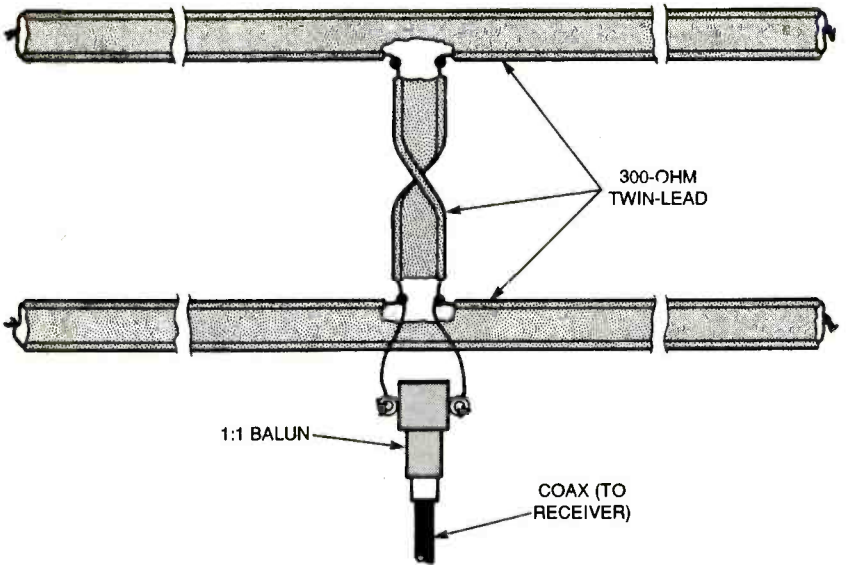


Fig. 6. ZL-Special twin-lead beam features two dipoles, spaced 0.2 wavelengths apart, and whose feedpoints are connected together 180 degrees out of phase.

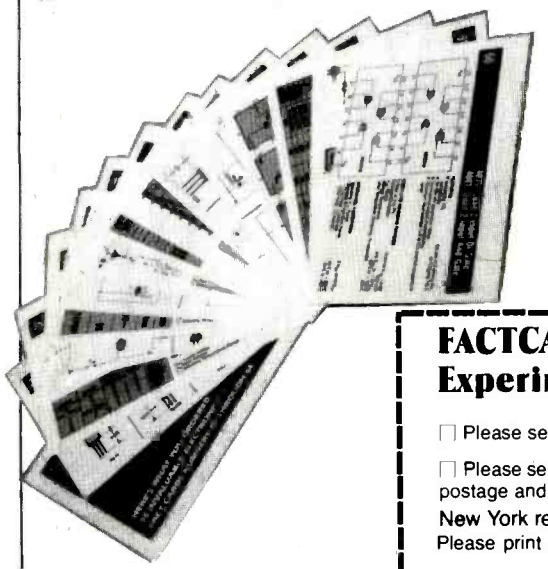
DIPOLE BEAMS

Figures 5 and 6 show two methods for getting gain out of folded dipoles. The gain of a folded dipole is about 0 dB with respect to a regular dipole (in other words, there is no difference), although if you want to make it sound like a big deal you can claim it has a gain of 2.14 dB above isotropic. To make the antenna exhibit gain one needs to use two or more in an array. The version shown in Fig. 5 uses two half-wavelength folded dipoles spaced a half wavelength apart (spacing in feet = 492/f_{MHz}). It doesn't matter whether these antennas are stacked side-by-side or one-on-top-of-the-other. The gain of this antenna is about 3 dB compared to a single dipole.

The other method to obtain a few dB of gain is shown in Fig. 6. That antenna is sometimes called the "ZL-Special." It consists of two half-wavelength dipoles spaced about 0.2 wavelengths apart. The center feedpoints of the two dipoles are connected 180 degrees out of phase by using a phasing harness consisting of a third piece of twin-lead. Note that the transmission line is crossed over (i.e. twisted over on itself once).

Before we conclude our discussion on twin-lead antennas, a short warning is required. Twin-lead is limited as to the amount of RF power it will handle. Do not use more than about 200 watts with 300-ohm twin-lead antennas. The 450-ohm twin-lead can handle a bit more, but don't push it with either type—use too much power and the insulation will melt! ■

FACTCARDS



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H is for Hypertext

BY JEFF HOLTZMAN

Here's our quiz for this month: 1. What is the world's most popular programming language? 2. What is the world's simplest programming language? 3. What is the world's most complex programming language? For each question, choose one from the following list: Machine language, Assembly language, C, C++, BASIC, FORTRAN, COBOL, Pascal, Modula, Smalltalk, Eiffel, Dylan, Visual Basic, Java, TCL/TK, other, some of the above, all of the above, none of the above.

Do you give up? Maybe this will help: This language has only two statements (PRINT and GOTO). It is completely platform independent; some version of it runs on nearly every machine ever invented.

Need more? OK: This language has its roots back in the 1940s, got a boost in the early 1960s, started accelerating in the mid 1980s (with a little help from Apple and the Macintosh), and underwent a hyperexplosion (hint hint) in the mid 1990s with the rise of W3 (the World-Wide Web).

Still don't get it? Try this: There is no standard for the language, but a cool reference model exists. Many, many application and tool vendors support at least one variation of it, and in some cases, several overlapping and contradictory versions.

Need more? Here are some characteristics of the language: It doesn't support object-oriented programming. It doesn't support structured programming. It has no looping constructs (For, While, etc.). It supports neither static nor dynamic code libraries. It has no data types, and it supports no data structures. It's weak in numerical support. Writing code in this language is simplicity itself, but managing and organizing that code is a *huge* problem. One thing it can do is call programs in other languages.

Time is up. The answer for all three quiz questions: Other.

What *is* this mystery language? It doesn't even have a name. For now, let's simply call it *H*. H is implemented in many products. If I mentioned the Windows Help System, you'd start to get an inkling of what this is all about. If I mentioned HyperCard, you Mac people would get an even better idea. If I mentioned W3 and HTML, everyone should get an immediate, intuitive flash. (You might think that H is some variation on HTML, the markup language used to create Web pages—but it's not. W3 has been good for raising consciousness about H, and that's it.)

THE ANSWER

OK, H is not really a programming language. It's a concept. It's a class (mammals) from which derive many instances (primates, bovines, etc.).

H is hypertext. I used to write in this magazine and others almost evangelical articles about hypertext (and hypermedia and multimedia). It seemed that I had to convince people that there was something to the notion. Society has embraced the notion, so evangelism is no longer required. Now it's self-evident.

The problem is that the self-evident portion—W3—represents a ramshackle, stripped-down version of what is really possible. Much of what is currently at stake technically has already been solved. Technically what's happening is that many of the spokes of the technical wheel are being reinvented (by Netscape, Microsoft, Oracle, Sun, and others) in an effort to dominate the market.

The interesting thing is the astonishing rate of evolution. In twenty years of participation in the computer industry, I've never seen anything take off so fast with so much serious money behind it.

HOW

From the point of view of a technical person, it's not enough to just use H in its various manifestations. We want to know how it works. So with this column, I am inaugurating a series of articles on H tools—tools for building H systems. Table 1 lists some of the tools that we'll be examining. The tools are arranged by the traditional categories they fall under, or have until now.

I'm not promising to examine every tool in every category. I couldn't if I wanted to. Nor can I state that the categories themselves are all that meaningful. The problem is that there is lots of overlap even now, and as W3 gains momentum, new categories may emerge.

TABLE 1—WEB AND HYPERTEXT PUBLISHING TOOLS

Category	Example Tools
SGML/HTML Servers, Browsers, and Editors	PageMill, Blackbird
Help System Development Tools	Robohelp, Doc-To-Help, Hypertext Suite
Multimedia Authoring Tools	Macromedia Director, Asymetrix Toolbook
Electronic Publishing Tools	Adobe Acrobat, Common Ground, OpenText, DynaText, Verity Topic
Coding tools	C, C++, Basic, Java, TCL/TK, JavaScript, BasicScript, VBA, PERL
Word processors and text editors	Word, Word Pro, TSE

WHY

What I really want to obtain is a good understanding of the strengths

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SCANNER SCENE

On The Campaign Trail

BY MARC SAXON

Change used to be what they gave along with the pack of chewing gum you bought. These days, change is what keeps happening to electronic hardware as manufacturers strive to continually update and improve their products. It just happened to *Uniden's Bearcat BC60XLT* handheld receiver. Like mythology's fabled *Phoenix*, the new BC60XLT-1 was reborn from the ashes of the previous BC60XLT model.

The upgraded BC60XLT-1 scans 30 channels set up on five banks. Those five banks can be selected individually, or in any combination, for scanning as well as for searching. The frequency coverage is 20 to 54 MHz, 137 to 174 MHz, and 406 to 512 MHz. A dedicated keypad button provides instant access to the 162-MHz weather channels.

Sensitivity is 0.4 μV (12-dB SINAD) from 137 to 174 MHz, and 0.5 μV above 406 MHz. Selectivity is –50 dB at ±15 kHz.

The BC60XLT-1 provides manual channel access, allowing you to go directly to any channel without the bother of stepping through other channels. Other standard features include a priority channel, lockouts, delays, keypad, and a low-battery indicator.

Power is supplied by four AA alkaline or rechargeable batteries (not included), or by an optional AC adapter accessory. A memory backup retains programmed frequencies for three days after loss of power.

The BC60XLT-1 is available from Uniden Bearcat dealers, and is priced quite reasonably.

MONITORING THE ELECTION

In the June issue, we explored monitoring Air Force One and Air Force Two. With the election campaign in full gear, it's good to keep an ear peeled there on a regular basis. Now is the time to punch up several additional frequencies—those used by U.S. Secret Service personnel and White House staffers. The channels are assigned code names, which are: *Bravo* on 165.7875 MHz, *Charlie* on 165.375 MHz, *Mike* on 166.2125 MHz, *Tango* on 164.65 MHz, and *Oscar* on 164.8875 MHz. Other related frequencies that might produce additional communications include: *Golf* on 166.50 MHz, *Hotel* on 166.2125 MHz, *Lima* on 168.7875 MHz, *Papa* on 164.40 MHz, *Victor* on 164.10 MHz, *November* on 166.70 MHz, *Sierra* on 166.5125 MHz, and *Romeo* on 165.6875 MHz.

Uniden's newly updated Bearcat BC60XLT-1 handheld receiver.

Eagle is the code name for President Clinton, while *Evergreen* refers to the First Lady. *Sundance* is Vice President Al Gore, and *Skylark* is the code name for Tipper Gore.

Yes, some Secret Service communications are digitally scrambled. Still, many transmissions are in the clear, so you'll be able to copy them.

TOWER OF BABBLE?

William Oaden, of Belford, New Jersey, writes to tell us that his local police have begun scrambling. When they speak, he describes it "like squelch noise with a jackhammer at the end of the transmission." He would like to know what he can get to monitor the communications, because other area police also use the same system.

Frankly, Will, that description of the scrambling doesn't provide an abundance of information, but it doesn't matter. For Will, and the other readers who have asked similar questions, the answer comes down to basics. Essentially, there are two approaches to voice scrambling in VHF- and UHF-communication systems. Those are digital and analog, and although there are several different types of digital scrambling, that fact isn't relevant here.

Digital communications sound like "white noise"—a hiss—when monitored on a scanner. You might hear them on some federal communications, trunked systems, and even on other public-safety and cellular frequencies. Most 900-MHz cordless phones are digital. There is presently no way that sophisticated digitally scrambled transmissions can be understood when monitored on a scanner. Thousands of easily changeable security codes are available in digital systems. Therefore, it is unlikely that scanners or adapters enabling reception will be available to the general public in the foreseeable future.

Analog scrambling is an inexpensive, low-tech type of communications security. On your scanner, its sounds like garbled voices. That makes it effective in providing at least a limited measure of privacy against casual eavesdropping. It's typically used by taxi dispatchers, broadcast-news assignment desks, and smaller public-safety agencies. It is used in all "scrambled" 46/49-MHz cordless

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ANTIQUE RADIO

History of Radio Detectors

BY MARC ELLIS

In order for communication to take place by radio, two things are needed: a method of generating a radio signal and a means of detecting that signal. During the early part of this century, fueled by competition among inventors and scientists, and spurred on by the communications needs of the first World War, both technologies evolved dramatically. In its own way, the evolution was not too different from the dramatic changes taking place in digital technology today.

In this month's column, I thought it would be interesting to take a broad look at the evolution of detector technology and discuss some of the major milestones of those early years.

HERTZ'S EXPERIMENTS

Most historians associate the birth of radio technology with the experiments of Heinrich Hertz (Germany, 1886). Hertz was attempting to test and verify the work of James Clerk Maxwell, a Scottish mathematician, who had theoretically predicted the existence and behavior of radio waves. Hertz's experimental radio waves were generated by the discharge of an electrical spark (created by an induction coil) across a gap formed by a pair of ball-shaped electrodes.

Hertz's detector was nothing but a loop of wire with a tiny gap in it. When the loop was oriented properly, a tiny spark could be seen in its gap whenever a spark jumped at the "transmitter." By placing experimental objects between the transmitter and detector, Hertz was able to prove that the waves passed through insulators, were reflected from metallic surfaces, and could be refracted by prisms.

THE COHERER

Even before Hertz's experiments, it had been observed that metal filings placed in the vicinity of a "Leyden Jar" (really a large capacitor) would cling together ("cohere") when the jar was discharged. That phenomenon was noted and further explored by Professor E. Branly of the Catholic University of Paris. In 1890, he partly filled a glass tube with such filings and closed the tube with a metallic plug at each end. Connecting a battery and indicating device across the tube, he found that the filings would not only cohere in the vicinity of an electrical discharge, but also decrease their electrical resistance—causing current to flow through them.

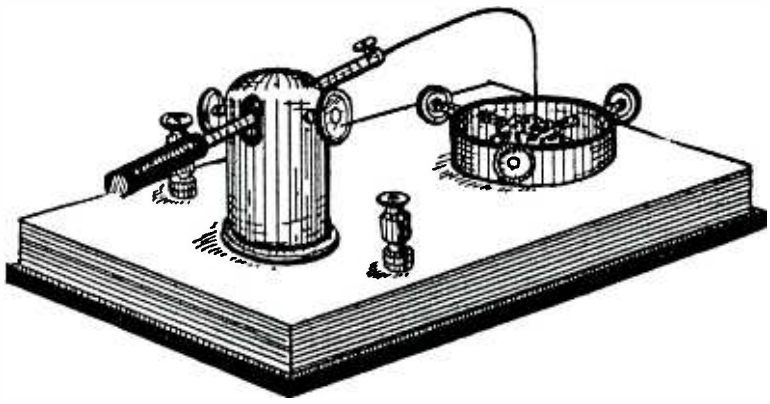
By now, scientists, engineers, and visionaries were beginning to perceive that Hertz's electromagnetic waves might be used as the basis for establishing communications over long distances without wires. That was a heady idea indeed, and it was obvious that a practical scheme for doing it could be extremely valuable for its inventor. In 1893-1894, Sir Oliver Lodge repeated Hertz's experiments, using the Branly coherer as a detector instead of the original loop-and-spark-gap. Thus equipped, he found that he could detect the presence of electromagnetic waves over a much greater distance than could Hertz.

By 1895, Alexander Popov (Russia) had devised methods for increasing the sensitivity of the coherer. He also found that the coherer, after detecting a discharge and passing a current, could be returned to its original high-resistance state with a light tap. He devised a "tapping-back mechanism," very much like the clapper of an electric bell, to jar the tube after the detection of each pulse. That made the instrument capable of responding to the repetitive pulses of a Morse-code signal.

That same year Marconi, who had also been following the work of Lodge, Hertz, and the other experimenters, made a number of innovations that improved the coherer's receiving range. He used a controlled mixture of nickel and silver filings in the instrument; and he sealed and removed the air from the tube. He was also the first to use an antenna and a ground for the purpose of transmitting and receiving signals. Marconi continued to improve his apparatus and increase its range until at last, in 1901, he was able to transmit that historic letter "S" across the Atlantic ocean.

IMPROVING SPEED OF RECEPTION

From that point on, many other inventors, particularly in the U.S., began to make contributions to radio technology. And during the next few



In early crystal detectors, a wire "cat's whisker" would be used to probe a galena or silicon crystal.

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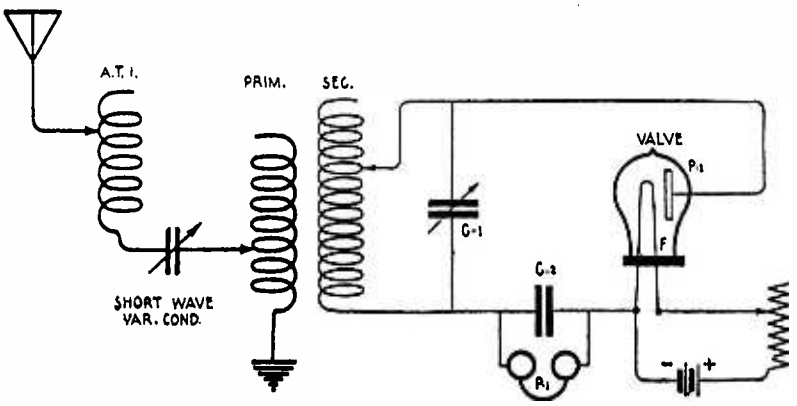
years, there was considerable focus on increasing the speed of reception. It was envisioned that the human ear could be substituted for the mechanical Morse inker used in the early Marconi installations—just as the ear had replaced mechanical receiving means in land-line Morse telegraphy years before. The operator could simply recognize the Morse character groups and write them down.



The first radio diode, the Fleming Valve detector replaced crystal detectors in receiving circuits.

It might have been possible simply to substitute a Morse sounder for the inker used in the coherer circuit. But the coherer itself was a speed bottleneck. It was slow to react and needed to be "decohered" (tapped) after receiving each pulse. The thinking was that it should be possible to listen to the signal directly using a sensitive telephone receiver. A different type of detector was required—one that didn't need to be reset after each pulse, and one that would "rectify" the radio signal, converting it into a pulsating direct current that would be audible in the receiver.

In 1902, Marconi himself designed a "magnetic detector" to replace the coherer. The detector used a multi-turn loop of iron wire passing through the field of two permanent magnets. The radio signal was impressed on the wire, and the received signal removed, via coils surrounding the wire. The output of the detector could be used to trigger a relay for mechanical detection of the signal, but was also audible in a telephone receiver.

That same year, R.A. Fessenden, whose later innovations in radio would become legendary, would invent what was probably the first "rectifying" detector. Known as the *electrolytic detector*, it was simply a length of platinum wire dipped in nitric acid.

During the next few years, the rectifying properties of crystalline minerals were discovered. Electrical contact would be made with the minerals via wire probes called "cat whiskers." The surface would be explored with the probe to find the most sensitive spot. Magnetite, carbon, molybdenum, and galena were tested and used, with galena becoming a favorite in both commercial and amateur service. From then on, until vacuum-tube technology became practical and widely available, most radio reception was done with crystal detectors.

THE DAWN OF TUBE TECHNOLOGY

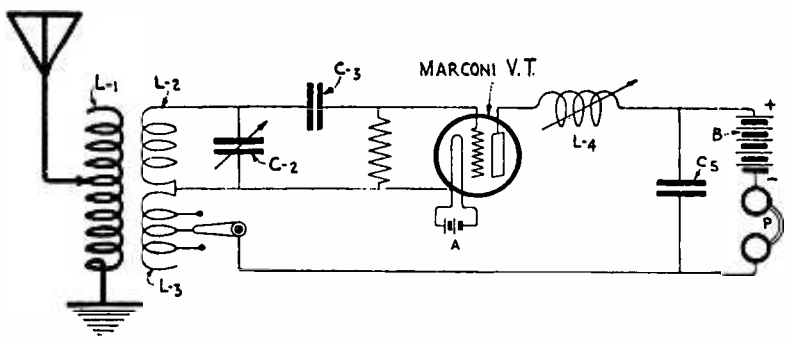
At the same time the properties of crystal detectors were being investigated, another researcher was proceeding down a different avenue. John Fleming, who was on the staff of British Marconi, was studying an effect noticed by Thomas Edison in his development of the electric light bulb.

While studying the problem of unwanted carbon deposits on the inside of the glass, Edison had sealed a metal plate into one of his bulbs. He was startled to discover that a milliammeter connected between the positive filament terminal and the plate showed a reading—which meant that an electric current was flowing between the filament and the plate through the vacuum separating them. But no current would flow if the milliammeter were switched to the negative terminal.

The eminent British scientist J.J. Thompson theorized that the current was a flow of infinitesimal "particles of electricity" which he termed *electrons*. Those negatively charged particles were emitted by the heated filament of the lamp and attracted to the plate whenever it possessed an opposite (positive) charge.

Fleming constructed an "Edison Effect" lamp and connected a source of alternating current between filament and plate. He found that current flowed in this loop during the portion of the AC cycle when the plate was positive with respect to the filament, but not during the portion of the cycle when it was negative. In other words, the alternating current was *rectified* (changed to direct current).

Now Fleming connected his device in place of the crystal detector in a standard receiving circuit. It worked quite well and freed the operator from the fussy "cat's whisker" adjustments required with the crystal. There was some loss in sensitivity, however. Fleming had developed the first radio *diode* (2-element tube). It became



In Armstrong's original regenerative circuit, note how the plate circuit is coupled back to the grid circuit.

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known as the "Fleming Valve" because of its ability to regulate the direction of the current flowing through it

THE AUDION

In 1906-1907, Lee De Forest patented a profoundly important innovation in vacuum-tube technology. Physically, there was nothing much to it. De Forest had simply surrounded the filament of Fleming's "valve" with a few turns of fine wire, positioning the coil between filament and plate. In use, a DC voltage was applied (positive to plate) between the filament and plate, establishing a current flow between those two elements. Now a DC voltage applied between filament and grid could be used to control the current in the plate circuit.

Making the grid positive with respect to the filament would accelerate the flow of electrons towards the plate, increasing plate current. Making the grid negative would repel the electrons back towards the filament, reducing the current. But the important thing was this: Very small voltages, and voltage variations, would cause corresponding, but much larger, variations in plate current. This meant that the *Audion*, as De Forest called it, could not only detect radio signals, but also amplify them greatly. The Audion was the first three-element tube, or *triode*.

In 1913, E.H. Armstrong patented a circuit that increased the Audion's sensitivity as a detector. His innovation was to feed part of the plate circuit's output back into the grid circuit, creating a controlled feedback loop. The process was called *regeneration*.

Even so, the first large-scale use of the Audion was not in radio, but as a voice amplifier for long-distance telephone lines—including the first U.S. transcontinental line, established in 1915. The application of the device to radio communications lagged, partly because ownership of the vital patents was divided between Marconi and De Forest. Realizing the critical need for vacuum-tube development during World War I, the U.S. government intervened, and eventually cross-licensing agreements were worked out. By 1920, tubes had all but replaced the use of crystalline devices in the detection of radio signals. ■

SCANNER SCENE

(continued from page 60)

phones, and even in a few cheaper 900-MHz models. Analog scrambling shields nothing from determined monitors. It might be clarified on any scanner by means of commercial descramblers, such as the Ramsay SS-70 (from Ramsay Electronics, Inc., 793 Canning Parkway, Victor, NY 14654; Tel: 716-924-4560).

WEATHER OR NOT

From a meteorological standpoint, this time of the year is eventful (for better or worse). You know about the 162-MHz weather-service broadcasts, but why not also tune in the two-way communications between pilots and ground-based meteorologists? Pilots obtain the latest ground weather at their destinations, and they advise ground stations about the current conditions as they appear from above.

One frequency used by general aviation, 122.0 MHz, is active in all areas of the U.S. Depending upon your location in the continental U.S., at least two (and possibly more) of the following frequencies will also bring you weather communications from commercial and military aircraft: 124.675, 126.625, 127.625, 128.475, 132.725, 133.025, 133.675, 133.775, 133.925, 134.175, 134.525, 134.725, 134.825, 134.875, 135.425, 135.475, 135.675, 135.7, 135.9, 135.925, 239.8, 263.5, 317.0, 342.5, 344.6, 359.6, and 375.2 MHz.

Remember that aircraft flying at high altitudes can be copied from several hundred miles away, even on VHF and UHF frequencies. That gives you a chance to get extra-early behind-the-scenes reports on approaching weather fronts, situations, conditions, and storms, as well as inside news of weather-related airline delays.

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COMPUTER BITS

(continued from page 59)

and weaknesses of various tools and how they can be applied to solve various problems in H. Why? I'm currently involved with a project that is designing and developing the next generation of a multi-million dollar industrial-manufacturing machine. Every aspect of the machine, including control-system software, electric power distribution, and mechanical design is modular and object-oriented. I'm under heavy-duty nondisclosure, so I can't tell you about the machine. But I can tell you about my role in the project, and some of my activities.

Part of my task is to define an up-to-date process and toolset for making all of the documentation—from design specs to manufacturing literature to end-user help—congruent with the rest of the architecture. A six-inch thick pack of specs would not represent a desirable outcome. An electronically searchable database available to all in real time would represent a desirable outcome.

For years, H developers have struggled with poor tools and lack of standards. H is not just the W3. There is a tremendous amount of hype and hogwash associated with W3, but the sheer market forces involved might help drive the H industry in a common direction. My hope is that instead of more than half a dozen categories of tools with overlapping capabilities and strong incompatibilities, we'll end up with a single architecture that supports a multitude of integrated development tools and integrated presentation engines. Something like a Web browser with plug-ins, but applicable across the entire life cycle.

Next time we'll take a look at the category of help-system development tools. ■

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More from Nick

JOHN YACONO
TECHNICAL EDITOR
WINDOWS MAGAZINE

Once again, Nick Cinquino has sent in enough quality circuit ideas to fill out a column. In keeping with our contest, he'll receive a kit, a 1967 MCL1010 quad AND chip, and a book. The contest is still on, but if you want to participate, do so before the kits are all gone. Also, if you just have a circuit or two, send it in. You'll get a free book for each submission printed.

Before we get to the letters, I'd like to start a new tutorial topic: inductance—a property of components that has its basis in magnetism. At one time, electrical phenomena like charge and current flow were not linked to magnetism. But for some time now we've known that electricity and magnetism are fundamentally linked, and we study them jointly under the name "electromagnetism." Electronic components called "inductors" take advantage of that relationship, affecting how circuits function through their magnetic properties.

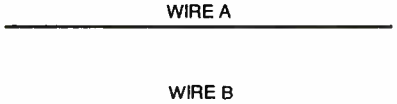

Fig. 1. If current is passed through two parallel wires, in the same direction, they are mutually attracted to each other.

A fairly simple statement summarizes the relationship between electricity and magnetism: a moving electric field (like the fields of electrons moving through a wire) creates a magnetic field; a varying magnetic field (either one that's moving or changing in intensity) creates an electric potential or voltage. I've read that principle over and over again in numerous texts, but only once did I see the relationship between electricity, magnetism, and velocity explained. This month I'd like to pass along this rarely printed explanation for the curious.

As a starting point, you'll have to accept a principle offered up from relativity theory: when an object moves, it experiences the space around it as compressed, almost as though the fabric of space becomes more dense. For a person to experience that he or she would have to travel at incredible speeds, but the effect does happen, albeit imperceptibly, at mundane velocities.

With that under our belt, look at the two wires in Fig. 1. If the electrons in either wire could peer across the gap,

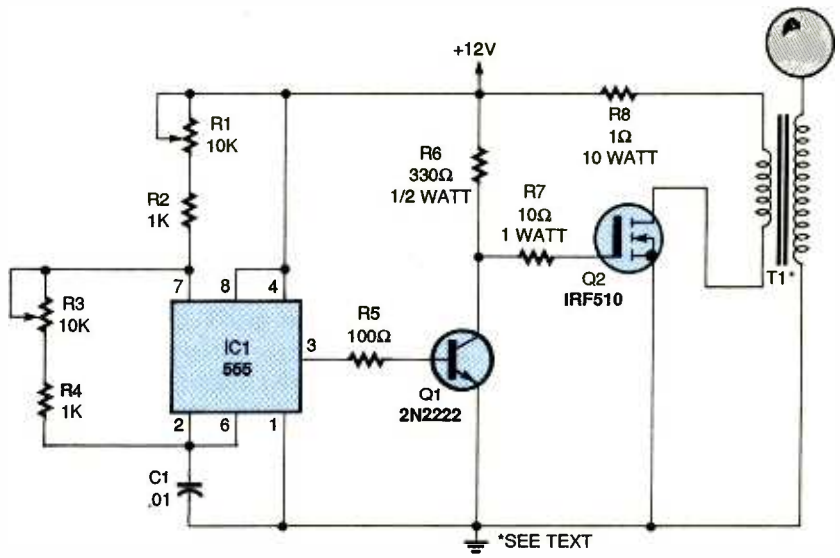

Fig. 2. This solid-state Tesla coil will output 10 kilovolts, which means you should keep your distance from the arcs it produces!

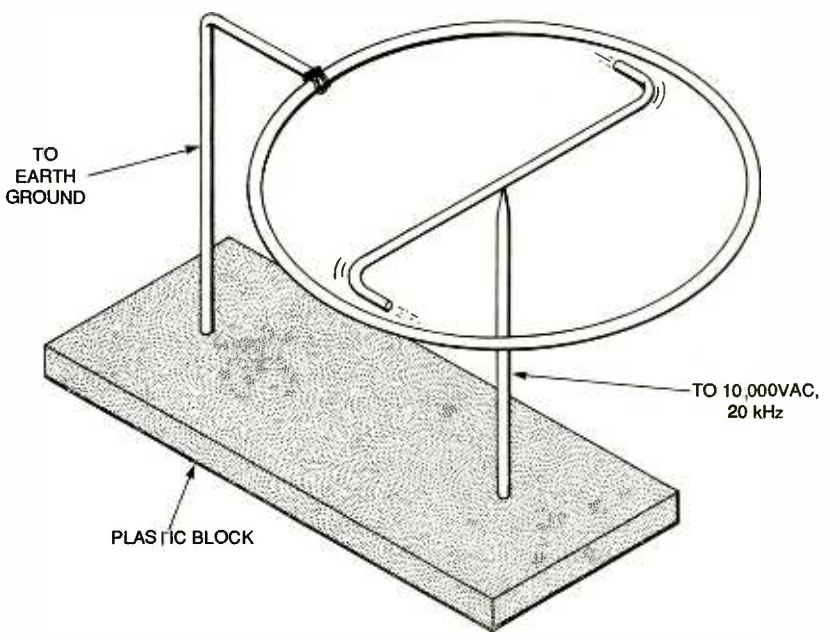

Fig. 3. The grounded ring surrounding this ion motor will help increase the amount of discharge, and therefore speed, of the S-shaped bar.

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they'd see that the number of electrons per unit length in the other wire is equal to the number of protons per unit length. So the net charge in either wire is zero and the wires neither repel or attract each other.

Now let's see what happens if we pass a current though wire A. To the stationary electrons and protons in wire B, the relative motion of the electrons in wire A now makes them appear more dense than their companion protons. It would appear as if there are more electrons per unit length than protons. That appearance attracts the protons in wire B but equally repels the electrons in wire B, so there's no net effect.

Now let's see what happens if current flows through both wires in the same direction, and for simplicity, that the electrons flow at the same velocity. To an electron it looks as though all the protons are whipping by, while the other electrons seem stationary. So to an electron it looks as though the number of protons per unit length has increased, while the number of electrons per unit length has remained the same. Because electrons see more protons per unit length in the adjacent wire than electrons per unit length, the wires mutually attract. Note the nice stationary protons experience a complementary increase per unit length in the electron population.

What happens when the currents flow in opposite directions? Well, the wires repulse; as to why, well I'll leave it as an exercise for the ambitious to explain. (Hint: Remember the greater the *relative* velocity, the greater the compression of space.) Now, on to the letters.

CHEAP HIGH VOLTAGE

I never get tired of experimenting with high voltage. After building a couple of spark-gap Tesla coils, I thought I'd try a solid-state version. In my circuit (see Fig. 2), a 555 timer (IC1) produces a squarewave of roughly 20 kHz. The frequency, and thus the output, are tuned via two 10,000-ohm potentiometers, R1 and R2. A general-purpose NPN 2N2222 transistor, Q1, is an interface between IC1 and Q2, a power MOSFET. The power MOSFET is available at Radio Shack and other sources for a couple of dollars.

MOSFET Q2 switches power on and off to the primary coil of a flyback transformer, T1. You can usually get a suitable flyback transformer from a local television-repair shop. Try to find one that doesn't contain a high-voltage diode, which would have to be removed anyway. To prepare the flyback, simply remove the primary and wind ten turns of 14-gauge wire on it. Ground the unit to earth as shown in Fig. 2, and connect a metal ball to the other wire connected to the secondary.

For the power supply try using 12 volts at a minimum of 2 amps. When

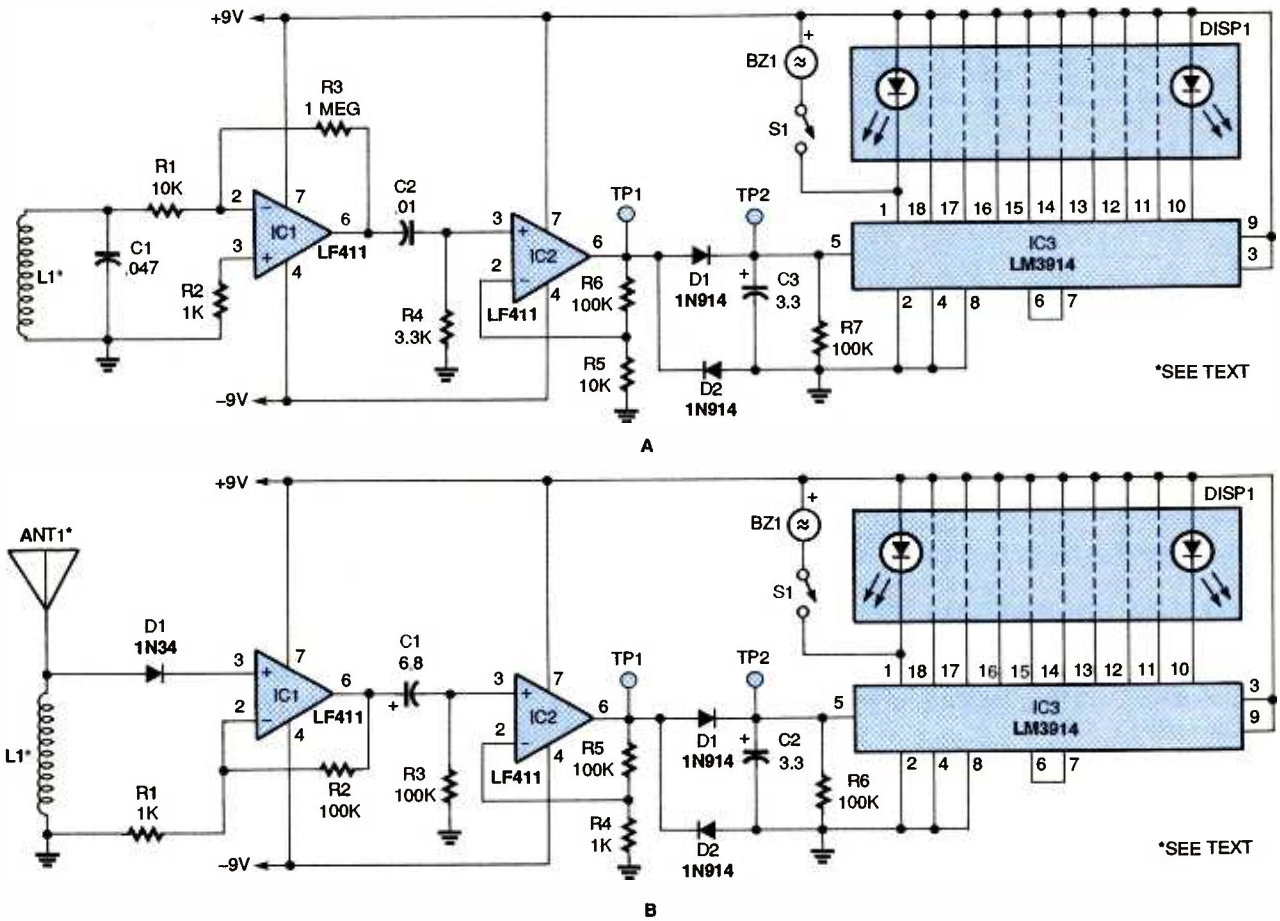

Fig. 4. Monitor VLF and HF signals generated by lightning with the receivers shown in A and B, respectively. Note the many similarities between the circuits.

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operating the device, you'll hear a continuous high-pitched whistle. Expect a minimum output of 10 kilovolts and quarter- to half-inch sparks, so watch your fingers!

—*Nick Cinquino, Schaumburg, IL*

Experimenters, be sure to mount T1 at a fair distance from the drive circuit. Also, insulate all the high-voltage connections with silicon caulk, and do not mount the project on wood. The moisture in wood could make it into a conductor. Use a plastic mount instead.

IMPROVED ION MOTOR

An ion motor is simply a copper wire bent into an "S" shape, and carefully balanced horizontally on a vertical wire or nail tip. When connected to a source of high voltage such as a Tesla coil or Van de Graaff generator, the S-shaped wire quickly picks up speed and continues spinning until power is disconnected.

It works like this: Corona discharge is greatest at the tips of the S-shaped wire. When the tip is charged to either polarity, the air in the vicinity picks up a like charge and they repel each other, setting the wire in motion.

Here's the problem I ran into: small Tesla coils such as the one in Fig. 2 could just barely get a normal ion motor going. A big Tesla coil, of course, has absolutely no problem spinning the wire fast; there's so much corona at the tips it looks like a micro-miniature bonsai tree!

The simple solution I came up with is illustrated in Fig. 3. In that approach you can coax more corona out of the ion motor by placing a grounded wire loop or ring around, and on the same plane, as the ion motor with a diameter just large enough to avoid sparking between the motor and the loop. In my system, the loop's diameter is ¾-inch wider than the ion-motor wire.

—*Nick Cinquino, Schaumburg, IL*

Use two separate leads of high-voltage wire to connect the ion motor to the high-voltage generator. Using coax or twisted pair is hazardous. Also, if you use hanger wire or magnet wire for the components, be sure to remove every scrap of varnish. Some StripX insulation remover should do it.

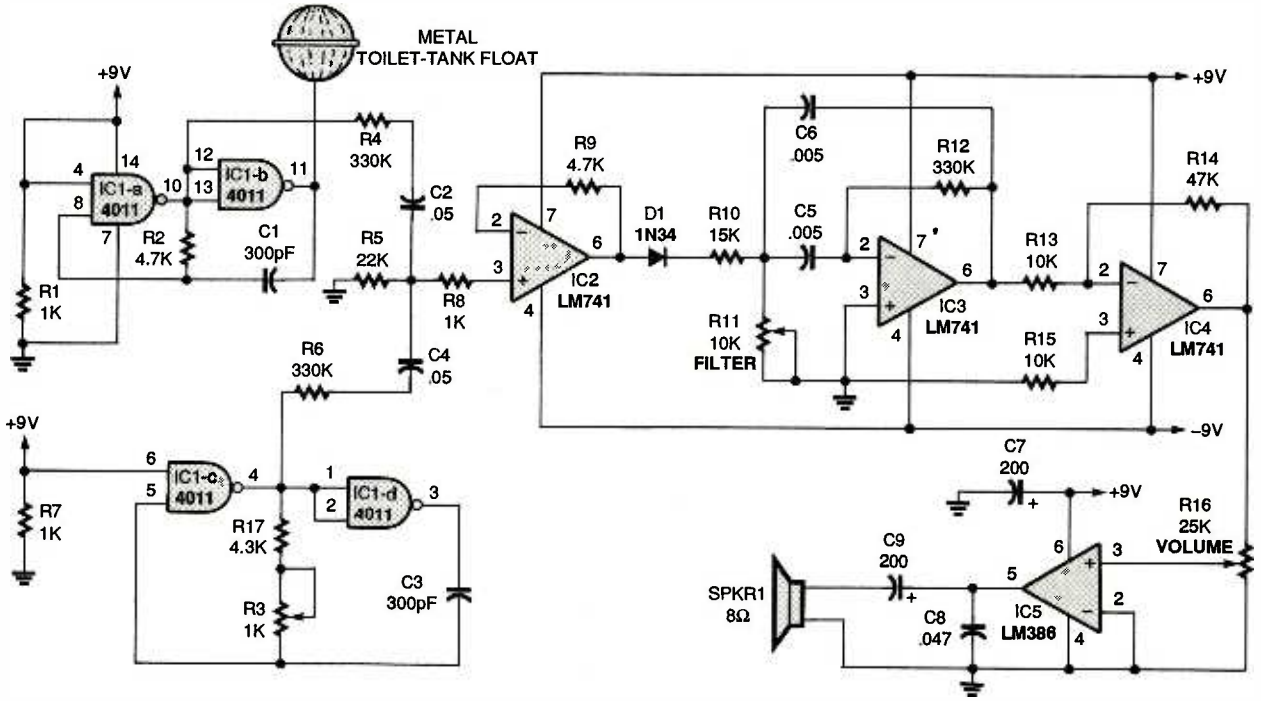

Fig. 5. Here's a Theremin that uses RC instead of LC oscillators to provide those eerie noises.

LIGHTNING RF RECEIVERS

It's known that cloud-to-ground lightning strikes emit far more VLF emissions than do cloud-to-cloud ones. So by monitoring both VLF and HF, lightning can be analyzed for such things as strikes per flash, leader steps, amplitude or relative range, and the ratio of cloud-to-ground or cloud-to-cloud discharge. The pair of simple receivers in Fig. 4 separately monitor both VLF and HF. With them you can stay inside during a storm, away from the rain and hundred-kilojoule discharges!

Take a look at both receiver schematics. Note that they're both extremely similar, except for their respective antenna coils. The VLF-antenna coil, L1, in Fig. 4A is made of 94 turns of 33-gauge magnet wire wound on an 11-inch-diameter cardboard disc. The HF-antenna coil (L1) in Fig. 4B is a common RF choke, or about 100 turns of very fine magnet wire on a ½-inch-long ferrite core (any similar junkbox choke should do). Antenna ANT1 is a 6-inch wire antenna.

The receivers are similar enough to be discussed together from here on. The first LF411 FET op-amps (IC1 in both circuits) are preamps. The second LF411s (IC2 in both) add more gain. Test-point 1 in either circuit can be used to connect high-impedance headphones or an oscilloscope. The diode/resistor/capacitor sections rectify, then shape the output for fast attack/slow decay. Test-point 2 in either circuit is for a connection to

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chart recorders or event counters.

The outputs of both circuits go to LM3914 bargraph-display drivers (IC3 in both circuits), which power both LED bargraphs (DISP1 in both) and low-voltage piezo buzzers (BZ1, again, in both receivers). The negative leads of the buzzers, while shown connected to pin 1, can be connected to any of the bargraph outputs. That makes the buzzers act as selectable-level warning devices. Both circuits are powered by split supplies.

To test them, power up both circuits. A good broadband noise source such as a light dimmer should register on the HF circuit. Switching a distant incandescent bulb on and off registers on the VLF circuit, but not the HF one. By the way, note the similarity between these receivers and the lightning receiver in "Lightning" by Martin A. Uman, *Think Tank*, April 1996.

—*Nick Cinquino, Schaumburg, IL*

Very cool, and very complete! Weather watchers, take Nick's advice and only use the circuits indoors. I further caution you not to mount L1 outdoors.

THEREMIN-ON-A-CHIP

Theremin theory is pretty simple if you think of them as misapplied metal detectors. Typically, a Theremin uses two separate Colpitts LC oscillators, one of which can be slightly varied in frequency. That can be done by placing your hand nearby, which varyies the capacitance a few picofarads. The two frequencies are mixed together, and demodulated to reveal a beat frequency. If the two oscillators are at the same frequency, there's no beat or audio, but if they're off due to the proximity of your hand, a difference or beat-frequency results, which is the audio output of the Theremin.

But I wanted to try a shortcut. Typically, LC oscillators require many components, and the coils they require can be hard to find. Further, when assembled, the oscillators can be awfully touchy. I figured, if LC works, why not RC? As it turns out, it does!

Look at the schematic in Fig. 5. A 4011 quad +scnand+xsc gate, IC1, is the heart of this Theremin, and is in essence a Theremin-on-a-chip. Two gates are used for each of the two required oscillators running at 250 kHz For the aerial, use a metal toilet-tank float. It works great and provides much better sensitivity than just a length of bare or insulated wire. The two RF signals are mixed, then amplified by IC2, an LM741 op-amp. Audio is detected by D1, a 1N34 diode. Another LM741, IC3, is set up as an adjustable band-pass filter, allowing the output to be "shaped" considerably. And another LM741, IC4, further amplifies the audio for IC5, an LM386 audio amp.

I originally built this circuit on a breadboard, and it works fine so long as the oscillator components don't get moved. That would make re-tuning necessary. Here's how to tune the unit: Potentiometer R3 is a 15-turn, 1000-ohm unit. Preset R3 so that the combined series resistance of R3 and R17 is 4700 ohms. Keeping your hand away from the float aerial and oscillator section, adjust R3 with an insulated screwdriver, turning it so the output audio frequency continues to decrease and finally goes silent. It's now tuned, and waiting for your hand to approach.

The sensitivity, or distance of hand to aerial at which audio breaks out is also adjustable via R3. The Theremin described here will start up at about 500 Hz (professional versions start much lower) and rise in pitch with the approach of your hand to well over 10 kHz!

A proximity-sensitive volume control could be added with another 4011 dual oscillator at a different frequency, and for those experimenters with more practical-joking tendencies than musical ability, try bypassing the 386, and running the signal to a 100-watt audio amp. That will get everyone's attention fast, and it makes finding the resonant frequency of various items around the house easy!

—*Nick Cinquino, Schaumburg, IL*

What might be neat is a pair of plates, each connected to an oscillator mounted in the heads of a pair of bongos. Talk about "beat" frequency!

That's another month's worth of electronic fun. Until next time, keep those soldering irons hot, and send your best work to *Think Tank*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

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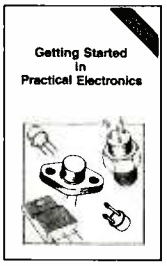

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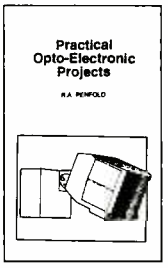

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DX LISTENING

Radio Habana Cuba

BY DON JENSEN

It all began in 1961, a few days before what Lourdes Lopez, head of *Radio Habana Cuba's* correspondence department, calls the "mercenary invasion of *Playa Giron*"—we call it the "Bay of Pigs."

The first experimental broadcasts consisted of two-hour transmissions in Spanish and English. Today, celebrating its 35th anniversary, Radio Habana Cuba broadcasts a total of 30 hours a day, in six additional languages—French, Portuguese, Haitian Creole, Esperanto, Quechua, and Guarani.

A major international broadcaster, the station transmits with a series of powerful transmitters, ranging up to 250 kilowatts. Lopez says that Radio Habana Cuba is the "friendly shortwave station of the Caribbean," and has received letters from listeners in 160 countries on all five continents.

Indisputably, Radio Habana Cuba offers some of the best Latin music on shortwave. It is home to Cuban salsa and a savory selection of rhythms from other countries.

On Sundays it airs *The Jazz Place,* which features performances by the likes of Irakere, Arturo Sandoval, Gonzalo Rubalcaba, and Emiliano Salvador. The arts also are showcased on Sunday on programs like *From Havana and Kaleidoscope.*

Lopez says that "items like *The Mailbag Show; Cuba Today; The World of Stamps; and DXers Unlimited,* our program for DXers; and many others have given us the opportunity to strengthen the friendly ties with our listeners."

RHC's English programming can be heard during much of the evening on 9,820 kHz. Not surprisingly, Radio Habana Cuba very much wants to hear from SWLs, offering not only QSL cards in response to correct reception reports, but other mementos, such as pennants and calendars. The address is P.O. Box 7026, Havana, Cuba.

SHORTWAVE FAX

Every SWL listens to voice transmissions. But have you ever seen a shortwave signal? You can if the transmission is in a mode called facsimile, or Fax.

Here's the logo of shortwave broadcaster Radio Habana Cuba, *which marks its 35th anniversary this year.*

A leaflet, available for just a quarter and a self-addressed, stamped envelope from Universal Radio, 1280 Aida Drive, Reynoldsburg, OH 43068, offers an interesting introduction to shortwave Fax.

Fax pictures are transmitted and received line by line, it explains. At the sending station, the image, usually a photo, map, or chart, is scanned, converting the visual picture elements, or pixels, into electrical voltages prior to SW transmission. At the receiving end, a Fax demodulator converts the radio signal back into electrical voltages, proportional to the lightness or darkness of the transmitted pixels. A print head or stylus reproduces the illustration on paper, pixel by pixel, line by line, at a rate of 60-, 90-, 120-, or 240-lines a minute.

To the ear, a SW Fax transmission has an unpleasant sound, like the scratching of a needle on an old phonograph record. That distinctive noise makes it fairly easy to tune a Fax signal on a quality shortwave receiver with good frequency stability and sensitivity. To receive a Fax picture, you'll also need a special converter, such as Universal's Info-Tech M-800, and a suitable computer printer.

The leaflet says that perhaps the strongest SW Fax signal heard in North America is *NAM*, a 24-hour-a-day U.S. Naval station at Norfolk, VA, which transmits on 3,357, 8,080 and 10,865 kHz. The U.S. military uses that station to transmit oceanographic charts, satellite pictures, weather maps, broadcast schedules, and test charts. Other military Fax stations include *NMF*, Boston, on 7,530 kHz; *NMC*, San Francisco, on 8,682 kHz; and *NPM*, Pearl Harbor, Hawaii on 14,826 kHz.

Foreign press services send photographs by shortwave Fax. Universal's leaflet lists a number of them, including *TASS*, Moscow, on 12,828.5 kHz; *LRO83*, Reuters, Buenos Aires, Argentina, on 18,433 kHz; and *JJC*, Japan's Kyodo news agency, on 17,067 kHz.

Shortwave is filled with meteorological Fax transmissions, sending weather maps, charts and satellite photos. Among those listed are *AXI*, Darwin, Australia, 7,535 kHz; *GFE*, Bracknell, England, 9,203 kHz; and *BAF*, Beijing, China, 16,025 kHz. Universal's leaflet illustrates what those radio pictures look like, details the equipment needed, and lists a number of reference books that will tell you more about DXing shortwave Fax signals.

FREEBIES, ANYONE?

If you're interested in getting current shortwave-station program sched-

CREDITS—Brian Alexander, PA; Jim Clar, NY; Richard D'Angelo, PA; Gary Froemming, AZ; Richard Hankison, KS; Richard Lemke, Alberta, Canada; Ed Newbury, NE; Mary Jo Ondrechen, MA; Ed Rausch, NJ; Doug Robertson, CA; Lloyd Roupe, WV; North American SW Association, 45 Wildflower Road, Levittown PA 19057

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ules without writing a lot of letters to individual broadcasters here's an address for you: Marbian Productions International, P.O. Box 1051, Pointe Claire, Quebec, Canada H9S 4H9, will send you a selection of up to date schedules from major international broadcasters. All you have to do is send a postcard asking for them.

By the way, that free service is operated by retired *Radio Canada International* broadcaster Ian McFarland.

FROM THE MAILBOX

Letters this month include one from Frank Steffans, Palm Springs, CA: "Years ago, when I was a boy," writes Frank, "I was interested in radio. I even built some of my own sets, albeit simple ones. Back then we spoke of kilocycles when we were talking about frequencies.

"In my retirement years, I have again become interested in shortwave. And now I see that frequencies are referred to in kilohertz units. When did this all change?"

According to Bob Grove, writing in the listeners' publication, *Monitoring Times*, the U.S. adopted kilohertz on Oct. 12, 1960, to honor Heinrich Hertz, the 19th Century discoverer of electromagnet waves. The National Institute of Science and Technology then defined the new unit of frequency measurement as equal to one kilocycle per second, or kc/s.

Adam McCarthy, Portland, ME, says he teaches junior-high youngsters. "As an SWL, I've always thought that shortwave would be an excellent way to teach students more about world geography and other cultures. I've persuaded my principal to let me develop a unit based on shortwave.

"I would be surprised if other teachers had not already done this in other communities across the country. I'd like to get in touch with them. Any ideas?"

Sure, Adam. *The Shortwave Classroom* is an international newsletter for teachers who want to use SW-radio listening in the classroom to teach about global perspectives, media studies, world geography, social studies, and other subjects. It is published as a volunteer project three times a year, in August, December, and April. It is available for $10 a year, and a contributed feature to share with other teachers.

For further information about Shortwave Classroom and a sample copy, send $2 to Neil Carleton, Naismith Memorial Public School, P.O. Box 280, Almonte, Ontario, Canada K0A 1A0.

I'm looking for your letters. If you have a question or comment about SWLing, drop me a line. As always, I'm looking for your reception reports: Share your loggings—what SW stations are you hearing, what sort of programming, when are you hearing them, and on which frequencies?

I'm also looking for pictures of you readers doing your favorite thing, listening to shortwave programs. Send in your clear, sharp, photos and I'll try to use them in future columns. Please describe your receiver and any other listening equipment shown in the photographs. The address is DX Listening, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale NY 11735.

DOWN THE DIAL

Here are some interesting listening targets to tune.

BOTSWANA—4,820 kHz. *Radio Botswana* broadcasts on this frequency, parallel to 3,356 kHz, at 0100 UTC with African language talk and music.

BULGARIA—9,700 kHz. *Radio Bulgaria* was heard at 2257 UTC, ending an English-language program called "Time Out for Music."

CANADA—11,705 kHz. *Radio Japan's* English programming at 1400 UTC is relayed from transmitters in Canada. So is the broadcast on 9,535 kHz at the same time.

CLANDESTINE—4,182 kHz. *Voice of Iraqi Kurdistan* might be the station noted with presumed Kurdish talk and music shortly after 0400 UTC.

CUBA—5,025 kHz. *Radio Rebelde* is the other Cuban SW station, intended for Spanish-speaking listeners. It has been noted here with Cuban music and identification at around 0215 UTC.

CZECH REPUBLIC—13,580 kHz. *Radio Prague* noted, parallel to 7,485 kHz, with an English transmission, an economics feature, and news, at 1415 UTC.

MONGOLIA—7,530 kHz. *Radio Ulan Bator* signs on with a half-hour English program at 1930 UTC, with identification, schedule and a newscast.

RUSSIA—5,930 kHz. *Murmansk Radio* is reported with Russian programming, signing on at 1558 UTC with bells.

SLOVAKIA—5,915 kHz. *Radio Slovakia* is heard in English at 1930 UTC, parallel to 6,055 kHz, with interval signal, ID, news, and a feature.

TIBET—4,750 kHz. *Xizang Peoples' Broadcasting Service*, Lhasa, has Chinese-language talk and music at about 1100 UTC.

TURKEY—6,900 kHz. *Turkish Meteorological Radio* broadcasts in Turkish. Noted at about 0520 UTC with Turkish music and a long talk.

ZAMBIA—4,965 kHz. *Christian Voice*, a relatively new SW station, heard after 2000 UTC until sign off at about 2035 UTC, with Gospel music, identification, and jingles.

ZIMBABWE—3,306 kHz. *Zimbabwe Broadcasting Corp.*, is noted during the 0315-0330 UTC period, with English ID and African music. ■

TRANSISTOR EQUIVALENTS GUIDE

BP85—Designed to help the user find possible substitutes for a popular use-oriented selection of modern transistors. Includes devices produced by more than 100 manufacturers. Wherever possible, equivalents are sub-divided into European, American and Japanese types. Material type, polarity and manufacturer are also shown. To order BP85 send **$9.95 (includes shipping and handling)** in the US and Canada to **Electronic Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240.** US funds only. Use US bank check or International Money Order. Allow 6-8 weeks for delivery. MA08

ELECTRONIC GAMES

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SCANNER ANTENNA

(Continued from page 34)

PARTS LIST FOR THE UNDERCOVER SCANNER ANTENNA

C1—0.1-μF, ceramic-disc capacitor
J1—BNC jack with threaded collar
J2—Miniature phone jack (should match the earphone used)
PL1—Miniature phone plug (should match the earphone jack on the scanner)
Project enclosure (see text), earphone with wire, audio cable, RG58/U coaxial cable, wire, solder, hardware, etc.

Secure BNC-connector J1 to the bottom of the canister by means of the jack's threaded collar. Next, mount the miniature phone jack, J2, on the lid. Then, connect a short piece of audio cable to plug PL1 and feed that through a grommet in the lid and into the canister.

Go on to make the internal connections shown in Fig. 2. As shown in that diagram, connect a short piece of RG58/U cable from J1 to capacitor C1. All other connections can be made with short bits of hookup wire. When you're finished, just snap on the lid, and the Undercover Antenna is ready to go.

Using the Antenna. To try out your unit you have to make three simple connections. First, attach J1 to the antenna connector on your scanner. Second, insert PL1 into the scanner's audio-out or earphone jack. Third, plug an earphone into J2. Then just put the earphone in your ear and turn on your scanner.

You'll probably find that, similar to a rubber ducky, the Undercover Antenna works better when held away from your body. However, unlike a rubber ducky, the Antenna still works quite well when worn on your belt.

I have used the simple little device a lot with my scanner, and have been quite pleased with the results. It will not rival a full-sized antenna, but was never intended to. What it will do is provide decent reception without being obtrusive or obvious. ■

SEARCH AND RESCUE

(Continued from page 52)

8-14 micron band. The IRIS "sees" all the emitted IR frequencies and passes the information to the sensing chip. It, in turn, transits the information to the PPM, which processes the image for display by the HMD. The sensor is sensitive enough to discern in great detail even tiny differences in temperatures, like hot spots behind walls and ceilings, or hot appliances and electrical terminals. Using Focal Plane Array (FPA) technology, the IRIS can detect temperature differentials as small as 0.5 degrees F.

The helmet-mounted display, with its high-resolution CRT display integrated with an optical mirror/lens system in a binocular configuration, presents a single "virtual-reality" image in front of both eyes. The 1:1 display lets firemen use size differentials to discern distances because the view is full-size.

The PPM containing the processor and battery pack is housed in a 7½- by 4- by 2-inch package that weighs only 1.8 pounds. Power is supplied by a 6-volt nickel-cadmium battery pack that provides a minimum of 30 minutes of continuous operation. The system comes with four batteries and a recharger. According to Cairns, the system has shown that it can reduce rescue times by an average of 50% because firefighters can visually scan areas quickly.

The Fire Finder II, offered by Dyn-Optics, allows the use of thermal-sensing technology without the large investment required for the CairnIRIS setup. The Fire Finder II looks and works much like an ordinary flashlight; it is powered by two standard, 9-volt batteries.

The device's sensitive infrared sensor can locate a 200°F heat source as small as one-square-foot in area at 20 feet, with much smaller ones detectable at closer ranges. When a heat source is found, an audible alarm goes off within 1/10 second. The pitch of the alarm is proportional to the temperature of the hot spot or fire. The hotter the heat source, the higher the pitch.

With no meters to read or lights to interpret, it can be used in complete darkness or in smoke-filled rooms. It will detect a hot spot even through a glass window or in bright sunlight. An optional built-in "Laser Pointer" will identify with pinpoint accuracy the exact direction in which the Fire Finder is aimed. The device will detect just about any hidden heat source, including super-heated air that can lead to flashover, as well as chemical fires such as with hydrogen and methyl alcohol, which burn with an invisible flame. ■

FOR MORE INFORMATION

Cairns & Brother, Inc.
60 Webro Road
P.O. Box 4076
Clifton, NJ 07012

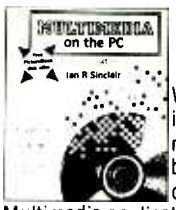
Delsar, Inc.
604 Caswell Road
Chapel Hill, NC 27514

Dyn-Optics
2 McLaren, Suite F
Irvine, CA 92718

Mistral Inc.
7910 Woodmont Avenue, Suite 1070
Bethesda, MD 20814

Sandia National Laboratories
Media Relations Department, MS 0167
Albuquerque, NM 87185-0167

Search Systems
4117 Rio Del Norte
Bakersfield, CA 93308



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New Products

WIRELESS A/V SYSTEM

RF-Link Technology's WAVECOM Jr. (*W*ireless *A*udio *V*ideo *E*verywhere *COM*municator) allows you to enjoy interference-free stereo-audio and video reception in or around your home or office, without running wires from room to room. The system's reliable 2.4-GHz signal penetrates walls, floors, doors, and ceilings, to a distance of up to 300 feet.

Consisting of a small portable transmitter and receiver, the system is fully compatible with any components that have standard audio and video input and output connections. The system sends FM signals over the 2.4-GHz ISM band, avoiding the interference associated with the crowded 900-MHz band used by cordless phones and other wireless audio/video transmitters. High-gain directional transmitting and receiving antennas, rather than omni antennas, are used to minimize interference from unwanted signals and eliminate the inherent problem of multipath.

The WAVECOM Jr. has a wide range of applications. It can be used to watch cable or DSS programs, or videotapes or laserdiscs, on any TV in the house without a separate cable/satellite or VCR/LD hookup. Similarly, it can be used to send stereo audio signals from a CD player, tuner, or other source, throughout the house. By transmitting the signal from a camcorder to the TV, parents can check on sleeping babies or children playing outdoors, using the WAVECOM Jr. as an audio/video baby monitor. With a CCD camera accessory, it can be used for home/office security. And with the addition of accessories available at most computer and electronics stores, computer users can watch anything on their computer screens that they normally watch on TV, or can transmit computer-generated images to a TV.

The WAVECOM Jr. has a suggested retail price of $199.95. For more information, contact RF-Link Technology Inc., 411 Amapola Avenue, Torrance, CA 90501; Tel. 310-787-2328; Fax: 310-787-2323; e-mail: rflinkmktg@aol.com.

CIRCLE 70 ON FREE INFORMATION CARD

PC-RADIO UNIVERSAL INTERFACE

The *Optolinx* universal interface from *Optoelectronics* adapts a wide variety of radios, scanners, decoders, frequency counters, global-positioning satellite (GPS) receivers, and other devices for connection to a personal computer's RS-232C serial port. Both full- and half-duplex devices can be connected simultaneously using software to switch between them.

The Optolinx offers special provisions for connecting the AOE AR2700 and AR8000 to a PC for full-featured computer-controlled scanning—even allowing the user to control multiple radios at the same time, all while switching back and forth between the radios. It also allows you to interface the AOR AR3000A receiver with the DC440 decoder to permit decoding of DCS and CTCSS tones and DTMF characters.

The Optolinx can interface with an NMEA 0183-compatible GPS or LORAN receiver. Together, the Optolinx, GPS receiver, and any communications receiver can be used to receive longitude and latitude coordinates for any signal that your scanner receives. (Future software by Software Developers will allow real-time position mapping.)

With the Optolinx interfaced to an Optoelectronics Scout frequency recorder, you can download Scout frequencies to a PC using the disk supplied with the Scout, then check the frequencies against the FCC database using the Spectrum CD-ROM. The Optoelectronics M1 frequency counter, using Optolog software, can be interfaced to the Optolinx to provide computer-controlled data logging of all frequencies captured by the M1. The Optolinx also provides computer control for the ICOM R7000, R7100, and R9000 receivers.

The Optolinx PC-radio universal interface costs $129. For further information, contact Optoelectronics, Inc., 5821 NE 14th Avenue, Ft. Lauderdale, FL 33486; Tel. 800-327-5912 or 954-771-2050.

CIRCLE 71 ON FREE INFORMATION CARD

LOGIC-ANALYSIS TEST KITS

Three logic test kits from *Global Specialties* offer logical solutions to digital troubleshooting problems. The Models *LTC-6*, *LTC-7*, and *LTC-8* are DTL/TTL- and CMOS-compatible. Each features a logic probe, a digital pulser, a 16-channel logic monitor, a tone ohmmeter, and an accessory kit, all packaged in a rugged plastic carry-

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ing case. Aimed at anyone who designs, repairs, or tests digital circuitry, the kits can be used to troubleshoot all CMOS/TTL digital circuits such as counters, A/D and D/A converters, microprocessors, flip-flop latches, and shift registers.

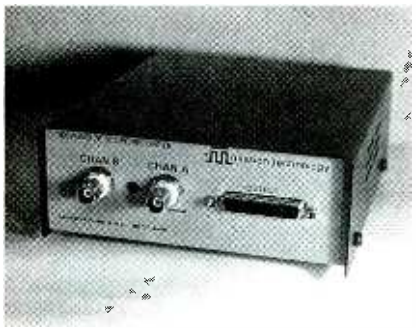
Each logic probe has a selectable memory and LEDs for indicating high and low logic states. The probe's pulse width varies with the kit selected—the LTC-6 comes with a 10-MHz probe, the LTC-7 has a 35-MHz probe, and the LTC-8 has a 100-MHz probe. The digital pulser is a pocket-sized pulse generator that is used to simulate logic circuits with a single pulse or a continuous pulse train. The logic monitor simultaneously displays the static and dynamic states of 16 logic inputs. The pocket-sized audible-tone ohmmeter can be used for locating bad ICs and detecting short or open circuits. The accessory kit includes interchangeable probe tips, ground clips, tip adapters, and quick hook cables, for hands-free testing.

The LTC-6, LTC-7, and LTC-8 logic analysis test kits cost $299.95, $324.95, and $379.95, respectively. For additional information, contact Global Specialties, 70 Fulton Terrace, New Haven, CT 06512; Tel. 800-572-1028; Fax: 203-468-0060.

CIRCLE 72 ON FREE INFORMATION CARD

PC DIGITAL STORAGE MULTISCOPE PERIPHERAL

Mission Technology's Multiscope is an external PC peripheral that turns any 386/486/Pentium PC into a dual-channel digital storage oscilloscope, spectrum analyzer, and strip-chart recorder.



The easy-to-install Multiscope connects to the PC parallel port. It has a user-friendly Windows graphical interface, and comes complete with two sets of clip probes and a parallel printer cable. It can be used by hobbyists, businesses, and schools, for scientific measurement and automotive diagnostics.

Mail-order prices for the Multiscope start at $399. For additional information, contact Amaze Electronics Corporation, 10395 Mary Avenue, Cupertino, CA 95014; Tel. 408-996-8943; Fax: 408-996-0366; or Mission Technology, Inc., P.O. Box 3016, Teaneck, NJ 07666; Tel. 201-837-8386; Fax: 201-837-6597.

CIRCLE 73 ON FREE INFORMATION CARD

SINGLE-AXIS ACCELEROMETER

B&B Electronics' Model ACL1 single-axis accelerometer can be used to measure tilt, orientation, and acceleration, or to detect motion. The device is configured to measure acceleration up to ±2 g's. Simply supply the unit with 5 volts DC and ground it through the attached six-foot shielded cable. The cable's third conductor is the 0- to 5-volt output signal, which provides a linear voltage proportional to the force of acceleration. B&B Electronics also offers serial and parallel A/D products that provide an inexpensive means of

logging the data to a computer.

The ACL1 accelerometer costs $89.95. For further information, contact B&B Electronics Manufacturing Company, 707 Dayton Road, P.O. Box 1040, Ottawa, IL 61350; Tel. 815-433-5100; Fax: 815-434-7094; BBS: 815-434-2927; e-mail: catrqst@bb-elec.com; Web page: http://www.bb-elec.com.

CIRCLE 74 ON FREE INFORMATION CARD

ADVANCED COMMUNICATIONS MANAGER

B.E.L.-Tronics has dubbed its *Model CF130* telephone the "Advanced Communications Manager." The phone provides users with the options they need for communications flexibility, privacy, and convenience.

The CF130's features are designed to optimize telephone-company Caller ID and messaging services. For instance, when the user subscribes to Caller ID, the phone's incoming-call storage features allow the users to memorize the numbers of incoming calls and separate them into those that should be rejected and those that should be stored as "preferred." The CF130 can simultaneously display the name, number, date, and time for up to 100 calls. One-touch Caller ID dialback is also provided.

With the Call-Waiting Caller ID feature, and the Call-Waiting service from the phone company, even when the user's line is engaged, subsequent incoming calls are identified on the CF130's display. The exclusive Call Reject feature allows the user to store into memory the number of any nuisance call. When that number calls again, Call Reject answers with a prerecorded digital message designed to discourage further calls. Preferred Caller Memory matches incoming calls with a personalized list of up to 50 user-selected numbers. The CF130 provides unique ring tones to distinguish preferred calls from regular calls. The user can even program the phone to ring only for preferred calls. Other features include a speaker phone, message-waiting and line-status indicators, five speed-dial keys, and a

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built-in clock and call timer.

The CF130 has a suggested retail price of $199.95. For more information, contact B.E.L.-Tronics Limited, 8100 Sagl Parkway, Covington, GA 30209; Tel. 770-787-6500 or 800-828-8804; Fax: 770-784-9898.

CIRCLE 75 ON FREE INFORMATION CARD

HANDHELD GLOBAL-POSITIONING-SYSTEM RECEIVER

Aimed at outdoor enthusiasts, sportsmen, and boaters, *RadioShack's Magellan GPS 2000* is a pocket-sized GPS receiver that will guide you where you want to go—in any weather, anywhere in the world—with the push of a button. It can be used for marking trails, recording fishing spots, tracking game, or simply finding your way through difficult or unfamiliar terrain.

The GPS 2000 relies on U.S. Government Global Positioning System satellites, which transmit precise time and position (latitude, longitude, and altitude) information 24 hours a day from their orbit 12,000 miles above the earth. The GPS receiver uses signals from three or more satellites at once to pinpoint the user's exact position.

The receiver's on-screen graphic display shows the exact location, direction, and distance to a chosen destination, and also indicates speed. The plotter screen draws a picture of the course, the route to be followed, the location of nearby landmarks, and progress to the destination. The GPS 200 measures 6-1/2 × 2-1/3 × 1-1/3 inches, weighs just 10 ounces with batteries, and will run continuously for up to 17 hours on four "AA" alkaline batteries.

The GPS 2000 receiver costs $229.99 and is available through RadioShack Unlimited, a special-order program through which orders placed at any RadioShack store will be delivered directly to the customer within a few days. For more information, contact RadioShack, 700 One Tandy Center, Fort Worth, TX 76102; Tel. 800-THE-SHACK.

CIRCLE 76 ON FREE INFORMATION CARD

MULTI-PURPOSE AUTOMOTIVE TESTER

HC Protek's Model D-988 handheld automotive tester provides quick, accurate, time-saving diagnoses of problems, capturing glitches and signal variations in less than one millisecond. The 4000-count, $3^3/_4$-digit auto-ranging meter can be used to test

ignition and engine systems; sensors, solenoids, and components; alternators, coils, and diodes; charging systems; cooling and heating systems; and lighting systems for all modern vehicles, including both distributor-type and distributor-less models.

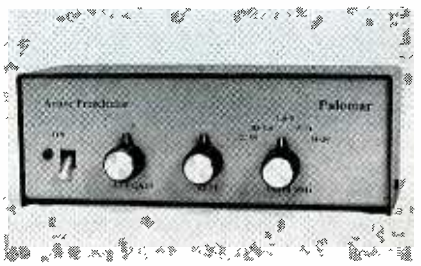
The D-988 measures RPM with a magnetic pick-up probe, positive or negative on-time pulse and duty-cycle, min/max/average, temperature in fahrenheit or celsius, and relative change. It also features a 0–2000-kHz frequency counter, data hold, and continuity buzzer. All features and functions are indicated on the unit's large backlit display, which also includes a 42-segment bar graph.

The D-988 automotive tester, complete with RPM inductive pick-up probe, test leads, alligator clips, temperature probe with adapter, removable rubber holster, padded carrying case, and illustrated instruction manual, costs $349.95. For more information, contact HC Protek, 154 Veteran's Drive, Northvale, NJ 07647; Tel. 201-767-7242; Fax: 201-767-7343.

CIRCLE 77 ON FREE INFORMATION CARD

ACTIVE PRESELECTOR

Aimed at SWLs and medium-wave DXers, *Palomar Engineers' Model P-508* active preselector covers 200 kHz to 30 MHz in five bands. Its high-quality tuned circuits reduce cross modula-



tion and receiver overload from strong out-of-band signals. An FET bipolar amplifier tolerates higher signal levels without overload to operate in today's high-signal-density environment. The P-508 also features continuous control of gain and attenuation, SO-239 connectors, and 12-volt-DC operation.

The Model P-508 active preselector costs $99.95 plus $6 shipping and handling. For additional information, contact Palomar Engineers, P.O. Box 462222, Escondido, CA 92029; Tel. 619-747-3343; Fax: 619-747-3346. ■

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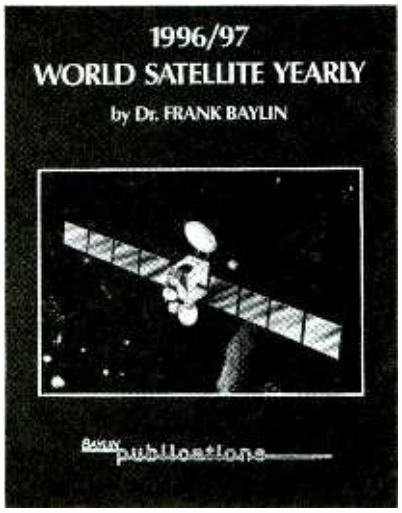
Electronics Library

1996/97 WORLD SATELLITE YEARLY

by Dr. Frank Baylin

Written for the professional as well as the educated layman, this book provides all the up-to-date information needed to determine the satellite programming available at any site in the world, along with detailed coverage of the equipment needed to receive those signals. The book is divided into five tabbed sections titled Technical, New Developments, Programming, Satellites, and Companies.



The Technical section begins by thoroughly exploring the function and use of broadcast satellites. It also describes how to read footprint maps, the role of polarity in the downlinked signal, and the components that make up a satellite earth station. That is followed by a study of the techniques needed to size satellite dishes and LNB, including the underlying analog and digital equations and detailed tables. A separate chapter is devoted to aiming the dish. Next, broadcast methods and standards are explored in a chapter that includes complete tables of broadcast formats organized by both country and format style, along with an overview of audio-transmission methods.

The latest details about rapidly evolving compressed digital video and audio methods and the role of MPEG 2 are presented in the first two chapters that fall under the New Developments heading. Subsequent chapters provide an overview of the basics and new developments in scrambling and encryption techniques; worldwide allocations of communications frequencies as well as spacecraft, systems, and channel frequency layouts for regional satellite systems; and marine satellite reception systems. A study of the explosive growth of DBS broadcasting rounds out this section.

The Programming section lists polarity, frequency, and language of video programming available on all the world's geostationary broadcast satellites. The 500-page Satellites section presents the characteristics and footprints of nearly all of the world's operational satellites. Complete directories of satellite programmers, operators, and manufacturers, as well as manufacturers of earth-station components, are found in the Companies section.

The 1996/97 World Satellite Yearly is available for $90 plus $5 shipping and handling ($40 air shipping outside the U.S.) from Baylin Publications, 1905 Mariposa, Boulder, CO 80302; Tel. 303-449-4551; Fax: 303-939-8720; e-mail: fbaylin@entertain.com.

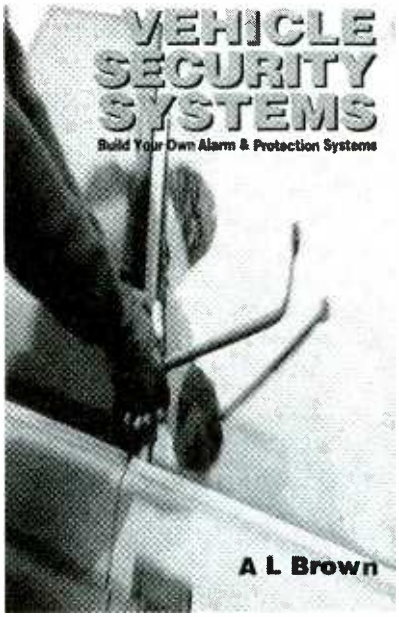
CIRCLE 80 ON FREE INFORMATION CARD

VEHICLE SECURITY SYSTEMS: Build Your Own Alarm & Protection Systems

by A.L. Brown

The threat of car theft affects all of us either directly or through spiralling insurance premiums. This book provides electronics hobbyists with all the information and designs they need to comprehensively protect their cars.

Every circuit in the book is clearly described and illustrated, and the parts are easy to find. The designs have all been rigorously tested on some of the most car-crime-ridden streets in the world, and the advice provided is based on real-life experience.



The designs include systems as simple as a warning beacon, a range of immobilizers, and a basic alarm system. More advanced systems include add-on features such as a personal-attack button and a courtesy-light delay. Intruder detectors are described, and full construction details are provided, including a guide to fault diagnosis and step-by-step installation instructions.

Vehicle Security Systems: Build Your Own Alarm & Protection Systems costs $28.95 and is published by Butterworth-Heinemann, 225 Wildwood Avenue, Unit B, P.O. Box 4500, Woburn, MA 01801; Tel. 617-928-2500.

CIRCLE 81 ON FREE INFORMATION CARD

ZWORYKIN, PIONEER OF TELEVISION

by Albert Abramson

Russian-born scientist Vladimir Kosma Zworykin was instrumental in the creation of cathode-ray television. In this book, the author uses patents, pub-

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lished and unpublished documents, and interviews with television pioneers—including Zworykin himself—to reconstruct the inventor's life.

Although the book covers Zworykin's early years in Russia through his death in 1982, its focus is on the years beginning in the late 1920s, when Zworykin worked for David Sarnoff to create an RCA television system, and culminating in the triumphant television demonstrations at the 1939 World's Fair and later commercial success. The author argues that it was Zworykin's inventions—including the iconoscope, the first practical television camera tube—that made modern, all-electronic television possible, and that he deserves the title "father of television."

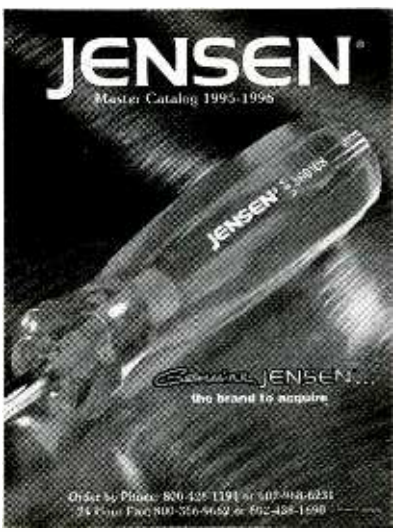
Zworykin, Pioneer of Television costs $36.95 and is published by the University of Illinois Press, 1325 South Oak Street, Champaign, IL 61820.

CIRCLE 82 ON FREE INFORMATION CARD

1996 MASTER CATALOG

from Jensen Tools

Aimed at field-service technicians, radio amateurs, and electronic hobbyists, this catalog offers a wide assortment of test and diagnostic instruments, high-quality tools, and accessories. The latest additions to the popular JTK (Jensen Tool Kit) line are presented, and seven models of the economical new Vantage line are introduced in the 240-page brochure.



The catalog also features products from many leading manufacturers, including Fluke, Wavetek, BK Precision, Tektronix, Leader, Biddle, Navtel, and others. Additional product categories include wire, cable and connectors, inch/metric tools, PC diagnostic gear, fiber-optics, power monitors/meters, soldering and SMT rework stations, cases, and shipping containers.

The 1996 Master Catalog is free upon request from Jensen Tools Inc., 7815 South 46th Street, Phoenix, AZ 85044-5399; Tel. 800-426-1194; Fax: 602-438-1690.

CIRCLE 83 ON FREE INFORMATION CARD

1996 EEM/ELECTRONICS ENGINEERS MASTER

from Hearst Business Publishing/UTP Division

For the first time, the *Electronics Engineers Master* is available not only in its traditional printed version, but also on a CD-ROM. The electronic version combines the scope of the EEM database with the speed and ease of

CD-ROM technology. It provides fast, efficient electronic access to all the product information in the world's largest catalog of electronic products. Users can conduct searches by product or by manufacturer. The EEM CD-ROM includes the complete EEM Manufacturers & Sales Offices Directory as well as more than 4400 product catalog data pages from over 1000 manufacturers.

The updated and expanded 1996 edition includes more than 4100 different product listings with hundreds of new products; 5300 manufacturer listings, including 300 new listings; 63 product sections, including new sections on LAN products, terminal blocks, and test accessories; 39 product selection guides; 20 mini-glossaries and charts, expanded with the latest hard-to-find technical details; and more than 1000 manufacturers' address and phone-number changes.

The 1996 EEM CD-ROM for Windows costs $115; the four-volume 1996 EEM/Electronics Master Catalog costs $99 plus $10 shipping. They are available from Hearst Business Publishing/UTP Division, 645 Stewart Avenue, Garden City, NY 11530; Tel. 516-227-1314 or 800-833-7138 for credit-card orders; Fax: 516-227-1453.

CIRCLE 84 ON FREE INFORMATION CARD

VCR CROSS-REFERENCE AND PARTS CROSS-REFERENCE Version Seven

from ISCET

The International Society of Certified Electronics Technicians (ISCET) has released both paper and electronic versions of the seventh edition of the VCR Cross-Reference and Parts Cross-Reference.

The software allows the user to search by manufacturer for model numbers and by description for part numbers. A sub-search by manufacturer and part-description is also a feature of the program. All the substitutes for the part entered are shown.

The 144-page, laser-printed book contains 1756 models and more than 6000 parts with all updated prices. The book is three-hole punched and shrink wrapped for easy filing.

The software is available to first-time purchasers for $69.95 plus $2 shipping. Registered previous purchasers can buy an upgrade for $20.95 plus shipping. The book costs $29.95 plus $3 shipping. The book or disc(s) (one 3-1/2- or two 5-1/4-inch) can be ordered from ISCET, 2708 West Berry, Fort Worth, TX 76109; Tel. 817-921-9101. ■

CIRCLE 85 ON FREE INFORMATION CARD

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TIPS FOR MAIL ORDER PURCHASE

It is impossible for us to verify the claims of advertisers, including but not limited to product availability, credibility, reliability and existence of warranties. The following information is provided as a service for your protection. It is not intended to constitute legal advice and readers are advised to obtain independent advice on how to best protect their own interests based upon their individual circumstances and jurisdictions.

1. Confirm price and merchandise information with the seller, including brand, model, color or finish, accessories and rebates included in the price.

2. Understand the seller's return and/or refund policy, including the allowable return period, who pays the postage for returned merchandise and whether there is any "restocking" or "return" charge.

3. Understand the product's warranty. Is there a manufacturer's warranty, and if so, is it for a U.S. or foreign manufacturer? Note that many manufacturers assert that, even if the product comes with a U.S. manufacturer's warranty, if you purchase from an unauthorized dealer, you are not covered by the manufacturer's warranty. If in doubt, contact the manufacturer directly. In addition to, or instead of the manufacturer's warranty, the seller may offer its own warranty. In either case, what is covered by warranty, how long is the warranty period, where will the product be serviced, is there a charge for service, what do you have to do to obtain service and will the product be repaired or replaced? You may want to receive a copy of the written warranty before placing your order.

4. Keep a copy of all transactions, including but not limited to cancelled check, receipt and correspondence. For phone orders, make a note of the order including merchandise ordered, price, order date, expected delivery date and salesperson's name.

5. If the merchandise is not shipped within the promised time, or if no time was promised, within 30 days of receipt of the order, you generally have the right to cancel the order and get a refund.

6. Merchandise substitution without your express prior consent is generally not allowed.

7. If you have a problem with your order or the merchandise, write a letter to the seller with all the pertinent information and keep a copy.

8. If you are unable to obtain satisfaction from the seller, contact the consumer protection agency in the seller's state and your local Post Office.

If, after following the guidelines, you experience a problem with a mail order advertiser that you are unable to resolve, please let us know. Write to Advertising Department, Gernsback Publications Inc., 500B Bi-County Blvd. Farmingdale, NY 11735.

Be sure to include copies of all correspondence.

CALLER ID

(Continued from page 49)

before your unit will work. The date and time is included in any subscription to Caller ID; in addition, you can subscribe to just the number, just the name, or both.

For your computer to work with the unit, you will need to either write a program (more on that later) or use the simple program shown in Listing 1. That QuickBASIC program will keep a running log of all incoming calls by displaying them on the screen and storing them in the file C:\CID. Type the program in and save it.

Plug the wall transformer into an outlet, the modular plug into a telephone wall jack, and the RS-232 connector into your computer. Note, always apply power to the unit before plugging it into an active RS-232 port or the oscillator might fail to start.

Start the QuickBASIC program and have someone call the telephone line that the unit is plugged into. The yellow LED (LED1) will flash shortly after the first ring as the caller-ID data is being received, then the red LED (LED2) will flash as the data is being sent to the computer. The computer will then show the date, time, number, and name on the screen, and store that data in the C:\CID file. As each new call comes in, the information will be displayed on the next line of the screen and stored in the next line of the file.

If LED1 fails to flash, there is either a wiring error somewhere between the unit and the phone jack, or the caller-ID data is not being sent down the line by the phone company. If LED2 fails to flash immediately following LED1, there is either an error in the RS-232 cable/connector wiring, or the program is not successfully opening the same serial port. Hit the ESC key at any time to exit the program.

The Caller-ID Computer Interface will store the data from each call (up to 256 characters) when the computer is off or not running the program. As soon as the program is started, all caller-ID data stored in the EEPROM will be sent to the computer.

Creating Your Own Program. It's possible to write your own program for the unit if you keep certain things in mind. The Caller ID communicates using 1200 baud, no parity, 8 data bits, and 1 stop bit. Your program should contain the line OPEN "COM1:1200,N,8,1" FOR INPUT AS #1, or similar. Also, the ON COM GOSUB statement should be used as shown in the sample program to handle branching to a subroutine when the caller-ID data is received.

As mentioned, all caller-ID data sent from the unit to the serial port is preceded by an "I," which identifies the string as the caller-ID data, and ends with a carriage return. Note, always use the COM(1) OFF statement at the beginning of your subroutine branched to by the ON COM GOSUB statement, then a COM(1) ON statement at the end after all characters have been received. Failure to turn off event trapping in this case will cause communications errors between the PC and the Interface.

BBS Applications. The unit can be used to grab the name and/or number of any caller to your BBS or other modem applications, and can serve as your computer's security system. Two important notes here: Because the caller-ID data is transmitted between the first and second ring, your modem must let two rings occur before it answers.

Also, the carrier used for modem communications is the same as that which delivers the caller-ID data. The unit listens for that carrier for a total of two seconds following each ring. You must have your modem wait at least two seconds after pick-up prior to issuing its own carrier to avoid a false carrier detection by the unit. ■

LISTING 1

```
CLS
OPEN "COM1:1200,N,8,1" FOR INPUT AS #1
OPEN "C:\CID" FOR APPEND AS #2
ON COM(1) GOSUB RECEIVE
COM(1) ON
DO
LOOP UNTIL INKEY$=CHR$(27)
CLOSE #1,#2
END

RECEIVE:
        COM(1) OFF
        IF INPUT$(1,#1)="I" THEN
                LINE INPUT #1, CID$
                PRINT CID$
                PRINT #2, CID$
        ELSE LINE INPUT #1, DISCARD$
        END IF
        COM(1) ON
        RETURN
```


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Caller ID / RS-232
Connects between a telephone wall jack and an RS-232 serial port. Decodes the caller ID data sent over the phone line and sends it to your PC or Mac, in a pre-formatted ASCII character string. Create your own program to log the name, number, date, and time of all incoming calls.

Telephone Call Restrictor
Connects to telephone wall jack. Disables all phones on the line if attempting to either: dial a number that has been stored in memory "Block" mode or, dial a number that has not been stored in memory "Allow" mode. Use touch-tone phone to enter telephone numbers into memory, and choose mode. Program from any phone on the line using your password.

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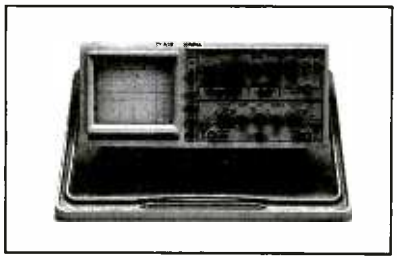

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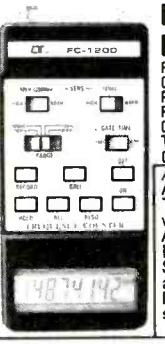

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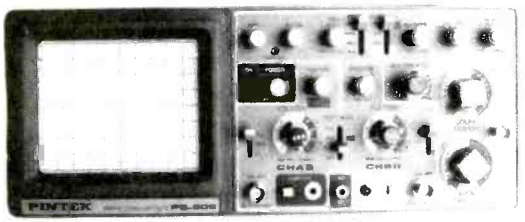

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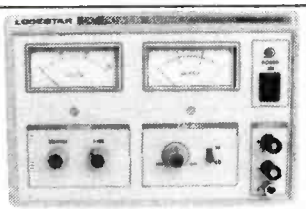

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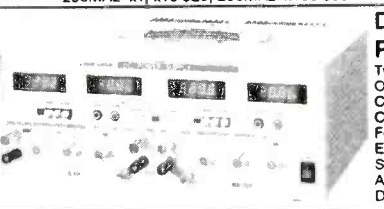

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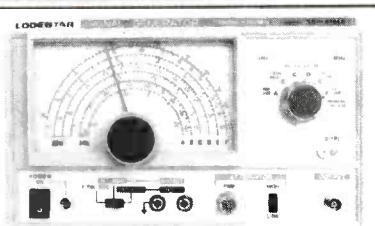

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- Uses the UHF TV band.
- Transmits video and audio.
- Up to 100 foot range.

E-Z Kit $29.95

16 levels of digital voice changing. Sound tougher, older or younger, female or male. Both use modular phone jacks.

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Works with regular or multi-line phones. Connects between handset and phone

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Small 3V Lithium battery. For use with XTL3000, XTL1000, XTR300, and XWB1000.

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- Dial home from anywhere and hear inside your home.
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- Stop burglars and intruders.
- Reliable 24 hour protection.

XLC 900 $49.95

800-950MHZ SCANNER CONVERTER KIT
- Uninterrupted coverage of the 800 to 950 MHz band!.
- Works with any 400-550MHz scanner.
- Gain: 6 dB typical.
- Noise figure: 3 dB typical.

XBD 200 $39.95

BUG DETECTOR KIT
- 1MHz thru 2000MHz frequency range.
- Uses super sensitive microwave transistor amplifier stage.
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- Uses 9V battery. (Not included)

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88-108 MHz FM STEREO TRANSMITTER KIT
- Separate level control for both left and right channels.
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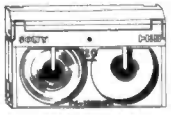

SONY Hi-8
Top quality, metal particle 120 minute video cassettes. Used for a short time, then bulk-erased. Each cassette has its own plastic storage box. Satisfaction Guaranteed.

$3.00 each

CAT # VCU-8

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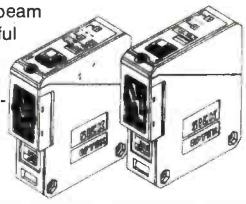
RANGE 20 METERS (65.6 FEET) INDOOR/OUTDOOR PHOTOELECTRIC SWITCH



SICK Optex # WS/WE260-M230
Invisible infrared beam and switch is useful for a variety of security, safety and sensing applications such as perimeter alarms, electric gate or garage door controls or conveyor line sensing. Modulated beam covers a 20 meter distance even with poor visibility. IP-66 enclosure rating makes it dust proof and splash resistant, suitable for most outdoor conditions. Light/dark switching selector. Sensitivity adjustment control. LED power and sense indicators. Two position cable entry gland (90 deg. apart) accepts 1/2" threaded conduit and a variety of wire sizes. Glass fiber-reinforced plastic housings are 3.05" x 2.5" x 1". Supply voltage: 22-240 Vac. Solid State Output: 0.5 amp (must have load to operate). Includes mounting brackets and hardware. UL and CSA listed.

CAT # PES-4 **$40.00 each**

Special Sale !!

SUPER NINTENDO POWER SUPPLY

Nintendo # SNS-002
New, original wall transformer with 9 foot cord and co-ax plug with center pin. Output: 10 vdc @ 850 ma. UL and CSA listed.

$4.00 each

CAT # DCTX-1085

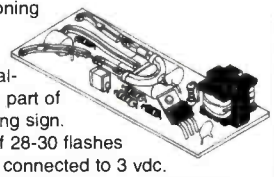
10 for $35.00

MAGNETIC CARD READER

Magtek# 21045002
Credit card or ID card magnetic strip reader consists of break-resistant plastic card guide with decoder pc board and head. Head is mounted on spring steel strip which keeps it pressed against the card surface. Terminated with a socket connector at the end of 5 color-coded leads. 3.57" X 0.9" X0.95"

CAT# MCR-2 **$6.00 each**

FLASH TUBE ASSEMBLY



Complete, functioning flash assembly with horseshoe flash tube, originally designed to be part of a highway warning sign. Flashes at rate of 28-30 flashes per minute when connected to 3 vdc. 3.32" X 1.17" X 0.7" high.

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Rohm # SLA-580MT-E49 T-1 3/4
GREEN, water clear in off state. 500+ mcd @ 2.1 v, 16ma.

CAT# LED-33 **2 for $1.00**

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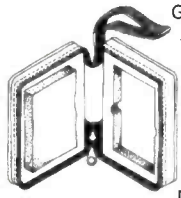
CANVAS CARRYING CASE



Good-looking, well constructed 7.5" X 6" X 1.95" canvas carrying case with zipper on three sides. Webbed nylon hand strap and ample foam padding inside. Probably originally designed for transporting memory storage media. The black foam padding inside can easily be reconfigured to accommodate photographic, audio or video components. The removal of one large chunk of foam gives you a well padded interior volume of 5.9" x 4.3" x 0.75". All black with red and white embroidered "K-stor" (tm) logo on front.

CAT# CSE-3

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Cadmium Sulfide photoconductive cell. 22 ohms in bright light. 2 meg ohms dark. Plastic encapsulated. 0.29" x 0.26" x 0.07". 1.5" long wire leads.

CAT # PRE-12 **75¢**

10 for $6.00 • 100 for $50.00

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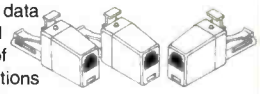

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Protects against data interruptions and eavesdropping of private conversations when fax machine, modem or phone shares a line with other similar devices. Easy to install. Plugs inline between wall jack and telephone line. Requires one for each instrument sharing the same line.

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MIDI KEYBOARD

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96C003 **$24.95 each**

CABLE FOR ABOVE

DB15 M-F, 10 ft. long. All 15 pins are connected. Will serve as joystick extension cable, but has extra wires needed for MIDI.

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TV DEMODULATOR BOARD

Takes channel 3, 4 or 5 signal and demodulates the audio. Comes with info and schematics, and additional schematics to build add-on video demodulator board.

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Rotates counterclockwise when viewed from the shaft end. Approximate rotation 45°. 1.125" diameter by 1.125" long.

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THE ROAR OF THE CROWD!

It roars, it screams, it chants at the press of a button! Activated by a button or bump switch, these were once the goals in a table-top hockey game, providing sound effects and flashing lights when a goal was scored. Batteries included. One of the noisiest devices we've seen to date!

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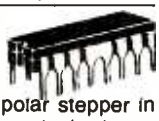
Better than Caller ID! This device detects an incoming call. If you subscribe to caller ID, the unit will automatically receive and display the caller's telephone number. If not, the unit will ask the caller to enter their telephone or personal ID number. The device will then display and compare this telephone or personal ID number to a memory bank of numbers that you've installed. If the system finds a match your phone will ring. If the system does NOT find a match, the caller will be directed to leave a message. All messages are digitally recorded. No tape or answering machine necessary. New, in factory cartons, with documentation.

96U001 **$59.95 each**

LONGWAVE ULTRAVIOLET LAMP

This pocket-sized longwave ultraviolet light may be used for detecting invisible inks, minerals in rocks, etc. It's the size of a pocket pager and even has a belt clip to keep it handy. Runs on two "AA" batteries (not included). 3.25"W x 1.75"H x 1"D.

95L007 **$7.95 each**



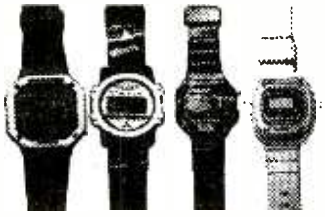
STEPPER MOTOR DRIVER IC

UCN5804-B. Drives a unipolar stepper in one of three operating modes: single phase, two phase or half step. Up to 1.25 Amps per phase. Step and direction input. Drive with a 555 oscillator, parallel port, etc. Build your own robot turntable for model trains, anything that requires precision positioning.

93I002 **$4.50 each**

• Above, packaged with 5V stepper motor (92M010) and schematics.

93I003 **$9.95 each**



BATTERIES INCLUDED!

Wrist watches with fresh batteries to install. As pictured above. Our choice of colors and styles.

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CARVER FM-STEREO ENHANCER

Installs between existing tuner-receiver and stereo amplifier to improve stereo reception of stations with weak signals and/or multipath distortion problems by as much as 20dB. New, in box.

94V019 **$49.95 each**

BATTERY CONNECTORS

75 Amp capacity. Red and black. Muller brand. Used, includes boot.

94J024 **2 for $3.95**

BROW MOUNTED BINOCULAR MAGNIFIER

Wear this handy magnifier with its velcro clasp. One size fits all so it's always comfotable. Magnifier assembly tilts up out of the way when not needed. Fixed lens gives 1.8X magnification for most close-up activity. For a closer look a second binocular lens tilts down from inside visor. For turbo peep mode, swivel the loupe in front of the right eye. Combinations are 1.8X, 2.3X, 3.7X and 4.8X.

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CONNER CP-3150

50MB, SCSI, 3.5" 19mS. Used, tested good.

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Twenty *very bright* red LEDs mounted in a plastic reflector/lens housing. Measures 16.5" long by 1.2" wide. 12VDC @ 400mA. From auto brake light.

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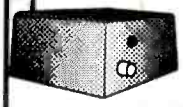
Many of our kits are available completely built



FM STEREO TRANSMITTER

Own your own FM radio station. Any stereo signal you plug into the FMST-100 will be transmitted to any FM radio tuneable from 76 to 108MHz FM. Transmit a wireless link through an auditorium, from your car to your camper, listen to your CD's while mowing the lawn, Play music on one channel sing on the other. Clarity is excellent, aprox. 40dB stereo separation. Length of antenna determines the distance of transmission. Complete with stereo input level controls & crystal for stereo separation. 9v battery operation. SIZE: 1.5" x 2.5" x 3"

FMST-100 Cabinet **$8.95** KIT **$29.95**

PHONE TRANSMITTER

Small but mighty,it fits anywhere. Phone line powered, never needs batteries. Transmits both sides of a phone conversation loud and clear, wireless, to any FM radio at great distances. Variable tunes from 70MHz to 130MHz FM. You can also use it as a speaker phone. SIZE:1.25" x .6".

TEL-B1 BUILT **$29.95** KIT **$12.95**

SUPER SNOOPER BIG EAR

Listen through walls, hear conversations across the room. Add a parabolic reflector and hear blocks away. The BIG EAR can be hidden about anywhere. Makes an ultra sensitive intercom. Can be used as a 1.5W AMP. We supply a mini-electret mike in the kit. Power requirement 6 to12v DC. SIZE:1.75"x 1"

AA-1 BUILT **$29.95** KIT **$10.95**

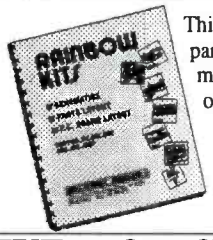
The "ZAPPER II"

With it's new and improved design it will not only test your radar detector... BUT it's tuned to the amateur radio band .

- While your out on American highways personally test yours and your fellow travelers radar detectors.

The "ZAPPER II" is a 10.450 GHz to 10.550 Transmitter

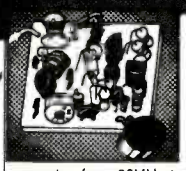
KIT **$39.95** BUILT **$49.95**



This Manual contains schematics, parts lists & P.C. board layouts for many of the Rainbow Kits. Use your own parts to construct our kits.

KIT BOOK $14.95

$9.95 with the purchase of any kit.



WIRELESS FM MICROPHONE

Small but mighty this little jewel will out perform most units many times its price. It really stomps out a signal. The WM-2 kit is a buffered wireless mike that operates from 80MHz to 120MHz FM, the frequency of any broadcast FM radio. Includes a mini-electret mike. 6 to 12v DC. SIZE: 1.25" x 1"

WM-2 KIT **$14.95**

MICRO-MINIATURE PHONE TRANSMITTER

We haven't seen a smaller phone transmitter than the MMPT2 kit. Powered by the phone, it requires no battery. Transmits both sides of a phone conversation to an FM radio up to a 1/4 mile away.Tunable from 88 to 108MHz FM. Attach it to one phone or add it to the line to pick up all incoming calls. The MMPT2 is undetectable if properly installed. Unit has surface mounted parts, you install the leaded parts. Size .45 "x .6"

MMPT2 KIT **$29.95**

MICRO-MINIATURE WIRELESS MIKE

So small you could hide this one on some real bugs! It's the smallest we've ever seen. With It's super sensitive mike it transmits a whisper or a room of conversation to an FM radio, tunable from 88 to 108MHz FM. With a proper antenna it transmits about 1/2 mile. The kit is made with surface mounted parts, we have already mounted these parts. You install the leaded parts. Power requirement 6 to 12v DC. Size .35"x.9"

MMWM5 KIT **$34.95**

632nm the brightest laser pen we've seen.

INCLUDES 2 AAA Batteries
PEN SIZE: Aprox. 5.5" x .5"

10 times brighter than the 670nm model!

COMPLETELY BUILT **$89.95**

THE SUPER SENSITIVE BIONIC EAR

12" PARABOLIC REFLECTOR

Complete with

- **Professional headset**
- **Ultra sensative microphone**
- **12" parabolic reflector.**
- Individual volume controls for each ear.
- Auto Safety Circuit shuts sound off at 95 decibels for your ear protection.
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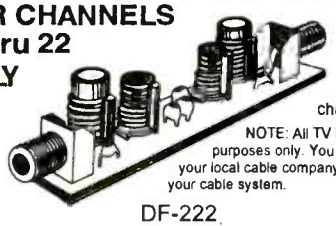
- Hear & pinpoint sounds of wild birds and animals, great for hunters, Search & Rescue teams, sports events and Law Enforcement.
- Hear mere whispers at incredible distances.
- Record those sounds with your own recorder.

BE-1 BUILT **$149.95**

TV NOTCH FILTERS

FOR CHANNELS 2 thru 22 ONLY



Our TV filters eliminate unwanted TV channels or interference that alters both sound and video with a beep beep beep. Works on cable channels 2 thru 22) only.

NOTE: All TV Filter Kits are sold for educational purposes only. You must obtain permission from your local cable company before using these filters on your cable system.

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- Auto power off
- Unit indicator
- Diode Test

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$99.95

TK-3000

$89.95

NEW!

Tools Included:
- SR-2 - Deluxe Soldering Iron
- SH-1 - Soldering Iron Stand
- ST-1 - Diagonal Pliers
- ST-2 - Long Nose Pliers
- ST-30 - Deluxe Wire Stripper
- SE-1 - Solder Ease Kit
- ND-3 - 3 pc. Nut Driver Set
- TL-8 - Precision Screw Drivers
- ST-5 - Screw Driver Slotted 3/16"
- ST-6 - Screw Driver #1 Phillips
- ET-10 - IC Puller
- SP-2 - Solder Pump
- ST-20 - Safety Goggles
- ST-9 - Pocket Screw Driver
- ST-4 - Solder Tube
- SW-3 - Solder Wick

A professional technician service tool kit in a metal reinforced tool case with heavy-duty handle and locks. A removable pallet handles most of the tools listed with more room for tools and parts in the lower half.

2MHz Function Generator
Model 4010

- Sine, Square, Triangle, Pulse and Ramp output
- Variable duty cycle

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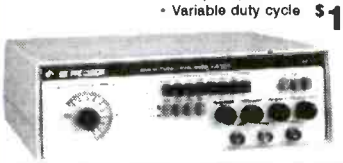

MX-9300 Four Functions in One

- One instrument with four test and measuring systems: 1.3GHz Frequency Counter • 2MHz Sweep Function Generator Digital Multimeter • Digital Triple Power Supply (0-30V @ 3A, 15V @ 1A, 5V @ 2A)

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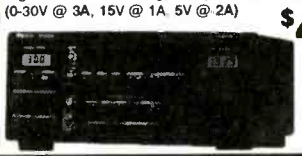

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Model XP-581

4 Fully Regulated DC Power Supplies In One Unit

4 DC voltages: 3 fixed - +5V @ 3A, +12V @ 1A, -12V @ 1A
1 Variable - 2.5 - 20V @ 2A

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Digital Multimeter
Model EDM-83B

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Model M-1700

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11 functions including freq to 20MHz, cap to 20μF. Meets UL-1244 safety specs.

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6 Functions & Transistor Test

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Elenco's advanced designed Digital / Analog Trainer is specially designed for school projects. It is built on a single PC board for maximum reliability. It includes 5 built-in power supplies, a function generator with continuously sine, triangular and square wave forms.
1560 tie point breadboard area.

XK-550
Assembled and Tested
$169.95

XK-550K - Kit
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Tools and meter shown optional

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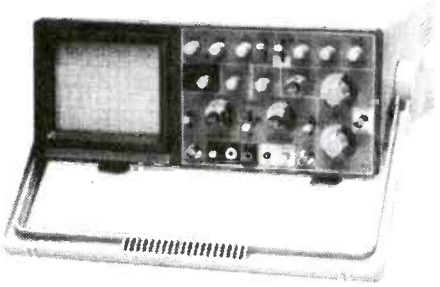

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DS-603 $1350
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- 20MS/s Sampling Rate

S-1365 $795
- Analog w/ Cursors

S-1360 $759
- Analog with Delayed Sweep

40MHz

S-1345 $569
- Analog with Delayed Sweep

S-1340 $489
- Analog

2 Year Warranty

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DS-303 $1095
- Analog / Digital Storage

S-1330 $439
- 25MHz Analog
- Delayed Sweep

S-1325 $335
- 25MHz Analog

OSCILLOSCOPE SELECTION CHART

ANALOG

Model	Bandwidth MHz	Sensitivity (max)	No. of Channels	Sweep Rate Max ns/div	Delayed Sweep	Video Sync	Component Tester	Beam Find	Time Base
S-1365	60	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1360	60	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1345	40	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1340	40	1mV/div	2	10ns/div	No	Yes	No	No	1
S-1330	25	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1325	25	1mV/div	2	10ns/div	No	Yes	No	No	1

DIGITAL STORAGE

Model	Bandwidth MHz	Analog Sen (max)	No. of Channels	Sampling Rate	Memory Channel	Internally Backed Up	Pretrigger %	Output
DS-303	30	1mV/div	2	20MS/S	2K	Yes	0, 25, 50, 75	RS232
DS-603	60	1mV/div	2	20MS/S	2K	Yes	0, 25, 50, 75	RS232

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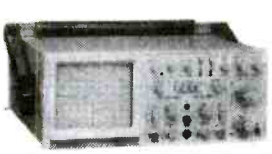
2125 - $539.95
Delayed Sweep



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Dual Trace

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Model 2260
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Dual Time Base • Delayed Sweep

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Sonic Rover Robot #3-174 $27.95

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Line Tracker Robot #3-188 $69.95

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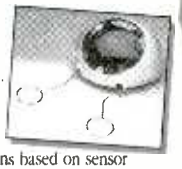

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A Top Selling Kit!

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Best seller!

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From MIT, a complete guide to designing & building robots: hardware, software, sensors, motors, "subsumption" software. 336 pages, illust. A must for all roboticists.

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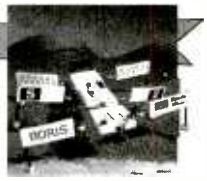

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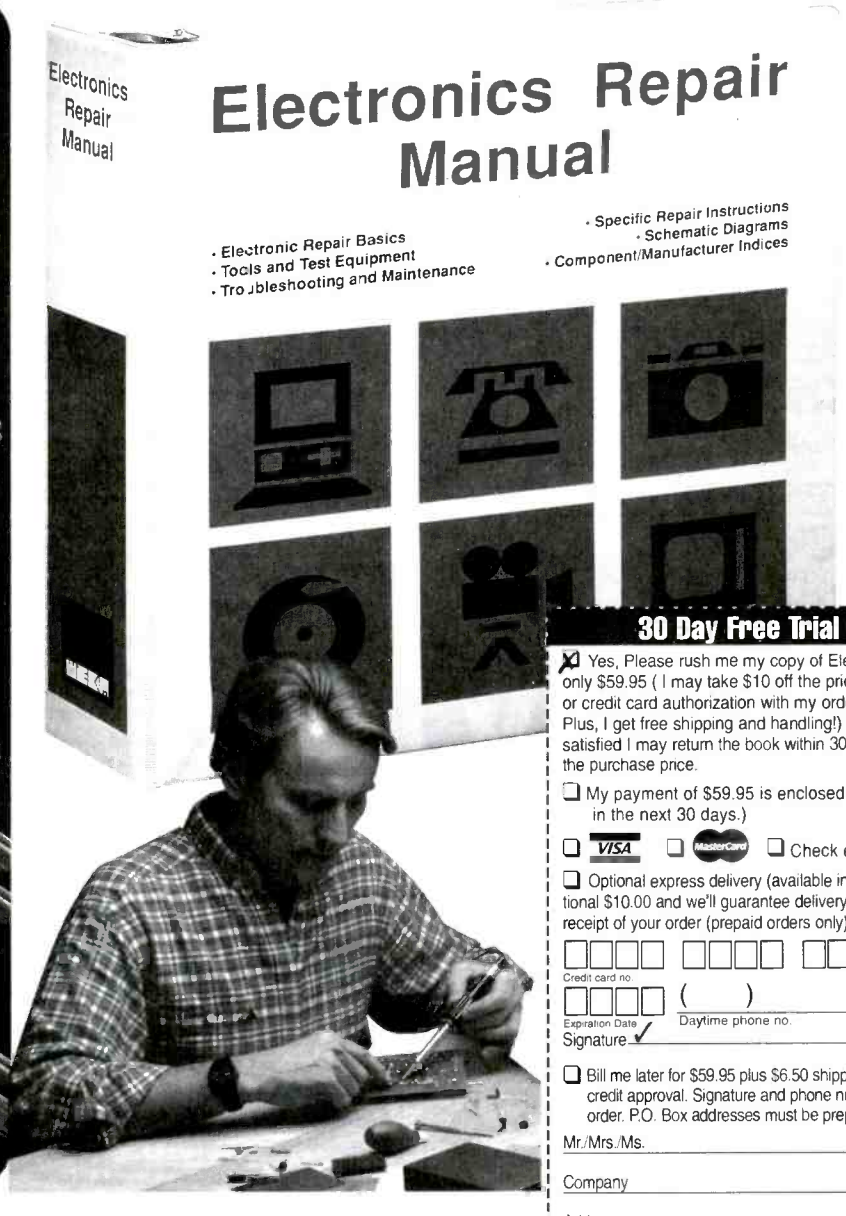

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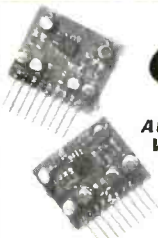

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DESCRIPTION	MODEL	A*	B**
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DUAL ELECTRONIC MIC INPUT AMPS	SIP-2	25.00	25.50
DUAL ELECTRONIC LINE INPUT AMPS	SIP-3	25.00	25.50
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DUAL VCA	SIP-9	20.00	20.50
FOUR COMMON BUFFER AMPS	SIP-10	19.00	19.50
DUAL ELECTRONIC SWITCH	SIP-11	21.00	21.50
VIDEO DA - 3 OUTPUTS	SIP-12	35.00	35.50
DUCKER	SIP-13	20.00	20.50
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AC TO ±18 VOLT REGULATOR CIRCUIT	SIP-18V	20.00	20.50

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Audio Transformers

PRIMARY IMPED Ω	SECONDARY IMPED Ω	USE	SECOND WINDINGS	POWER LVL 60Hz	MAGNETIC SHIELDING	CASE STYLE	MODEL	$
18.75 / 75	150 / 600	LO	1	+18	-10 dB	M	MI-75	37.25
18.75 / 75	150 / 600	LO	1	+18	-30 dB	C	MI-45	76.50
18.75 / 75	150 / 600	LO	1	+30	-30 dB	N	MI-83	46.75
18.75 / 75	150 / 600	LO	1	+30	-30 dB	D	MI-46	134.50
150	600	O	1	+24	NONE	S	MI-119	23.90
150	5k	MI	1	-20	-30 dB	R	MI-116	27.70
150 / 600	150 / 600	LI	1	+18	-10 dB	M	MI-72	37.25
150 / 600	150 / 600	O	2	+18	-10 dB	M	MI-73	37.25
150 / 600	150 / 600	O	2	+18	-30 dB	C	MI-12	76.50
150 / 600	150 / 600	O	2	+18	-30 dB	C	MI-14	76.50
150 / 600	150 / 600	O	1	+30	-10 dB	N	MI-80	46.75
150 / 600	150 / 600	O	2	+30	-10 dB	N	MI-81	46.75
150 / 600	150 / 600	O	1	+30	-30 dB	D	MI-18	134.50
150 / 600	150 / 600	O	2	+30	-30 dB	D	MI-20	134.50
150 / 600	600	LI LO	1	-10	NONE	L	MI-67	21.40
150 / 600	600	LI LO	1	-10	-10 dB	I	MI-53	29.60
150 / 600	600	LI LO	1	-10	-60 dB	B	MI-8	39.40
150 / 600	600	LI LO	1	-10	-60 dB	F	MI-31	40.50
150 / 600	600	LI LO	1	+4	-60 dB	F	MI-88	54.50
150 / 600	600	LI LO	1	+4	-30 dB	I	MI-93	37.25
150 / 600	600	LO	1	+18	-10 dB	O	MI-97	56.50
150 / 600	600	LO	4	+18	-10 dB	M	MI-74	37.25
150 / 600	600	LO	4	+18	-30 dB	C	MI-43	76.50
150 / 600	600	LO	1	+30	-10 dB	O	MI-100	66.75
150 / 600	600	LO	4	+30	-10 dB	N	MI-82	46.75
150 / 600	600	LO	4	+30	-30 dB	D	MI-44	134.50
150	800	5k	MI	1	-10	NONE	L	MI-111	21.40
150	800	5k	MI	1	-10	-30 dB	I	MI-109	26.90
150	800	5k	MI	1	-10	-60 dB	B	MI-102	39.40
150	800	5k	MI	1	-10	-60 dB	F	MI-106	40.63
150	800	5k	MI	1	+18	-10 dB	M	MI-112	37.25
150	800	5k	MI	1	+18	-30 dB	C	MI-103	76.50
150	800	5k	MI	1	+30	-10 dB	N	MI-113	47.20
150	800	5k	MI	1	+30	-30 dB	D	MI-104	134.50
150	800	15k	LI LO	1	-10	NONE	L	MI-64	21.40
150	800	15k	LI LO	1	-10	-30 dB	I	MI-50	29.60
150	800	15k	LI LO	1	-10	-60 dB	B	MI-5	39.40
150	800	15k	LI LO	1	-10	-60 dB	F	MI-28	40.50
150	600	15k	LI LO	1	+4	-30 dB	I	MI-90	37.25
150	600	15k	LI LO	1	+4	-60 dB	F	MI-85	54.50
150	600	15k	LI LO	1	+18	-10 dB	M	MI-69	37.25
150	600	15k	LI LO	1	+18	-10 dB	O	MI-96	56.50
150	600	15k	LI LO	1	+18	-30 dB	C	MI-9	76.50
150	600	15k	LI LO	1	+30	-10 dB	O	MI-99	66.75
150	600	15k	LI LO	1	+30	-10 dB	N	MI-77	46.75
150	600	15k	LI LO	1	+30	-30 dB	O	MI-15	134.50
600	600	LI	1	0	-30 dB	R	MI-117	27.70
600	600	O	1	+18	NONE	S	MI-118	21.75
3.75k	15k / 50k	LI LO	1	+18	10 dB	M	MI-76	37.25
3.75k	15k / 50k	LI LO	1	+18	-30 dB	C	MI-13	76.50
3.75k	15k / 50k	LI LO	1	+30	-10 dB	N	MI-84	46.75
3.75k	15k / 50k	LI LO	1	+30	-30 dB	D	MI-18	134.50
15k	15k	LI	1	+14	-30 dB	R	MI-115	27.70
15k	15k / 60k	LI	1	-10	NONE	L	MI-68	21.40
15k	15k / 60k	LI	1	-10	-30 dB	I	MI-54	29.60
15k	15k / 60k	LI	1	-10	-30 dB	B	MI-22	39.40
15k	15k / 60k	LI	1	-10	-60 dB	F	MI-32	40.50
15k	15k / 60k	LI	1	+4	-30 dB	I	MI-94	37.25
15k	15k / 60k	LI	1	+4	-60 dB	F	MI-89	54.50
15k	15k / 60k	LI	1	+18	-10 dB	O	MI-95	56.50
15k	15k / 60k	LI	1	+30	-10 dB	O	MI-98	66.75

MI = MIC INPUT, LI = LINE INPUT, LO = LINE OUTPUT, O = OUTPUT

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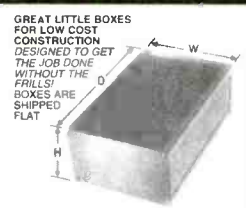

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MODEL	W x D x H in.	A*	B**
LPB-1	4 x 6 x 2	10.50	12.50
LPB-2	5 x 7 x 2	11.00	13.00
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LPB-4	6 x 8 x 2	13.75	16.25
LPB-5	7 x 7 x 2	11.50	13.75
LPB-6	7 x 9 x 2	13.75	16.25
LPB-7	7 x 11 x 2	15.50	18.50
LPB-8	7 x 13 x 2	17.75	21.00
LPB-9	7 x 15 x 2	25.25	30.00
LPB-10	10 x 17 x 2	30.75	36.50
LPB-11	13 x 17 x 2	36.50	43.25
LPB-12	4 x 6 x 3	12.25	14.50
LPB-13	5 x 7 x 3	13.25	15.75
LPB-14	5 x 9.5 x 3	15.25	18.00
LPB-15	7 x 12 x 3	19.50	23.25
LPB-16	7 x 15 x 3	25.50	30.25
LPB-17	8 x 12 x 3	25.00	29.50
LPB-18	8 x 17 x 3	27.50	32.50
LPB-19	10 x 12 x 3	29.75	35.25
LPB-20	10 x 14 x 3	30.00	35.50
LPB-21	10 x 17 x 3	31.50	37.50
LPB-22	12 x 17 x 3	35.75	42.25
LPB-23	14 x 17 x 3	44.00	52.00
LPB-24	17 x 17 x 3	45.00	53.25

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Mini Project Boxes

MODEL	W x D x H in.	A*	B**	OPT***
MPB-1	1 x 2 x 1	2.05	2.35	1.35
MPB-2	1 x 4 x 1	2.55	2.65	1.90
MPB-3	1 x 6 x 1	3.00	3.35	2.45
MPB-4	1.5 x 2 x 1.5	2.15	2.35	1.60
MPB-5	1.5 x 4 x 1.5	2.65	2.95	2.45
MPB-6	1.5 x 6 x 1.5	3.10	3.80	3.30
MPB-7	1.5 x 2 x 3	2.35	2.65	2.05
MPB-8	1.5 x 4 x 3	2.85	3.25	3.30
MPB-9	1.5 x 6 x 3	4.15	4.65	4.55
MPB-10	1.5 x 2 x 5	2.60	3.60	3.30
MPB-11	1.5 x 4 x 5	3.05	3.70	4.40
MPB-12	1.5 x 6 x 5	4.40	5.20	6.25
MPB-13	2 x 2 x 2	2.30	2.70	1.90
MPB-14	2 x 4 x 2	2.75	3.25	3.00
MPB-15	2 x 6 x 2	4.55	5.15	4.15
MPB-16	2 x 8 x 2	6.85	7.60	5.25
MPB-17	3 x 2 x 3	2.55	3.05	2.45
MPB-18	3 x 4 x 3	3.00	3.65	4.15
MPB-19	3 x 6 x 3	4.35	5.05	5.80
MPB-20	3 x 8 x 3	4.80	5.65	7.50
MPB-21	4 x 6 x 3	4.70	5.30	4.45
MPB-22	4 x 10 x 3	5.65	6.10	10.55
MPB-23	4 x 12 x 3	5.90	6.50	12.55
MPB-24	4 x 14 x 3	6.30	7.00	14.50

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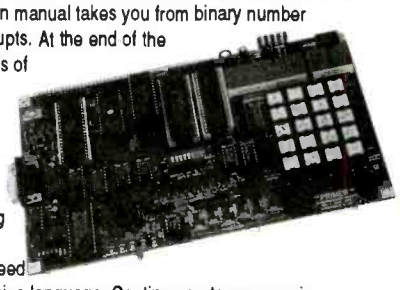

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Specifications:

Vertical deflection: • Bandwidth :DC coupled (DC to 20MHz normal), AC coupled :(10Hz to 20MHz normal) • Deflection factor: 5mV/div to 5V/div in 10 calibrated steps of 1-2-5 sequence • Rise time: 17.5nS or less

Horizantal deflection: • Time Base A: 0.2µs to 0.2S/div in 19 calibrated steps.1-2-5 sequence • Uncalibrated continuous control between steps of at least 1: 2.5.

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BU-208/O	TOSHIBA	1	4.50
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2SD-1398	SANYO	10	1.49
2SD-1650	SANYO	5	1.69
STRD-1005	SANKEN	1	4.15
STR-30130	SANKEN	1	2.66
STRS-5301	SANKEN	1	8.50
TA-7777N	TOSHIBA	1	6.96
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• Adjustable Temp.: 300°F - 790°F - 150°C - 480°C
• Grounded Tip for Soldering : Static Sensitive Devices, Heater Aid.
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• Overheat Protection W/ Temperature Control
• Auxiliary Grounded Terminal
• Comes in digital LED display
• 48 Watts soldering iron

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ORDER Nº 82-1055

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General

Display: 3-1/2 Digit LCD, 21mm Figure Height with Automatic Polarity
Overrange Indication: 3 Least Significant Digits Blank
Temperature for Guaranteed Accuracy: 23°C±5°C RH<75%
Temperature Ranges:
Operating: 0°C to 40°C (32°F to 104°F)
Storage: -10°C to 50°C (14°F to 122°F)
Power: 9V Alkaline or Carbon-Zinc Battery(NEDA 1604)
Low Battery Indication: BAT on Left of LCD Display
Dimensions: 188mm long x 87mm wide x 33mm thick
Net Weight: 400g

DC Voltage (DCV)

Range:	Resolution:	Accuracy:
200mV	100µV	
2000mV	1mV	
20V	10mV	±(1%rdg+2dgts)
200V	100mV	
1000V	1V	

Maximum Allowable Input: 1000V DC or Peak AC.

DC Current (DCA)

Range:	Resolution:	Accuracy:
200µA	100nA	
2000µA	1µA	±(1.2%rdg+2dgts)
20mA	10µA	
200mA	100µA	
10A	10mA	±(1.2%rdg+2dgts)

Overload Protection: mA Input. 2A/250V fuse.

AC Voltage (ACV)

Range:	Resolution:	Accuracy:
200V	100mV	±(1.2%rdg+10dgts)
750V	1V	

Frequency Range: 45Hz-450Hz
Maximum Allowable Input: 750V rms
Response: Average Responding. Calibrated in rms of a Sine Wave.

$19.00 any qty

Resistance (Ω)

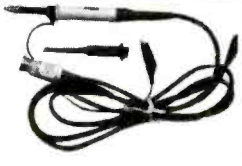
Range:	Resolution:	Accuracy:
200Ω	100mΩ	
2000Ω	1Ω	
20KΩ	10Ω	±(1.2%rdg+2dgts)
200KΩ	100Ω	
2000KΩ	1KΩ	
20MΩ	10KΩ	±(2%rdg+10dgts)

Maximum Open Circuit Voltage: 2.8V

Diode Test
Measures forward voltage drop of a semiconductor junction in mV test current of 1.5mA Max.

hFE Test
Measures transistor hFE.

CAT NO	DESCRIPTION	PRICE
9300G	Rugged High Quality DMM with Rubber Boot	$19.00



Switchable Scope Probe Sets

(Selectable X1/Ref/X10) These high quality scope probe sets are for oscilloscopes up to 60MHz (model HP 9060) or 150MHz (model HP9150). Both sets include a handy storage pouch and include an IC test-hook adapter for the probe. The BNC connector rotates to avoid cable tangle or kink. Cable length is 1.4 meters.

CAT NO	DESCRIPTION	PRICE EACH 1	10	100
HP-9060	Scope Probe Set DC~60MHz	$16.49	$14.49	$11.58
HP-9150	Scope Probe Set DC~150MHz	24.95	21.95	18.62

Positive Photo Resist Pre-Sensitized Printed Circuit Boards

These pre-sensitized printed circuit boards are ideal for small production runs. They provide high resolution and excellent line width control. High sensitive positive resist coated on 1oz. copper foil allows you to go direct from your computer plot or art work layout. No need to reverse art.

Single-Sided, 1oz. Copper Foil on Paper Phenolic Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
PP101	100mm x 150mm/3.91" x 5.91"	$2.55	$1.90	$1.70
PP114	114mm x 185mm/4.6" x 6.6"	2.98	2.45	1.98
PP152	150mm x 250mm/5.91" x 9.84"	5.40	3.98	3.60
PP153	150mm x 300mm/5.91" x 11.81"	6.15	4.48	4.10

Single-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
GS101	100mm x 150mm/3.91" x 5.91"	$ 3.90	$2.98	$2.60
GS114	114mm x 185mm/4.6" x 6.6"	4.80	3.49	3.20
GS152	150mm x 250mm/5.91" x 9.84"	8.69	5.98	5.78
GS153	150mm x 300mm/5.91" x 11.81"	10.20	7.20	6.80

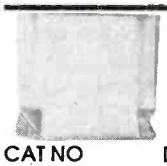
Double-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
GD101	100mm x 150mm/3.91" x 5.91"	$ 5.07	$3.68	$3.38
GD114	114mm x 185mm/4.6" x 6.6"	5.95	4.29	3.99
GD152	150mm x 250mm/5.91" x 9.84"	10.47	7.39	6.98
GD153	150mm x 300mm/5.91" x 11.81"	11.95	8.69	8.30

Etching Chemicals/Ferric Chloride

A dry concentrate that mixes with water to make 1 pint of etchant, enough to etch 400 sq. inches of 1oz board.

CAT NO	DESCRIPTION	PRICE EACH 1	5
ER-3	Makes 1 pint	$3.50	$2.75



Developer This product is used as the developer on our positive photo-resist printed circuit boards. Includes instructions. 50 gram package, mixes with water,

CAT NO	DESCRIPTION	PRICE EACH 1	10	25
POSDEV	Positive Developer	$ .95	$ .80	$ .50

Etching Tank This handy etching system will handle PC boards up to 8" x 9", two at a time. Ideal for etching your PCB's! System includes an air pump for etchant agitation, a thermostatically controlled heater for keeping etchant at optimum temperature and a tank that holds 1.35 gallons of etchant. A tight fitting lid is also supplied to prevent evaporation when system is not being used. Typical etching time is reduced to 4 minutes on 1oz. copper board!

REDUCES ETCHING TIME!

CAT NO	DESCRIPTION	PRICE
12-700	Etch Tank System	$37.95

Desoldering Pumps

These powerful plastic body desoldering pumps are designed for easy one hand operation for fast, efficient desoldering. Double O-ring piston seals for maximum suction.

CAT NO	DESCRIPTION	PRICE EACH 1	5	10
08-366S	Large Desoldering Pump	$15.89	$13.49	$11.95
08-366E	Regular Desoldering Pump	10.89	8.59	7.39
08-366TIP	Replacement Tip	1.95	1.95	1.95

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Electronic Soldering System

Here's the ideal solution when **Temperature Control** is required. Easy to use slide control allows user to set system from 300°F to 840°F. Voltage to iron from control unit is 24V. Iron heating power is 48W. Replaceable 5.3mm tip is standard. Replacement irons and tips are available.

AS LOW AS $50.00

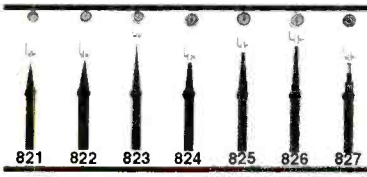
CAT NO	DESCRIPTION	PRICE EACH 1	5
SL10	Temp Controlled Soldering Iron	$56.00	$50.00
SL24V	Spare 24V Soldering Iron	10.50	7.50

Electronic Soldering System with LED Display

Deluxe temperature controlled system with LED display for maximum accuracy. Temperature is adjustable from 160°-480°C (320°-900°F). Iron heating power is 48 Watts. Runs on 24V from controller unit. Replacement irons and tips are available. Tip size is 5.3mm.

AS LOW AS $75

CAT NO	DESCRIPTION	PRICE EACH 1	5
SL30	Deluxe Soldering System w/LED	$86.00	$75.00
SL24V	Spare 24V Soldering Iron for SL10 or SL30	10.50	7.50

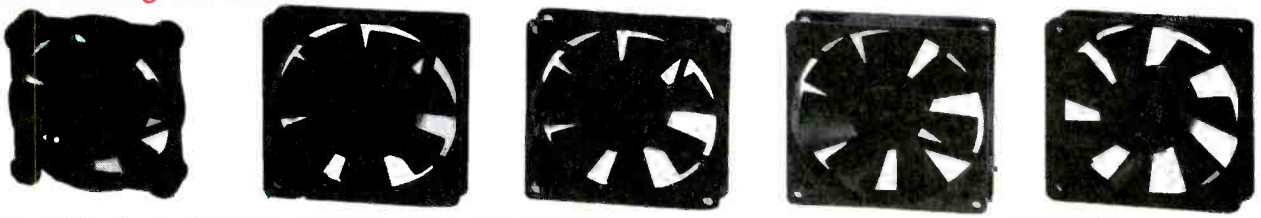


Replacement Tips for SL10/SL30

We now offer a variety of replacement tips for the SL10/SL30 soldering stations.

CAT NO	DESCRIPTION	PRICE EACH 1	5
821	1/32" Pencil Tip	$1.39	$1.19
822	1/32" Pencil Tip	1.39	1.19
823	1/64" Pencil Tip	1.39	1.19
824	1/16" Chisel Tip	1.49	1.29
825	1/8" Chisel Tip	$1.49	$1.29
826	3/64" Chisel Tip	1.49	1.29
827	3/64" Pencil Tip	1.59	1.39

Ball Bearing 12V DC Fans



These High Quality Fans feature Ball Bearings and Brushless DC Motors. All of them are designed to meet UL, CSA & VDE Standards. Design these fans into power supplies, computers or other equipment requiring additional air flows for heat removal. These fans are regular Circuit Specialists stock items — they are not surplus.

INDUSTRY BEST PRICING!

CAT NO	PRICE EACH 1	10	25	100
CSD 4010-12	$ 9.88	$ 6.38	$5.48	$4.87
CSD 6025-12	9.38	5.91	5.41	4.71
CSD 8025-12	8.88	5.85	5.19	4.49
CSD 9225-12	8.95	6.14	5.29	4.59
CSD 1225-12	11.45	8.96	7.82	6.85

Specifications

CAT NO	DIMENSIONS (MM)	RATED VOLTAGE (V)	START VOLTAGE (V)	INPUT CURRENT (A)	AIR FLOW (CFM)	STATIC PRESSURE (INCH-H_2O)	SPEED (RPM)	NOISE LEVEL (dB)	WEIGHT (g)
CSD 4010-12	40x40x10mm	12	7	0.06	5.1	0.19	5,500	26	20
CSD 6025-12	60x60x25mm	12	5	0.13	13.7	0.165	4,500	28	65
CSD 8025-12	80x80x25mm	12	5	0.16	37.8	0.177	3,000	31	80
CSD 9225-12	92x92x25mm	12	5	0.32	42	0.18	2,800	37	95
CSD 1225-12	120x120x25mm	12	5	0.35	62	0.180	2,500	42	135

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CAT NO	DESCRIPTION	PRICE EACH 1	10	25
RH60-1	1-lb. Spool, .031", 60/40	$ 6.90	$ 5.96	$ 5.30
RH63-1	1-lb. Spool, .031", 63/37	6.95	6.10	5.41
RH60-4	4.4-lb. Spool, .031", 60/40	24.00	21.90	17.92
RH60-TUBE	6-oz. Tube, .031", 60/40	.99	.89	.79

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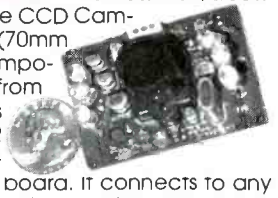

This black and white monochrome CCD Camera is totally contained on a PCB (70mm x 46mm). The lens is the tallest component on the board (27mm high from the back of the PCB) and it works with light as low as 0.1 lux. It is IR Responsive for use in total darkness. It comes with six IR LED's on board. It connects to any standard monitor, AUX or video input on a VCR or through a video modulator to a TV. Works with a REGULATED 12V power supply (11V-13V). Hooks up by connectiong three wires: red to 12V, black to ground (power & video) and brown to video signal output.

CAT NO	DESCRIPTION	PRICE EACH 1	5
CA-H34A	PCB Mounted IRCCD Camera	$125.00	$109.00

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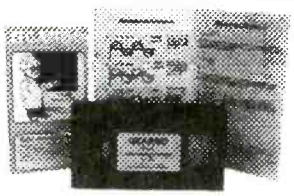

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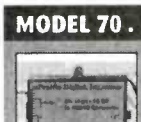

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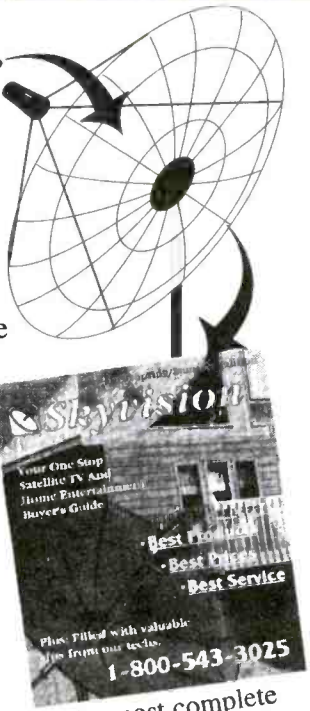

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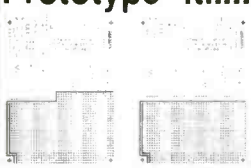

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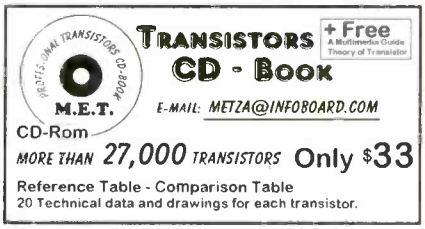

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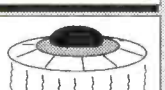

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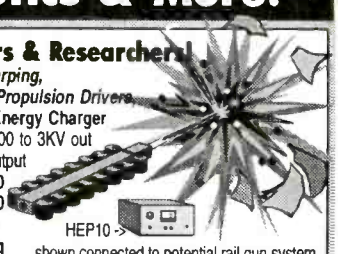

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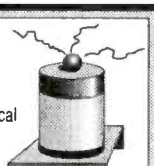

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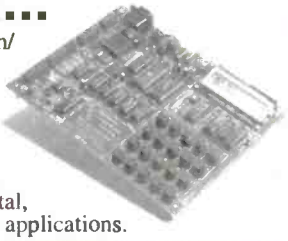

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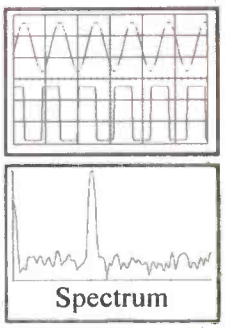

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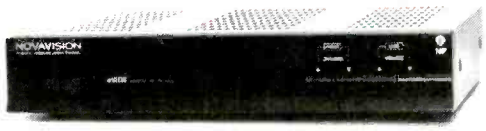

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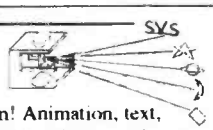

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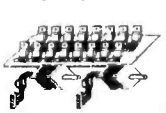

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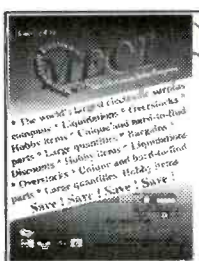

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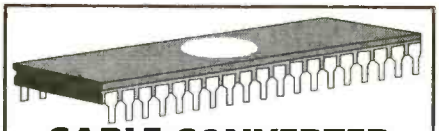

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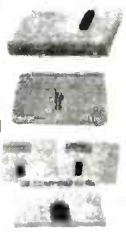

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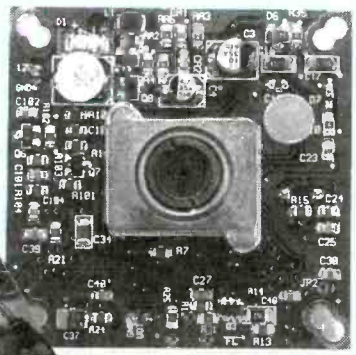

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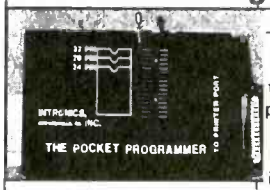

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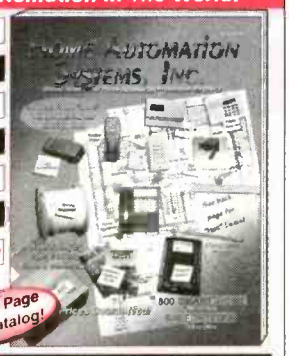

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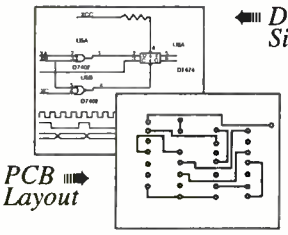

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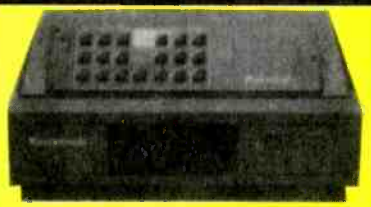

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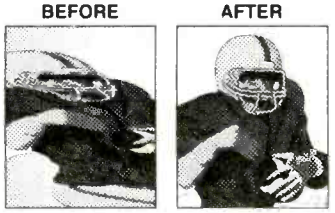

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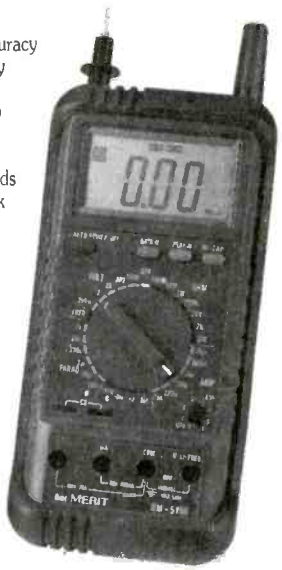

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