December 1978 $1.50

modern electronics

Ⓕ 06707

SPECIAL FEATURE:
Biggest ever Xmas list of electronic gift ideas
24 pages of goodies for yourself and others

Digitrance... you're getting sleeeepy / a project you'll love

Electronic Quizmaster / easy to build, fun to play

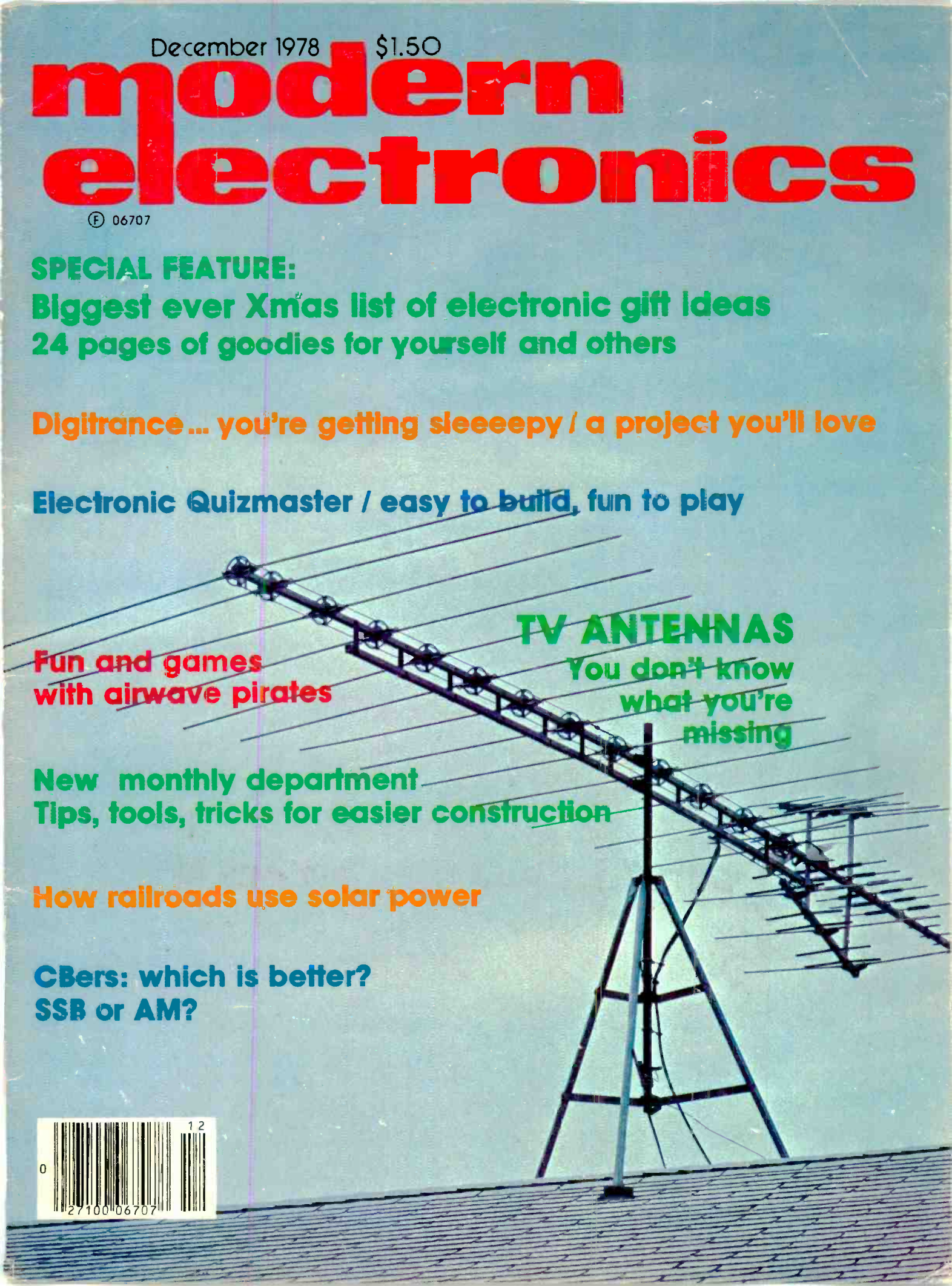
TV ANTENNAS
You don't know what you're missing

Fun and games with airwave pirates

New monthly department
Tips, tools, tricks for easier construction

How railroads use solar power

CBers: which is better? SSB or AM?



0 12
27100 06707

The Touch

by Regency

16 channel scanner

Fantastic Offer:

$224.95

(Add $5 for shipping and insurance.)

the most advanced scanning monitor available in the world today — "The TOUCH," manufactured 100% in the United States by Regency, makers of the world's first transistor radio.

FEATURES AND SPECIFICATIONS

★ Search or scan. You can either search through all bands for unknown frequencies, or listen to the stored frequencies you've selected for the sixteen (16) scanning channels. Either way you can scan any combination of 16 channels in Lo, Hi or UHF Band, creating a total of 15,357 different frequencies available at your fingertips.

★ Frequency range Lo Band 30-50 MHz, Hi Band 146-174 MHz, UHF Band 440-512 MHz.

★ Receives all public service frequencies including police, fire, ambulance, mobile telephone, FBI, Customs, VHF marine, 2 meter amateur, plus many others.

★ Comes equipped with AC power cord for home use, DC power cord for mobile use, telescopic antenna and complete operating instructions for immediate use upon receipt.

★ Automatic scan delay momentarily stops the scanning after a call, to wait for a reply.

★ Has priority control switch so that you can automatically override calls on other channels and never miss a call on your favorite frequency.

★ Discover "Live" frequencies you never knew existed by activating automatic search with a single touch.

★ No crystals required — never buy another crystal.

★ One year warranty.

★ Weather alert receiver will automatically alert you in the event of a severe weather warning broadcast by the National Weather Service (subject to availability by local weather service transmitter).

Send certified check or money order for immediate shipping. Also available C.O.D.

JAY NORMAN SALES COMPANY
2936 Merrick Road, Bellmore, New York 11710
Phone: (516) 826-8090

CIRCLE 6 ON READER SERVICE CARD

modern electronics

DECEMBER 1978 | CONTENTS | VOLUME 1 NUMBER 9

Feature Story

Las Vegas right in your hands

Special Features

Projects

Monthlies

Columns

Info

Modern Electronics is published monthly by Cowan Publishing Corp., 14 Vanderventer Ave., Port Washington, NY 11050. Our title is registered with the United States Postal Service. Application for second-class postage is pending at Port Washington, N.Y.

Postmaster: please send form 3579 to Modern Electronics, 14 Vanderventer Avenue, Port Washington, New York 11050

comment me

OUTPUT FROM MODERN ELECTRONICS' EDITOR

by Mort Waters
Editor, Modern Electronics

In case you're wondering how come you're reading the December issue, but you never received a November issue, an explanation is certainly in order. Simply put, there was no issue printed for last month. Not that we didn't try. Boy, did we ever. Unfortunately, Murphy's Law came down on us in spades. Permit me to explain.

With the sudden, unexpected departure of the former editor, we were left with virtually an empty set of files that were supposed to have been filled with articles and columns for future issues. Somehow those files had become depleated. In order to get an issue on press for the November schedule, our staff and writers worked overtime for several hectic weeks. As the due date grew closer we realized that it would be pretty close one way or the other. In order to make certain that we didn't miss press scheduling, the entire editorial crew worked an entire weekend at our film house in New York. This cost us several thousand dollars in overtime for Saturday and Sunday labor. But it was well spent because the final pages were finished and ready to be delivered to the printer just two or three hours ahead of the deadline. They were packed up and left on Sunday evening outside our office door for the messenger service.

Wouldn't you know it, but somebody broke in the building that Sunday night and absconded with the package. By the time the theft was discovered it was too late to get the missing pages reproduced for November. Never fear, subscribers will have their expiration dates moved up a month.

However, the issue of *ME* that you'll receive for January will be drastically different. The magazine has been merged with *CQ*, a magazine devoted to amateur radio. The new combined publication will include all the best features of both magazines, so you won't be getting less for your money, but more. We'll still publish construction articles, computer material and programs, and many fine general interest features. In addition, we'll provide you with all the latest that's happening in amateur radio and short wave listening, two great hobbies. The magazine will carry the heading "Hobby Electronics" above the *CQ* logo, and the words "including *Modern Electronics*" just below. We think you're going to like the new magazine even more than than the present one. Please let us know after you've had a chance to evaluate it, as your opinoins are most important to us.

modern electronics

Business Staff

President and Publisher
Richard A. Cowan
Associate Publisher
Richard A. Ross
Vice President
Jack N. Schneider
Chairman of the Board
S. R. Cowan

Advertising Staff

Display Advertising
Richard A. Cowan
telephone (516) 883-6200
Midwest Sales Director
Jim Reilly
telephone (312) 824-2412
Circulation Manager
Janet Kurtz
Production Consultant
Cary L. Cowan

Art Staff

Art Director
William H. Travis
Assistant Art Director
Liz Beener
Design
Sheryl Stern
Illustrator
Harold Perry
Staff Artist
Fran Vitrano
Staff Artist
Tom Batcher

NOW! Learn to repair video cassette and disc systems with NRI's at-home training in TV and Audio Servicing.

Keep up with opportunity by keeping up with the state of the art. Learn to service and repair color TV, audio systems, video cassette and disc systems with NRI training. Prepare for extra income, a new career, even a full- or part-time business of your own.

Learn at Home in Your Spare Time

You learn right at home, at your convenience, without quitting your job or going to night school. NRI "bite-size" lessons make learning easier...NRI "hands-on" training gives you practical bench experience as you progress. You not only get theory, you actually build and test electronic circuits, a complete audio system, even a color TV.

Build Color TV, 4-Channel Audio, Professional Instruments

As part of your training in NRI's Master Course in TV and Audio Servicing, you assemble and keep NRI's exclusive, designed-for-learning 25" diagonal color TV. As you build it, you introduce and correct electronic faults, study circuits to gain a better understanding of how they work.

You also construct a 4-channel stereo amplifier and tuner, complete with cabinet and speakers. You even assemble professional test instruments, so you know what makes them tick, too. You build a transistorized volt-ohm meter...a CMOS digital frequency counter...integrated circuit TV pattern generator...even a solid-state triggered-sweep 5" oscilloscope. You use them in your course, keep them for actual TV and audio servicing work.

Free Catalog... No Salesman Will Call

Send today for the 100-page catalog that shows all the lessons, all the equipment and training material you get. The catalog will also show you other NRI opportunity fields like Digital Computer Technology, Complete Communications and more. With the addition of video cassette and disc systems, television has added an exciting new dimension. NRI training can put you right in the center of that dimension.

If card has been removed, write to:

NRI SCHOOLS
McGraw-Hill Continuing Education Center
3939 Wisconsin Ave.
Washington, D.C. 20016

Letters

INPUT FROM MODERN ELECTRONICS' READERS

Ideas, Ideas, Ideas . . .

Dear ME:

I accept your invitation to suggest how your magazine can be improved.

The construction article mix can be improved with more advanced projects. Three suggestions: a digital multimeter in the form of a series upgrading from the most basic instrument until it ends with a meter equal to the best the trade has to offer, transmitter-receiver combination for home security systems, and a TV audio receiver.

Sigmund S. Kahn
Brooklyn, N.Y.

Dear ME:

Since you've asked repeatedly about the ultimate orientation of ME in the October *Letters* section, here's my 15¢ worth.

Mixing beginning and advanced materials: absolutely. One of the things that irked me as I tried to find out more about electronics was the presumption that the readers already understand it. There are a lot of electronic hobbyists at the beginner/intermediate level more willing to try small, one evening projects. It may have been true in the past that the ideal audience possessed electronic experience, but the on-rush of CB and hobby computers seems to be attracting an entirely new mix to electronics as a hobby.

Dennis E. Hamilton
Penfield, N.Y.

Dear ME:

Your new magazine is off to a good start and I find it unique. You want suggestions from your readers—OK:

Regardless of how simple or complex the projects—if they're good, print them.

Here are some circuits I'd like to see: digital tach (DC); digital thermometer (DC); squelch for CB; phase lock loop for servos; radar detectors; electronic light dimmers; musical effects (reverb, wa-wa, fuzz); indoor FM antenna.

Art LaPole
Baltimore, MD

Dear ME:

This is in response to your editorial Comment in my October issue, just received.

1. Don't replace Pete Stark. What he has done for *MODERN ELECTRONICS* is superb!
2. Dump the fillers such as "Parallel Resistance Made Easy". Michael Yurkovich's suggested replacement for the "complex" reciprocal-of-the-sum-of-the-reciprocals is even more complex, if not tortuous. My advice to Mike is to use his $5.00 four-function calculator to balance his checkbook and invest $20.00 in a scientific calculator with an EEX key and a 1/x key. If he doesn't know what to do with it, he should send $8.00 to Forest Belt and order Training Monograph 28 A 0101 "Easi-Way™ Solutions for Electronics Math and Formulas."

I wasted years of my life trying to memorize shortcut formulas and remembering how to adjust microfarads, millihenries, kilohms and megohms before I finally learned to use scientific notation, which always gives the correct answers to the *original* basic formulas.

3. I ran out of room, even single-spaced.

John R. Dye
Lacy, WA

Have no fear, JRD, Pete will be a part of ME as long as he wishes, which we hope will be for a long, long time. As for the fillers, we can understand your reaction to "Parallel Resistance," but several readers thought it was great. The choice is simple—informative fillers or public service advertisements. Which would you prefer?

Dear ME:

I like your magazine pretty well so far, except for the computer sections.

I subscribed to it after the first copy I saw. But if you follow the other trees in the forest, you're going to lose a subscriber.

Other magazines are all computer, ultra-sophisticated digital IC projects, and audio—why be a carbon copy? Fill a need that isn't being filled. PLEASE make your magazine for the electronics tinkerer, with articles and projects ordinary people can read and build. We are not all Edisons and Einsteins.

Robert Peck

See C.B. Helis, below. And, remember, if you have a problem with a project, there's always Clinic. *Stick with us; we like our subscribers.*

Dear ME:

I refer to R.C. Degler's letter in the October issue. He is pushing for a more advanced electronic publication. I believe you would find most of your readers' interests are not in accord with him.

The many letters you received about the construction projects in the February and March issues were asking for IC pin identification, power connections, etc. These were obviously from beginners or, at least non-technical hobbyists.

Because other magazines have become quite advanced and technical, I no longer read them. Please don't let your publication go this route. The Deglers can satisfy their more advanced interest with other papers meant for them. Keep your magazine aimed at us.

C.B. Helis
Mountain View, ARK

OK, we'll try. We do like to mix a little, though, and will have some sophisticated projects now and then.

Thanks to all for the suggestions. We'll try to mix the sophistication of our projects. Keep the ideas coming, and we'll keep trying to give you what you need.

And speaking of robots . . .

Dear ME:

Presently I am building my own alpha class robot, and I own David Heiserman's book, *Build Your Own Working Robot*. I was wondering if you or one of your readers could help me find more books or plans on robots.

I have found a good place to buy motorized wheels for a robot; they're geared, 4½" in diameter and run on 6 or 12 VDC. You can get them from Surplus Center, P. O. Box 82209, Lincoln, NE 68501, as Item #5-936 at $11.98 apiece. This place also sells a geared drive-motor without the wheels for $6.98.

Please keep up the articles on robots.

Mike Engel
Frankenmouth, Michigan 48734

Thanks for the tip, Mike. See Doug Orlowski's letter, above. Anyone else have robot info?

Dear ME:

One of your letters asked if anyone is building his own robot. I am. It is 5 feet tall and its body is round; it looks like the robot on "Lost in Space" a series that was on TV a few years ago. When I get done it will talk, move backwards and forwards, turn right or left, and will light up. I have the whole body and head and legs finished, and a lot of the insides. In another year it will be complete. Your article on robots helped me a lot.

David Stone
Millstadt, ILL 62260

Sounds interesting. Our readers will probably want to know the results, so keep us informed.

Canadian connection

Dear ME:

I enjoy your magazine very much, especially the short wave section. I notice you mention several U.S. clubs in your articles. I am Secretary-Treasurer of Canadian S-W-L International. A copy of the September issue of CANDX, our monthly bulletin, is enclosed, and we'd like readers to know about us.

All the best for now.

John J. Garner
Thunder Bay, Ontario

Thanks for the newsletter; we enjoyed reading it. Readers can find out more about the club by writing to them at P. O. Box 142, Thunder Bay, Ontario P7C 4V5.

DJ lasers

Dear ME:

First I would like to say that I enjoy your magazine. There aren't many magazines as easy to understand.

Recently I went to a disco. The disc jockey held something in his hand which resembled a small flashlight. At first I thought it was a laser, but I've never seen one that small. I would like to know what it was, if it would be possible for me to make one, and how.

Nathaniel Gibbs
Summerville, SC

We'd like to help. Can you tell us what the DJ was doing with the device?

Radar Endorsement

Dear ME:

By accident, I saw my first issue of ME today on the newstand. Good issue! Clinic: good. IC Timers: good. Test Equipment: Good. Haven't read the test equipment article yet, but it looks good.

Know where I can get a study guide for the radar endorsement?

Ed Jones WB2DVL
Somerset, NJ

Thanks for the nice words, Ed. A good study guide for the radar endorsement is the Marine Radiotelegraph Operator by Edward M. Noll, published by Howard Sams.

Better ideas

Dear ME:

I am very interested in electronics and would like some information on books, magazines, or notes. Possibly you know of some good electronics kits I could buy. Please send the most helpful info you can on kits, or better ideas.

Your friend,

Joey Welch
Saratoga Springs, NY

We don't have anything specific. Any readers with suggestions? Send them on.

Detective Mike

Dear ME:

I am building a new robot just out, called MIKE. This robot uses the KIM-1 computer as its "brain."

I want MIKE to be able to locate me in a room, a crowd, or a mall. The way in which he would do this would be to find, locate, and go to the source of a transmitter that I would carry in my pocket. The transmitter would be small, lightweight, and give off a low power signal. On the robot would be a type of DF sensor that would find the signal, then go to the source.

If you have any info that I might use, I would appreciate it very much.

I really like your magazine. It has been of great help to me.

Mike McCrory

Sorry, we can't help you. Perhaps some of our readers have some ideas. If so, let's hear from you.

Auto reverbs

Dear ME:

Do you know of any companies that make reverbs for automobiles? I'm interested in the electronic type, not the spring delay type. Could you list some companies, or do you have some plans to make a reverb?

Hugh Koehler
Siloam Springs, AR

Sorry, we don't have the information, and we don't plan to build one in the near future. Can anyone out there help?

Wants career info

Dear ME:

In your October issue, the Computer column by Pete Stark hit upon something that might be good to see more of: career perspectives.

His explanation of types of computer programming jobs and their approximate salaries was very informative and useful. Many of us are thinking about electronics careers, but know little about the various fields, what they pay, and what they lead to.

I'd like to find out more about computer service technicians. What does TV repair pull in the job market? What *are* the other fields and what other opportunities do they lead to? Is it worth getting an Electronics Engineering degree or is experience and on-the-job training better? How about self employment or small businesses? Or part-time work? What's it like to work for large electronics companies?

Ronald A. Baltrunas
Bogota, New Jersey

The best answers to your questions will come from the people already working in the industry. Write to some companies of various sizes and see what they have to say. Good luck!

Help for Hugh

Dear ME:

In the October issue Hugh Barrie asked about an electric mini-car. If he looks into the magazine *Electric Vehicle News* he has a good chance of finding the maker of the electric mini-car, or a similar one. The magazine's address is P.O. Box 533, Westport, Conn. 06880.

Jack B. Elrick
Elizabeth, Ill.

Thanks, Jack. We're sure that many of our readers will appreciate that info.

clinic

READERS WRITE FOR HELP WITH TECH PROBLEMS

BY JEFF SANDLER

No way

First, I must say your column is great! I have a problem which I hope you can help me with. I can't find any material on building a linear amplifier for a CB base set. I would like it to have a 100 watt output with the driving power set by control. If possible, I'd like it to work from both 110 volts ac and 13.7 volts dc.

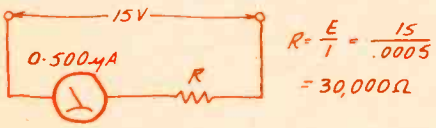
R.A.S., Covington, IN

I know many CBers use linear amplifiers, but the fact is that linears are illegal. No CBer can legally use, or even own, a linear. So, to put it mildly, the FCC takes a very dim view of anyone promoting the use of a linear. There's just no way ME will encourage any form of illegal activity, especially the use of CB linears.

Metering electrons

I built a variation of your universal power supply, and now have a variable 8 to 15 volt supply. My problem is metering. Do you have a circuit I could use with a 500 microamp meter? I'm new to this so please keep it as simple as possible.

M.S.S., Ottawa, ONT



Although you didn't specify the range, I assume you want your meter to give you a full-scale reading of 15 volts. Any meter that can measure current can be made to measure voltage. All you have to do is add a multiplier, which is a resistor that limits the current flow to the meter's full-scale value when the desired full-scale voltage is applied. In your case, the value of the multiplier will be equal to the full-scale voltage, 15 V, divided by the full-scale current of your meter, .0005 A, or 30,000 ohms.

Beeping cassette recorder

Do you have a circuit that can be connected to a six-volt cassette recorder to signal the end of the tape? My recorder doesn't turn itself off when the tape runs out, so I'd like some kind of tone alarm to remind me to turn the cassette over or turn the recorder off.

R.F., Yale, MI

I hate giving indefinite answers that begin "it depends . . .," but in this case it depends on the layout of your particular recorder. If you can get at the drive mechanism inside the recorder, you have a chance. In some units, it's just too difficult to get at the capstan drive. If you can get to it, or to the flywheel, you can use a photocell to detect movement.

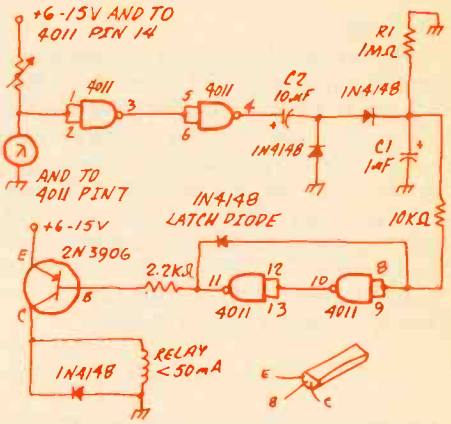
Digital speedometer

I am a 15 year old electronics nut and have just acquired a car. I want to convert all the instrumentation to digital readout. I'm having a problem finding circuits for digital speedometers and odometers. Can you help?

T.L., Indianapolis, IN

I'm afraid you've stumped me. I've been trying to work out a practical method to convert analog speedometers and odometers to digital display for several years, without success. I've tried a photocell triggered by a white strip painted on the drive shaft, and on a wheel. I've also tried picking up the field of the rotating magnet inside the speedometer housing. All have failed. One possibility is a magnet attached to the drive shaft passing by a pick up coil, converting the impulses to a dc level, and using a DVM circuit. But so far, this hasn't proved too successful either. Although I'm stumped, perhaps some of our readers have devised a practical home-brew digital speedometer/odometer circuit. I'd like to hear from you if you have.

To do this, you must paint the drive shaft or flywheel black, with a white stripe parallel to the axis of rotation. The photocell is then mounted so the white strip passes in front of it once each revolution of the shaft. You may have to install a small lamp to illuminate the shaft—again, it depends on how much ambient light gets through the openings in the case. The output of the photocell, which is a series of pulses occurring at the rate the white strip is passing it, is detected by a pair of diodes. The resulting dc level charges capacitor C1, which discharges through resistor R1. When the drive shaft stops, the output of the photo cell becomes a dc level—near the



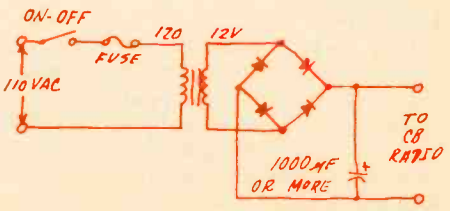
supply voltage if the black part of the shaft is in front of it, or near zero if the white strip is there. In either case, no series of pulses appears across the diodes, and C1 eventually discharges through R1. With the values shown, the discharge time is a second or two. When C1 is discharged sufficiently to cause the 4011 gate to change state, the PNP transistor will turn on, closing the relay contacts. You can wire any kind of alarm you'd like through the relay contacts.

Immobilizing car CB

I have a mobile CB radio that runs on 13.8 Vdc I would like to operate in my home. Is there an easy and relatively inexpensive converter I can build to run my CB radio on 120 Vac?

J.L., Brookfield, WI

This is a fairly simple project and similar to one that appeared in the May issue of ME—the Universal Power Supply. In fact, the



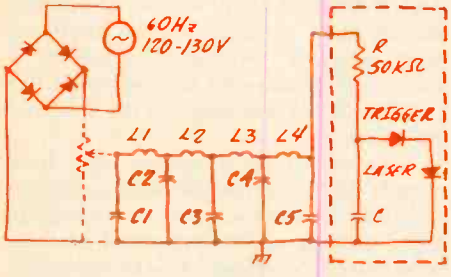
power supply shown in the article will work fine if your CB doesn't draw more than 1 amp. Just use the 7812 regulator chip. But, if your radio draws more than an amp, you can use a simple rectifier and filter circuit such as the one shown here. You can get the 12-volt transformer, capacitor and diodes from Radio Shack. This basic supply is not well regulated, but should give you acceptable results. If you use a very large capacitor, you may want to insert a few ohms between the diode output and the capacitor to limit the peak current when the supply is first turned on. Keep the resistance low to minimize the voltage drop during normal operation.

Zapping a laser

I am building a laser diode circuit that needs 120 Vdc. I have a power supply that delivers the 120 Vdc, but I want to vary that voltage continuously from zero up to the full output. The voltage-varying circuit should have as low a current drain as possible.

S.L., Des Moines, IA

As you can imagine, designing a variable-voltage regulated supply able to provide from zero to 120 volts is a complicated, difficult task. But every once in a while, a seemingly difficult problem has a very simple solution. In the case of your supply, the solution can be as simple as adding an inexpensive 25K variable resistor. The laser circuit you supplied has a current drain of about 4 mA. If the current drain of other circuits you plan using this supply with is also low—in the 10 mA range—this circuit will do quite well. How



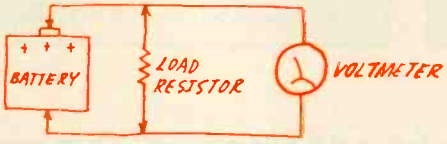
well depends on the actual current drain. The load draws widely varying current during operation, the change in voltage drop across the active portion of the pot can be large enough to cause improper operation. But, with a steady current drain, even one that is relatively high, the pot won't significantly affect the circuit operation. Use a two-watt pot.

Testing batteries

Could you tell me where I can find a list of resistor values that I can use with a multimeter to determine the true value of various batteries? They way things are now, they check out okay on the meter, but don't work in the circuit.

B.E., Castro Valley, CA

I assume you're referring to the proper value of loading resistor for each of your batteries when you ask about a list of resistor values. There is no magic value of resistor that gives you the test results. The idea is to test the battery voltage under conditions identical, or as near to identical as you can make them, to



the actual circuit operation. The best way to do this is to measure the actual circuit current flow with a brand new battery. Then, using Ohm's law, calculate the equivalent resistance. In other words, divide the battery voltage by the current you measured. Then, use the resistor with a resistance value closest to the calculated value. Once you've picked the load resistor, connect your multimeter across the battery and note the reading. Then, connect the load resistor across the battery and note the voltage drop. If the drop is noticeably greater with your old battery than it is with a new one, the old one hasn't long to live. As a very rough point of reference, you can use the following list to pick load resistors for general testing.

AA battery—10 ohms, ½ watt
C battery—20 ohms, ¼ watt
D battery—60 ohms, ¼ watt
9 volt battery—900 ohms, ½ watt
6 volt latern battery—40 ohms, 1 watt
12 volt latern battery—80 ohms, 1 watt

Ham in the am

I am a 13 year old novice-class amateur radio operator. Do you know where I can get a converter that will let me receive the 40 or 80 meter ham bands on my broadcast receiver?

B.K., Pittsburg, PA

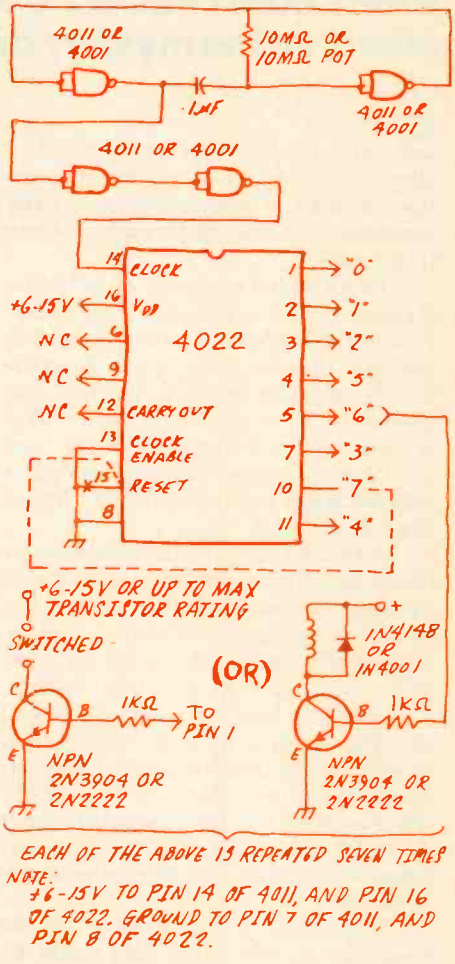
Some years ago such converters were available, but things have changed since those days. To my knowledge, there is no commercially made ham-to-broadcast converter now available. You may stumble across one at a hamfest flea market, but even that's not likely. The truth of the matter is that today's very crowded ham bands, especially the novice portions, would overwhelm any broadcast receiver. A typical broadcast receiver has a bandwidth almost one-third as wide as the entire novice band. And, of course, your receiver has no BFO. If you try to build your own converter with a BFO and decent selectivity built-in, you're going to have to spend $75 or more for parts. For that sum, you can buy a used receiver with all the goodies already installed.

Sequencing switcher

I need a circuit that will sequentially turn on each of seven swtiches for one second. Please make it as simple as possible. Oh yes, each switch should turn off before the next turns on.

T.B., Fayetteville, AR

You didn't mention what, if any, time delay is needed between each turn on. If you need, say, one second off time, you'll have to use a chain of flip-flops. If, however, you only want to be sure that just one switch is on at a time, here's a very simple approach to the



problem. A single 4001 or 4011—they have the same pin connections—produces a 1 Hz clock input to a 4022 counter IC, which has eight outputs. As the clock pulses appear at the 4022's input, each of the outputs in turn goes high, but only 'til the next clock pulse. So, in effect, each output is turned on for one second—in sequence. All you need to do is add a transistor to switch on the load during the one second period its output is high. You can use any NPN—the 2N3904 or 2N2222 works well. Depending on the load current, you can connect it directly into the collector circuit, or you can use a relay. Don't forget the protection diode across the relay coil. If you can't use all eight outputs, you can break the connection between ground and pin 15, which is the reset terminal. Then, connect pin 15 to the next higher count than you want. For example, reset the 4022 after the seventh count, connect pin 15 to pin 10. Although pin 10 is labeled "7", it is actually the eighth output because the count starts at zero, *not at* one.

computers

HOW THEY WORK, HOW YOU USE THEM, WHAT THEY CAN DO FOR YOU

BY PETE STARK

RAM? ROM? PROM? Confused? Don't be. This month's piece clears up the mystery and ends the confusion. Let there be light.

Several readers have recently asked about various types of computer memories. Instead of answering each letter separately, let's devote an entire column to the subject.

Every digital computer must have a memory. Historically, the big breakthrough in digital computers came with the idea of a stored program machine which held the instructions that controlled it—the program—in some sort of an internal memory. Obviously, you can't have a stored-program computer without some such memory; it's an indispensable part.

Although a very simple computer might use its memory only for storing its program instructions, most of the time the memory also stores data . . . numbers or other quantities which the computer uses in working on some problem. This might include input data which you give the computer prior to starting it on its job, intermediate data which the machine temporarily stores in its memory while working on a program, and output data which is stored in the memory just before being printed out or *outputted* in some other way.

Depending on the type of job the computer is doing this data could be numeric, alphanumeric, or logical. A scientific problem might involve mostly numbers or numeric data. A business problem might involve a mix of numeric data—money amounts and social security numbers, for example—and alphanumeric data such as names and addresses, product descriptions and so on. A computerized control system for a production line might use both numeric data, such as the level of liquid in a tank or the speed of a conveyor belt, and logical data such as a yes-no signal to control a valve or motor.

Although there are many types of program instructions or data to be stored in the computer's memory, they are all stored in exactly the same way—as binary numbers. The binary digits, also called bits, 0 and 1—the only two used in binary numbers since the digits 2 through 9 are not allowed—are stored as voltages. Most commonly a 0 is stored as a voltage near zero, while a 1 is stored as somewhere between 3 and 5 volts. A typical binary number stored in memory might be 01001110, which might be either a program instruction or a piece of data. There is no way of telling which it is just by looking at it, since various kinds of instructions and data can be intermixed within memory.

Since the memory can store many thousands of such numbers, there has to be some other way of telling them apart. This is done by dividing up the memory into separate locations, much like the rows of mail boxes in a post office, with each location having an address. Each location can store exactly one number.

The address is also a binary number. Both the binary address, as well as the binary number stored in a particular location, consist of a specific number of binary digits. In most home-type computers, the address is a sixteen-bit number, while the number stored in each location has eight bits. If the address or the contents of a location is shorter than this, then extra zeroes are added at the left to stretch the number to the required 8 or 16 bits. As an example, the number 01010101 might be stored in memory location 0000110001110001. In real life, these numbers are binary but when we normally refer to them as part of a program we may use some other number system. But that's another story.

Typical Memory Connections

As the diagram shows, the connections to a typical memory consist of three main types of signals besides power and ground: address inputs, data inputs and outputs, and control signals.

Since there are 16 address bits, the address inputs also contain 16 wires in most systems. In simple systems fewer may be used. These carry the address of the location the computer wants to reach. The arrowheads on the diagram show that these signals travel into the memory.

The 8 data lines at the right of the drawing are shown as both inputs and outputs. When data is being stored into the memory, we say that it is being *written;* when it is being taken out we say that it is being *read.* Hence the data lines are used both for reading and writing.

At the bottom are shown three control signals by which the computer controls the memory. The *Read/Write* line tells the memory whether to read or write at any particular time. The *Address Strobe* is a timing signal which is sent to the memory just after the address is applied, to inform the memory that an address has been sent and that a memory operation is about to begin. The *Input/Output Strobe* is another timing signal which starts the actual reading or writing at the precise instant that the computer needs it. If you keep in mind that a memory may perform a million or more reads or writes in just one second, it becomes clear why the precise timing of each read or write becomes very important to prevent chaos.

Not So Simple

Although our drawing shows the typical memory as just a box, in reality the memory system may be anything from a single integrated circuit to a room-full of cabinets, depending on the number of bits required and the speed of the memory.

A very small computer used in a simple control job might have just a few hundred memory locations with four or eight bits in each. Integrated circuits with internal memory of up to 512 eight-bit locations are fairly common, for a total of 4096, or 4K, bits in one IC. Newer IC's with as many as 32K bits each are just coming from the development labs, and will probably be in fairly wide use within the next few years. Thus a small system might have just one or two memory IC's.

On the other hand, large commercial computers with a million eight-bit locations are not unusual, with some of the monster machines having as much as a billion locations. When you multiply that out to get the total number of bits stored, the number becomes quite impressive. This is where a number of large (air conditioned) cabinets may be needed to house the memory alone.

Actually, not all modern computers use integrated circuit memories. Many of the early machines of the fifties used

rotating drums coated with magnetic material similar to recording tape to store bits. Other popular approaches tried at one time or another included mercury delay lines where bits were constantly recirculated through a length of hose filled with mercury, and even more unusual—for today—approaches. All of these are obsolete today for main memory, but magnetic core memory has lasted through close to a quarter century and is still popular.

In a core memory, each bit is stored as a magnetic field in a tiny core of ferrite material just a few thousandths of an inch in diameter. Strung on hundreds of tiny wires, these cores form an early and still economical storage method, especially for large memories. They are still made today, and there is a lively race on between manufacturers of core and integrated circuit memories for the memory business which, I suspect, will go exclusively for semiconductor memories in a short time.

Types of IC Memories

There are several types of semiconductor IC memories: RAM, ROM, PROM, EPROM, and EAROM. Each has its own special features and uses.

The letters RAM stand for Random Access Memory. This is a type of memory which can be used for both reading and writing. It can be used for program instructions and data, and can be erased and re-written as often as needed. In a general purpose computer which is used for many tasks each day, most memory would be RAM so that it can be erased and re-used for many different jobs. RAM is generally quite fast, but it has the disadvantage that when power is removed it becomes erased. Here is one very large advantage of core memories—they are RAM, but when power is removed they retain their contents for years. This is quite different from an integrated circuit RAM.

An integraed circuit RAM would therefore be used mostly for temporary information. Although it is possible to provide battery backup power supplies in a computer so that the memory is retained even in case of a power loss, this is really only practical for small memories at this time. There are types of RAMs which take very low power and can be powered by a flashlight battery for many months, but right now they are still quite expensive.

A ROM is a Read Only Memory, and is generally of a type called mask-programmed. During the manufacture of the ROM integrated circuit, a specific bit pattern is stored in the ROM by altering the pattern of the photographic image used to make the IC. In this way a permanent set of instructions or data is stored into the IC which can thereafter be read as often as needed, but never changed. Since fairly complicated steps are needed during the manufacture to store this bit pattern into the IC, this procedure can be very expensive. Mask-programmed ROMs are inexpensive in large quantities, but the set-up charge of $1000 or more to produce the photographic negatives used in manufacture makes it impractical to make just a few.

The ROM has the advantage of being permanent. Once written, it cannot be erased even during power failures. Hence it is used whenever a computer program is repeated over and over, day after day, without change. A typical application is a small computer control system which is part of a larger machine. A good example is the electronic cash register in many stores, where the controller which monitors the keys, controls the printer, calculates the tax and totals, is in fact a small computer with its control program permanently written in a ROM.

The mask-programmed ROM has the disadvantage of high cost in small quantities. Another kind of ROM, the PROM, is Programmable. The PROM is built in such a way that the IC, as supplied by the manufacturer, contains either all 0 or all 1 bits. By proper application of voltages, it is possible to change these to the desired contents.

Most common PROMs contain tiny fuses on the surface of the integrated circuits, one for each bit. When the PROM is programmed, these fuses are selectively burned out to store bits. For instance, a given PROM might contain all 0 bits, and wherever a fuse is burned out the bit changes from 0 to a 1. Once this is done, there is no way to change back to a 0. Writing into, or programming, such a PROM is often called 'burning', for obvious reasons.

In large quantities, PROMs are more expensive than mask-programmed ROMs, but that doesn't affect their use. They are specifically intended for small volume users who cannot afford the high cost of starting up the production line for the masked ROM. Machines for burning PROMs, called PROM Programmers, are available to make the job easier.

Once a PROM is programmed, it cannot be reused. This is especially painful for the hobbyist who may have to make frequent changes to his system, or who tends to make many mistakes! If you write a bit in the wrong place, you have to throw the PROM out and start with a new one.

This is overcome by the EPROM, an Eraseable PROM. Unlike the PROM, the EPROM is not burned in programming. Instead, bits are stored as electrical charges buried in a thin layer of insulating material near the surface of the silicon crystal used to make the integrated circuit. These charges are placed there by high-voltage pulses of electricity. The term high-voltage is only relative, since most EPROMs use around 25 volts; but this is higher than the +5 volts used in normal operation.

The EPROM is reusable by simply erasing it and then writing it again. Erasing is usually done by placing the IC in a strong beam of ultraviolet light; the IC package generally has a small window to allow the light to reach the silicon crystal. Most semiconductors act as light detectors when exposed to light, by becoming more conductive than normal. In the case of the EPROM, this effect makes the stored charge leak off to ground so that the entire IC is erased. Fairly strong light is needed, often for a half hour or more, so erasing an EPROM is not something done very often.

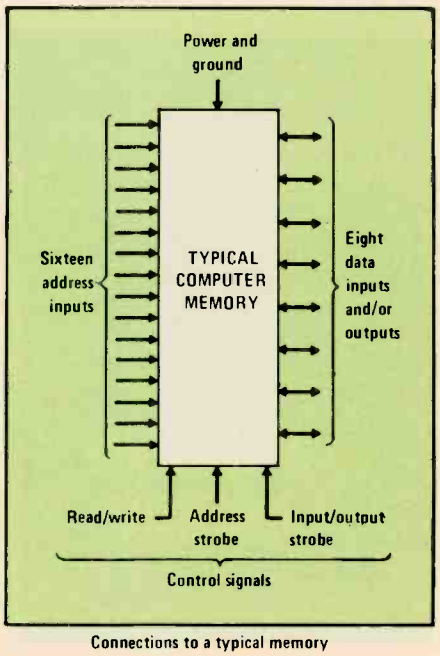
EPROMs are popular whenever programs or data must be frequently changed. But there are still cases where we want the advantages of a ROM—long-term stability even in case of power outage—with the prime advantage of a RAM—being able to erase and rewrite quickly if needed. The EAROM is one device which gives us the best of both worlds.

The EAROM is an Electrically Alterable ROM. It is very similar to the ultraviolet erasable EPROM, except that erasing is done electrically. Thus an EAROM can be installed in a computer, and periodically erased and rewritten by the computer itself.

THE EAROM is primarily intended for reading, and its speed shows that fact—reading takes place in typically one microsecond. Erasing and writing, on the other hand, takes around 1000 microseconds.

Like the EPROM, early EAROMs had to be completely erased before being rewritten. But newer EAROMs do something EPROMs cannot—they can be erased just one location at a time. So they

please turn to page 90



Connections to a typical memory

review

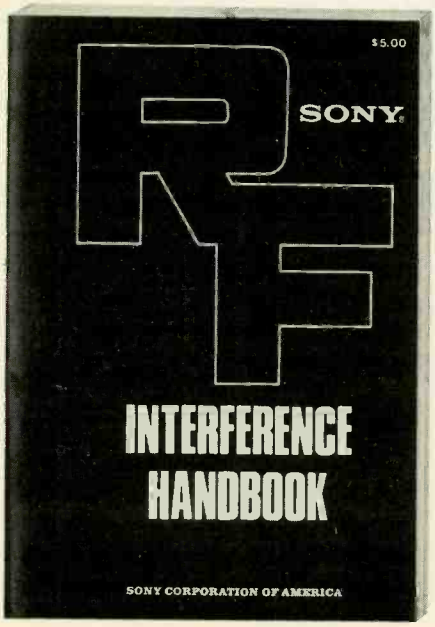
NEW BOOKS AND CATALOGS

Curing RF Interference

With the explosion in personal communications, RF interference to TV and sound systems continues to be a major problem. Several articles have already appeared in ME, including one based on the FCC's own RFI handbook. This handbook, by the way, is available directly from our publisher for $1.25 postpaid. All of these articles, however, deal in generalities. Not so the *RF Interference Handbook* published by Sony Corporation of America, 47-47 Van Dam Street, Long Island City, NY 11101.

Sony's Handbook is aimed at the qualified service technician, and carries a warning to that effect. But, with care, anyone with basic electronics experience can make use of the info it contains. Remember, though, that making modifications to the internal circuitry of home entertainment equipment voids the warranty.

The book is divided into two parts—defining the problem and solving the problem. The first part is unfortunately too skimpy to be of much value. Running only about three pages in length, it attempts to cover all sources of RF that can interfere with your TV and audio system. Three pages just isn't enough to do an acceptable job on the subject.



The second section dealing with the cures for RFI more than makes up for the shortcomings of the first. For one thing, it's profusely illustrated, not just with drawings, but with photographs of filters identified by brand name. And the accompanying text is about as complete as you're likely to find anywhere.

The first chapter of the section deals with TV interference—not just from the local super-power CBer, but also from FM broadcasting stations, aviation and public service radio, electric motors, automobile ignition systems, and even other TV sets. Illustrations include a large selection of filters, antenna patterns and TV screens with interference symptoms displayed.

The second and third chapters deal with AM and FM radio interference while the fourth deals with audio equipment. All are every bit as thorough as the chapter dealing with TV interference. Chapter 5, however, is a little on the short side—it runs all of ten lines—and deals with interference to the Sony Betamax VTR. The essence of the chapter is that you should send for Technical Memo 76-1 if your Betamax is subject to RFI. Not much help for VHS-format VTR owners. A one-page appendix gives the name and address of 14 interference-filter manufactures, from whom you may be able to get more information.

Sony's *RF Interference Handbook* carries a $5 price tag, which is a little steep if you're looking for general information. But, if you're after specific "how-to" instructions, it's well worth the price.

What's new in electronics?

Electronics is very dynamic, with new technologies popping up with great regularity. If you're not quite on top of what's happening in microelectronics, you may want a copy of John Douglas-Young's *Technician's Guide to Microelectronics* from Parker Publishing Company, West Nyack, NY.

As the name implies, the book is not meant for the beginner. But, you don't have to be an engineer either. In fact, there's very little in the way of mathematics included. You'll benefit most from the book if you have a reasonably sound background in basic electronics with a passing knowledge of transistor circuits.

The *Guide to Microelectronics* begins with a look at MOS technology, including what MOS is, what it does, and how it compares to bipolar transistors. From there, the book covers the fabrication of MOS devices, including preparing the silicon wafer, packaging, and helpful hints for mounting the finished device.

Chapter Three provides a refresher course in logic circuits beginning with gates and running through decoders and display drivers. This is followed by a chapter dealing with the various families of logic devices—RTL, DCTL, TTL, ECL, and CMOS. The two following chapters cover practical circuits and troubleshooting, and include plans for building your own logic probe.

The Guide also contains a chapter on linear circuits, microwave devices, and troubleshooting techniques.

One of the most useful features of the book are the four appendixes. The first of these is a four-page collection of standard semiconductor symbols, many of which are not included in the ME symbols chart. Appendix 2 provides nine pages of information about the metric system, including the correct form for several units of measure. Appendix 3 provides two pages of conversion factors. The final appendix is a 16-page glossary of microelectronic terms.

The *Technician's Guide to Microelectronics* is a hardcover book with a hardcover price—$14.95. At this price, the *Guide* is not the kind of book the average hobbyist will want to have sitting on the workbench under the soldering iron stand. Still, if you're interested in microelectronics and need a good basic reference book, and can spring for the price, it will make a nice addition to your library.—*Bob Margolin*

FREE THE BIG NEW HEATHKIT® CHRISTMAS CATALOG

Over 40 new and unique electronic products in this colorful new catalog plus nearly 400 others — all in easy-to-build, money-saving kit form. Read about all the exciting gifts you can give, OR GET!

NEW! VF-2031 Hand-Held Two-Meter Transceiver. 8-channel simplex with + or −600 kHz offsets giving you a total of 24 transmit and 8 receive channels with only 8 crystals.

NEW! ID-4001 Weather Computer. The first computerized instrument to combine all these important weather instrument functions. Displays time, wind direction and magnitude, indoor/outdoor temperature, barometric pressure, even wind chill factor. Computer memory provides useful storage and recall of data.

NEW! Rack-Mount Stereo Components. A powerful and sophisticated stereo amplifier and an LED output indicator are two new products designed for stylish rack-mounting! Both offer the power, features and value Heathkit hi-fi-equipment is famous for! More to come!

NEW! Digital Readout Car Clock with Trip Timer. Versatile clock/timer shows time in hours and minutes, 24-hour timer that reads to nearest second. Bright, easy-to-read display; low-power circuit that doesn't drain battery.

NEW! Deluxe Dual-Trace Oscilloscope. Low-priced scope features extra-bright traces, selectable triggering, 7-position variable time base, DC to 5 MHz bandwidth.

NEW! RECHARGEABLE Portable Light. Fluorescent light serves as a handy and rugged portable light for outdoor uses. Rechargeable battery power supply for years of dependable, money-saving use!

This NEW Heathkit Catalog is yours FREE!

OVER 40 NEW PRODUCTS — SEND FOR YOUR COPY NOW!

OR, you can redeem this coupon at your nearest Heathkit Electronic Center where Heathkit products are displayed, sold and serviced. Check the white pages of your phone book for the store nearest you. If coupon is missing, write

Heath Company, Dept. 378-482
Benton Harbor, Michigan 49022

HEATH
Schlumberger

Heath Company, Dept. 378-482
Benton Harbor, Michigan 49022

MAIL COUPON TODAY!

Please send me my FREE Heathkit Catalog.
I am not on your mailing list.

Name _____

Address _____

City _____ State _____

CL-673 Zip _____

CIRCLE 15 ON READER SERVICE CARD

stereo hi-fi

AUDIO, VIDEO, RECORDING, PLAYBACK

BY HANS FANTEL

Top quality sound doesn't have to have a top quality price tag. Some of today's moderately priced audio gear will give you all the fidelity you want at a price you'll want even more.

This Kenwood KX-530 stereo cassette tape deck is typical of the high-quality, moderately priced machines now on the market. Complete with build-in Dolby noise reduction system, this $200 deck offers a 30 to 14,000 Hz response with less than 1.5% harmonic distortion.

With the price of almost everything climbing faster than a scared squirrel, the typical audio fan—according to a recent survey—nowadays spends an average of $1500 for his rig. I was looking for ways to beat this average and see if you can get away for a lot less and still get first-rate sound. So when I set off to Chicago to check out the Consumer Electronics Show, the big annual audio trade fair where the industry trots out all the new gear to show off to the press, my main aim was to sniff out the best of the low-cost gear. Of course, I also listened to a lot of the more expensive equipment. Predictably, it sounded better, but not much.

How come? The answer lies in the price structure of audio. Up to a point, performance goes up along with the price tag. In short, you get what you pay for. But beyond that level—about $600-800 for a complete system—the price goes up a lot faster than the corresponding rise in performance. So you have to spend a lot more to get just a little extra.

In a way, that's good news for the budget-bound. It means that moderately priced equipment gives you more per dollar. But this doesn't mean the cheapest equipment is the best buy. On the contrary: equipment specifically designed to sell cheaply rarely offers real value and often sounds terrible. With this in mind, I've tried to pinpoint outstanding designs in the lower brackets, along with a report on general design trends.

Turntables

Starting up front, I looked at the new crop of turntables, the firm item in the usual component line-up. The trend here is clearly toward single-play units, which makes sense. After all, how often do you really want to stack up a whole bunch of records on a changer? Besides, most people playing LPs like to flip the disk after one side is finished—and that's something a changer can't do. Single-play turntables generally offer higher quality per dollar. Manufacturers, after all, must allocate costs: they can either put it in automation or in basic quality. And if quality on a budget is what you want, single-play units are your best bet. Since nearly all single-play units nowadays have accurate cueing devices, you won't have to set down the tone arm by hand, risking damage to your records or the delicate stereo stylus.

Two excellent low-cost turntables are the Pioneer PL-512 and the B.I.C. Model 911, both selling for $100. They both run smoothly and are notably free of rumble. They are particularly well insulated against outside vibrations, so the tone-arm won't jump grooves even if your floor shakes. For the same money, you can get the JVC JL-A-20 or the Sanyo JCX 2100KR, also excellent designs but with an additional and very useful feature. After the record is finished the tone-arm returns automatically to the resting position and the motor shuts itself off. All these tables are equipped with precision arms capable of tracking at very low stylus pressures—as low as 1 gram, depending on the cartridge you use.

Speakers

For a somewhat higher price, you can get excellent turntables with automatic tone-arm positioning at the start of the record. A value-standout in this group is the $150 Technics' SL-230, which has servo-controlled speed regulation that detects the slightest change in turntable speed and immediately corrects it. You can pay lots more for fancy direct-drive, quartz-controlled turntables, but, for all practical purposes, I doubt that you can hear the difference.

When it comes to loudspeakers, the most important single item in any sound rig, recent trends also tend to favor those with limited cash. Small speakers nowadays put out a lot more sound than they used to. Sure, that's not true of all of them. Again, it's a matter of picking the real winners. To my ears, the winners in the low-ticket sweepstakes are the Acoustic Research AR-18 and the Infin-

The PL-512 by Pioneer is one of the new breed of single-play, belt drive turntables that are pushing the record changer off the market.

ity Qe, selling at $65 and $105 respectively. In the lower brackets, I was also greatly impressed by the $100 Electro-Voice Interface 1, the $85 B.I.C. Model 11 and the $140 Radio Shack Optimus 10. All of these owe their outstanding performance to some unusual features.

The AR-18, for example, has a liquid-cooled tweeter, which enables this little bantam to manage power levels up to 60 watts. Like any mechanism converting energy into motion, loudspeakers generate heat as a byproduct. At normal volume levels, this heat is negligible. But some rock fans pile so much wattage on the voice coil that the incidental heat generated by the tweeter ceases to be incidental. As a result, some speakers driven beyond their limit literally burn out at temperatures sufficient to fry eggs.

To provide cooling for the overheated parts, some audio designers, including Acoustic Research, now immerse tweeter voice coils in a newly developed magnetic fluid which is far more thermally conductive than the formerly air-filled magnet gap. As a result, the heat build-up in the coil is quickly dissipated and the speaker can absorb more wattage without disintegrating.

In the case of Infinity's Qe speaker, it's also the tweeter which accounts for its exceptional quality. This tweeter consists of a flat, lightweight diaphragm placed within the magnetic field generated by magnets made of samarium cobalt. This rare material can exert more control over the sound-producing vibrations because of its high concentration of magnetic flux. The flat diaphragm is equally impelled all along its surface by a flat electrical conductor, the functional equivalent of the voice coil in conventional speakers, bonded to its back. Consequently, the entire diaphragm moves in unison—like a flat piston surface pushing the air—without any of the bending or buckling that is a frequent cause of distortion in poorly designed tweeters. As an added bonus, this tweeter accepts power levels of up to 100 watts without audible stress. From where I sit, it puts out just about the cleanest sound you'll hear anywhere, regardless of price. The only drawback is that the bass falls off, though only very slightly, below 45 Hz. If that bothers you, you can get a similar speaker with a larger woofer, Infinity's Model Qa, for $150.

The special strength of the Interface I and the Radio Shack Optimus 10 lies in their ultra-efficient bass projection. They picked a design approach which, though by no means unique, is still fairly new—the use of a passive radiator, or *drone cone* as it is sometimes called. This is a regular woofer cone stretched over an opening in the enclosure, but without a magnet and coil to drive it. Instead, it flaps back and forth in rhythm with the main woofer, being pushed by the dammed-up back-pressure in the box. These two cones, the regular woofer and the drone, moving in tandem make up a much bigger sound-radiating surface than the woofer alone, thereby augmenting bass projection. In addition, the drone converts the back pressure, normally trapped in the box, into audible sound energy.

Thanks to the conversion efficiency of electrical energy into audible sound achieved by this design, these speakers need less than 10 watts to drive them to room-filling volume. The B.I.C. Model 11 works on a similar principle but employs a tuned duct instead of the drone cone. Because of its high efficiency, which produces more sound per watt, the same design is also used in several excellent compact sound systems by Panasonic and Fisher.

As far as the electronic guts of a sound system is concerned most recent innovations have been in the top brackets.

Panasonic's Technics SL-220 is a good example of today's mid-range turntables. Equipped with a servo-controlled motor, this turntable offers very low wow and flutter.

Today's moderately priced stereo receivers are excellent buys. This Kenwood KR-2090 receiver, for example, costs around $220, but provides a full 16 watts per channel with 20 to 20,000 Hz response, and a total harmonic distortion of no more than 0.1%. A few years ago, this kind of performance would have cost you two or three times as much.

There you will find digital tuners that lock to FM stations with crystal-synthesized tuning frequencies in their front end, and beefed-up power amplifiers pumping out 300 watts per channel or more at distortion ratings so low that test instruments can hardly measure them. The great names in audio—Technics, Pioneer, Yamaha, Nikko, Hitachi, JVC, Akai, Marantz—to name just a few, all made significant contributions in the ultra-expensive upper stratosphere of audio.

But progress is also evident in the lower brackets, as advances formerly found only in expensive models are now filtering down into the economy range. An outstanding example of this trend is the Technics SA-200, a receiver delivering 25 watts per channel over the entire audio range from 20 to 20,000 Hz with no more than 0.04 percent total harmonic distortion. This distortion figure is considerably less than can be normally found on receivers with a $230 price tag. The same company also offers outstanding receiver values with higher power ratings. Other good receiver values in the low-cost field are Kenwood's 18-watt per channel KR-2090 at $215, JVC's 18-watt per channel S-61W at $190, and Radio Shack's 12-watt per channel Realistic STA-52B at $200. Of course, in evaluating receivers, the power rating is not the only factor to be taken into consideration. Distortion figures are quite as important and should never exceed 1% where the object is fidelity. Tuner performance and operating features also should be taken into consideration.

On the whole, stereo receivers still remain far more popular than separate amplifiers and tuners. This is hardly surprising since receivers nowadays fully equal the performance of separates and are both more convenient and more economical.

Cassette Decks

Low-cost cassette decks, selling for around $200, have finally reached true high-fidelity standards. Improved drive mechanisms and, in many cases, servo-controlled speed regulation have reduced flutter and wow to imperceptible levels. What's more, frequency response has been extended up to 15 kHz, which puts the cassettes sonically on par with all but the best disc recordings. Even low-priced decks now offer wow and flutter specifications typically down to about 0.1 percent and signal-to-noise ratios better than 50 dB, assuring a very quiet background. The latest standout entries include the $220 Sony TC-K3, the $200 Kenwood KX-530, and the $200 Technics RS-616.

Any of the components listed here will give you clean, realistic, and immensely enjoyable sound. In restricting this brief survey to the bottom-dollar brackets of component fidelity I hope to prove that it's still possible to get good sound and beat inflation at the same time - especially since most of these items are available at a discount.

The Radio Shack 12-159 Timekube®

Need the time of day? Try this nifty cube. It receives National Bureau of Standards 24-hour a day time broadcasts from station WWV on three different frequencies.

Suppose your receiver doesn't cover WWV. What if WWV had been only an afterthought when your receiver was designed or you can only receive WWV when the moon is right . . . sometimes. Well cheer up, Radio Shack has the answer in a small, battery operated receiver just for WWV.

The 12-159 Timekube® is actually a small receiver covering three crystal controlled frequencies: 5, 10 and 15 MHz. It has a built-in 10-section 41" telescoping antenna (there is also an external antenna terminal on the back) making the receiver completely self-contained.

To turn the receiver on just select the WWV frequency you desire and simply push the appropriate tone-bar switch. You can switch from one frequency to the other or by pushing the last bar on the left you can shut it off. There is a volume control located on top adjacent to the antenna.

Reception is quite good here on 15 MHz with the telescoping antenna and no attempt was made to use an external antenna. WWV comes through loud and clear. It's quite a nice addition to the shack, or anywhere in the house.

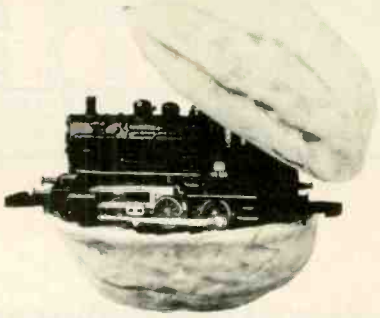
The 12-159 Timekube® comes complete with crystals, battery and manual. The front panel has a sliding time scale which you can set up for converting GMT to your particular local time. The attractive cabinet is finished in simulated rosewood. The receiver measures 3⅛"x4½"x3½". There is also a CHU version available in the Northeastern USA and Canada (12-158).

Both units are priced at $34.95 and could find many uses in the shack and other activities where exact time is needed such as sports car rallyes, SWLs, astronomy and even in setting your new digital watch.

The Radio Shack Timekube® should be available at most of their stores. If not, write to Radio Shack, 2617 West 7th Street, Fort Worth, Texas 76107. It may be a radio with only three stations (and the programming is rather repetitious) but it's well worth the investment if you consider the time you save. —A.D.

"ALL ABOARD

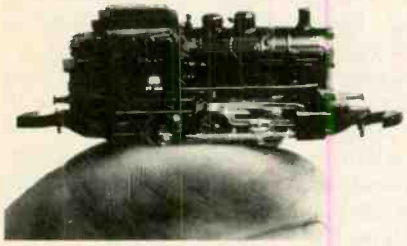
the world's smallest operating model railroad."



Measuring only 2" long, the locomotive pictured here represents a breakthrough in precision miniaturization.

Your eyes are not playing tricks on you. No, we did not use trick photography or a giant size walnut in illustrating the remarkable trains shown on this page.

They have been photographed and reproduced to their actual size. The effect is startling, but nothing compared to watching them in action.



A Locomotive No bigger Than Your Thumb

THE WORLD'S SMALLEST RAILROAD

We've named them Micro-Trains. Brought to the U.S. by Beacon Scientific, they were developed and are manufactured in West Germany. Micro-Trains simply cannot be compared to other small-scale model railroad gear you have ever seen. To put them in proper perspective, our Micro-Trains are about three times smaller than H.O. gauge. In model railroad terminology, they are rated as "Z" gauge.

SMALL IS BEAUTIFUL

Each Micro-Train represents a masterpiece in miniature. The scale is a gem size 1.220 with every feature perfectly detailed. The tank-type locomotive is a precise duplicate in every detail of the German Federal Railway's 0-6-0 class 89 locomotive. Its dye-cast zinc body is finished in mat black with bright red headlights and wheel accents. There are six driving wheels, which employ a specially designed non-skid, sure-grip surface for amazing traction and power. The scale, detail, and finish are remarkable when you consider that the locomotive measures only a fraction over two inches from end-to-end.

CONSTRUCTED WITH WATCHMAKER ACCURACY

The design and construction of working miniatures as small and detailed as our Micro-Trains most closely resemble that of a fine watch. Assembly is carried out under strict white-glove, atmospherically controlled, clean room conditions. At completion the power modules are encapsulated against dust and moisture. Due to their rugged design and construction, it is unlikely that they need never be opened for service no matter how often or hard they are run.

EXPANDABLE

The Beacon Micro-Train program incorporates a complete model railroading system. Cars, engines, and accessories add up to over 140 different items available, and the list is still growing. In addition to the tank locomotive, our basic set consists of a low-sided freight car, tank car, box car, and caboose. The power pack is engineered to provide complete control. A single knob enables you to control speed and polarity reversing so trains can be run in either direction.

SHEER PLEASURE

Model railroading is a fascinating and relaxing hobby. Our Beacon Micro-Trains make it practical as well. Imagine a complete operating railroad so small you can fit an entire layout in your desk drawer! A set-up that normally would spread out over an entire playroom floor or the top of a ping-pong table can now be constructed in an area smaller than a cocktail table.

INDULGE YOURSELF

Let's face it. There are times when you need a change of pace to relax your mind and get the creative juices flowing. Construct your own Micro-Train layout on a corner of your playroom bar. Better yet, put a set in your office or reception area. Makes a marvelous conversation piece, as well as provides relaxation for you and your visitors.

Please don't forget the children. A Micro-Train system is the gift of a lifetime, a present that will be remembered for countless years. Ask nicely, and they may even let you play with their trains.

NATIONAL SERVICE NETWORK

Because of the precision, care, and quality control standards under which Micro-Trains are produced, we sincerely doubt that service will be required. However, your purchase is protected by a network of authorized service centers located throughout the U.S.—one probably right near you. Or, if you wish, a central service by mail facility has been established and will promptly handle any problem.

WE PUT OUR REPUTATION ON LINE

We're Beacon Scientific, a division of Beacon Photo Service Inc. (a public company.) We're proud of our company and the products we market. Each product must meet a stringent set of guidelines with respect to quality, value, and unique appeal. Our reputation rides along with every product we advertise and every package we ship.

As a measure of our confidence in our extraordinary Micro-Train system, we invite you to try them yourself for 15 days at our risk. Use them at home or set it up in your office. If for any reason you are not satisfied, return them for a prompt refund of purchase price.

The entire set as pictured here including 18"x30" track layout is priced at just $124.95. It can, of course, be expanded into an infinite variety of layouts and shapes. A complete 20 page booklet in full color illustrates the entire Micro-Train system. Includes dozens of different locomotive cars and freights as well as track layouts and accessories. Order your Beacon Micro-Train set at no obligation today.

YOU CAN BE CHIEF ENGINEER

Every railroad needs a Chief Engineer in control. So we engrave your name on a special panel for display on the top of the power pack control center.

Our Beacon Micro-Trains system not only is the world's smallest railroad, but it is also the world's most memorable business gift. If you have a special customer or client whom you feel would also enjoy being Chief Engineer, please list his name on a separate sheet of paper when ordering.

CREDIT CARD ORDERS
24 HOUR TOLL FREE SERVICE
800-621-8318
In Illinois call 800-972-8300

BEACON SCIENTIFIC
Dept. 834-2 482 Sunrise Hwy., Rockville Centre, NY 11570

( ) Please send _____ Beacon Micro-Train System(s) at $124.95 plus $3.50 postage & handling. I understand that I may use the trains for 15 days at your risk. If I am not absolutely delighted with their performance, I may return the set for a full refund of purchase price.

( ) Send your complete 20 page Micro-Train catalog at $5.00 each. I understand that I may apply the catalog purchase price to future Micro-Train orders. (Catalog is included at no extra charge with the purchase of set.)

( ) CHARGE IT ☐ Carte Blanche ☐ American Express ☐ BankAmericard ☐ Master Charge (Interbank) # _____

Charge #_____ Exp. Date_____

Signature_____

Name (Print) _____

Address _____

City_____ State_____ Zip _____

NY State residents add sales tax.

mobile el

CAR, BOAT, PLANE, RV: ELECTRONICS IN THE GREAT OUTDOORS

BY RON COGAN

Safety at sea makes sense. But even if you don't venture too far from shore, a two-way radio can save your life. Here's the way to install yours.

If you own a watercraft and venture more than a stone's throw away from shore, it's a good idea to outfit your boat with two-way radio equipment. Unlike driving an automobile, boating does not necessarily take you along well-traveled paths where aid can be secured from passers-by. If you break down a few miles from shore or get lost, your options are to get angry or start worrying.

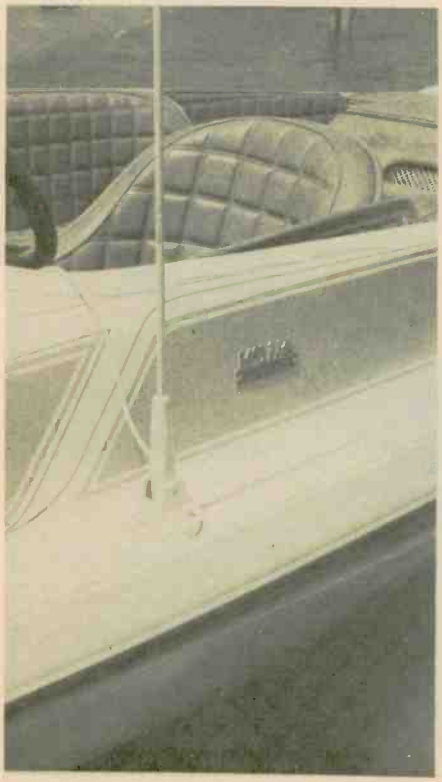
If you are radio-equipped, you can make a quick call for aid and then get mad that your day has gone down the tubes. If your boat is devoid of radio equipment, however, you had best start hoping that someone wanders in your direction. In the meantime, worry. You deserve it 'cause it might work out to be a rather long wait . . .

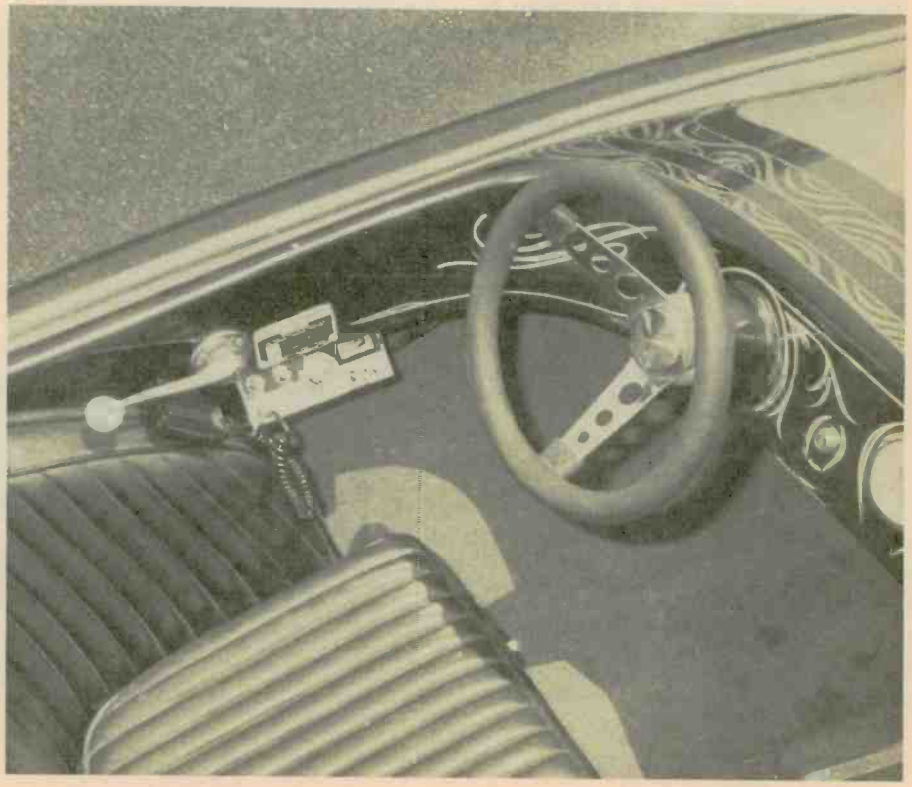
One of the real problems encountered by boaters in the past is the rather high price of a VHF-FM transceiver used for marine radio. In a nutshell, many of those who went boating offshore without radio equipment simply couldn't afford a rig. The rest simply couldn't justify the expense. Shelling out $500 to $1,000 for a marine transceiver that might never be needed makes this decision a tough one, indeed.

Salvation came with the onset of the citizens band radio boom. While the majority of the CBs sold found themselves in cars or in the home, a certain percentage were installed in boats. Sure, the range is limited and CB frequencies leave a lot to be desired in the way of static-free privacy, but this type of two-way system is far better than none at all. However, a major drawback was the fact that citizens band frequencies were not regularly monitored by any organization. And nothing is worse than needing help, keying the mike, and hearing nothing but static on the other end.

A recent decision by the U.S. Coast Guard has ended all of this. Because of the decision, all U.S.C.G. Search & Rescue stations around the country regularly monitor emergency Channel 9 in the citizens band. This, in effect, has made citizens band radio a viable two-way communications system for boaters who venture within radio range of these stations. It won't help you if you're far offshore, in which case you really should be packing a standard marine transceiver. It is a comfort, though, to know that someone will be monitoring if you

please turn to page 88





NEXT BEST THING TO BEING THERE!

With your own tutor, electronics naturally seems easier, more understandable. Now these unique training aids bring you friendly, over-the-shoulder, hands-on guidance, as if you had an expert right beside you. All planned and prepared in our effective Easi-Way™ teaching style. Only face-to-face instruction could be more personal. Nothing else like these...anywhere!

Two Forest Belt's **Service Training MONOGRAPHS:**

"TRIGGERED OSCILLOSCOPES—Four Hours to Familiarity"

Sit down in front of your triggered scope 30 minutes a day, and go through carefully organized exercises. In less than two weeks, you can truly UNDERSTAND how your scope displays signal waveforms; where to set the knobs and switches; what waveshapes mean; what to do when you can't seem to get a display on your scope. End up feeling comfortable and self-assured with any triggered oscilloscope.

Order 48A - $12.50 postpaid

P.S.—The above title is available also as a Forest Belt's **SELF-TRAINER KIT**: two audio cassettes plus a dozen sets of Worksheets (for a group).

Order 48K - $ 79.50 postpaid

Additional Worksheets Order 48W - Ten for $ 25.50

"Easi-Way™ Solutions for Electronics Math and Formulas"

Spend a half-hour each day with your inexpensive scientific calculator (many models under $40). Learn quickly to solve electronic formulas without knowing algebra. Thorough Easi-Read™ explanations, plus dozens of planned examples and exercises for you to work yourself. Shows you how to deal with Ohm's Law, Kirchhoff's Laws, series and parallel circuits, reactance, impedance, resonance, decibels, and plenty more. Handle complex math easier than you ever thought possible.

Order 28A - $ 12.50 postpaid

Scientific Calculator Order 28SC $ 35.50 postpaid

Enclosed in my $_____check or money order (outside U.S., add 20% to all prices). Please ship:

_____MONOGRAPH 28A "Easi-Way™ Solutions for Electronics Math and Formulas" @ $ 12.50 each

_____Scientific Calculator 28SC (suits use with 28A) @ $ 35.50 each

_____MONOGRAPH 48A "TRIGGERED OSCILLOSCOPES—Four Hours to Familiarity" @ $ 12.50 each

_____SELF-TRAINER KIT 48K "TRIGGERED OSCILLOSCOPES—Four Hours to Familiarity @ $ 79.50 each kit

_____Additional Worksheets 48W (for larger groups to use with KIT) @ $ 25.50 for ten

My name is _____ Age _____

Address _____ Phone _____

City _____ State _____ Zip Code _____

Forest Belt's **Service Training MONOGRAPHS**
Box 68120 Indianapolis IN 46268

Electronic dice

Why bother with real dice—they're small and hard to handle—when you can use this easy-to-build electronic dice roller? Just push a button, and presto, your dice roll appears as if by magic on state-of-the-art LED digital readouts.

by John Knoll

It isn't that ME advocates gambling—it doesn't. Nor do I. But . . . if you're going to yield to temptation, and who doesn't once in a while, why not do it in style. Instead of holding a pair of old fashioned dice—and who knows what other hands have held them—use ME's lucky 7-11 electronic dice. Just push the button for a second or two, and your roll will be displayed on the LED readout. And, even if you never gamble, it's a nifty project to build.

The whole works, including a pair of C batteries fits nicely inside a Radio Shack 270-285 Digital Display Case, but you can use any enclosure you have handy. The Lucky 7-11 shown here was build on two small pieces of perfboard. If you're into printed circuits, you can easily build your electronic dice circuit on PC board.

No on-off switch is provided in the circuit. Instead, the circuit automatically turns itself off after a period of 15 seconds or so following a roll. If a new roll is made before the circuit shuts off, the timer recycles to provide the full 15-second on-time for the new roll.

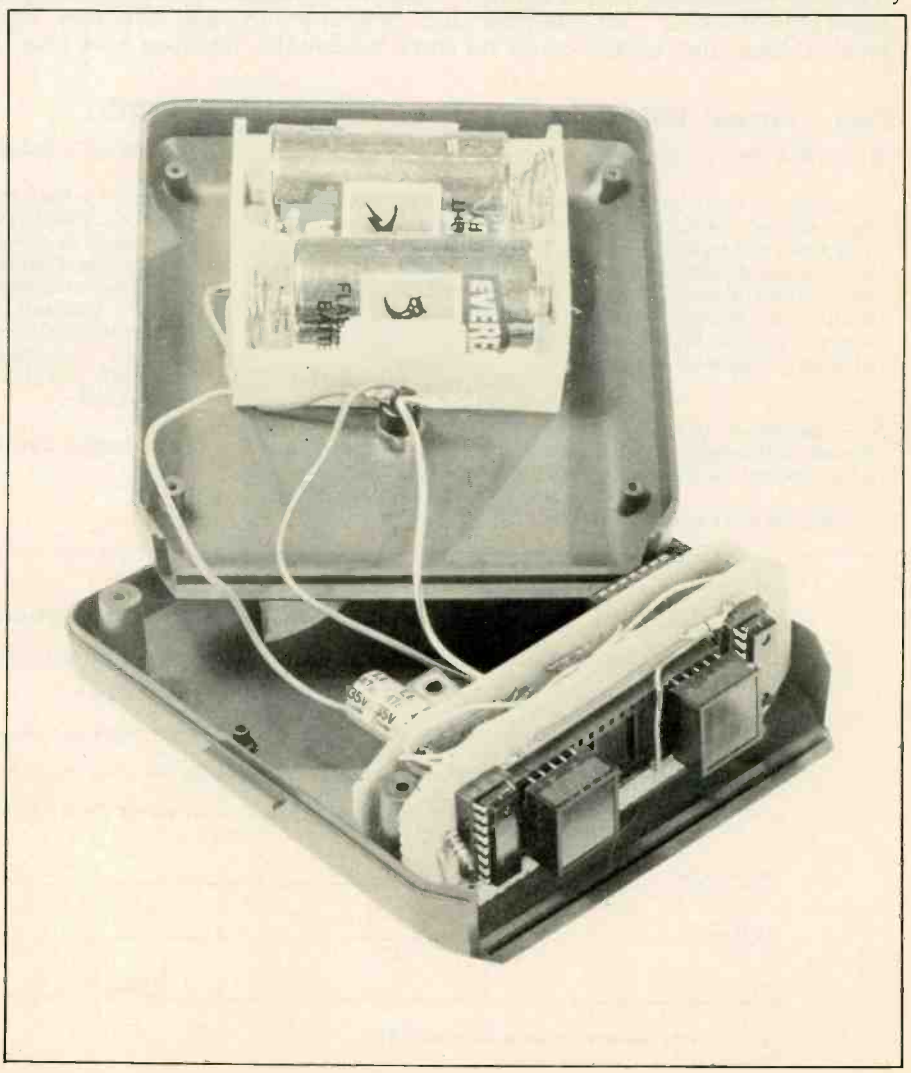
Construction is simple and straightforward. Parts layout isn't critical. With the exception of the two ICs, all of the parts are available at Radio Shack and from many mail-order suppliers. The ICs are common CMOS numbers, and should be available at most electronics distributors and mail-order houses. I got mine from Quest Electronics, P.O. Box 4430, Santa Clara, CA 95054.

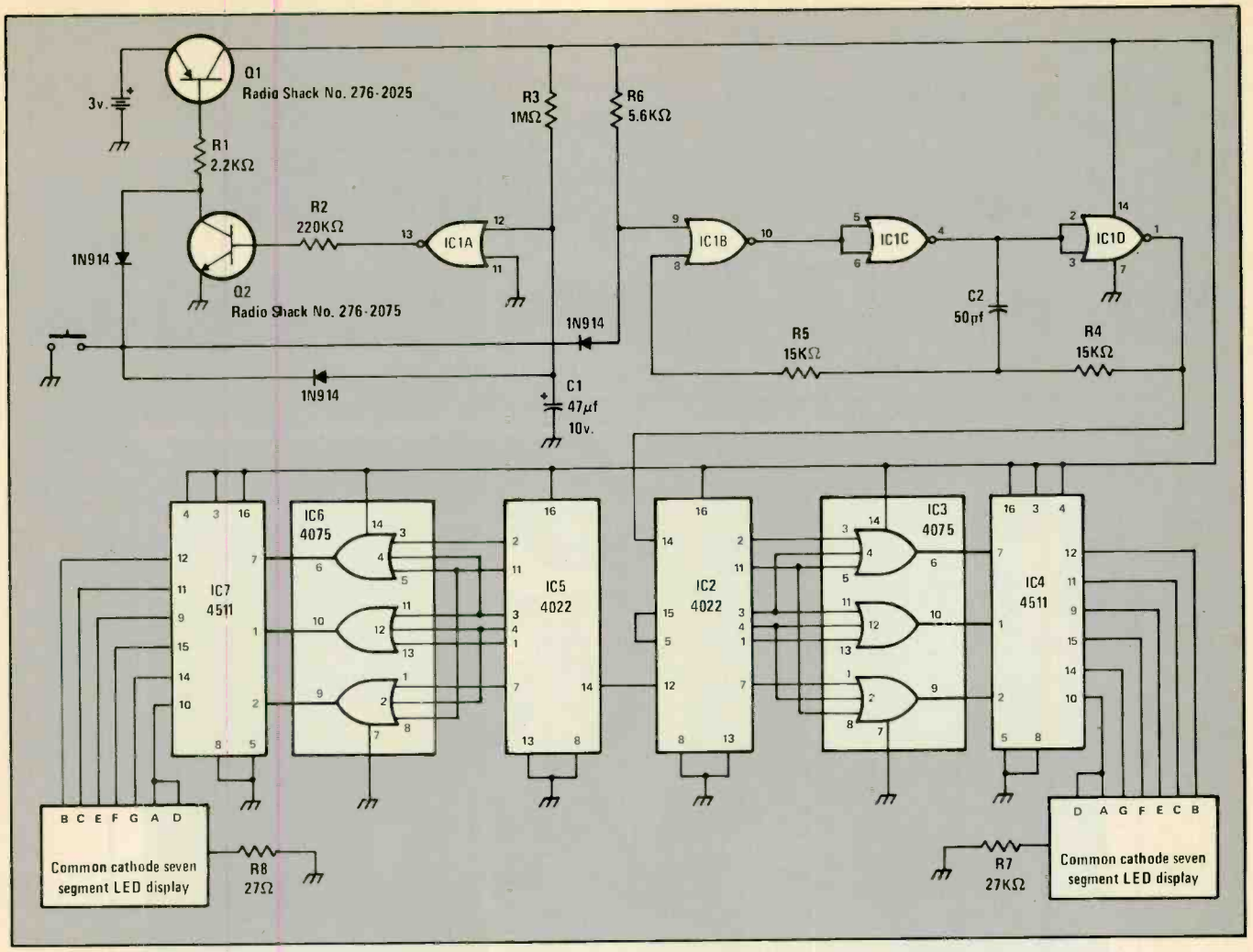
The circuit

ME's Lucky 7-11 circuit consists of three parts—a gated free-running oscillator, a random number generator, and manual-on, automatic-off power supply. Pushing the roll button turns on the power supply, which remains on for about 15 seconds. During the period when the roll button is held down, the free-running oscillator is gated on. The oscillator output is applied to the random number generator. When the pushbutton is released, the oscillator stops running, and the output of the random number generator freezes. This two-digit number represents your roll.

The free-running oscillator is built around three sections of a 74C05 quad NOR gate IC. The oscillator frequency is determined by the values of R4, R5 and C2. As shown in the schematic diagram, the oscillator is gated on by grounding one input line through the roll pushbutton. Releasing the pushbutton raises that input line to the Vcc potential, gating off the oscillator.

The output of the oscillator is applied to the clock input of a 4022 divide-by-eight counter. The counter output is fed to a 4011 LED decoder through a 4045 triple three-input OR gate, which produces the random number sequence for display on the digital readout. The second digit is generated by a second set of 4022-4045-4011 ICs fed from the carry





out terminal of the first 4022.

Power for the oscillator, random number generator and LED readout is obtained from the collector of transistor Q1. This transistor is gated on and off by a one-shot oscillator consisting of the fourth section of the 74C05 quad NOR gate used in the oscillator, and transistor Q2. In the off condition, Q2 is not conducting, so the base of Q1 is open. Pushing the roll button grounds the base of Q1, causing it to conduct. This action connects the positive terminal of the battery to the Vcc line, triggering the one-shot.

During the period of time the one-shot is flipped on, the base of Q1 is grounded through Q2, and remains so regardless of the roll pushbutton. When the one-shot flops back to its off state, however, the base circuit through Q2 opens and Q1 stops conducting—unless the roll pushbutton is held down.

Construction

The output of each 4011 is connected to the seven-segment LED digital readouts with one small modification. The standard seven-segment display of the numeral 6 has a single-segment vertical stem above the loop. To make a more natural appearing six, an additional horizontal segment has been added across the top of the display. This was accomplished by adding a jumper between pins "a" and "d" on each of the LED displays.

Parts list

Part	Description	Radio Shack number
IC1	74C02 NOR gate	—
IC2, 5	4022 divide-by-eight	—
IC3, 6	4075 triple OR gate	—
IC4, 7	4511 LED driver	276-2447
Q1	PNP transistor	276-2025
Q2	2N2222 transistor	276-2009
C1	47 mfd @ 10 WVDC	—
C2	500 pf @ 50VDC	—
R1	2.2K ¼ watt resistor	—
R2	220K ¼ watt resistor	—
R3	1M ¼ watt resistor	—
R4, 5	15K ¼ watt resistor	—
R6	5.6K ¼ watt resistor	—
R7, 8	27 ohm ¼ watt resistor	—
D1-3	1N914 or equivalent	276-1122
—	Battery holder	270-385
—	cabinet	270-385
—	LED seven-segment displays (2)	—

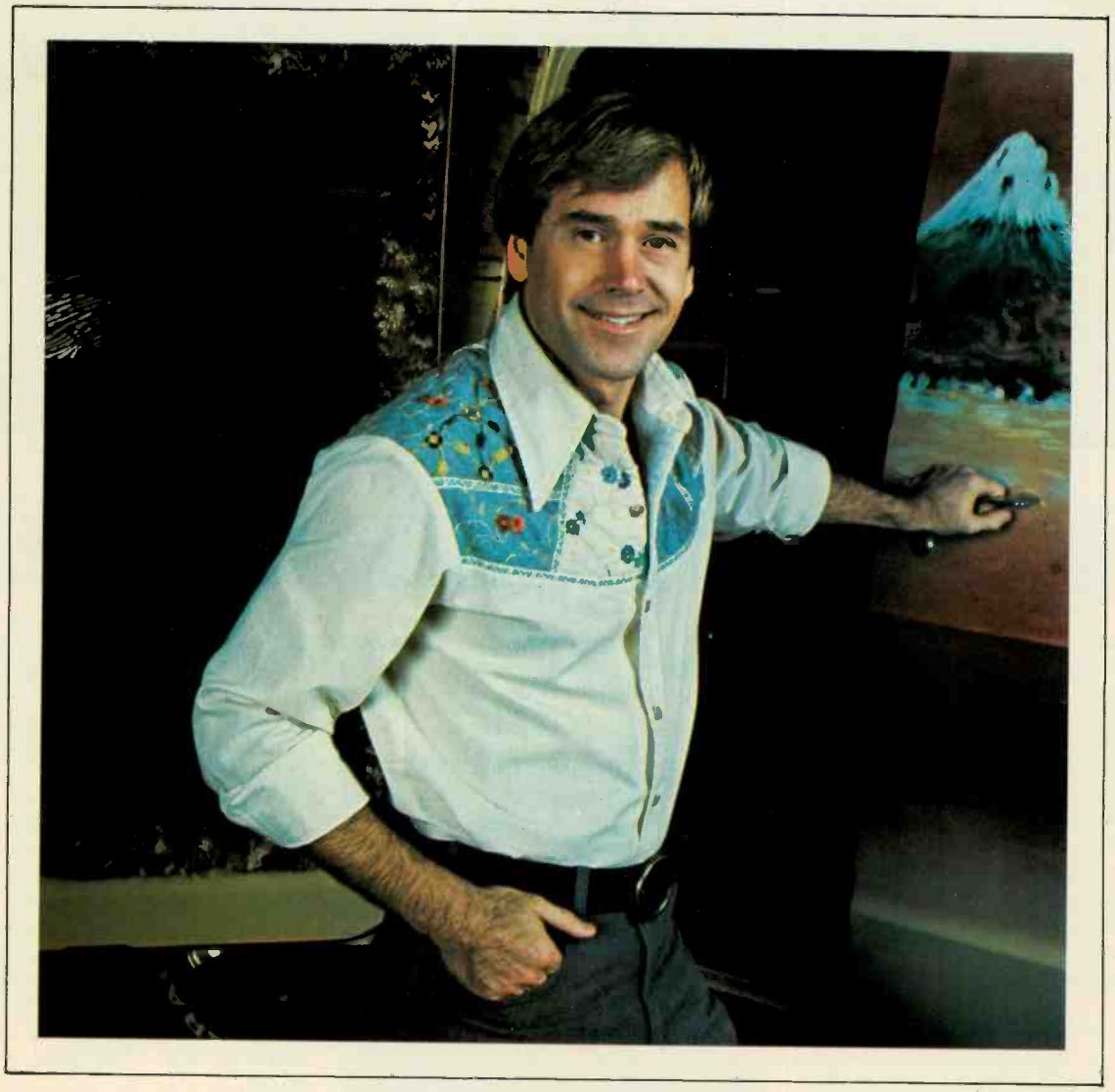
The prototype was built into a small, streamlined enclosure, necessitating the use of two circuit boards. However, if you build your electronic dice in a larger cabinet, you can easily put the entire circuit on a single board.

Although the layout isn't critical, the tight pin spacing of the seven ICs does demand care in wiring. In the prototype, the two seven-segment LEDs are mounted directly on one of the circuit boards, which is positioned behind the front lens. If you use a single circuit board, you may prefer to mount the LED displays directly to the front of your cabinet. This will require a 12-wire cable between the LEDs and your circuit board.

Because the LEDs are mounted on the circuit board, plug-in common cathode FND 500s were used—FDN503s can also be used. But, you can use any seven-segment LED common-cathode display you have handy. The 4011 drivers will handle most displays of 0.5 inches or less. Larger displays will require transistor drivers, reducing battery life.

The ME Lucky 7-11 electronic dice is an easy project to build, if you take your time and wire the circuit carefully. Mounted in an attractive cabinet, it'll make a good conversation piece if left on your living or room coffee table.

You gotta shop around.



When you do, you'll probably pick CIE. You can't afford to settle for less when it comes to something like electronics training that could affect your whole life.

When you shop around for tires, you look for a bargain. After all, if it's the same brand, better price—why not save money?

Education's different. There's no such thing as "same brand." No two schools are alike. And, once you've made your choice, the training you get stays with you for the rest of your life.

So, shop around for your training. Not for the bargain. For the best. Thorough, professional training to help give you pride and confidence.

* * *

If you talked to some of our graduates, chances are you'd find a lot of them shopped around for their training. They pretty much knew what was available. And they picked CIE as number one.

Why you should shop around yourself.

We hope you'll shop around. Because, frankly, CIE isn't for everyone.

There are other options for the hobbyist. If you're the ambitious type—with serious career goals in electronics—take a close look at what we've planned for you at CIE.

What you should look for first.

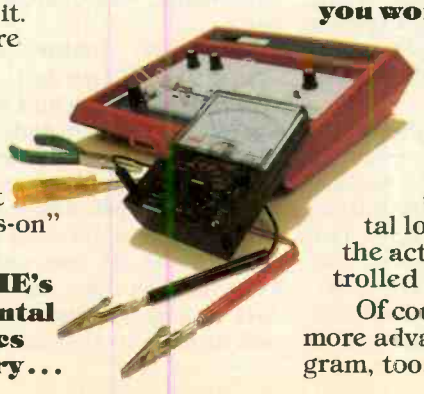
Part of what makes electronics so interesting is it's based on scientific discoveries—on ideas! So the first thing to look for is a program that starts with ideas and builds on them!

That's what happens with CIE's Auto-Programmed® Lessons. Each lesson takes one or two principles and helps you master them—before you start using them!

How practical is the training?

This is the next big important question. After all, your career will be built on what you can do—and on how well you do it.

Here are ways some of CIE's troubleshooting programs help you get your "hands-on" training...



With CIE's Experimental Electronics Laboratory... you learn and review the basics—perform dozens of experiments. Plus, you use a 3-in-1 precision Multimeter to learn testing, checking, analyzing!

When you build your own 5 MHz Triggered-Sweep, Solid-State Oscilloscope you take your first real professional step. You use it as a doctor uses an X-ray machine—to "read" waveform patterns... lock them in... study, understand and interpret them!

When you get your Zenith 19-inch Diagonal Solid-State Color TV you apply your new skills to some real on-the-job-type troubleshooting! You learn to trace signal flow... locate malfunctions... restore perfect operating standards—just as with any sophisticated electronics equipment!

Pattern simulated.

When you work with a completely Solid-State Color Bar Generator—actually a TV signal transmitter—you study up to ten different patterns on your TV screen... explore digital logic circuits... observe the action of a crystal-controlled oscillator!

Of course, CIE offers a more advanced training program, too. But the main point is simply this:

All this training takes effort. But you'll enjoy it. And it's a real plus for a troubleshooting career!

Do you prepare for your FCC License?

Avoid regrets later. Check this out before you enroll in any program.

For some troubleshooting jobs, you must have your FCC License. For others, employers often consider it a mark in your favor. Either way, it's government-certified proof of specific knowledge and skills!

More than half of CIE's courses prepare you for the government-administered FCC License exam. In continuing surveys, nearly 4 out of 5 CIE graduates who take the exam get their Licenses!

Shop around... but send for CIE's free school catalog first!

Mail the card. If it's gone, cut out and mail the coupon. If you prefer to write, mention the name and date of this magazine. We'll send you a copy of CIE's FREE school catalog—plus a complete package of independent home study information! For your convenience, we'll try to have a representative contact you to answer your questions. Mail the card or coupon—or write: CIE, 1776 East 17th St., Cleveland, OH 44114.

CIE Cleveland Institute of Electronics, Inc.
1776 East 17th Street, Cleveland, Ohio 44114
Accredited Member National Home Study Council

☐ **YES...** I'm shopping around for the **right** kind of career training in electronics troubleshooting—and CIE sounds well worth looking into. Please send me my FREE CIE school catalog—including details about troubleshooting courses—plus my FREE package of home study information! MO-17

Print Name _____

Address _____ Apt. _____

City _____

State _____ Zip _____

Age _____ Phone _____
(area code)

Check box for G.I. Bill information:
☐ Veteran ☐ Active Duty

Mail today!

SOLAR POWER

Here's one railroad's answer to the high cost of running remote installation with commercial power.

by Bob Margolin

Hardly a day passes that someone doesn't mention the use of solar energy to heat buildings. And, you'll still find mention of using solar panels to generate electricity. But very little has actually been done to put the sun to work on commercially feasible projects. The solar-powered signaling installations on the Southern Railway are the exception to this.

Southern, like most other railroads, has thousands of miles of track—much of it running through rugged and otherwise inhospitable territory. Nevertheless, every mile of track needs support from a variety of electrically operated protection equipment. Some of this equipment protects grade crossings where roads cross over the tracks. Other equipment detects the presence of trains and sets trackside signals to prevent collisions with other trains on the same track.

The big problem facing the Southern and other railroads is how to get electrical power to these devices in the most economical way. If, by chance, the track runs near the wires of a local power company, there is no problem. But, out in the boondocks, the nearest power line may be miles away. The cost of running a power line to the track may run into the tens of thousands of dollars.

Southern is the first railroad in the country to use solar power for these out-of-the-way locations. Back in 1974, they made their first solar-powered installation at Rex, Georgia, where the sun was and is used to power the highway grade crossing signals. Since then Southern has added solar powered signaling circuits at Lake Ponchartrain near New Orleans, and at the Tombigbee River in Jackson, Alabama.

The solar-powered systems now in use on the Southern are built by Solar Power Corporation of North Billerica, Massachusetts. They consist of a solar cell array panel, standby batteries which are charged by the solar cells, and the signaling equipment itself.

The size of each installation is determined by the load requirements, and the historical weather patterns of the area. A typical track detector draws about 1 amp, but the drain jumps to over 5 amps when the track is occupied by a train. Worked into the calculations is a safety factor requiring the batteries to power the installation for 20 consecutive overcast days. The original installation at Rex, for example, has a 45 square-foot array with 119 solar cells feeding a bank of 168 amp-hour lead-calcium batteries.

Solar power pays

The installation at Lake Ponchartrain is a good example of how using solar energy can save money. The Southern tracks run on a levee, control of which is in the hands of a local Levee Board. Before power lines could be strung along the tracks on the levee, authorization would have to be obtained from the local Board.

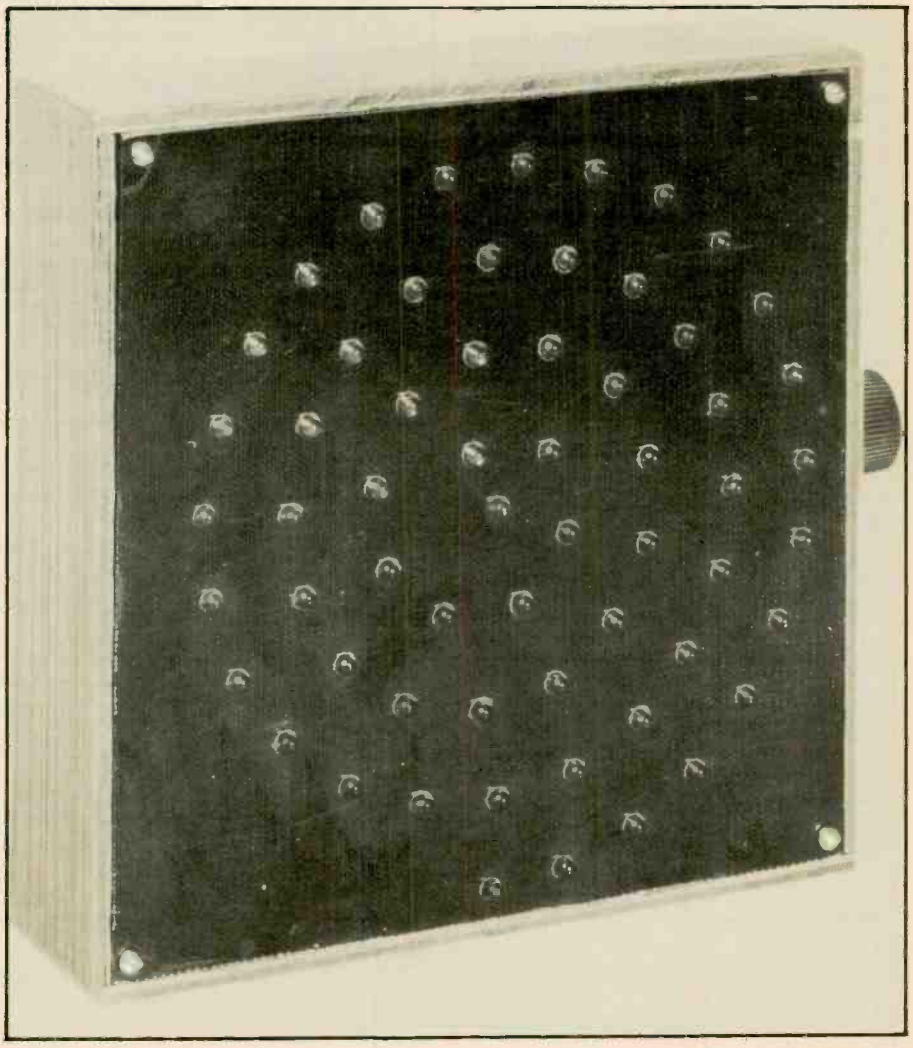
In addition to the costs of applying for the required permits, the Southern would also have to pay for the installation of a power line between the existing lines and the trackside circuitry. That cost was estimated by the power company to be about $50,000. The solar-powered installation, on the other hand, cost less than $5000. And, the cost of maintaining the solar cells and storage batteries is more than offset by the savings from not having to buy commercial power.

The Southern's other solar-power installation at Jackson, Alabama currently includes several track signals protecting the approach to the Tombigbee River drawbridge. These will shortly be joined by a solar-powered lock-out circuit to prevent the drawbridge from being raised after a train has entered the approach track. Southern also intends to add solar-powered signaling installations on their line between Hattiesburg, Mississippi, and Chattanooga, Tennessee.

Obviously, Southern's installations are all in the sun belt, which means plenty of sunshine and not very much snow. But even in parts of the north, there are many areas where sunny days predominate, and where solar power can and will work. The Southern was the first railroad to use solar power, and to demonstrate its cost-saving potential. Hopefully, in these days of impending fuel shortages, other major industries will turn to on-site solar power.

Digi-trance

This clever project manages to simulate motion by electronic means in a way that will keep you fascinated . . . to the point of hypnosis

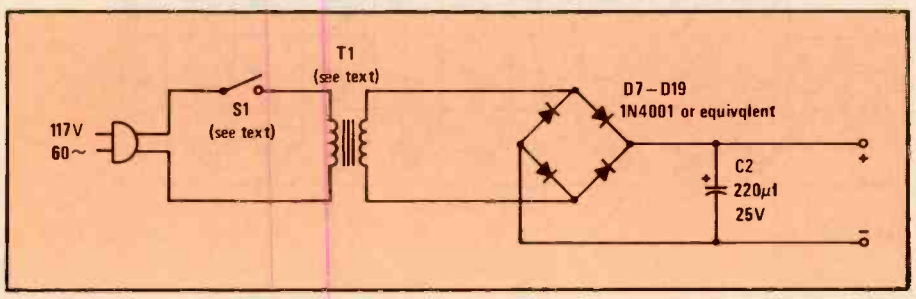


by Fred Blechman

We can't guarantee that this device will hypnotize your friends, but we can't guarantee that it *won't*, either! Sixty light-emitting diodes, LEDs, are arranged in a spiral pattern, and CMOS digital integrated circuitry turns on one LED at a time. You set the speed of apparent movement of the LEDs with a control mounted on the side of the enclosure. As you twist the control clockwise, the movement is quicker. At its most rapid, all the LEDs appear to be lighted at the same time. Twist the control further and all the LEDs except one are off. Since the lighted one is randomly selected by the circuitry, and can't be predicted, you can use the DIGI-TRANCE as a *wheel of fortune* by just assigning a number to each LED! At certain settings of the control, the effect is that of a pulsating spiral, which might be effective as a tool in hypnosis.

The unit shown in the photos was built in a home-made wooden box. Any enclosure could be used if it has enough frontal size for your spiral layout. The spiral shown in figure 2 is a suggested layout, but you can have a larger or smaller spiral if you prefer. You can make your own spiral pattern with a pencil, string and a small-diameter hub. The hub can be, for example, a piece of ¼-inch dowel.

Place the hub at the center of a piece of paper and attach one end of the string to it. Attach the pencil to the other end of the string. The string length determines the maximum size of the spiral. Now, holding the hub so it does not turn, move the pencil point around, either clockwise or counterclockwise. The string will wrap itself around the hub, slowly pulling the pencil toward the center, generating a spiral! Use the paper as a template and mark the positions of the LEDs at equal distances along the spiral, starting from the center.



You can power your Digi-trance from a 12-volt latern battery if you'd like, but for prolonged operation an ac power supply is recommended.

Building your Digi-trance

Use a piece of wood or masonite for the display board, with holes drilled at each LED location. Make the holes slightly under the LED diameter size, so the LEDs can be installed by simply pressing them into place from the rear of the board. Orient each LED so that the cathode lead, usually marked by a flat or notch on the base, faces the outside of the spiral.

Starting with the outermost LED, solder a bare wire to the cathodes of the first 10 LEDs. Do the same with the second group of ten LEDs, then the third group, and so on. You'll end up with six groups of 10 LEDs—these are the six horizontal

lines on the schematic.

Now, using insulated wires, connect together the first LED in each of the six groups. Then do the same with the second LED in each group, and so on. These are shown in the schematic as the ten common-anode vertical lines connected to IC1. Put this sub-assembly aside temporarily and wire the digital counting board next.

You can use perforated board for the counting circuitry, but it's a lot easier with *prototype board*—that's perfboard with printed circuit traces or pads on one or both sides. This makes construction much easier. If a trace appears between two points and you don't want it there, just cut it with a razor blade or sharp knife. By careful planning, you can construct this circuit with very few jumper wires on a prototype board. The author's counting board is small and crowded, but you can make yours larger. Sockets for the ICs are recommended.

The counting board should include the four ICs, diodes D1 through D6, R1 and C1. You'll probably want to mount potentiometer R2 and the optional switch, S1, on the cabinet.

All that remains is to connect the counting board to the display panel, potentiometer, switch and a power source. The wiring between the board and panel can be done with any flexible, stranded, insulated wire, but small-diameter color-coded ribbon cable is best. Using one group of six wires, and another group of ten wires, connect the six common-cathode wires and the ten common-anode wires as shown on the schematic. Note that the LED anodes run from "0" to "9" and the cathodes from "0" to "5". This can be confusing, so proceed slowly and carefully. It's easi-

Parts List

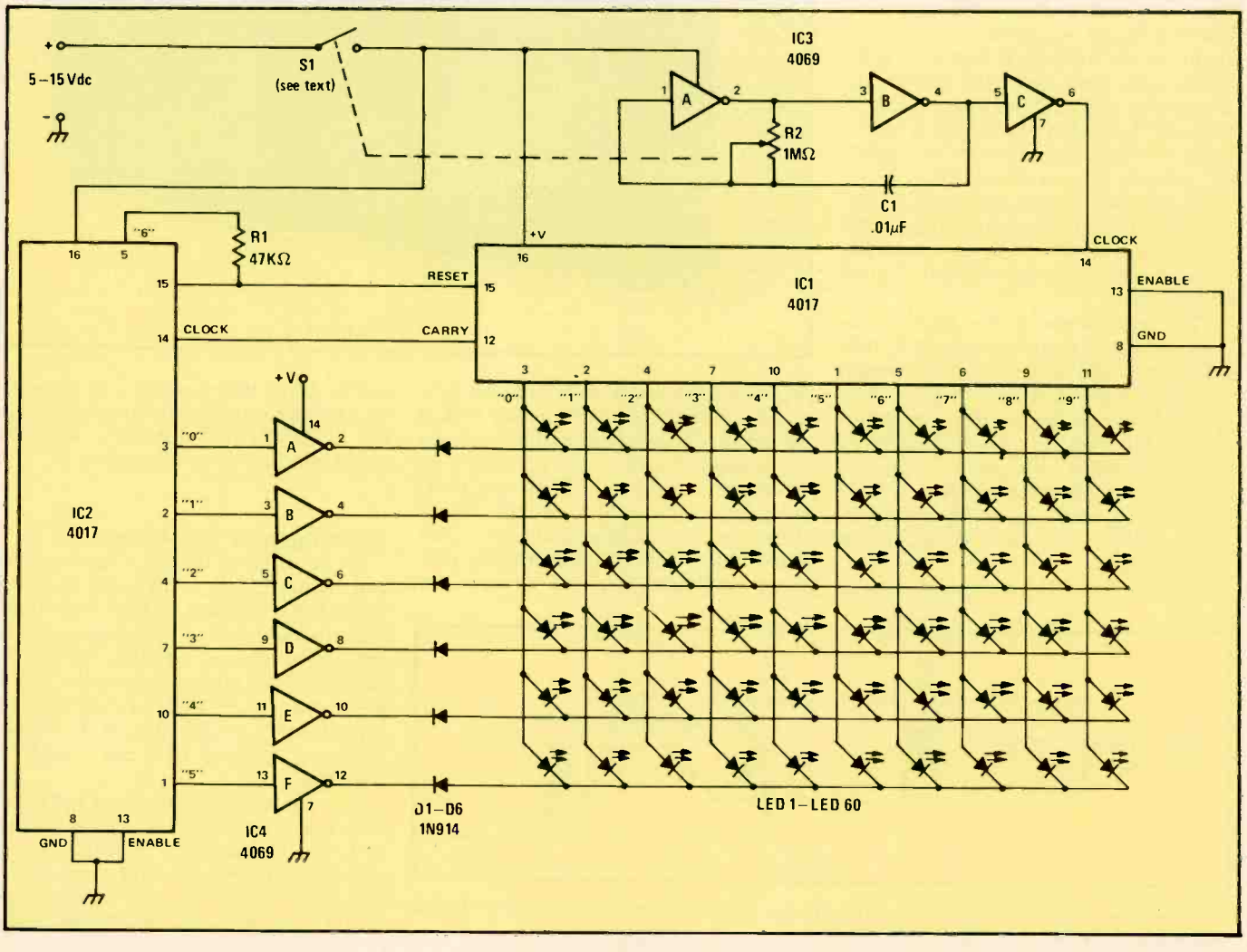
	DESCRIPTION		Calectro	Radio Shack
	IC1, IC2	CMOS 4017 Counter	See text	See text
	IC3, IC4	CMOS 4069 Hex inverter	See text	See text
	R1	47K, ½ W carbon resistor	B1-404	271-000 47K
	R2	1 megohm potentiometer	B1-692	271-211
*	S1	Switch (see text)	Part of B1-692	271-1740
	C1	.01 mfd disc capacitor	A1-029	272-131
	LED1-LED60	Jumbo red LEDs	See text	See text
	D1-D6	1N914 signal diode		276-1122
*	1 each	Perforated board	J4-601	276-1395
*	1 each	Prototype board	J4-610	276-152
	1 each	Knob	E2-705	274-407
*	2 each	14 pin DIP sockets		276-1999
*	2 each	16 pin DIP sockets		276-1998

Misc.: Cabinet, front panel, screws, nuts, wire, solder and ribbon cable (see text).

Optional Power Supply

*	T1	Transformer (see text)	D1-742	273-1384
*	D7-D10	Rectifier diodes, 50V @ 1A		276-1101
*	C2	Electrolytic capacitor 220 mfd @ 25 V	A1-131	272-1017
*	1 each	Line cord	L3-717	278-1255

* These are optional items. See text.

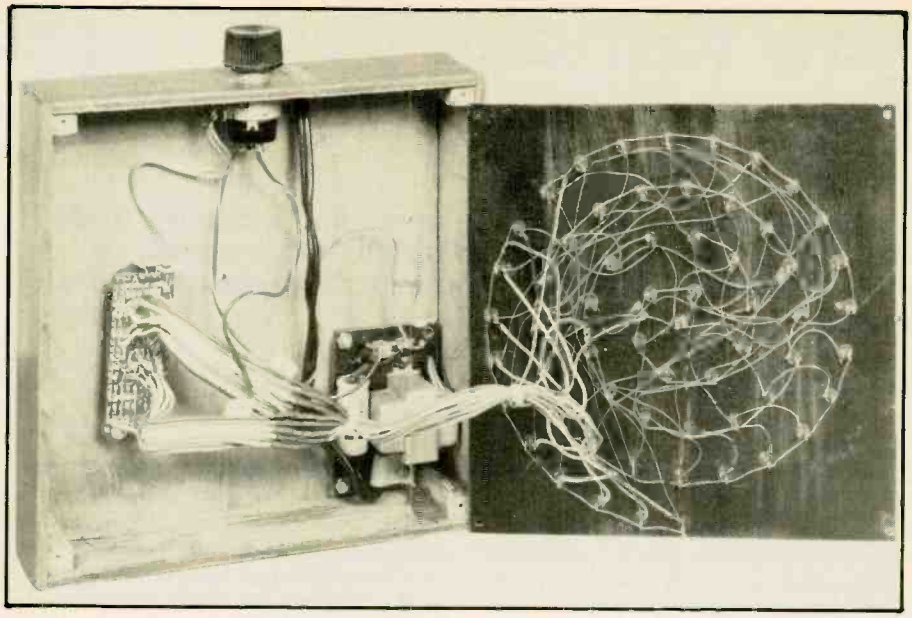


HOW IT WORKS

Although there are 60 LED's used in this circuit, there are very few other parts. The LED's are wired in a matrix as shown in figure 1. One output of IC1 provides a positive voltage to the anodes of six LED's at any given time. At the same time, only one output of IC2 is high, and this is inverted to a low state by a section of C4, providing a ground to the cathodes of ten LEDs. However, only the one LED with the positive anode voltage lights! In this manner, each LED is lighted in sequence as IC1 and IC2 *count*.

How do they count? Well, C3 is wired as a square-wave oscillator, with the frequency determined by the value of C1 and the setting of R2. The output of this oscillator is buffered by section C of IC3, and the pulses used to *clock*, or trigger, IC1 to advance count, with the *carry* output of IC1 clocking IC2 every 10th count. At the end of 60 counts, the "6" output of IC2, through R1, resets both IC1 and IC2 to zero, starting a new counting sequence. Since the LEDs can only tolerate a small reverse voltage, diodes D1 through D6 are used to block high-state IC4 outputs from the LED cathodes.

You may wonder why the LEDs seem to be running wide-open, that is, without dropping resistors. That's because the ICs have inherent current limiting, so the LEDs can't avalanche. However, it's a good idea not let any one LED stay on for more than 10 seconds. This will prevent the ICs from overheatting.



er if you follow the standard color code where 0 is black, 1 is brown, 2 is red, 3 is orange and so on, when connecting each colored wire in sequence to the six groups of LED's, and the ten LED's in each group.

Use two more wires to join the positive and ground points, and another two wires to the center and right terminal potentiometer terminals, looking from the rear of R2. You may use a separate switch, or one mounted on the back of the potentiometer, as in the author's unit. The location of the switch in the circuit depends on your method of powering the unit.

You can use four C or D batteries wired in series to provide six volts. Since the average battery drain at 6 volts is only 12 milliamperes, four C cells will last over 200 hours, and four D cells will run the unit for over 400 hours. You can also use a typical 9-volt transistor radio battery, but since the drain is about 30 milliamperes at 9 volts, this battery would last less than an hour! If you use batteries, connect the switch to the circuit as shown in figure 1.

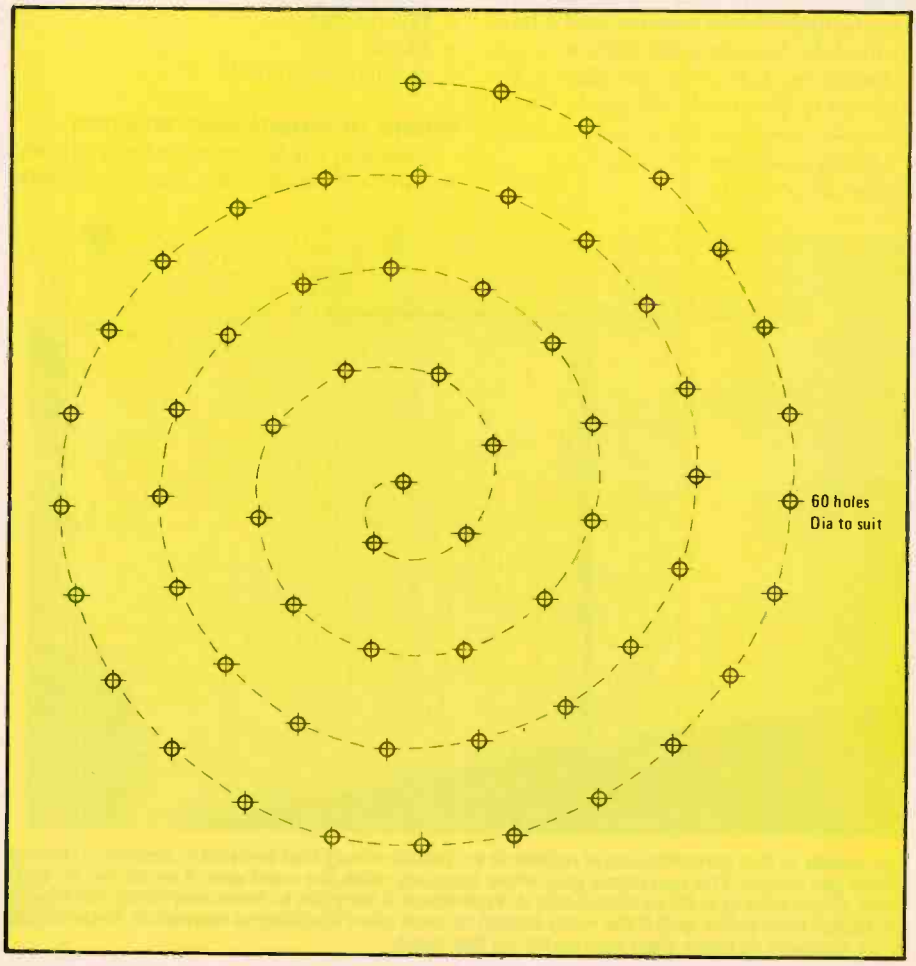
110-volt version

If you wish to use the unit for long periods, it makes sense to power the unit from the AC line. You can either build-in a small power supply as shown in figure 3 or use a typical tape-recorder wall-plug AC adaptor that supplies dc at 6, 7½ or 9 volts.

If you build your own power supply, wire switch S1 as shown in figure 3. Use the smallest filament transformer you can find—even at 12 volts the unit only draws 60 milliamperes. *Do not*, however, *exceed 15 volts dc*, or you can destroy the ICs. If you use a transformer rated at 6.3 volts at 300 mA, for example, you'll probably find you have 8-9 volts at the output because of the low current drain.

You can be very liberal with parts substitutions, except for the ICs. Calectro and Radio Shack part numbers are given for most items. If you don't have access to parts this way, a good mail-order source for digital projects is JAMECO Electronics, 1021 Howard Ave., San Carlos, CA 94070. They sell 10 V at 50 mA JE-100 transformer which costs only 99¢.

The DIGI-TRANCE is intended to be used for entertainment purposes only, and not for medical use or gambling. However, it's a simple but challenging construction project, and it's certain to be a great conversation piece at your next party . . . or seance!



How to make your TV picture perfect

Are you sure your TV is being given half a chance to do its job? You may be surprised by the improvement in your reception if you follow the expert suggestions given here.

by Harry Greenberg*

Are you one of those who have spent a lot of money buying a new TV set only to experience disappointment and frustration whenever you turn it on? Instead of the widely-promoted "sharp, bright, clear" pictures you hope for, you see "snow," double images, interference, smeary color, and other annoyances. Sometimes you may not even receive all the channels.

In order to reproduce a picture that has been transmitted, every television set must have a sufficient signal input to function properly. Receiving the signal and delivering it to the set is the function of the antenna, transmission line and the other parts that make up the "reception system."

Because reception conditions vary considerably from area to area, antenna manufacturers make hundreds of different models. Selecting the right one can be confusing. Let a local specialist in TV antennas help you. He will guide you in selection of the right antenna, materials and equipment for your installation.

There's no mystery about how to set up an antenna to do justice to that new color set you've just bought, or to spark up the one you've been enjoying all along. With the basic equipment, a few tools and some practical hints you'll save yourself a lot of grief, a few bucks, and have the satisfaction of doing the job yourself!

Chief Engineer, Channel Master, Division of Avnet, Inc.

Tools you'll find handy

Though you probably have most of the tools you'll need in your kit, here's a quick checklist:

- Large and small blade screwdrivers
- Large and small Phillips screwdrivers
- Vise grip pliers
- Wire cutters
- Pliers
- Adjustable wrench

Where to mount your antenna

Selecting the location for the antenna installation could be the most important decision of your life. Never put it up near high voltage power lines. You could be severely injured or even electrocuted if your antenna comes in contact with high voltage power lines.

You can mount the antenna on either the chimney, the roof, or an outside wall. Choose the one which best suits your particular situation. Before you begin installing your antenna, familiarize yourself with the various components. The quality of the picture you receive will depend on how you use them.

■**Standoffs**—Use them to keep the transmission line fast to the mast (transmission line shouldn't be wrapped around, or taped to the mast).

■**Masting**—Be sure it's strong enough to withstand the wind, rain, snow and sleet, while supporting the antenna you're mounting.

■**Guy Ring, Clamp and Wire**—To keep the mast standing tall.

■**Ground Rod, Ground Wire and Antenna Discharge Unit (Lightning Arrestor)**—for lightning protection.

The importance of a quality transmission or lead line cannot be stressed enough. It's the link between that specially engineered antenna you're installing, and your TV set.

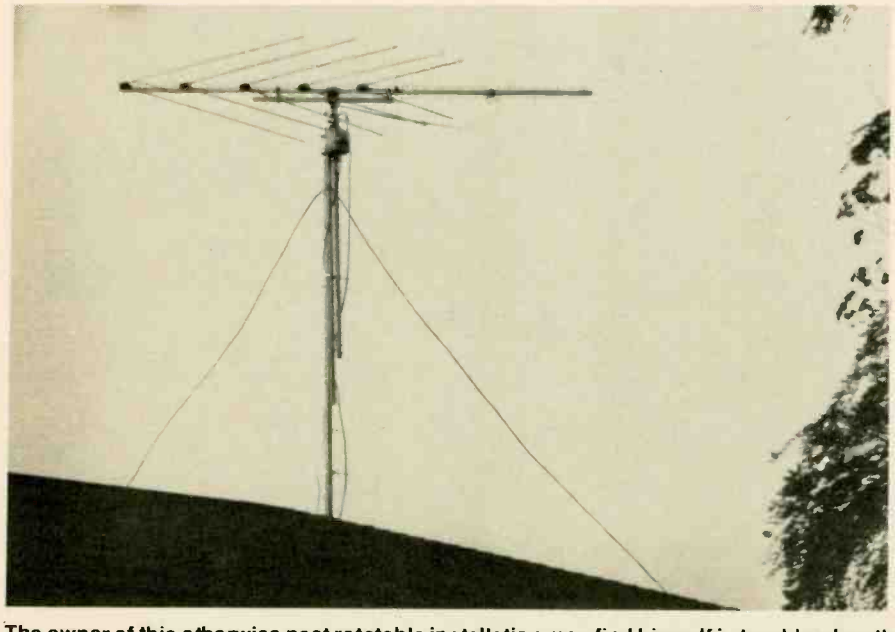
When you're leading the transmission line, be sure it doesn't come into contact with other materials. Contact with, or pressure from any material, particularly metals, may cause loss of signal.

Secure the lead line to the masting with snap-on standoffs placed close to the antenna to prevent flapping in the wind. Keep a taut line for best reception!

Be sure the transmission line is securely attached to the antenna. It's surprising how many people forget to tighten all the nuts and bolts, and then wonder why they're not getting the picture.

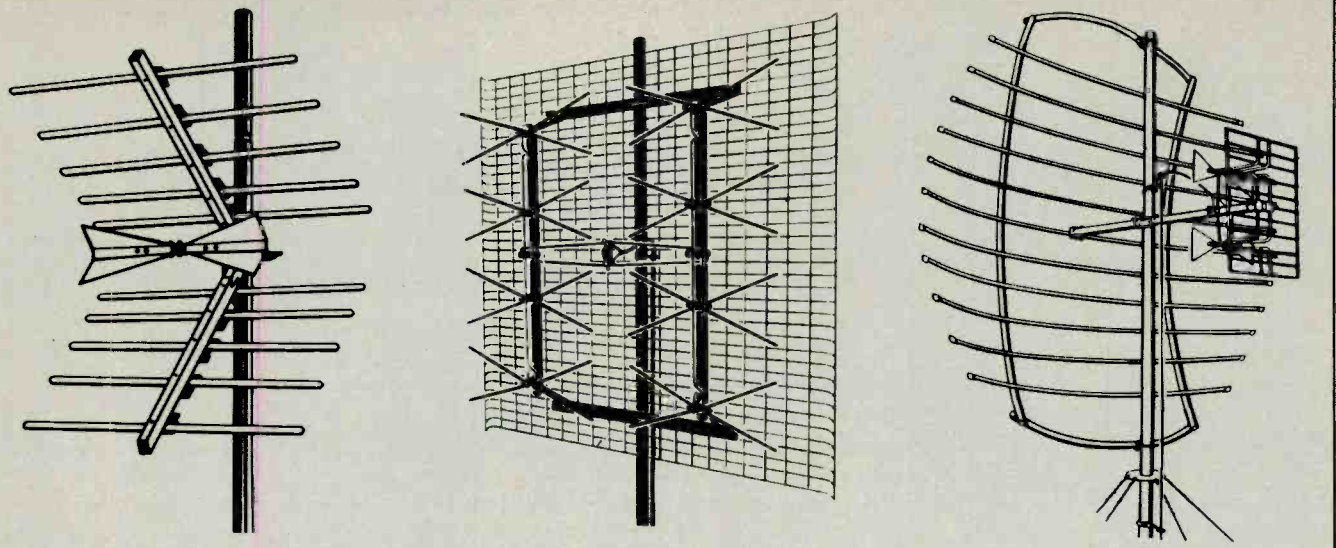
To maintain a strong signal, lead the transmission line in as direct a path as possible to the TV set, taking care to avoid gutters, drains, downspouts and so forth. For this reason we recommend using standoffs at 5 foot intervals.

Be especially careful to lead the line over gutters at a minimum of 7½". Don't drop it through a downspout, and bring it in the house through a storm window,



The owner of this otherwise neat rotatable installation may find himself in trouble when the winds get rough. The two loose guy wires hanging from the mast aren't much better than none. Guys strung in three directions is a minimum if they are to mean anything. Four guys are better than three, and if the mast height or local wind conditions warrant it, there ought to be support at more than one point on the mast.

Drawings courtesy Channel Master



Some TV antennas get pretty exotic. Here are three configurations of UHF signal snatchers used where convention antennas won't do the job. (left to right) Corner reflector; an 8-bay bow and screen unit; and a dish. The latter type offers the most gain.

QUESTIONS AND ANSWERS ABOUT TV ANTENNAS

Q. How important is the antenna to your set's performance?

The antenna is—quite literally—the eyes and ears of your TV set. Your reception therefore, can only be as good as your antenna. The most expensive set with a poor antenna will generally not perform as well as a cheap set with a good antenna.

Q. Is this a matter of concern only to a new set buyer?

No. Constant exposure to wind, ice, rain, sunshine, and other outdoor conditions often cause the antenna installation to bend, break, or rust, and the transmission wire to weaken or even break. If your old antenna is up more than 2 years, it's a good idea to ask yourself: "Am I completely satisfied with my reception quality on all channels?"

Q. What is the "right" antenna for you?

That depends on where you live. Sometimes—if you're very fortunate—the right antenna can be a simple, inexpensive "rabbit ear" perched on top of your set. The trouble is that they have severe limitations. They can only be used in very strong signal areas, and they can't do much to eliminate ghosts and other kinds of interference (more about this later). Outdoor antennas produce the best results. If you must use an indoor antenna. try those with built-in amplifiers. In any event, always make sure you take one on a trial basis should you wish to return it.

Q. Is it true that it's more difficult to get good reception today than it was 10 years ago?

This is generally correct. Ten years ago, most people owned just one black and white TV set. Today many families have 3 or 4 color sets, plus one or 2 FM receivers. Poor results can be expected if all these sets aren't hooked up to the antenna properly. There are other problems, too—new sources of interference where none existed previously, which must now be eliminated by a properly-selected antenna. More stations are on the air, too. And for the sports fan, blacked-out home games have created a demand for antenna systems that can get the games from a distant city. So you can see, antennas have a bigger job than ever before.

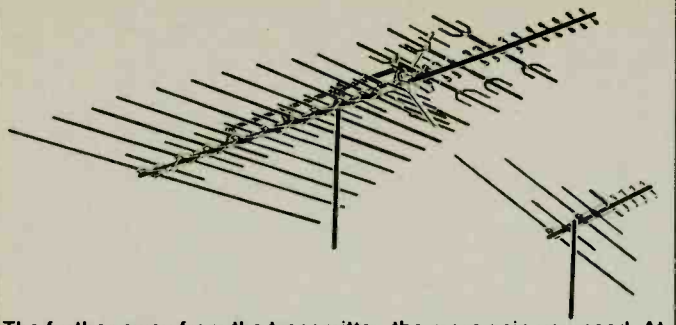
Q. How do I go about getting reception from stations which lie in different directions?

People living in localities where signals can be received from differnet directions can receive all available channels by using one of the following methods, bearing in mind that all antennas have a "front" which should point at the desired station: ROTATORS, used with a multi-channel antenna. The rotator is installed on the mast, with a control box near the TV set. The antenna is easily rotated to face in any desired direction. COUPLING SYSTEM, used with separate, individually-aimed stationary antennas. Couplers permit you to use 2 or more specialized antennas of your choice, joining them all to a single wire that runs down to your set. It all works automatically—all you do is switch your set to the desired channel and enjoy the show.

Both of the above systems are quite popular and serve specific needs. Your serviceman can help you determine the right system for you.

Q. Do you need a separate antenna for your FM Stereo?

The FM stations are all situated between channels 6 and 7. This means that most well-designed all-channel VHF antennas can receive FM stations reasonably well. As a general rule, the FM sensitivity of an all channel VHF antenna of recent design will be about the same as it is on TV. A coupler is readily available to separate the TV and FM signals coming down from the one antenna. Easily attached to the wire, it channels the TV signals to the TV set(s), and the FM signals to the FM set(s). Once



The further away from the transmitter, the more gain you need. At left is 173-inch boom UHF/VHF/FM model for deep fringe VHF and deepest UHF. Little brother (right) is only 39 inches long and is for reception of UHF/VHF/FM in metropolitan areas. Your requirements may fall between these extremes.

again, consider the family. If the TV and FM stations lie in different directions, the antenna will have to be rotated, which means that every member of the family cannot necessarily have it aimed where he wants it at a particular time. In a home with clearly defined TV watchers and FM listeners, separate antennas may be the recommended manner of maintaining domestic tranquility.

Q. What do you do when you've got several sets and just one antenna?

Don't do what some people do. Do not cut into your antenna wire and join wires from several sets. This will cause the sets to interact with one another and make good reception impossible on all of them.

The right method is to use couplers (2-set, 3-set, or 4-set couplers) designed for this purpose. They are economical and keep the sets electronically isolated from each other, even when they're all in use.

Q. What happens when the most powerful antenna still doesn't produce a snow-free picture?

You can take one more step: install a booster, an antenna-mounted signal amplifier. The newest ones are transistor-powered.

Q. How high should an antenna be installed?

As a general rule, the higher the better. If you can't go high enough, this disadvantage can be offset by switching to a more powerful antenna model.

Q. How can you tell how well an antenna will stand up to the weather?

The best antennas are ruggedly constructed, and this is something you can see with your own eyes. You should also exercise care in the selection of transmission wire. Heavier wire will withstand sun and rain, will la t longer, and will provide better reception under all conditions. If wire is to be run inside building walls, or through metal pipes, or near electric motors or similar sources of interference, be sure to use shielded coaxial cable.

Q. Can an outdoor antenna be installed in an attic?

Yes. If there is no metal sheathing or foil-lined insulation on the attic roof or walls, an attic installation can be a good idea—provided it offers enough elevation. A major benefit of such an installation is the protection it affords the antenna against the ravages of weather.

Q. What should you know before selecting an antenna?

There is no single, cure-all antenna. These are the factors which will influence your selection:

1) Where you live in relation to the source of the TV signals:

(A) Primary area—the location relatively near the transmitter, where the signals are very strong. As a rule, antenna selection in such areas is a less demanding tasks, and only here can indoor or built-in antennas be used with any degree of effectiveness. Ghosts in such areas are often a special problem.

(B) Secondary area—a suburban or other location where TV signals may be somewhat weaker, and an antenna of intermediate power required.

(C) Fringe area—the outermost limits of TV reception, requiring the most powerful antennas and the tallest installations.

These are relative terms. No hard and fast mileage determines what an area may be called, since many variables come into play. For example, in UHF reception, the nature of TV waves is such that a fringe area is much closer than in VHF.

2) Type of terrain:

TV waves travel in a straight line, and travel further over flat surfaces and water. Thus, the terrain in your vicinity is important: if it is hilly between your set and the transmitter, you may need a more powerful antenna than mere distance would indicate.

3) Presence of tall buildings, hills, etc.

Tall buildings, huge fuel storage tanks, and other structures present a similar problem. Big-city dwellers, in strong signal areas, are often puzzled by "ghosts" caused by signals reflected off such structures. Proper antenna selection makes it easy to deal with such problems effectively.

4) The number of TV stations received in your area.

Whether your area gets only one or two stations—or half a dozen—strongly affects the choice of your antenna. There are antennas designed to receive one channel, several channels, and all channels.

5) The type of TV stations received in your area.

It makes an important difference whether you are in a VHF area, a UHF area, or one which receives both. And before limiting your self to the reception available today, be certain to check with your serviceman to learn whether new stations are in the offing. The right choice now can save you added expense later.

Q. Does color TV require a special antenna?

Most antennas available today will perform as well on color as on black and white. However, newer models do a better job than older ones. If you've had black and white for a few years and are buying a new color set, it would be a good idea to get the most out of your investment by putting up a new antenna—especially if your old one didn't deliver perfect pictures on all channels before. Old antennas can be counted on to aggravate picture problems in color.

TYPICAL RECEPTION PROBLEMS

SNOW

When an actor on your TV screen looks like he's caught in a blizzard—and it's a play about springtime—you have a common weak-signal problem. Snow is caused by the movement of electrons within every set, and it shows up on your screen only when the picture-signal is very weak. That's where the right antenna comes in. The more powerful the antenna, the more effectively it suppresses snow, simply by strengthening the signal . . . which means more picture-power.

GHOSTS

When you look at your TV screen and decide that maybe you've had a few too many...and you haven't had any—you are seeing TV ghosts. These multiple images (double, triple, or even more) can occur in strong or weak signal areas.

Here's what happens: your antenna picks up one signal directly from the transmitter. A split second later it picks up another, identical signal of the same image which has been reflected by a building or some other structure and arrives at the TV antenna from a different direction. Thus, two or more separate pictures appear on your set.

How can the antenna help exorcise ghosts? If it has good directivity, it will pick up picture-signals from one direction only, the front. Troublesome reflected signals are not picked up.

INTERFERENCE

We are now surrounded by more power stations, more trains and trucks, more electric motors, and more FM stations than ever before. All of these are major sources of interference which cause streaks, lines, bars, and patterns to mess up your TV reception. Such interference, often called "electrical air pollution" follows on the heels of population growth, and is developing at a rapid rate throughout the country. It is penetrating into suburban and rural areas which until recently were, electrically speaking, quiet and clean. New antennas have been specially designed to remove this pollution before it reaches your set.

OTHER DIFFICULTIES

Not all picture defects, of course, are so directly related to your antenna. However, although such bogies as flickering, dim, rolling pictures, or fadeouts are generally caused by defects within the TV set, they may also be a sign that all is not well with your antenna installation—a loose or broken wire, for example. Your serviceman will advise you.

aluminum or otherwise, and expect a TV picture. Though this is often done, it causes severe signal loss and will wipe out all the extra precautions you've taken so far.

The best lead-in is straight down from the mast, into the house through a hole drilled into the basement, then up through the floor behind your TV set. Once again, be sure to keep the lead line a minimum of 7½" from waterpipes, vents and other metal objects.

Ground

Now that you've set your lead, be sure the installation is electrically grounded to lessen the chances of lightning damage. You can ground by running a #8 aluminum wire from a bolt on the mast or its base, down to a ground rod driven at least 4 feet into the earth. Keep the line at a respectable distance from your transmission wire to prevent signal interference . . . if you can run it down the other side of the house and into a rod driven into moist soil, you will be ahead of the game. A UL-approved static discharge unit should also be used on the transmission line. Follow the manufacturer's instruction for proper installation.

Chimney mounting

First check our your chimney. Is it strong enough to support the antenna under severe winds? Remember, an antenna can act like a sail, and weakened chimneys have been known to go with the wind. Be sure to fasten the chimney straps that hold the mounting brackets as far as possible from one another, for firm support, and keep your antenna well above the chimney line to prevent crusting and corrosion from smoke and soot.

Roof mounting

Mounting the mast directly on the roof is easy, but be sure you:

- Never walk on a composition roof in cold weather
- Never walk on a dry wood shingle roof
- Wear sneakers or crepe soles, and use a safety rope.
- Cover the bolts with roofing compound when you install the mounting base on the roof. Use at least three guy wires to support the mast.

Wall mounting

Choose a location near the TV set, and, if possible, on the sheltered side of the house. The reasons for this are clear: since TV signals weaken as they are conducted through wire, the shorter the line, the less signal loss you incur.

It's generally a good idea to mount your antenna as high as possible, bearing in mind that signal strength varies with location and height.

Between 5 and 10 feet above your roof line is a good rule of thumb, though if conditions permit, you may want to test the signal at different heights.

Now, by following manufacturer's instructions, you've got your antenna mounted, connected and grounded. Turn on the TV set to test for peak signal locations. With one person at the set and another at the roof, turn the antenna until you get the best picture, being sure to mark your locations for each channel. Then set the antenna at the spot that gives you best overall reception.

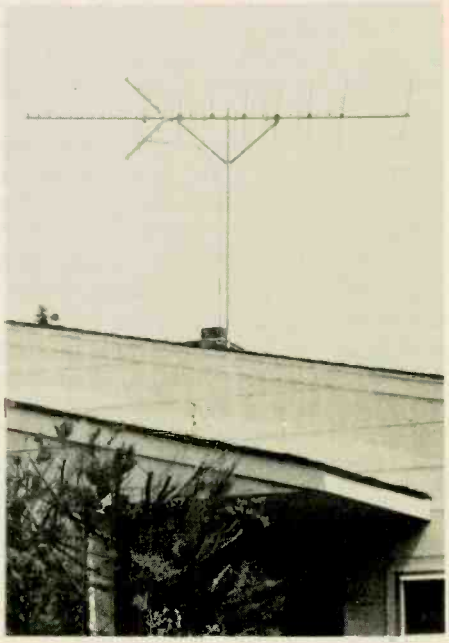
ANTENNA CHECK LIST

Picture Check

- Are you getting all the channels you should? . . . including UHF?
- Do you get them all clearly? Or do you get ghosts or snow?
- Do you ever get intermittent streaks, bars, patterns, or shooting lines across your picture?
- On color sets, is your color picture uniformly good on all channels?
- Does your picture get worse in the rain? Does your picture jump when the wind blows?
- Is there a distant channel (100-125 miles) you'd like to receive (to see blacked out games, for example) but can't?

FM Check

- Does your signal fade in and out?
- Can you get all stations within a radius of 50 miles?
- Do you hear a background hiss on any FM stations?
- On stereo broadcasts, do you get clearly defined reproduction of separate stereo channels?



Frequency response

Flat response, kilohertz, and decibel are terms widely used in the audio field, but not always thoroughly understood. Here's a painless look at what it's all about.

by Craig Anderton

What we call "sound" is basically a rhythmic variation in air pressure. This phenomenon is not unlike the motion of ocean waves, except that instead of having crests and troughs of water, we have crests and troughs of air pressure. But not all sounds are alike, by any means. Some are bassy, some are shrill; some are very loud, like thunder, and some are very soft, like a leaf falling.

We can classify these sounds in terms of their *level*, often referred to as volume, and in terms of their *frequency*. Frequency is simply a quantitative measurement of the changes in air pressure. If these pressure changes occur many thousands of times in a single second, then we are dealing with a high frequency sound. If the air pressure changes occur at a slower rate—say, only 40 or 50 in a second—then we have a comparatively low frequency sound. Because of the wave-like motion of sound, each *wave*, the crest and the trough, is called a *cycle*. We measure frequency by counting how many cycles occur in a single second; this gives us a figure in *cycles per second*.

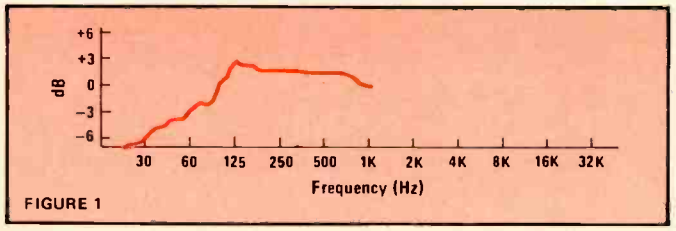


FIGURE 1

Recently, the term "cycles per second" was replaced with the single word *Hertz*, abbreviated Hz, to commemorate a scientist who contributed much to the subject we are discussing. So, whereas it is correct to refer to a 100 cycles per second tone, we would more likely call it a 100 Hertz tone. Once we get past a few thousand Hertz, we can use the term *kilohertz*, abbreviated kHz, which stands for a thousand Hertz. Thus, a 1,000 Hz tone has the same frequency as a 1 kHz tone.

As far as *level* is concerned, that's not too hard a concept to grasp. The level is basically how *loud* or *soft* the sound is that we are hearing; so, if we know the *frequency* of a sound and the *level* of that sound, we have a pretty good idea of the type of sound we're talking about. Well, that defines the terms we need to continue this discussion, so now let's turn to the subject of frequency response.

Frequency response is a characteristic we usually associate with a particular piece of audio equipment. Since everyone has a set of ears, that's a pretty universal piece of audio equipment to examine first. Our ears respond to frequencies over about a 10 octave total range, from approximately 20 Hz to 20 kHz; but unfortunately, these figures only hold true for the ears of a healthy youngster. As we get older, our ears lose their ability to respond to high frequency sounds; so at a very advanced age we could have a response that only extends up to 5 or 6 kHz. This is the case of uneven frequency response—in other words, the ears respond *differently to different* frequencies (in this case, higher frequencies produce less response).

Let's take this a step further. If the ear was a perfect listening machine, then it would stand to reason that if a sound source—loudspeaker or whatever—produced tones from 20 Hz to 20 kHz at exactly the same level, then our ears would respond equally to these tones; the high frequency ones would sound just as loud as the low frequency ones. This would be an example of *flat response*—i.e., the response is even throughout the audible frequency range. But as we have already seen, there is a tendency for the ear to lose treble responses as it ages, which means we suffer a deviation from flat response.

The aging effect is not the only problem we have with our nonetheless marvelous hearing mechanism; the ear also exhibits a different frequency response at different sound levels. At fairly low listening levels, the ear responds *less* to very high, and very low, frequencies. On the other hand, at high listening levels the response of the ear is much flatter, although it still is not the ideal we would hope for. So much for the problem inherent in our hearing; but there are also other problem spots in the audio signal chain.

A speaker *never* has flat frequency response. No matter how much you spend, every speaker will have deviations from the ideal response we're looking for. For example, at very high frequencies a loudspeaker has to create very fast variations in air pressure; but the mass of the cone of the speaker, friction problems, and other error sources make very accurate high frequency reproduction difficult. At the other end of the audio range, you have low notes that require the movement of large amounts of air. Even a 15" speaker can have trouble moving enough air to generate massive air

pressure changes; so, this gives problems with the low frequency response. A typical loudspeaker will have a frequency response that rolls off towards both the extreme high and low ends . . . but that's not all; resonances, or response anomalies, in the speaker and speaker enclosure itself can cause deviations in the midrange response. To complicate matters even further, the room in which you are listening to the speaker will contribute its own shaping to the sound. A room with many hard surfaces like concrete, will bounce high frequencies around and make them appear more

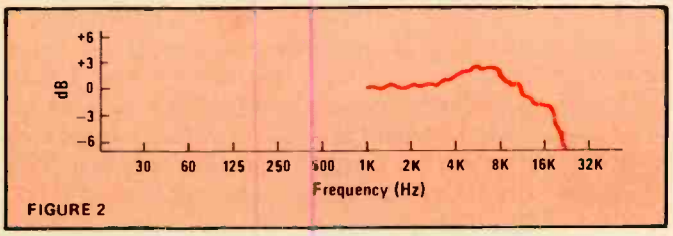


FIGURE 2

prominent, while the thickly carpeted room will *absorb* many of the high frequencies. To think people call this process high fidelity!

Think our problems are over? Not by a long shot. Phonograph cartridges, microphones, guitar pickups, and other transducers have the same type of problems in giving flat frequency response as loudspeakers. As we mentioned last column, these half mechanical/half electronic devices are typically inefficient little beasties, and that goes for their frequency response characteristics, too.

Amplifiers don't have perfect frequency responses either, but compared to our ears, or loudspeakers, they are quite good. Many amplifiers can reproduce tones from 20 Hz to 20 kHz, or even 100 kHz, with ruler-flat response. Generally, the amp will not be the weak link in our frequency response problems.

We're reaching the end of the puzzle. Our conclusion: With so many variables between musician and listener, we have to do something to keep the chaos to a minimum. Hence, whenever possible, we try for audio systems that have the flattest possible response. Then, the only variables left are the ears and listening environment of the listener, which can be compensated for *by* that listener. Studios spend a fortune on tape decks, monitor speakers, and room tuning devices in order to

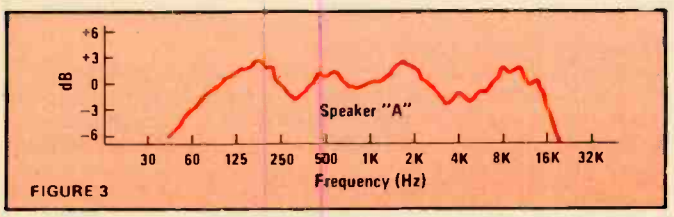


FIGURE 3

insure flat frequency response in the master tape they produce. If that tape (or recorded dub) plays through a listening system with flat frequency response, then we'll hear the same overall sound through both systems. But if the studio loudspeaker exaggerates the high frequencies, then any tapes made in that studio will probably sound deficient in highs when played over a system with flat response. So, in order for this whole hi-fi process to work smoothly, every system has to have flat frequency response, both at the recording *and* playback end.

We've gone through a lot of heavy stuff here, so let's just recap a bit. We've learned about sound waves and the associated properties of frequency and level. By examining whether a device responds to all frequencies of identical levels in exactly the same way, we can determine whether that device has flat frequency response, or, as is more likely, some deviation from the norm of which we should be aware.

Well, it's all very nice to have this new knowledge, but now we must relate what we've learned to the real world. If you ask a speaker manufacturer about the frequency response of a speaker, for example, you'll probably be handed a sheet of graph paper with squiggly lines all over it and strange markings given in Hz and kHz, which we already know about, and decibels which we'll cover next. Simply stated, the dB is a unit of ratio between two audio signals; probably the best way to become familiar with the dB is through some examples.

Let's say you're listening to an amplifier/speaker combination, and have a sound level meter calibrated in dB that registers changes in the acoustic output of your system. Furthermore, let's suppose the input to the amplifier is not a complex musical source such as a recording, but instead is a very pure audio test tone that can vary in frequency from 20Hz to 25 kHz.

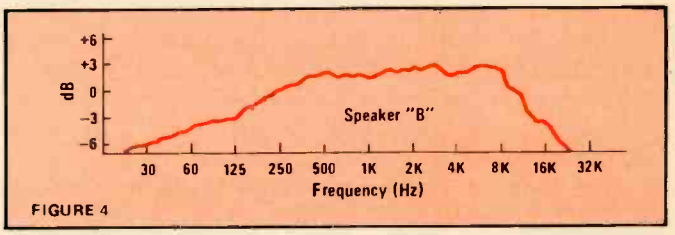


FIGURE 4

Remember, since the dB expresses a *ratio*, we're going to need some kind of standard signal which we can compare other signals against in order to derive this ratio. Under ideal circumstances, you would adjust the level of the tone for a comfortable listening level, and adjust your meter so that it reads *0 dB* at this reference level. Notice a big advantage already to working with the dB . . . the absolute sound level coming out of the speakers is not important, so we can listen at any volume level. What we're looking for are *changes* in volume level so we can set up some ratios.

A good reference frequency to start off with is 1 kHz; the biggest response anomalies occur at the limits of response, so 1 kHz is a good reference frequency since it lies in the approximate middle of the audio spectrum. A signal that is stronger than our reference creates a ratio that is – so many dB; a signal that is weaker than our reference creates a ratio that is – so many dB.

So, we have our reference frequency, 1 kHz, and our reference level, 0 dB. Now, let's change the test tone frequency and see if there are any changes in the sound level. Figure 1 shows a plot of a loudspeaker low end response. As our signal generator starts going down in frequency, we don't notice very much change in the sound output. It might deviate a dB or two from the reference. But after a slight boost around 125 Hz, the response starts dropping off and becomes relatively uneven. Now, let's perform the same type of exercise, but move upwards in frequency from 1 kHz instead. Figure 2 shows a plot of the upper end of our speaker.

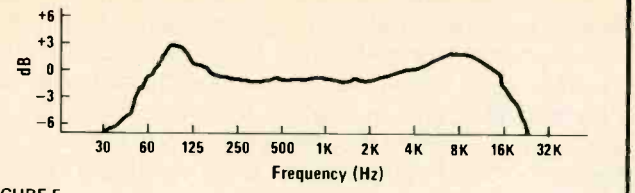


FIGURE 5

As you can see, there is a slight peak in the upper midrange region; but the response starts to fall off dramatically around 16 kHz.

If we wanted to summarize the performance of this speaker, we could say that it is flat within 3 dB, or ±3 dB, from 60 Hz on up to about 18 kHz. We could also express the response as being ±6 dB, 60 Hz-18 kHz, which is the type of short form summary often given with loudspeaker specifications. We could alternately characterize the speaker by saying that it is ±6 dB from 30 Hz to 20 kHz. Either way of looking at the speaker's performance is correct.

Having this knowledge enables us to do certain things. For one, since we now know our system is not flat, we can twiddle with the amplifier tone control knobs in order to help compensate for the speaker's anomalies. Or, what about that peak in the treble range? If we combine this speaker with, say, a phone cartridge that also has a trebly peak, then the resulting sound of the two working together will be unnaturally tinny and bright. On the other hand, by choosing a cartridge with a more subdued high end, the speaker/cartridge combination will complement, rather than oppose, each other.

Let's look at two comparative speaker response curves, figures 3 and 4. Notice that for a short form description, A would be ±3 dB from approximately 60 Hz to 16 kHz, whereas B would be ±3 dB from 125 Hz to 13 kHz. If this was the only information we had, we would conclude that speaker A has a more wide-range response, and assume this is the superior speaker . . . but it ain't necessarily so. Let's compare points on the two curves where the speaker response is down 6 dB. For speaker A, this occurs at about 50 Hz on the low end, but for speaker B this occurs at 30 Hz . . . indicating that speaker B has a slightly better low end response overall than speaker A. At the high end, A is down 6 dB at about 18 kHz, but B goes up to about 20 kHz before the response goes down an equivalent amount.

Let's look at the nature of the curves. Speaker A is very "peaky," and suffers from a very fast dropoff in responses at both the extreme high and extreme low ends. Speaker B has a much smoother response, and its roll-off is much gentler at the extreme limits of response. This speaker could probably be made pretty flat through the judicious use of tone controls, but speaker A would be much more difficult to equalize. So, notice how, according to one interpretation of the specs, speaker A comes out ahead. But when looked at in greater detail, speaker B is actually a speaker with greater potential fidelity and evenness of response.

As another example, I was asked to look at a tape recorder that had a "boomy" low end and a "funny sounding" high end. I ran a variable test tone that was perfectly flat into the input of the recorder; but what came out the output was anything but flat. In fact, it looked somewhat like figure 5. Here was an obvious explanation for the "boom": a large peak, about 3 dB, in the bass range. The "funny sounding" high end was attributable to a boost in the 10 to 12 kHz region. Although this boost brings out the sheen of instruments, it can also make them sound thin. Part of the reason for the high frequency boost may have been improper bias and/or equalization settings on the machine; but these controls were not accessible, so we had to do the best we could with what was available.

Luckily, the recorder's owner had a pretty flexible equalizer (tone control) unit, so I suggested cutting the bass at the peak's frequency during recording to offset the boost induced by the tape recorder. As it turned out, this action offset the boost just enough to give a fairly flat response. As for the high frequency boost, I suggested recording *without* attempting to offset this boost. As a result, on playback there was an artificially bright high end. However, by using the equalizer again to take off some of the high end during *playback* not only did the artifical brightness go away, but any tape hiss was brought down a little bit at the same time.

If you want to try running some tests like these, it's not too hard . . . especially if you have equipment with some VU meters built in so you can easily monitor the results—mixers, tape recorders, etc. Most electronics people would use a piece of test equipment called a sine wave oscillator as the signal generator; the sine wave is a very pure type of signal that is ideal for testing audio equipment. However, if you do not have access to a lab quality signal generator you can often get by with a synthesizer oscillator module. Many synthesizers can produce acceptable quality sine waves over a wide enough range to give good qualitative results.

GIFTS and GOODIES for CHRISTMAS

The calendar will confirm that Christmas is indeed just around the corner. It's time to start thinking about goodies for yourself and other electronics freaks . . .

To help you celebrate—or bemoan, if you happen to be Scrooge—the fact that Christmas is nearly upon us, *Modern Electronics* has gathered together on the following pages a veritable supermarket of things electronic.

The variety is wide. There's a simple plug-and-jack box for owners of Radio Shack's ubiquitous TRS-80, and Sharp's marvelous SC-8000 all-in-one stereo receiver and microprocessor controlled cassette deck.

Our own favorite category is Games. Judging by their obvious popularity and huge sales, we suspect many others will agree with our choice . . . But it really doesn't matter, because there's something for everyone.

Let's go shopping . . .

Editor's Note: All prices listed on the following pages were current at time of preparation. Due to well known factors, they are changing very frequently. Therefore, use them only as a guide to what the current amount may actually be.

MORE GIFTS and GOODIES for CHRISTMAS

Good sounds all around

A

B

C

D

E

F

I

H

J

G

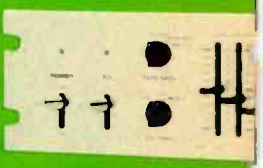
Sharp in looks as well as name, the SC-8000 (A, facing page), combination stereo receiver and microprocessor cassette deck bears a list price of $549.95. The receiver is rated at 75 watts RMS per channel at 8 ohms. The unique cassette deck performs the same functions as Sharp's RT-3388, with five forms of memory, a digital clock for controlling the timed functions and, of course, Dolby noise reduction system. At B, Sony's TC-K8B is not for the price-conscious bargain hunter at $850 suggested retail. Quality seekers, however, will want to look closely at some of its unusual features. One is the liquid crystal, peak-reading record level meters with dynamic range of from -40 to +5 dB, providing utmost accuracy in recording. Marantz has a new turntable, Model 6350Q (C). Precise speed accuracy is due to a quartz-locked, direct drive motor. Speed deviations are as little as .003%. If it's disco sound you want, try Electro-Voice's $338 PI-12-1, a full range speaker system that can handle 100 watts of continuous power. Pioneer's new front-loading cassette deck, CT-F500 seen at E, suggested retail of $175, has four memory functions and a unique flourescent peak-reading level indicator instead of VU meters. Includes Dolby NR, 3-position tape select switches and automatic shut-off. At F, Panasonic's RS-612US front-loading stereo cassette deck, with Dolby NR. Housed in a simulated wood cabinet, has separate bias and equalization switches, DC servo motor, automatic stop in both play and record modes. Cassette access door is oil damped, and there is a full complement of the usual controls. Yamaha NS-225 "Natural Sound" 2-way bass reflex bookshelf speaker system, $175, seen at G, is rated at 8 ohms impedance, handles 60 watts maximum input power, frequency range of 40 Hz to 20 kHz. Contemporary styling and superior sound quality enhance the value of Koss' K/6ALC stereophones (H). Features low-angle drivers to minimize distortion, volume controls, contoured ear cushions, all contributing to better-than-ever sound. Suggested retail, $34.95. Here's a new compact speaker system (I) small enough to be used in a car or at home, and good enough to have excellent sound. Bass reflex design, frequency response is 65-16,000 Hz. Maximum power rating is 15 watts, comes complete with mounting bracket that makes wall or shelf installation easy. It's by Aiwa, Model SC-47E. At J, the top of the Wharfedale line. It's the E-70 computer-optimized, 3-way speaker system. Handles up to 100 watts. Typical system response is virtually flat from 50-18,000 Hz. Weighs 70 lbs. Retail price, $420.

MORE GIFTS and GOODIES for CHRISTMAS

Sounding better every day

A

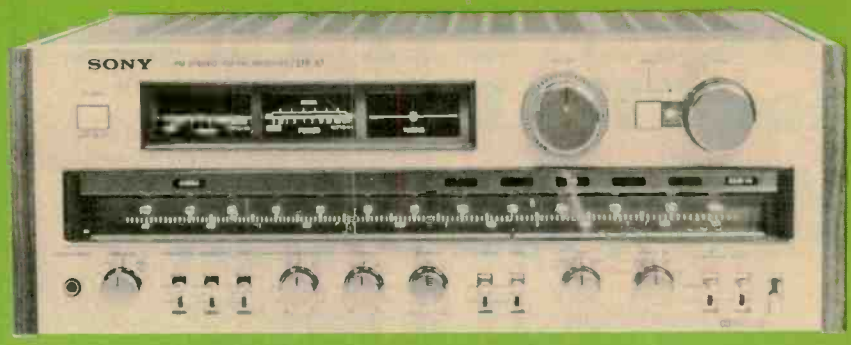
E



B

C

D



G

F

H

Sharp Electronics' Compact Music System SG-200, shown at A, has just about everything. FM/AM/FM Stereo, with front-loading cassette tape deck, 8-track record/playback deck, and a full size automatic record changer. Available with SP-3000 speakers as shown, $359.95. Sansui calls their Model G-6000 (at B) "a bottom of the line receiver with top capability". At 65 watts minimum RMS into 8 ohms with no more than .04% THD, this receiver compares well with the most sophisticated components. Suggested retail, $600. Another fine product from Sharp is shown at C. It's the SM-1122 integrated stereo amplifier. Minimum RMS power at 8 ohms is 15 watts. LED indicators for all functions, front panel mic input for mixing in all modes, and detented bass, treble and balance controls. $139.95 is the suggested list. Optonica's tuner and integrated matching amplifier and tuner are at D. The amp (top) is SM-3201, 40 watts power per channel minimum into 8 ohms. Features transformerless input and output, low noise equalizer amplifier, independent tone controls. List, $250. The tuner is ST-4201, $200, featuring PLL multiplex circuitry, FM air check calibrator, dual tuning meters, and switchable FM muting. At E, Sansui's Model AU-517 DC integrated stereo amplifier, $370, lays claim to having the widest frequency of any of today's DC integrated amplifiers: +0,-3dB from 0 to 200,000 Hz (from Main-In); 65 watts per channel minimum RMS into 8 ohms. Nikko's EQ-1 graphic equalizer, (F), $279.95, has 12 dB cut or boost in each of 10 bands per channel. THD is .006%, and signal-to-noise ratio is 105 dB (IHF A). Slider type controls with detent stops at zero plus five more on each side of zero, with convenient finger grips. Sony brings out its STR-V7, top of the line at $820, (G, above right), with exceptional capabilities, some not even available in separates. This is a high power unit—150 watts RMS per channel into 8 ohms, with no more than .07% THD. Tuner has FM bandwidth selector, Dolby FM decoder and direct coupled preamp. Two output meters display the power that is being delivered. Pioneer has an interesting receiver/cassette deck/automatic record changer unit, #KH-8833, (H, lower right above). Delivers 22 watts RMS per channel with no more than 0.7% THD, 40-20000Hz. Fully automatic belt-drive record changer, complete with Audio-Technica cartridge. Dolby cassette has PMS auto search/editor, auto rewind and replay. Shown with CL-70 bass reflex speakers.

MORE GIFTS and GOODIES for CHRISTMAS

VIDEO TAPE RECORDERS
Preserve your favorites

TV buffs have to be slaves of the clock to avoid missing their favorite programs. Be the master, not the slave with a video tape recorder. Go on about your business while it tapes whatever you choose. View it later at your convenience.

A

B

C

D

E

ITEM	MANUFACTURER	MODEL	PRICE	DESCRIPTION	READER SERVICE NUMBER
A	Gusdorf	2450	$55	Video cassette storage cabinet-100 tapes	59
B	Sony	SL-8600	$1100	Latest Betamax with remote pause	60
C	RCA	VCT400	$1300	Can be set to four different programs	61
D	Panasonic	PV-1000	$1100	Four-hour recorder with timer	62
E	AKAI	VT-300	$1300	Battery-powered portable VTR	63

MORE GIFTS and GOODIES for CHRISTMAS

MOBILE STEREOS Speakers

No matter how good the rest of the equipment is, it's the speakers that really tell the sound quality story.

A

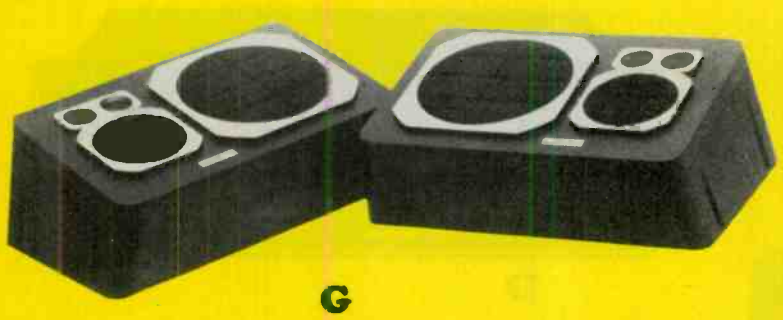
B

C

D

E

F



G

H

ITEM	MANUFACTURER	MODEL	PRICE PER PAIR	SPEAKER SYSTEM	MOUNTING	READER SERVICE NUMBER
A	Fujitsu	SSB8B7	$185	Three-way	Rear deck	80
B	Kriket	8072	$85	4x10 coax	Rear in-deck	81
C	Panasonic	EAB-800	$150	Two-way	Rear deck	82
D	Pioneer	TS-695	$120	Three-way	In-door or deck	83
E	Big Brute	HR610	$130	Three-way	Rear deck	84
F	Mura	CH-6	$15 each	PA horn	Under hood	85
G	Kraco	TRI-4699CF	$105	Three-way	Rear deck	86
H	Metro Sound	MS-102	$50	Two-way	Under dashboard	87

MORE GIFTS and GOODIES for CHRISTMAS

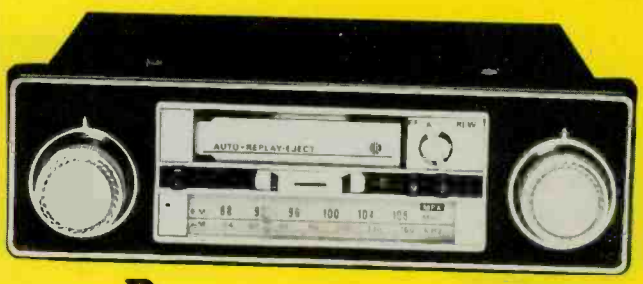
MOBILE SOUND
Stereo on wheels

From an enormous number of car radios we've chosen some with special features we thought you'd like. There are so many you're sure to find exactly what you want.

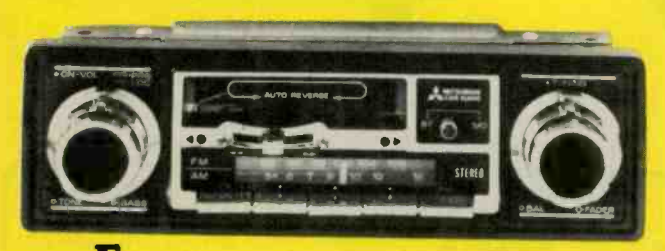
A

B

C



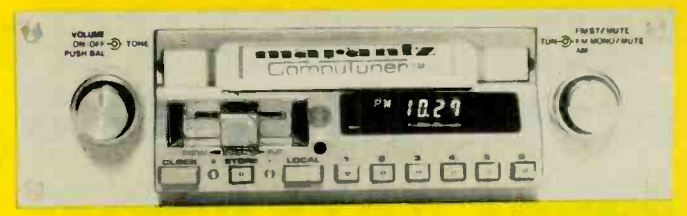
D



E

G

F



H

I

J

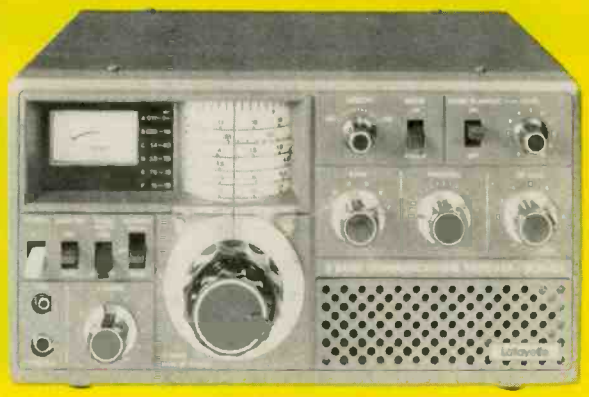
K

L

ITEM	MANUFACTURER	MODEL	PRICE	POWER PER CHANNEL	AUTO REVERSE	SPECIAL FEATURES	READER SERVICE NUMBER
A	Roadstar	RS-3700	$335	5	X	LED dial indicators	110
B	Jensen	R430	$470	30		Dolby "B" system	111
C	Pioneer	Pioneer	$250	--	X	Needs power booster	112
D	J.I.L.	632	$260	10	X	--	113
E	Mitsubishi	RX-69EM	$200	7	X	Has fader control	114
F	Sharp	RG-3200	$170	8		Has local/distance switch	115
G	Midland	67-440	$400	15	X	Digital AM/FM readout	116
H	Marantz	CAR-410	$340	6		Digital dial and clock	117
I	Metro Sound	MS-8659	$365	25	X	Has FM muting switch	118
J	Panasonic	CQ-8520	$400	7	X	Electronic signal seeking	119
K	Cobra	99GTL	$200	12		Has fader control	120
L	Sanyo	FT1490A	$200	14	X	Has Dolby and bi-amp	121

MORE GIFTS and GOODIES for CHRISTMAS

SHORT WAVE RADIOS
Listen to the world

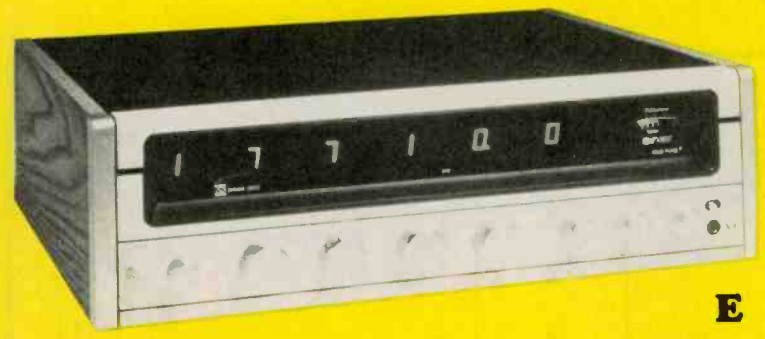


A

B

C

D



E

ITEM	MANUFACTURER	MODEL	PRICE	DIGITAL DIAL READOUT	BANDWIDTH FILTER	SPECIAL FEATURES	READER SERVICE NUMBER
A	Lafayette	BCR-101	$350		X	Noise blanker, calibrator	170
B	Yaseu	FRG-7000	$300	X		Clock/timer, fine tuning	171
C	Radio Shack	DX-300	$380	X	X	Attenuator, fine tuning	172
D	Panasonic	RF-4800	$300		X	Antenna trimmer, ANL	173
E	McKay DyMek	DR-33	$1500	X	X	Audio notch filter	174

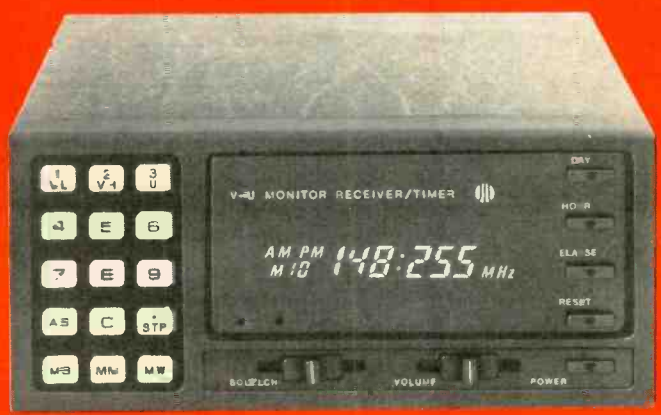
MORE GIFTS and GOODIES for CHRISTMAS

SCANNERS
The automatic ear

Sophisticated scanners for sophisticated listeners let you select large portions of the radio spectrum for easy hands-off listening. Or zero in on other favorite frequencies whenever the ears want a change of menu.

A

B



C

D

ITEM	MANUFACTURER	MODEL	PRICE	NUMBER OF CHANNELS	SPECIAL FEATURES	READER SERVICE NUMBER
A	Radio Shack	PRO-2001	$400	16	Battery maintains memory	150
B	Regency	K500	$400	591	40 programmable, 551 pre-programmed	151
C	J.I.L.	SX-100	$500	16	2 preset weather channels, built-in clock	152
D	Bearcat	250	$400	50	Priority and lockout channel controls	153

MORE GIFTS and GOODIES for CHRISTMAS

CB RADIOS
AM base and mobile

Remotely operated mobile units with all the controls in the mike are zooming in popularity—and with good reason. They can't be beaten for convenience. Locked away in the trunk or mounted out of sight they are far less prone to ripoff than more conventional radios. We've chosen a few of these, and several other fine 40 channel units. So, for forty channel fun, zip right over to your friendly radio store.

A

B

F

G

C

D

E

H

J

I

K

L

ITEM	MANUFACTURER	MODEL	PRICE	RF gain	Delta tune	Noise blanker	SWR meter	SPECIAL FEATURES	READER SERVICE NUMBER
A	SBE	LCB-8	$330	X	X	X	X	Clock/timer, channel 9 switch	122
B	Royce	582	$180					Remote—all controls in mike	123
C	Cobra	86XLR	$180		X			Power microphone	124
D	J.C. Penney	6238	$200	X	X	X	X	Built-in clock/timer	125
E	Audiovox	MCB-5000	$280					Remote—all controls in mike	126
F	Radio Shack	TRC-454	$260	X	X	X	X	Channel 9 priority switch	127
G	Lafayette	LM300	$170	X		X	X	Secondary receive only channel	128
H	Pace-Pathcom	8016	$100					Power mike, only 5½" deep	129
I	General Electric	3-5815	$180					Remote—all controls in mike	130
J	Midland	75-764	$90					Three-channel hand-held unit	131
K	Motorola	CC975AX	$390					In-dash with AM/FM cassette	132
L	TRS Challenger	1200	$380	X		X	X	Has tone control and base mike	133

MORE GIFTS and GOODIES for CHRISTMAS

CB RADIOS
SSB base and mobile

If you're an old timer, recent convert, or even just about to jump into the excitement of CB radio, and you want to go first class, one of these super rigs is for you. All are capable of 40-channel SSB operation, upper and lower sidebands, which with AM gives you the equivalent of 120 channels in capability.

A

B

C

ITEM	MANUFACTURER	MODEL	PRICE	Noise blanker	RF gain	SWL meter	Clock	SPECIAL FEATURES	READER SERVICE NUMBER
A	Midland	78-999	$350		X	X		Modulation meter, antenna switch	135
B	Radio Shack	TRC-459	$440	X	X	X	X	Microprocessor controlled	136
C	Palomar	SSB 500	$225	X	X	X		Digital display, dimmer control	137
D	DAK	Mark X	$575		X	X		Modulation and watt meters	138
E	Cobra	2000GTL	$700	X	X	X	X	Digital frequency display	139
F	J.C. Penney	6241	$250	X	X			--	140
G	Tram	D201A	$970		X	X		--	141
H	SBE	LCBS-8	$580	X	X	X	X	Additional manual receive channel	142
I	Royce	639	$270	X	X	X		Channel 9 monitor switch	143
J	TRS Challenger	1400	$600	X	X	X	X	Channel 9 monitor switch	144

E

F

D

G

H

I

J

MORE GIFTS and GOODIES for CHRISTMAS

GAMES
Chips that challenge

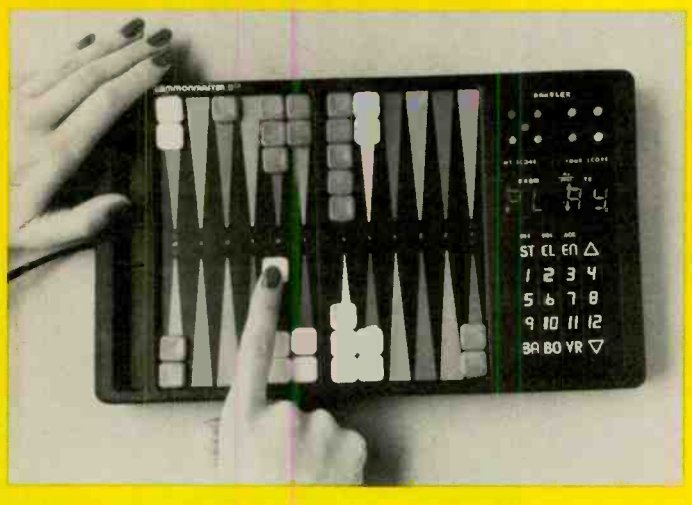
Some marriages may have been made in heaven, but there are times when we suspect it was not so with the union of microprocessors and games. The little devils can drive you up the wall if you let 'em get to you.

A

B

C

D



E

views of *Boris*, the wise-cracking, chess-playing computer, and (D) *Chess Challenger 10*, the latter a product of Fidelity, already mentioned above. Boris and the Challenger must be discussed jointly. Conflicting claims as to which actually won the matches they have played against each other serve only to spice up the game. Perhaps the only way to find out is to get both and pit them against one another. Approximate price for either is approximately $275 to $300, depending on where one shops.

F

Microprocessors are everywhere. Here are some remarkable games built around these marvelous chips. Even *Simon* (G, lower right), the seemingly simplest of all, will keep an adult absorbed for hours. Simon, an electronic musical variation on childhood's Simon Says, dares you to copy his toots and blinks. If you miss, you get razzed, but if you succeed, Simon razzes himself! For kids of 4 to 84 years. Made by Milton Bradley Company, sold through toy and department stores, about $35. Atari's *Video Computer System* (A, facing page, top) and Fairchild's *Channel F System II* (B), both use your present television set on which to display their wares. There is a similarity in how you use them in that both employ plug-in cartridges that carry the programs for the games you play. Both have numerous cartridges available, and more are always being developed so that you will probably never exhaust the supply of fresh games. Cartridges contain far more than a single game. A typical one is Combat, the cartridge supplied by Atari with the purchase of their system. It contains 27 games and variations on the theme of its name. Additional cartridges for both systems are priced at $19.95 each. Channel F System II *Videocart* units contain semiconductor memory programmed to produce specific games in color and sound. Game selection is through the keyboard console. Mobile screen elements are manipulated by hand controllers. Atari's unit carries a suggested list price of $189.95; Fairchild's is $149.95. Both are sold by electronics distributors, department stores, some sporting goods shops and toy retailers. (E and F, this page) are electronic versions of old familiar but eternally challenging board games. *Gammonmaster II*, from Tryom, Inc., is a backgammon-playing computer, as you may have guessed by its name. There are two models, #101 for beginning and intermediate players, listing at $189.95; and #202, *The Doubler*, $239.95, for experts. Gammonmaster is programmed to adapt to your strategies, whatever they are. It will beat a novice and intermediate player most of the time, yet anyone can play and win at any given time. *Checker Challenger*, (F), by Fidelity Electronics, comes in two models, 4-level, $149.95, and 2-level, $69.95, the numbers indicating the different levels of skill at which the computer is capable of playing. (C) Two

G

MORE GIFTS and GOODIES for CHRISTMAS

COMPUTERS
The marvelous micros come of age

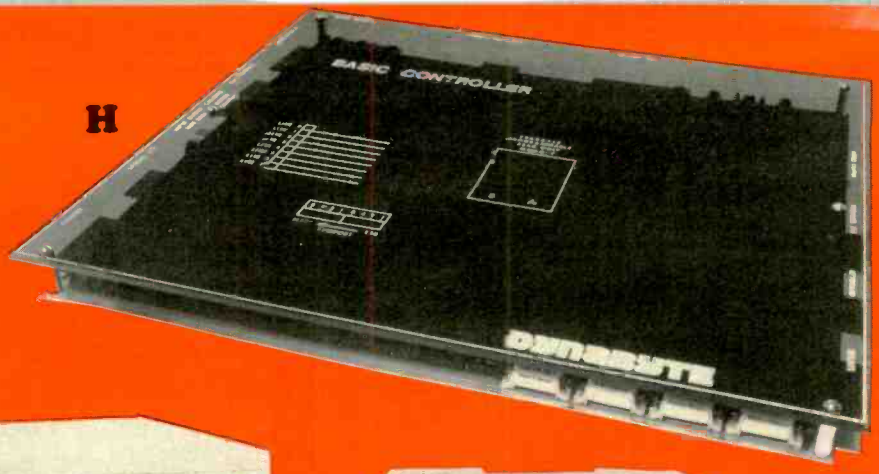
A

C

D

E

F



H

I

G

J

K

Talk about variety! Here are six computers (not to mention the other items) that run the gamut from Heathkit's hand-held OC-1401 (J), described as the "world's first true hand-held on board navigation computer," to Dynabyte's Basic Controller (H). This is a self-contained computer for industrial and laboratory control applications but represents, in ME's opinion, an indication of a coming trend—dedicated computers interfacing with the home environment, in order to more efficiently control power and fuel using devices. Here are more details on the remaining items. (A) Disk II, mini-floppy disk drive described by Apple Computer, Inc., its manufacturer as "easiest to use, lowest priced and fastest yet offered by any personal computer manufacturer." Storage capability is 116K bytes (soft-sectored format). (B) A new family of fast and inexpensive minis from New England Digital Corp., designed for small business use. They feature the Real-Time XPL operating system. XPL is considerably more powerful than Basic, yet is easy to use. (C) Ohio Scientific's latest is Superboard II, shown here as Challenger 1P, one of the options in which it is available. Here's a serious competitor for the home market. Price is only about $349, with case and power supply. (D) APF's PeCos I, with 9" CRT, standard size 60-key keyboard and dual cassette decks, $1695 suggested retail. Language is JOSS, developed by Rand Corp. and "the most English-like computer language." (E) Heathkit's H17 floppy kit is identical to the WH17, the assembled version. Price is $530; plus $295 optional second drive and $100 for the operating system software. (F) RCA's amazing 6502-based hobbyist computer called COSMAC-VIP creates and plays games, generates graphics, plays music (with an accessory board) and is an excellent all-around learning tool. Small, low-priced and lots of fun. (G) A special accessory for TRS-80 users eliminates the pull-plug, push-plug annoyance involved in operating the computer's cassette system. By mail from Picotron, Box 62076, Sunnyvale, CA 94088, for $29.50. (I) Keltron Corp.'s Series DM-300 digital printers are compact, medium speed units that handle up to 18 columns of 13 characters per column, at a rate of 2.5 lines per second. (K) Exidy Corp. features the Sorcerer. Exclusive ROM-pac cartridges plug in and contain high level programming languages, operating systems or special proprietary software. Suggested retail only $895.

MORE GIFTS and GOODIES for CHRISTMAS

AMATEUR RADIO
Talk to the world

A

B

C

D

E

F

H

G

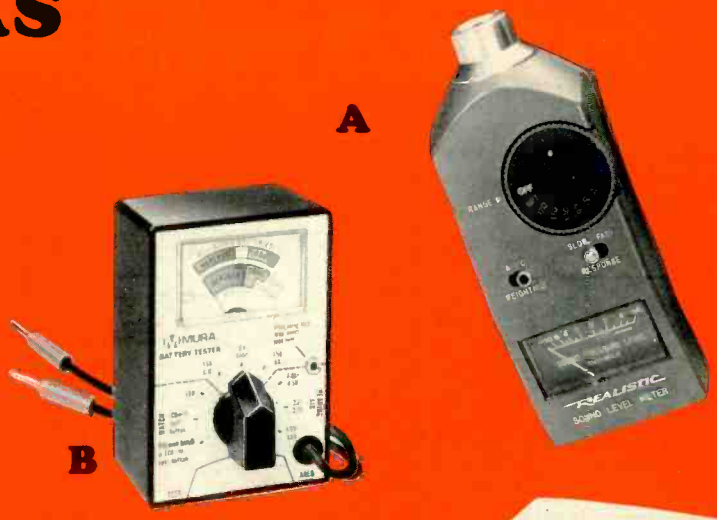
K

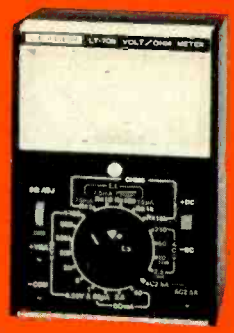
For UHF enthusiasts, the news is that Amperex, long known for vacuum tubes, among other products, has entered the amateur field with two 100 watt amplifiers for the 144-148 mHz band. Requiring 10 watts of driving power, Model 110 (A, opposite page), $189.90; Model 130, needing 30 watts drive, is $179.90. At your ham equipment dealer, or from Amperex, 230 Duffy Avenue, Hicksville, N.Y. At (B) above, is Yaesu Electronics Corp.'s 144-148 mHz hand-held FT-202R. Some relevant specs are: six channels, 1 watt output, double conversion superhet receiver, selectivity, 60 dB down at MB 20 kHz. Three channels supplied. Requires eight AA-size NiCads. Numerous goodies from Heathkit, Benton Harbor, Michigan, include the following: (C) The rugged, reliable HW-101, time-tested CW/SSB vacuum tube transceiver, 3.5 through 30 mHz. Rated at 100 watts output into a properly matched load. Kit, $369.95. 400 Hz CW filter option, $34.95. Requires AC power supply, kit HP-23C, $57.95. At (D) a fitting partner for the HW-101 is the SB201, the latest version of another time-tested product. Input power, 1000 watts DC, 1200 watts PEP. Modification of this kit is presently in work to comply with new FCC restrictions on linear amplifiers. Price to be announced. At (E) the other end of the power line. The mighty mite, HW-8 flea power CW transceiver, works the world on a couple of watts. Great for novices or bored old-timers wanting new challenges. Kit, $129.95. Economy priced but full of desirable features, HR-1680 (K) is Heath's latest solid-state receiver. Covers all amateur bands from 3.5 to 29 mHz. Operates from 12 volts DC or built-in AC supply. Kit, $199.95. Shown at F, G, and H above, are three selected items from the fast-growing line of MFJ Enterprises, P.O. Box 494, Mississippi State, MS 39762. From top to bottom, the Grandmaster Memory Keyer, MFJ-484, has a programmable 4096 bit memory, that can be set up for use in numerous ways. Extreme flexibility is the byword. $139.95. The CW/SSB variable selectivity filter at G, MFJ-721, has four steps of selectivity for each mode, the narrowest CW position being 80 Hz. $59.95. At H, MFJ-941B, the Versa-Tuner II. Built-in SWR bridge, dual range watt meter (30 and 300 watts). Matches your transmitter to any kind of feed line. Covers 1.8 through 30 mHz. $89.95. MFJ products may be ordered through local retailers or by mail from the factory.

MORE GIFTS and GOODIES for CHRISTMAS

TEST EQUIPMENT

It's nearly impossible to adjust or repair electronic equipment without the proper instruments. This selection of test equipment spans the distance between a simple VOM and a specialized CB signal generator.





ITEM	MANUFACTURER	MODEL	PRICE	DESCRIPTION	READER SERVICE NUMBER
A	Radio Shack	42-3019	$40	Sound level meter wieghing less than 8 ounces	64
B	Mura	NH-41	$10	Non-polarized battery tester	65
C	Eico	272	$70	Digital multimeter with 1% accuracy	66
D	BP Electronics	VM547B	$30	10,000 ohm/volt VOM	67
E	NES	Slimline	$220	Field-scaleable ac digital ammeter	68
F	NLS	RMS-350	$190	True rms-reading digital multimeter	69
G	Heathkit	CO-2600	$400	Electronic ignition analyzer in kit form	70
H	Triplett	3300	$190	Digital multimeter with RF probe	71
I	Leader	LT-70B	$45	High-sensitivity Volt-Ohm-Milliammeter	72

ITEM	MANUFACTURER	MODEL	PRICE	DESCRIPTION	READER SERVICE NUMBER
A	B&K-Precision	3020	$325	Combination function/sweep generator	73
B	Continental	LP-1	$45	50 nanosecond logic probe	74
C	Philips	PM5519	$1450	Color tv pattern generator	75
D	Davis	7208	$200	600 MHz frequency counter /prescaler	76
E	Data Precison	5800	$430	520 MHz, 8-digit frequency counter	77
F	Hickock	266	$500	CB/RF signal generator	78
G	Radio Shack	22-351	$100	45 MHz portable frequency counter	79

MORE GIFTS and GOODIES for CHRISTMAS

THIS AND THAT
Unclassified but too good to pass

A

B

C

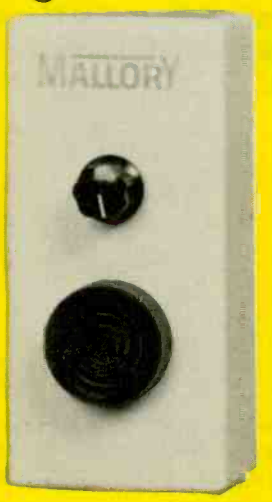
D

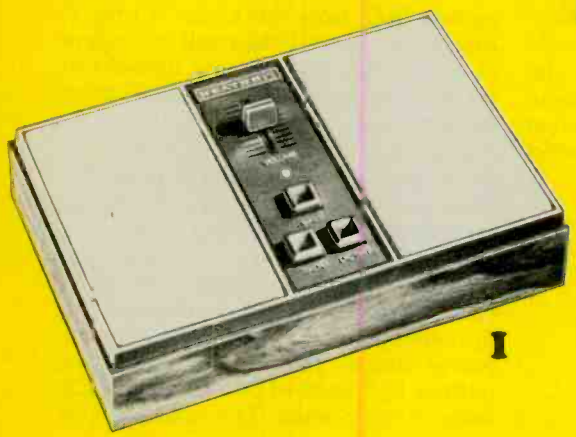
E

F

H

G





I

J

ITEM	MANUFACTURER	MODEL	PRICE	DESCRIPTION	READER SERVICE NUMBER
A	Panasonic	KX-T1030	$130	Telephone amplifier with built-in digital clock/timer	100
B	McKay Dymek	DA5	$185	AM broadcast receiver with directional antenna	101
C	Weatheralert	TA-25	$60	Weather radio with automatic storm warning alarm	102
D	PAIA	1550	$300	Polytonic Keyboard system kit	103
E	Electronic Specialists	--	$9	Stereo phono-input CB/RF interference filters	104
F	Fobel Enterprizes	--	$4	Plastic te t lead storage rack	105
G	Mallory	DRSDC	$30	Battery-powered intrusion alarm	106
H	Bearfinder	2+2	$250	X and K band radar detector	107
I	Heathkit	GD-1114	$45	Wireless intercom for desk or wall mounting	108
J	Gemini Dial Spotter	--	$170	Short Wave receiver digital frequency readout	109

Why SSB?

CBers will find these well-chosen words helpful in understanding the differences and similarities of AM and SSB radios. This article may even make up your mind about one being better than the other.

by George McCarthy

"Hey, I've been having a ball with my CB radio. Not only have I met loads of new friends on the air, but the rig came in very handy in a few tight places on the road. Now, some 'good buddy' is telling me that I haven't seen the half of it, that I ought to get into sideband. He claims it's much better than my faithful old AM radio. One thing I do know, those sideband radios cost a lot more. Are they really that good, good enough to lay out those extra bucks? And how well will they work with my AM buddies?"

Sound like a question that has been asked a few thousand times on CB radio? I've heard it many times. And it's a good question, too, one that deserves a thorough answer, not just something off the top of the head. After all, those bucks don't come in too easily, and we want to make sure we're getting our money's worth before we lay out a bundle.

Modulation and Power

This article will try to answer that question by stripping away some of the mysteries of radio and the difference between AM and SSB in the process.

What most of us are looking for, whether or not we realize it, is maximum communication efficiency per dollar, so let's first talk about *communication effectiveness* in making our comparison between amplitude modulated and single sideband suppressed carrier radios. From this point on we're going to save a little space by referring to them as AM and SSB, rather than by those long names.

In order to understand the basis of making the comparison, let's first look behind the meaning of those words.

The process of modifying a radio signal in order to impose intelligence upon it for the purpose of transmitting messages or entertainment is known as *modulation*. Actually, the turning of a radio carrier off and on by sending a series of dots and dashes is a form of modification that transmits messages, but in the strict sense the carrier is not modulated. Audio frequency energy that is picked up by a microphone, amplified in a radio, and superimposed on the carrier that goes out over the air, is said to be modulating that carrier.

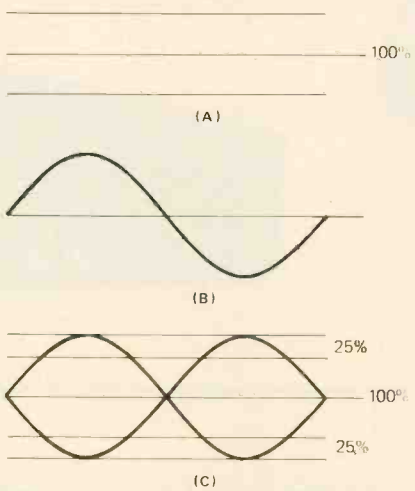


Figure 1 **At "A" the unmodulated carrier at 10 khz. At "B" a pure audio note at 1 khz. At "C" the carrier has been 100% modulated by the audio signal. At the "peak" of the audio cycle, carrier power is increased by 50%, half of which appears in each sideband.**

The modulation process is not very complicated. When we talk about *power* we mean the product of voltage and current. It's no different than the power that lights a 60 watt lamp bulb. The bulb is connected to 115 volts of alternating current (AC) from our house wiring. It draws (i.e., uses) about a half an ampere of current that heats up the filament to the point of incandescence. The current (.5 amp) times the voltage (115) equals the power, in this case 60 watts.

What about power in our CB radio? It's the same. We take DC power out of our car battery (or from a power supply that takes 115 volts AC from our house wiring and changes it to 13.8 volts DC). How much power we use depends on the amount of current we drain from our power source. If it is 1 amp, we are putting 13.8 watts of power into our CB radio (1 amp times 13.8 volts = 13.8 watts).

That's what we are putting *into* the radio, not how much is coming out.

To change the subject for a moment, this example we're using—putting 13.8 watts into the CB radio—doesn't necessarily mean we are exceeding the legal limit of 5 watts. Everything in the radio uses power—even the pilot lights. But it is the power applied only to the final stage of the radio that should not exceed 5 watts. By the same token it is the power *output* of the final stage of the radio that is of concern.

No device that uses power is 100% efficient. There is always some loss between the energy supplied and the energy that ultimately performs the work we want. In electricity, most of this loss is dissipated in the form of heat.

The percentage of power that comes out describes the efficiency of a device. Most AM final amplifiers work at about 70-80% efficiency, so if you want to get four watts of output from the final amplifier,

the input would have to be five to six watts.

So far, we're just talking about carrier power (transmitted unmodulated radio frequency power), R.F. energy in the form of an alternating current cycling at millions of times a second! Actually, the exact number of cycles decides the channel on which you are transmitting. For example, 27,150,000 cycles per second puts you on channel 5. Of course, for ease of reference we refer to it as 27.150 megacycles. Or we did, until a few years ago when cycles was replaced by hertz to honor Heinrich Hertz, the man who first proved the existence of radio waves. Now, it's megahertz, abbreviated as MHz, or kilohertz, kHz if we are talking about thousands instead of millions.

Sheer carrier power alone does no good unless we modulate it with voice

Figure 2 **Power distribution in the AM signal. Each sideband is a mirror image of the other and each contains 16.6% of the total power in the signal.**

energy. In AM this is done by amplifying voice power until it is equal to half the input power to the final amplifier of our CB radio. This power level will be reached only on voice peaks, since the average audio power is probably only about one-third of that.

The audio power varies exactly with our voice power, and, since our voice is really a form of alternating current, the current which is the result of amplifying the voice from the microphone is a current that aids the power into the final amplifier of the radio in one half of its cycle and opposes it in the other.

You can see that the power into the R.F. amplifier is changing in exact proportion to our voice modulation. It follows that the power output will change accordingly. Thus, the modulation increases carrier power in one direction and reduces it in the other (see Fig. 1.)

Where sidebands come from

Since we've already said that an audio amplifier must be able to put out 50% of the input power to modulate the carrier at 100%, you may wonder what becomes of this extra power. It goes into the two sidebands produced as a result of the modulation process. Just as two additional tones are produced when two piano keys are hit at the same time—one is the *sum* of the two original frequencies and the other is the *difference*. To illustrate, if we struck a 1,000 hertz note at the same time as one of 1,200 hertz, we would hear not only the two original tones, but a third at 200 hertz (the difference) and a fourth at 2,200 hertz (the sum).

If you've now got a handle on that concept, let's look at the modulation process when we lay a signal on the carrier. Suppose the carrier was generating a signal on 10 khz and we modulated it with a 1 khz signal? We would produce two new signals, one at 11 khz and one at 9 khz. On an oscilloscope we would see a pattern just like that in Figure 1. There would be an upper sideband at 11 khz and a lower sideband at 9 khz. Actually, measured from the middle of the carrier, the two sidebands are identical. Keep that point in mind!

Of course, our illustration is very simple. In reality, the human voice consists of very complex wave forms; all are transmitted at the same time. But, regardless of how complicated the audio wave pattern, all of the frequencies will show up in *both* sidebands. At the receiver, the carrier is removed by a process of detection or demodulation, leaving only the two sidebands. A circuit converts them into the audio frequency energy, same as they began, which your loudspeaker changes into the sound you hear.

Looking again at Figure 1, note that on positive peaks the 1 khz audio tone increased carrier power by 50% and on the negative part of the cycle it almost cut off carrier power entirely. Hey, that's great! By our AM modulation we were able to increase our transmitted power by 50%. Correct. But we had to create two sidebands in the process. Half of this *additional* energy was in each sideband. The carrier remains as it was, it is merely a

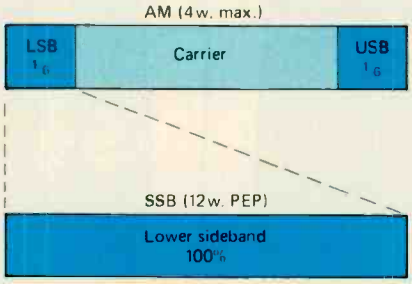


Figure 3 **In the AM signal only one sixth of the power is in the sideband. In the SSB signal 100% of the power, six times as much is in the sideband, and the SSB signal can run more power!**

vehicle for transporting the sidebands.

Now have a look at Figure 2. It shows where the power is in an AM signal. Two-thirds is in the carrier, and one-third is split between two sidebands, each one having only one-sixth of the total power.

So what, you say. It's doing the job, isn't it? Sure it is. But, only one of those two sidebands is needed to transmit a signal that carries intelligence in the form of speech. That means that only about 16% of the total energy is needed to do thejob. The rest is wasted.

Before issuing type acceptance, the FCC measures the output of an AM radio by feeding it single note (sine wave) modulation to the 100% level, then measuring the output into a perfect (resistive) load. The result should not exceed 4 watts. According to our earlier arithmetic, all that is needed to transmit voice is the one sideband, 16% of 4 watts or a grand total of about two-thirds of a watt!

Are we telling you that your legal CB AM radio is doing that great job of communicating with less than a single watt of needed power? Yep, we sure are!

Now, let's be entirely fair, and admit that your voice doesn't look anything like that pure sine wave that a single tone gives. In fact, it's made up of a group of very complex waveforms in which the peak power will be double the average power of that sine wave. But don't start jumping up and down for joy over that statement. We're going to follow it with the statement that unlike a sine wave, the average power of the typical voice is only half that of the sine wave average, which puts it at one-fourth of the peak power. And, it is the peak power which determines the point of 100% modulation.

You may have to double back and go over the last paragraph a few times to let its full import sink in. To sum it up, what we've said is that the peak modulation power of your AM signal contains only ⅔ of a watt in one of the sidebands. And that's *at peak*. Your voice average is only about 25% of that, so the average power in one sideband is 1/6 of a watt! By now you should look at your AM CB radio in wonderment that it can do such a great job.

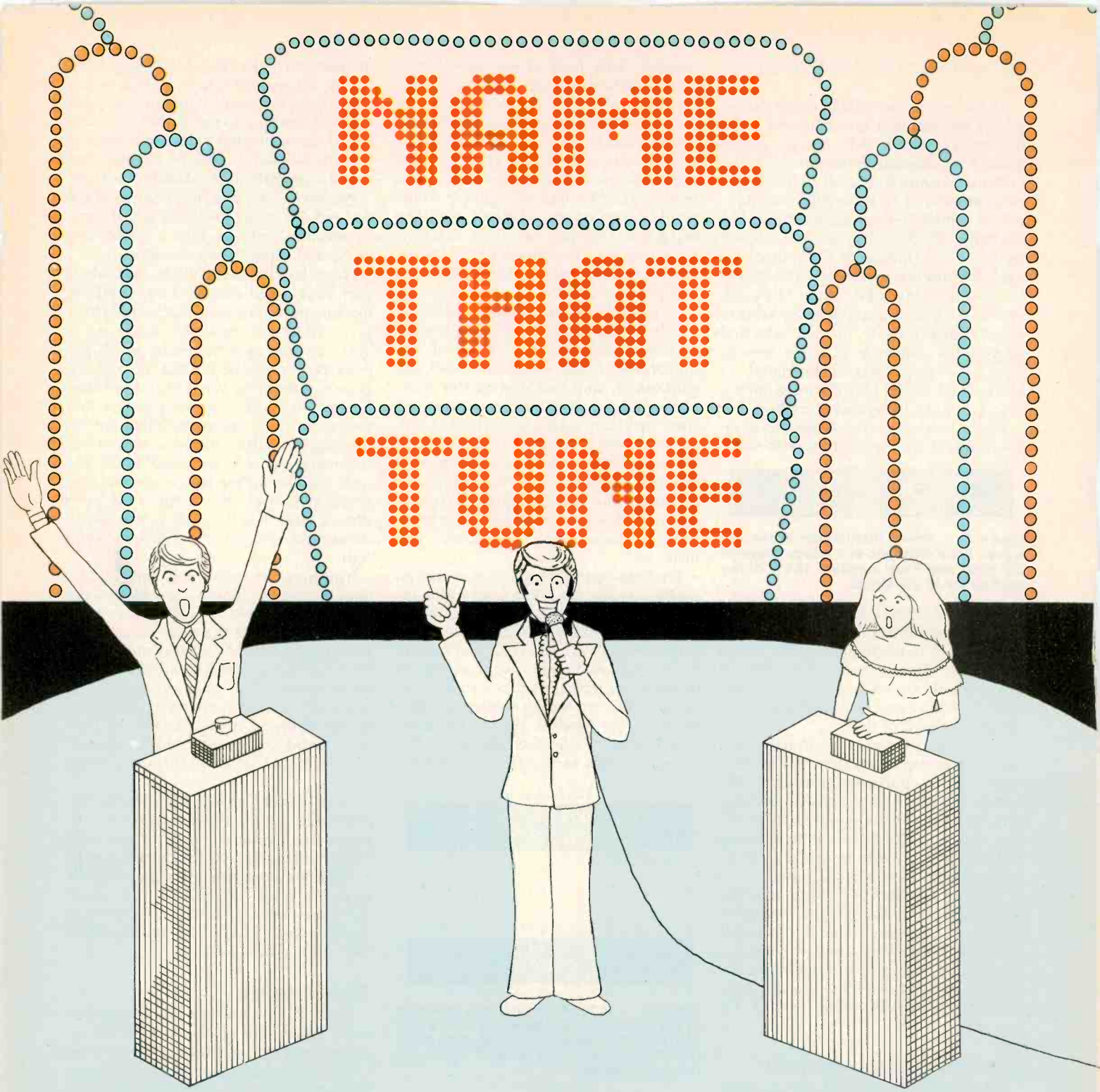
Now look at Figure 3. It shows that the *entire* output of a *sideband* radio is contained in only one sideband. There is no carrier to take up two-thirds of the power. One hundred percent of the available power is used to transmit your voice. Compare that to 16% of the power in one AM sideband. That's a six to one advantage right off the top!

SSB explained

The SSB radio does a few tricks of its own. It takes the audio from the microphone and AM-modulates a low level carrier it generates just for this purpose. Sidebands are also generated with this carrier. The small AM signal is run through a special circuit called a balanced modulator which takes out the carrier, leaving the two sidebands. Next comes a filter that only allows a certain band of frequencies to pass. The passband is wide enough to let one sideband through. The other is left behind. This sideband is then changed into RF energy that comes out on the desired channel.

There's a couple of odd results of this process. If the microphone does not hear a voice, it picks up nothing, it amplifies nothing, and there is literally no signal on the air. Not even a little whistle to let someone know a carrier is there, (pro-

please turn to page 88



Fun to build and more fun to use! It's ME's version of the popular tv show that's sure to be a hit, especially on rainy, rainy weekends.

by Jeff Sandler
Contributing Editor

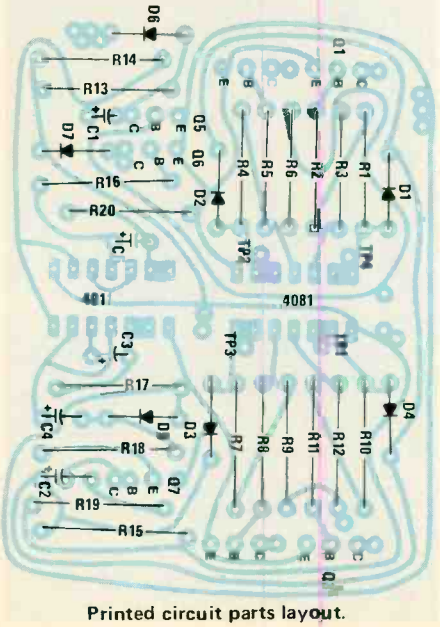
Four players sit on the edge of their seats waiting for the music to begin. One, two, three notes appear. Then three more. Suddenly, one of the players reaches out and touches a pair of small plates on a plexiglass board. Instantly the music stops and a lamp turns on near the plates by the player. "Macho Man," shouts the player. "Right," agrees the MC, and another point is chalked up.

And so it goes with this easy-to-build home-version of the popular tv show *Name That Tune*. Although the game shown here can accommodate up to four players, you can add as many as you wish by simply building more player stations. Operation of the game is simple, requiring only a cassette or 8 track with an external speaker jack.

An external speaker is connected to the tape deck with the normally closed contacts of a relay. The MC starts the tape recorder playback, which is heard through the external speaker. When a player knows the tune, he or she hits a touchplate which energizes the relay, opening the external lead and killing the music. At the same time, the remaining player's touchplates are electronically locked-out and an indicator lamp identifies the active player.

After about five seconds, the lock-out disables so that other players can again take over the game if the first player hasn't answered, or gives the wrong answer. After about five more seconds, the relay de-energizes, reconnecting the tape recorder output to the external speaker, and the music resumes.

If you wish, you can add an external reset switch, as shown in the schematic diagram, which lets the MC reactivate the player touchplates before the five second delay built into the game. The MC can also use the tape recorder controls to prevent the music from resuming after the built-in ten second delay.



Printed circuit parts layout.

This *Name That Tune* game is designed for use with a tape recorder because it lets you choose the music and the time it is heard. But, it can also be used with any radio having a external speaker jack. Using a radio removes control of the game from the players, but lets two people compete against each other equally.

The circuit

The ME *Name That Tune* is built around a 4081 quad AND gate, and a 4011 quad NAND gate. The 4081 and its associated components make up the player control circuit. When a player bridges the gap between the two terminals of the touchplate, output of the respective 4081 section goes high, causing its associated transistor to turn on. As shown in the schematic, turning on the transistor causes a lamp in its collector circuit to light. You can replace the bulb with resistor and LED, or with a relay to control larger lamps.

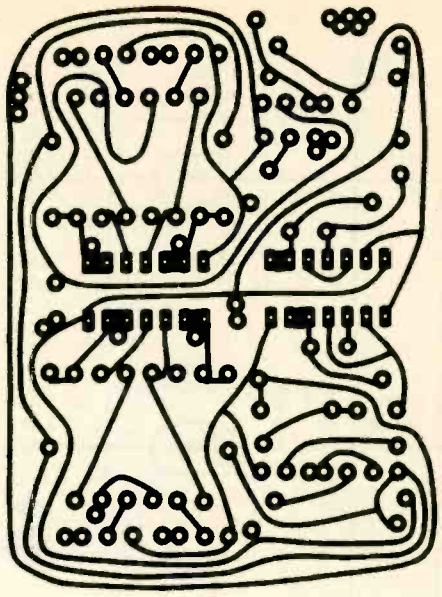
Parts list

Description	Quantity
Light emitting diode (LED)	1
2N2222 transistor	7
1N4148 diode	7
4011 quad NAND gate IC	1
4081 quad AND gate IC	1
1K resistor, ¼ watt	1
2.2K resistor, ¼ watt	6
10K resistor, ¼ watt	7
1M resistor, ¼ watt	1
2M resistor, ¼ watt	1
10M resistor, ¼ watt	4
1 mfd capacitor	2
10 mfd capacitor	3
12-volt lamp bulbs	4
12-volt SPST relay	1
SPST momentary contact switch	1
SPST on-off switch	1

When the 4081 output goes high, another transistor, Q5, also turns on, effectively grounding the normally high side of the player touchplates. This action locks-out the other players. Only the first player to touch his or her touchplate will get control of the game.

Part of the change-of-state signal at Q5 is fed through a differentiator, C1 and R14, to the inputs of two flip-flops. These flip-flops are built around the 4011 and determine the time delays used in the game. C3 and R17 determine the time during which the touchplates are locked out. C5 and R20 determine the time during which the external speaker relay contacts are open. You can change these values to suit your own needs.

An LED connected to the collector of Q7, which in turn is connected to the touchplate lock-out circuit, indicates the touchplates are active. During operation, the LED will turn off when the first player hits his or her touchplate. Then, regardless of what's happening in the game, after the five-second delay has expired, the LED will turn on signalling the other players that the board is once again active.



Printed circuit foil layout.

Construction

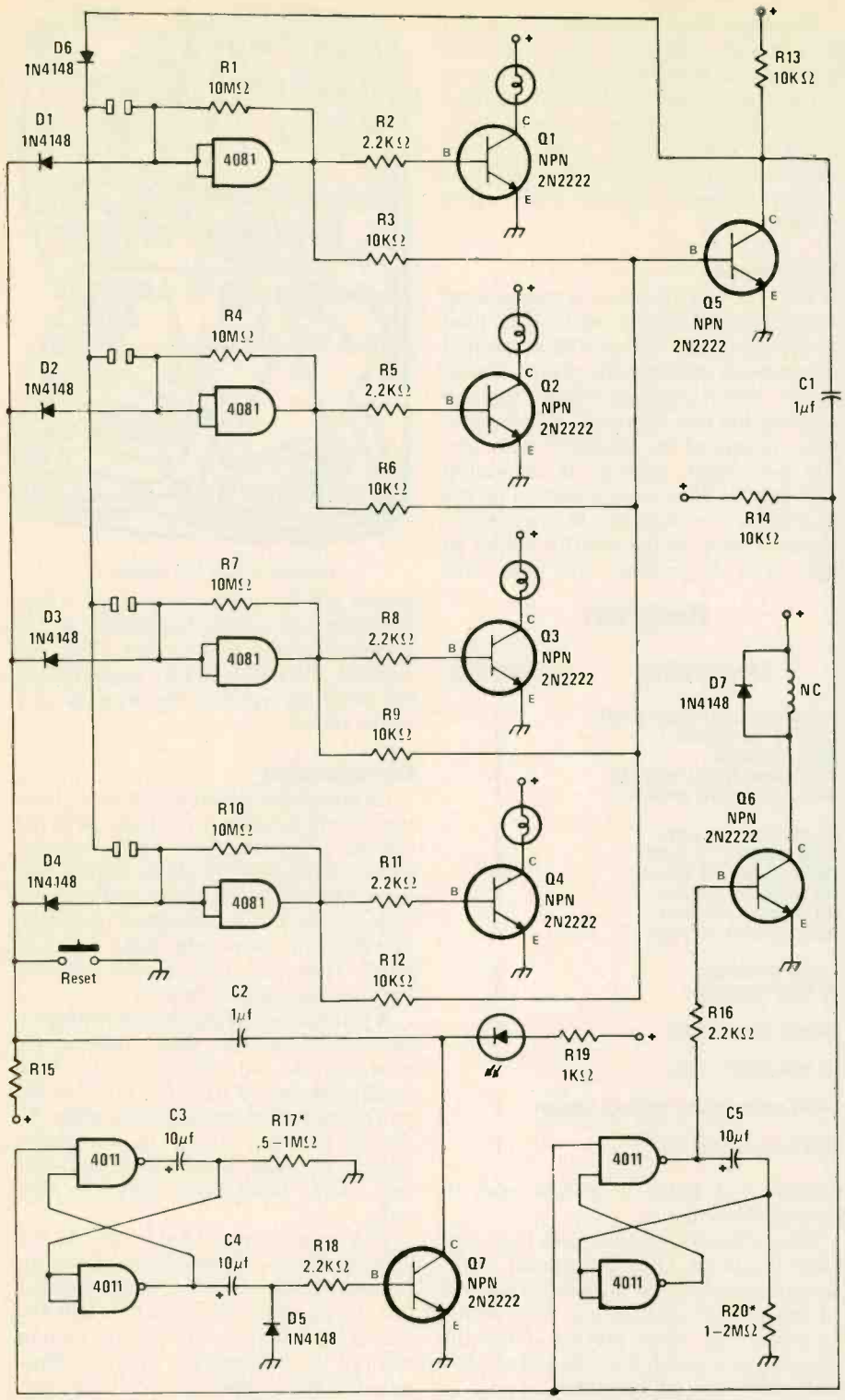
Although the circuit uses a large number of components, circuit layout is not critical. Since the two timing circuits merely determine the delay period during which the touchplates and music is locked out, you can substitute parts near in value for those you don't have on hand. However, you should use only first-quality components.

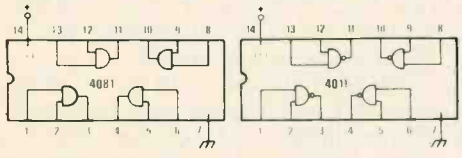
A printed circuit layout is provided for those readers who enjoy making PC boards. You can, of course, try your hand at layout as well. Or, you can use perfboard and point-to-point wiring. Although this appears to be a complex project, it is really quite simple, and with care, can be hand wired with little difficulty.

Power can be provided by any 12 volt source. No on-off switch is shown in the schematic, but one is needed because of the current drain through Q7, R19 and the LED. If you opt for strictly manual reset of the touchplates, you can eliminate the entire flip-flop circuit. The current drain in the standby mode will then be very, very low, permitting you to eliminate the on-off switch.

The circuit board can be mounted in a small box and located most anywhere. The touchplates and indicator lamps can be mounted on a large player board, as was done in the prototype, or in individual player boxes. Using individual boxes will let the players scatter around your living or game room. A game board, on the other hand, creates the competitive atmosphere that can add to the enjoyment of the game.

Although not shown in the schematic, it's a good idea to connect an eight-ohm





Name That Tune is built around a pair of CMOS quad-gate ICs. Although it appears complex, it actually is easy to build and fun to use. If you eliminate one or more touch-plate stages, or the automatic reset, make sure to connect the inputs of the affected gates to the positive supply voltage.

resistor from the armature to the speaker return lead. This will insure your radio or tape recorder output is always seen between four and eight ohms load.

The touchplates can be made from any conductive material, including printed circuit board. The two halves of the plate should be about one-sixteenth of an inch apart. Because of the very high input impedance of the 4081, and the 10 meg-ohm feedback resistor used, it is very important that the two halves of the plate be well insulated from each other.

The ME *Name That Tune* game is fun to build, and even more fun to play. With a little care in construction, you should have no trouble putting yours into operation. So, Name That Tune!

$1,000 Reward Offered by Mad Train Collector

For the reader who can come up with the following old Lionel Electric train for my fast-growing collection:

Model No. 700E Scale Hudson (No. 5344 appears on the side of the cab). If any reader can get this set for me together with either the scale freight cars No. 714–717 or the passenger cars No. 792, 793, and 794, I will gladly pay up to $1,000 for the set. Actual price will be based on condition.

There are many other old pre-WW II Lionel engines and cars that I need, both in Standard Gauge and in "O" Gauge. Blue Comet sets, state cars, and Stephen Gerard cars are desirable Standard Gauge items. Hiawatha and others of the better passenger sets are worth lots of dollars to me in clean condition.

Old trains are not just my hobby. They're an obsession that I simply cannot overcome. So, if you've got old Lionels around, don't be bashful. Give me a call or drop me a note. To determine the value of your trains I'll need the numbers that appear on all the cars, the colors, and the approximate condition. Remember, those old trains that are gathering dust in the attic could be bringing joy and pleasure to a mad collector.

Dick Cowan, Mad Train Collector
Publisher, Moderr Electronics
14 Vanderventer Avenue
Port Washington, NY 11050
Phone: 516/883-6200

ME reviews the MINI-MAX—CSC's frequency counter

If you've been looking for a high-quality frequency counter at an affordable price, this six-digit portable should end your search.

by Irwin Schwartz, K2VG

Every serious electronics hobbyist knows the value of a versatile and functional test bench. Certainly no hobbyist would be without some kind of volt-ohmmeter. A more sophisticated bench might include AF and RF signal generators, an oscilloscope and a frequency counter. Of course, all of these luxuries cost hard-earned money and as a discriminating buyer you want to make sure you get the best possible trade-off between the quality of the equipment and the price paid for it.

In that regard, Continental Specialties Corp. has recently marketed a new gadget designed for the serious electronics hobbyist, and at an easily affordable price. CSC's *MINI-MAX* is a flexible piece of gear at a reasonable price. It costs just $89.95.

The unit can be used in audio, ultrasonic and radio frequency applications in two different ways. It can be hooked up to a frequency generating device either directly or by indirect coupling. For example, if you want to measure the frequency of an IF oscillator—455 kHz, say—either clip the input of the meter to the output of the oscillator or screw in the accessory antenna, which is supplied with the meter. Place it near the oscillator and look at the readout.

The *MINI-MAX* has a high-sensitivity pre-amplifier that allows readouts from signals as low as 30 mV. The unit is diode-protected for input voltages with up to 100 volt peaks.

The counter has no range switch. This allows for easy and immediate measurement of a frequency source.

The *MINI-MAX* can be purchased with several accessories. These include the model NMA4 antenna ($3.95), the model MMC5 carrying case ($5.95), the model MM-IPC cable with clip leads ($3.95) and the model MMAC2 110 volt AC adapter or the model MMAC3 220 volt AC adapter ($9.95).

Send all orders and inquiries to Continental Specialties Corp., 70 Fulton Terrace, Box 1942, New Haven, CT 06509, or to 351 California St., San Francisco, CA 94104.

Specifications

Frequency Characteristics

Range	100 Hz to 50 MHZ, guaranteed
Gatetime	0.1 second, providing 100 Hz resolution throughout the frequency range

Input Characteristics

Impedance	greater than one megohm, diode protected
Connector	miniature phone jack
Coupling	AC
Sine Wave Sensitivity	30 mV rms (100 Hz - 30 MHz) 100mV rms (30 MHz - 50 MHz)
Maximum Input	100 V peak (100 Hz - 1 kHz) 75 V peak (1 kHz - 10 MHz) 50 V peak (10 MHz - 50 MHz)

Internal Time Base Characteristics

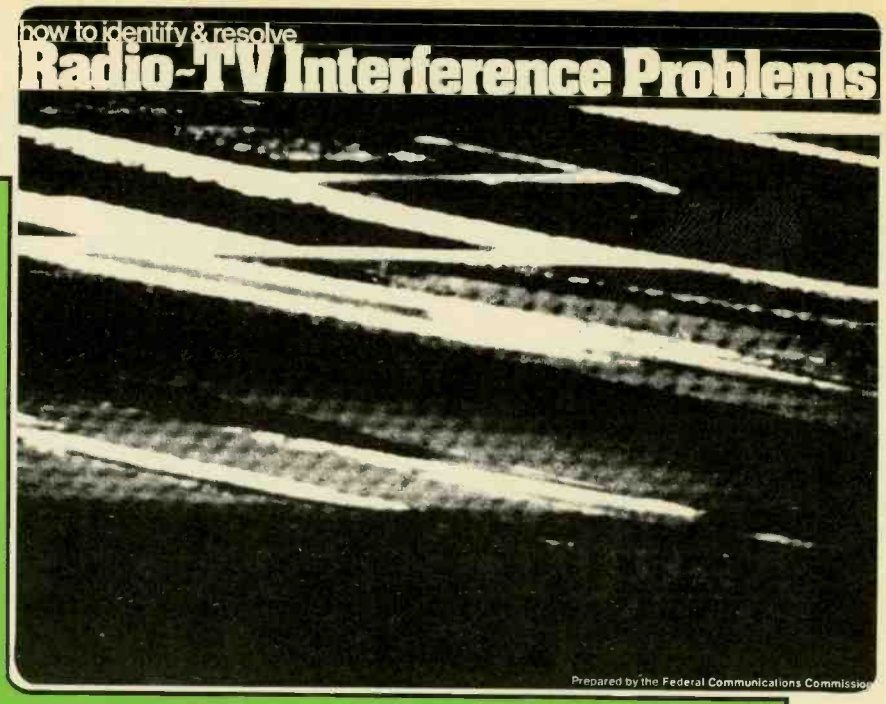
Frequency	3.58 MHz crystal oscillator
Accuracy	±3 ppm @ 25°C
Trimmer Adjustment	±40 ppm
Temperature Stability	better than 0.2 ppm/°C, 0 to 50°C
Maximum Aging Rate	10 ppm/year

Display Characteristics

Display	six 0.1" magnified LED digits, with anti-glare window
Lead-zero Blanking	all zeros to the left of the first non-zero digit are blanked; kHz and MHz decimal points automatically light up when the unit is turned on
Display Update	six per second

General

Power Requirement	one 9 V alkaline battery or 110 or 220 VAC battery eliminator
External Battery Life	alkaline, 2 hrs. continuous use; 8 hrs. intermittent use
Size	3" x 6" x 1.5" (HWD)
Weight	8 ounces



Let the FCC's own Radio-TV Interference booklet be your club's first line of defense on the TVI front.

For the first time here's an easy-to-read guide showing all of the classic TVI symptoms and their cures.

Use it as a "handout" by the local TVI committee, defuse tricky "irate neighbor" situations, help the local TV repair shop root out RFI/TVI problems in your area.

This top-quality booklet (40 pages 10¼ x 8") is available in quantities of 12 at $9.00 plus $1.00 shipping. Single copies are available for $1.25, postpaid. Note that the FCC offers the self-same booklet for $1.50 per copy with no quantity discount.

Prepared by the Field Operations Bureau of the Federal Communications Commission and reprinted at low cost by the Publishers of ME, the booklet offers guidelines for the amateur, non-amateur and CBer alike in dealing with RFI and TVI. A dozen full-color illustrations show most interference patterns with descriptions and solutions for each problem.

The booklet should be on your "must" list for reading and your "do" list to help eliminate the problem. Order a dozen copies today!

me 14 Vanderventer Ave.
Port Washington, N.Y. 11050

12 copies $9.00
plus $1.00 shipping

☐ Enclosed is $10 for each 12 copies.
☐ Enclosed is $1.25 for each single copy.

Quantity ordered _____
Amount enclosed _____

Single copies $1.25 Postpaid.

Check One: ☐ Check ☐ Money Order
☐ Master Charge ☐ Bank Americard

My account number is ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Name _____ Call _____

Address _____

City _____ State _____ Zip _____

114

Pirate broadcasting for fun-not profit

As if the FCC didn't have enough problems along come pirates who raise the devil.

by Harry Helms, Jr.

During January of 1978, listeners in New York City were treated to the programming of two new broadcasters—WDBX and WGOR. Unlike other local AM stations, their programming was entirely free of commercials. Listeners were invited to call in for on-the-air discussions of anything, even X-rated topics. The two stations had odd-ball operating hours—generally restricted to after midnight on weekends—and were to be heard on unusual frequencies, 1620 and 1630 kHz.

You won't find WDBX and WGOR in any listing of American radio stations. The Federal Communications Commission doesn't know the locations or operators of these stations, either. For WDBX and WGOR are just two of the bumper crop of *pirate* radio broadcasters—highly illegal, unlicensed, hidden stations—which have popped up during 1978.

For several years there have been various *bootleg* radio operations in the United States, mainly run by young would-be radio personalities using salvaged radio gear. But, in 1978 there has been an unprecedented amount of activity, all widely heard and managing, so far, to escape being caught. Amazingly enough, some of them even QSL listener reports, making them super targets for alert DXers.

While there's nothing illegal about listening to a bootleg radio station, being on the business end of the microphone is another story. Both the author and *Modern Electronics* warn readers that operators of pirate stations face five years' imprisonment and a $10,000 fine if caught and convicted. And with the FCC's increasing use of sophisticated mobile enforcement units, the chances of being caught rise with each passing month.

WDBX and WGOR were so similar that many listeners and DXers frequently confused the two, although they operated on separate frequencies, WDBX around 1620 kHz and WGOR at about 1630 kHz. To add to the confusion, both stations changed calls frequently in an apparent attempt to mislead the FCC. WDBX tended to use such call letters as WICE, WPOT, and WFSR while WGOR favored WFCC and WFAT. Operation was erratic, but both tended to be active on the weekend, from around 11:00 p.m. Eastern time until well after 2:00 a.m.

Both WDBX and WGOR worked out ways to get into so-called telephone loops, enabling them to take calls without giving out their own phone number. A typical loop is what you get into when you call a disconnected number. You are connected to a recording giving the new number. By clever manipulation of this system, the pirates were able to take calls and yet avoid having their station phone traced.

DXers who called the stations were told that both were in Brooklyn and used less than 100 watts of power. Despite such low power, the pirates were heard well throughout the eastern half of the United States and Canada. Your author heard them both several times at his listening post in South Carolina.

The pirates do not lack a sense of humor, twisted as some might think it. On the weekend of January 21-22, 1978, when most of the eastern United States

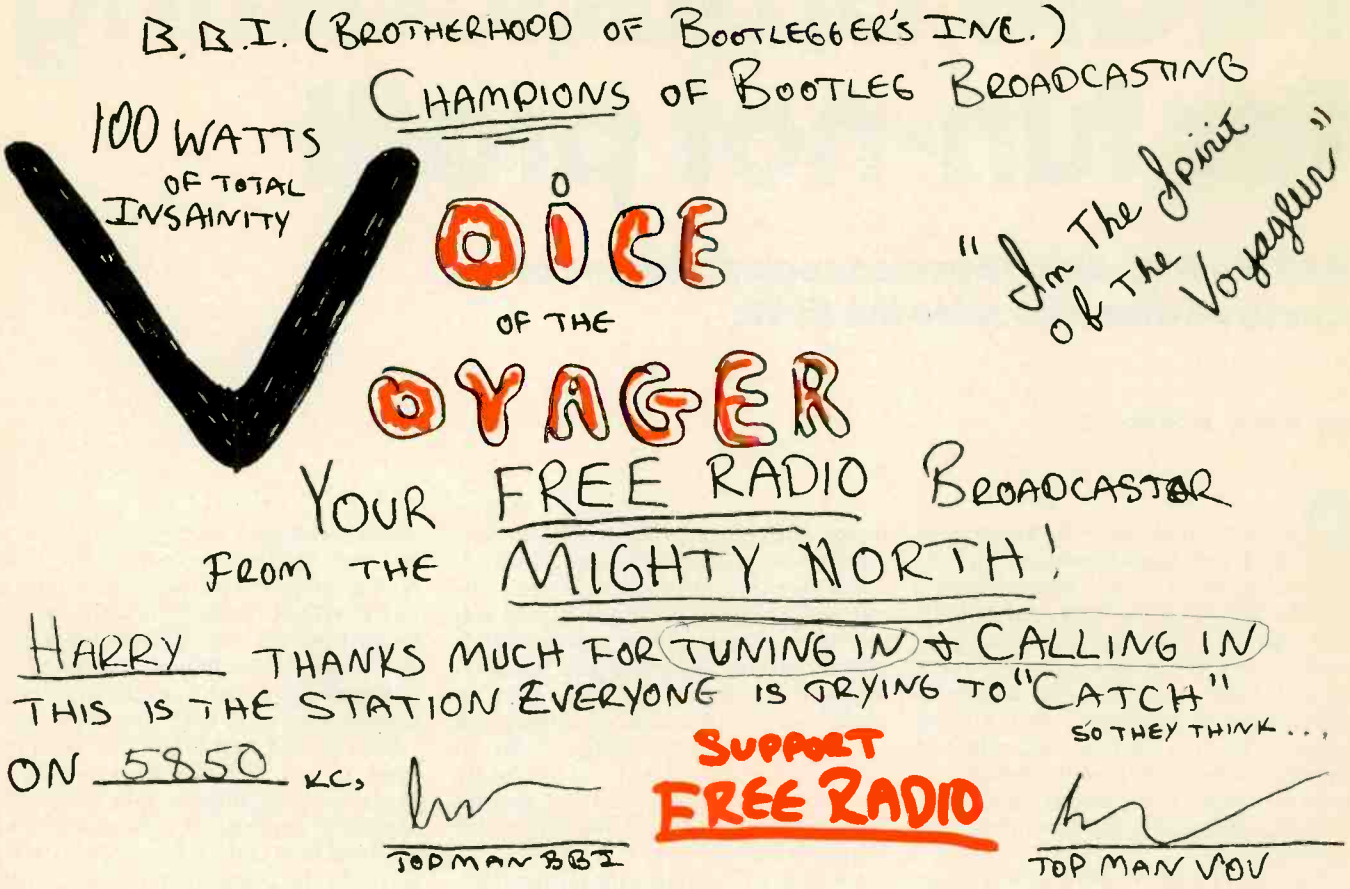
Word gets around . . .

A few days after your editor mentioned an interest in photos of a pirate station, the pictures and captions you see here arrived in ME's mail, anonymously, of course. The postmark was unreadable, but a cryptic return address had been scribbled on the envelope: "One Mile North of Nowhere." It's surely not as impressive as the Voice of America, but they do manage to make themselves heard, don't they?

R.F. Gain at the microphone

VOV's studio

Transmitter, nicknamed "The Fuse"



The author received this QSL card from the *Voice of the Voyager*, one of the pirate radio stations discussed in this article.

was at a standstill due to heavy snows, WDBX changed its call to WICE in honor of the weather and WGOR became WFAT. Around this time WICE began putting out a strong second harmonic on 3261 kHz which was also widely heard.

With the coming of spring both WDBX and WGOR disappeared, though they had managed to avoid being caught by the FCC, but in June listeners again reported hearing a station identifying itself as WFAT, operating irregularly on 1630 kHz late weekend nights. Listeners should keep close watch on the 1600-1650 kHz segment during the next few winter months. My guess is one or both of these stations might return to the air.

The Voice of the Voyager

Few stations in the history of SWLing have caused as big a sensation as *The Voice of the Voyager*. Operating on 5850 kHz, this remarkable pirate is apparently run by a group of SWLs!

Guide to Recent Bootleg Radio

Frequency	Station
1620	WDBX, Brooklyn, New York. Rock music, phone-ins, active until March, 1978.
1630	WGOR, Brooklyn, New York. Rock music and phone-ins similar to WDBX. Still active in June, 1978.
3261	Second harmonic of WDBX, heard in January, 1978.
5850	*Voice of the Voyager*, believed Minnesota or Michigan. Rock music, phone-ins, DX and SWL features. Still active in mid-July, 1978.
6206	WINT, Radio 62, somewhere in the Midwest. Rock music and young announcers. Active mid-March, 1978.
7450	WMMR, Midwest Music Radio, believed to be in Indiana or Illinois. Beatles music, active May and June, 1978.
28625	Radio VOCAD, believed to be in the Chicago area. DX talk and music, active June, 1978.

The *Voice of the Voyager* was first reported by SWLs in March of 1978. It was heard Friday and Saturday nights, signing on at 0500 GMT. With the arrival of Daylight Savings Time later in the year, its schedule changed to Saturday nights only, signing on at 0400 GMT. Programs lasted for approximately one hour and consisted of rock music, DX tips and news of interest to an SWL. There were occasional phone-ins, apparently with a system similar to the one used by WDBX and WGOR.

At this moment (this is being written in mid-July), the station is still operating. The operators have openly announced that they plan to continue broadcasting at least through December, 1978.

Many listeners to the *Voyager* were surprised to hear DX tips read straight out of the bulletins of various SWL clubs. When SWLs reported reception of the station to their clubs, they found themselves receiving QSLs! In addition, some telephone callers have also received QSLs.

The station has never given out a mailing address. Its true location remains a mystery, although rough direction-finding efforts have placed it in northern Minnesota or the upper peninsula of Michigan. QSLs bear a Detroit

postmark, but most SWLs do not believe the station is located there.

Editors of various DX club bulletins have received letters from the *Voice of the Voyager*, all written by one "A. Nony Mouse" a rather heavy-handed attempt at humor. The letter writer claims that the station uses a 100 watt transmitter. The antenna is supposed to be a half-wave dipole. The station power is modest, but obviously effective because reception throughout North America is generally fair to good. In June, the station was even heard in Newcastle, England by Ruddy Edelwich.

The *Voice of the Voyager* uses a distinctive interval signal—ten notes on a guitar, followed by "Voice of the Voyager, champions of bootleg broadcasting," and the song "We Will Rock You/We Are the Champions," by the English rock-and-roll band Queen.

Voyager's channel is mostly clear but there are times when radioteletype interference is heard. My guess is that when the nation goes off Daylight Savings Time in October, the station will likely return to its Saturday night 0500 sign on—provided that the FCC hasn't caught up with them.

Other pirates have been heard during 1978, although none have achieved the notoriety of the previous three. A station identifying itself as "WINT, Radio 62" was heard in mid-March and was believed operating from the Midwest on its frequency of 6206 kHz. Another Midwestern pirate was "WMMR, Midwest Music Radio," which was heard on 7450 kHz during May and June. Programming was the usual rock music favored by pirates and sign off was around 0200 GMT most evenings.

Still another pirate with apparent connections to the SWL community, is "Radio VOCAD," believed in the Chicago area. It was logged on 28625 kHz during June. This station made frequent mentions of the *Voice of the Voyager*, although it is not believed the two are connected. VOCAD also requested reception be reported to SWL club bulletins for QSLs.

The Future

Pirate broadcasters tend to have a short life span. Prolonged activity—as with WDBX, WGOR, and the *Voice of the Voyager*—is the exception, rather than the rule.

New pirates can and do pop up anytime without warning. Alert SWLs should keep a watch on 1600-1650, 6200-6300, and 700-7500 kHz where most have been reported in the past. It's impossible to predict whether activity will continue as its recent fast pace or return to the lower level of prior years. Whether or not it does, listening to bootleg broadcasters can provide some of the most exciting and unusual DXing available. It's quite a challenge to catch a pirate—before the FCC does!

Phone lock

If you're worried about people running up your phone bill with long distance calls made while you're out, you'll really like this super-simple combination phone lock. It's easy to build, costs only a few dollars for parts, and doesn't have any keys to lose.

by Jules H. Gilder

To prevent unauthorized people from using the telephone, people often go out and buy a telephone lock to keep the dial from operating. If you're one of the many people who has done that you probably know that just when you want to put the lock on, you can't find it. It's rather small and easy to lose. So is the key. Ever put the lock on and then lose the key? Try to use the phone then!

You can eliminate these problems by building and attaching an electrical phone lock to your telephone. While preventing unauthorized persons from

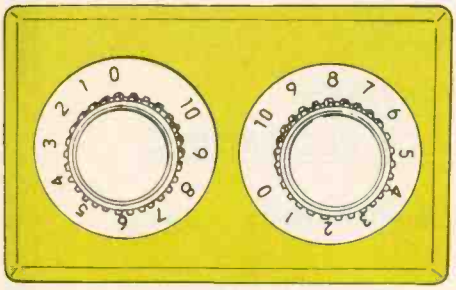


Figure 1

making phone calls, the phone lock will not in any way affect incoming calls. The best part about the lock is that there is no key to lose. To use the phone, dial the phone lock in the proper combination and the phone is unlocked. If you want to make the combination more difficult, all you have to do is add additional switches.

The phone lock is one of the few projects in this book that requires a direct electrical connection to the telephone. The connections you make however will in no way damage the phone and cannot be detected by the phone company. In certain areas of the country, the attachment of foreign objects to the phone line is prohibited by tariffs of the local operating companies. However, recent pressure from telephone accessory manufacturers has caused the phone companies to ease up on these tariffs in many instances and to allow some devices to be connected to the line. To be sure, you should contact your phone company.

About the circuit

The circuit for the electrical phone lock is a very simple parallel circuit of three rotary switches. The connection of the switches is designed so that unless the proper combination is dialed in, a short circuit will appear across wires A and B. But, when the correct combination is set on the three rotary switches, an open circuit appears across A and B.

To understand how this helps lock the phone, let's take a look at the dialing action of a telephone. Look at the back of a telephone dial. You will see that there is a set of normally-closed switch contacts that open and close as a number is dialed. The number of times they open and close depends on the number dialed. For example, the number 3 would cause the contacts to open and close three times.

This opening and closing of the contacts is what enables you to dial different numbers. When the phone is not in use and waiting to receive a call, these contacts are normally closed. So if you contact a shorting wire across the terminals of these contacts you have caused no change in the circuit.

Construction

If you try to dial the telephone while the terminals are shorted nothing will happen. Although the moving dial is causing the switch to open and close, the wire you connected across the switch makes it look as if that switch is still sitting there doing nothing. But if you were to disconnect that shorting wire, telephone dialing would be normal.

This in essence is what the phone lock does. Wires A and B are connected to the normally-closed dialing switch. When the correct combination is set on the rotary switches, the circuit between A and B is an open circuit and calls can be made. But, if the rotary switches are set to anything but the proper combination, a short circuit will appear across A and B. This short circuit will prevent the dialing switch in the telephone from pulsing the phone line and dialing a number.

Installation and operation

Fabricating the phone lock is very simple. Purchase three (or as many as you wish) rotary switches. They should have about ten or twelve individual positions. Such a switch is designated as a single pole ten throw (SP10T) or single pole twelve throw (SP12T) switch. Mount the switches in a small bakelite case or any other convenient enclosure. Now, connect all of the centerposts of the three switches together. This will be wire A.

Determine what combination you want to use for the lock and short all the contacts on each switch together except the contact to the number you have chosen. That is, if you have decided that the combination you want is 583, on the first switch leave the terminal for position 5 empty and short all the remaining ones on that switch together. The same is done for terminal 8 on the second switch, and terminal 3 on the third switch.

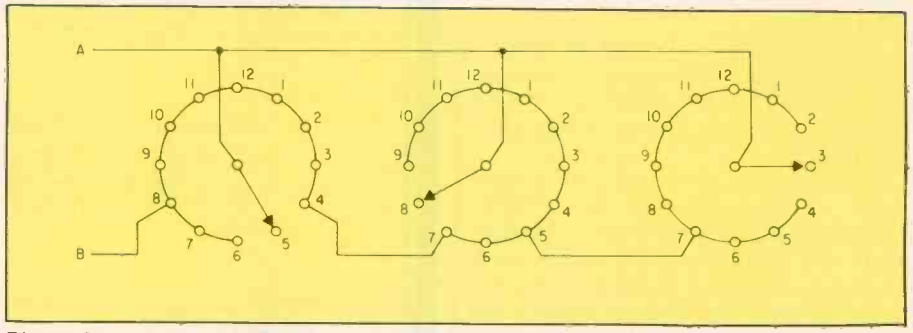


Figure 2

Now connect all of the shorted terminals on the three switches together. This will be wire B. To check the circuit, place an ohmmeter or continuity tester across A and B. Dial in the combination. The ohmmeter or continuity tester should

indicate an open circuit. If it doesn't you have connected the switches properly. If it does, turn one switch to another number. A short circuit should immediately be indicated.

Attach a piece of lamp cord, or just two individual wires, to A and B that are long enough to reach your phone. Fasten the case closed.

The phone lock can be attached directly to the telephone with a piece of double-sided tape, or can be installed at some remote point.

To connect the device to the phone, remove the case by unscrewing the two screws located on the bottom of the telephone. Next locate the network block, which is inside the phone with the screw terminals on top of it.

In certain areas of the country, the attachment of foreign objects to the phone line is prohibited. To be safe, you should contact your local phone company.

For telephones manufactured by Western Electric, ITT, or Bell Telephone, locate the green and blue wires coming from the dial to the terminal block. Connect lead A from the phone lock to the green terminal, which is usually designated RR on the terminal block. Wire B from the phone lock should be connected to the blue terminal, designated F.

For telephones manufactured by Automatic Electric or General Telephone, locate the blue and yellow wires coming from the dial to the terminal block. Connect lead A from the phone lock to the blue terminal, which is usually designated No. 1 on the terminal block. Wire B should be connected to the yellow terminal, which is usually designated as No. 11.

On some telephones the dial may have to be removed to get to the terminal block. This can be done by simply pressing down on the dial and pushing it towards the front of the phone.

Once the phone-lock leads have been connected, route the wires out of the phone and replace the cover. It is now ready to use. To place a call, set the combination on the phone lock and dial as you normally do.

To prevent unauthorized use of your telephone, simply turn each switch so that it is set on any number but the number in the combination. Now only incoming calls can be received. No outgoing calls can be made.

By the way, since the phone lock connects directly to the dial switch, it can be used to secure all the lines of a multiline phone, as well as single line ones.

One more important point, if you have one or more extension phones in the house, each one must have a phone lock on it to effectively secure your phone system.

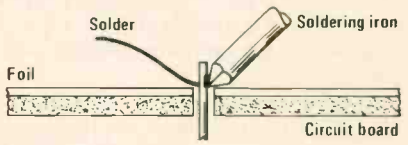
Six steps for successful PC soldering

There's no question about it, using a printed circuit board makes circuit construction much, much easier than old-fashioned point to point wiring. But, if you're not careful, you'll find printed circuits also make it a lot easier to create *short* circuits. That's because it's so easy accidentally to leave a solder bridge between two adjacent foil strips.

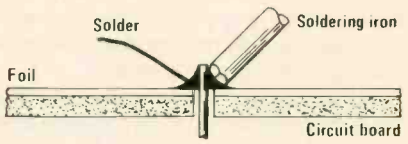
Another problem you might encounter using printed circuit boards is a false connection—a solder joint that looks good, but is in fact no connection at all. This happens when only the component lead is heated. The solder forms a blob on the lead, which becomes insulated from the copper foil by rosin from the solder's core.

The trick to using printed circuit boards is to do a good job of soldering the component leads to the copper foil. It's really easy to do, if you'll follow these tips and take your time.

- Use a soldering iron designed for use on printed circuits. These are usually rated at 25 watts and have relatively small tips—perhaps a chisel point about 1/8th-inch wide.
- Use a top-quality electronic solder, which must be of the rosin core variety. Use the smallest diameter solder you can obtain.



- Place the soldering iron tip on the copper foil and against the lead to be soldered. Apply the solder to the junction of the foil and lead on the side opposite the soldering iron.



- When the foil and lead have been heated to the proper temperature by the soldering iron, the solder will *flow* onto the foil and lead like a drop of light oil.
- Remove the solder and iron. As the solder cools and hardens, it should appear smooth and it will shine.
- As you remove the soldering iron from the foil, *lift* it away. If you drag it away, you risk making a solder bridge across the gap to the adjacent foil strip.

Automatic turn-on

Mechanical switches have a way of failing at the most inconvenient moments. Here's a fool-proof switch with no moving parts that runs your sump pump. Water turns it on.

By Jules H. Gilder

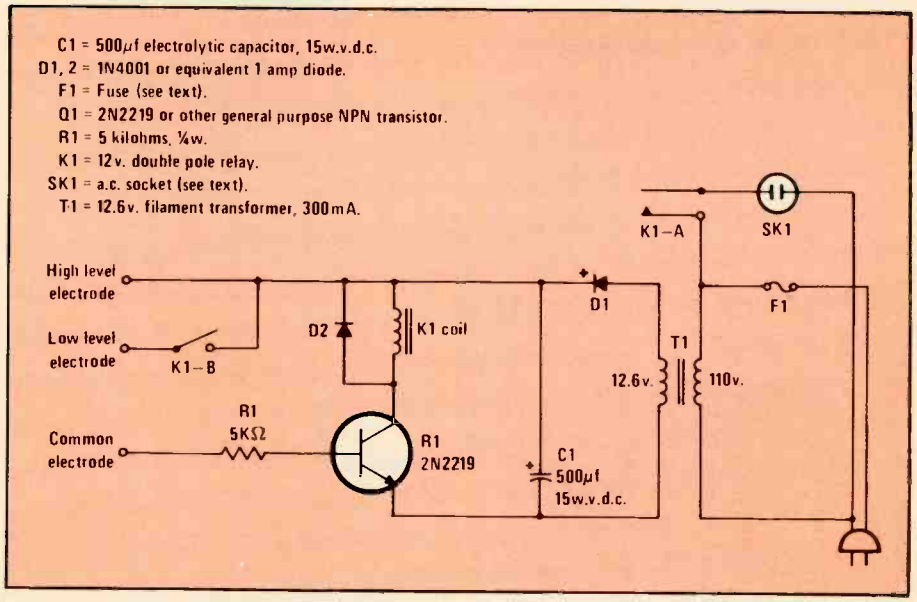
With the storm season upon us it's not uncommon to wake up in the morning and find that you have an unexpected pool in your basement. Wouldn't it be nice to have an automatic sentry that would turn on an electric pump whenever water started to accumulate?

You can build this simple water-operated switch for less than $10 or you can go out and buy a special float switch for $25 or $30.

The circuit for the water switch is very simple. The heart of it is the NPN transistor, which is used here as an electronic switch. A characteristic of the transistor is that when a positive voltage is applied to its base, it switches on the relay K1 which starts the pump by feeding power to it.

To detect the presence of water, and thus cause the transistor to energize the relay, we make use of the fact that the water contains impurities and will act as a conductor of electricity. Distilled water, however, does not conduct electricity. When water is present and it touches both the high water level electrode and the common electrode, a current flows and a voltage is applied to the base of the transistor, which in turn closes the relay and starts the pump motor.

If this were all there was to the circuit the motor would run until the level of the water fell below the electrode. As soon as the electrode was clear the pump would stop. Then, a few minutes or seconds later it would turn on again when the water level rose once more. Continually cycling this way would soon wear out the relay contacts, and probably shorten the life of the pump. To prevent this from happening, another set of relay contacts (K1B) is used to switch in a third element, the low water level electrode. With this electrode located at a lower level the pump turns on only when the high level is reached and stays on until the pump removes enough water to reach the low level. Then it shuts off and doesn't cycle on until the water level is once again high. This difference between turn-on and turn-off is called *hysteresis* and can be adjusted by simply increasing or decreasing the height of the two electrodes.



A convenient way of arranging the electrodes is to tape three wires to a plastic rod. Make sure that at least the lower inch of wire has its insulation removed and that none of the three wires touch each other. Now, make the wire that will be deepest in the water the common electrode and the one that will be shallowest in the water the high water level electrode. The third wire thus becomes the low water level electrode. This entire assembly is then simply placed in the water in an area whose level will fall as the pump eliminates the water.

Power for the unit is supplied by a little supply consisting of a 12.6 V filament transformer, a capacitor and diode D1. This produces about 15 V DC for the transistor circuit. Diode D2 is used to protect the transistor from turn-off voltages generated by the relay.

The entire unit can be built into a 3"x3"x6" aluminum mini-box. *Danger:* Since the device is connected to 110 VAC, be sure to check and see that no electrical connection is made to the box itself and that the box is located well away from the water. The electrode leads can be made as long as necessary, so this should pose no problem. Make provision for a socket to be mounted on the box. This is where the pump is plugged in. Don't forget to include a fuse in the pump power circuit. The fuse rating will vary with the pump used, so check the motor plate for the maximum current required.

Why it won't work . . . the first time

Anyone interested in electronics long enough to have built one or two projects knows the sinking feeling when it fails the smoke test or simply lies there not doing a thing. Here are some common but often overlooked sources of trouble. Check them out first.

by David L. Heiserman

Whenever you build a circuit yourself, don't count on it working properly the first time you try it. I'm not trying to be depressing about the matter. Quite the contrary. I'm hoping to offer you some encouragement about something that can happen to anyone who builds a circuit from scratch—it doesn't work.

Building circuits is a complicated affair. It isn't complicated in the sense that you have to be some sort of super genius; but rather in the sense that it involves a long series of relatively simple tasks. And goofing just one of those little tasks can botch the whole job.

No matter where the schematics, wiring diagrams, parts lists and parts come from, you're bound to run into trouble getting a circuit working now and then. Sometimes you're responsible, sometimes the schematics and parts lists are wrong, and every once in a while the components are defective. Actually there are six clear-cut things that can go wrong with a construction project. Being aware of these six bugaboos, knowing how to cure them and avoiding them in the first place, can help make circuit building a more fruitful and enjoyable experience.

Incomplete or incorrect wiring

This is undoubtably the number-one reason why a newly built circuit doesn't work the first time. Even the best of us leave out a wire or get a couple of them crossed now and then. Curing the problem in this case is a matter of carefully rechecking the wiring.

Compare the wiring in the circuit, one conductor at a time, with the schematic or wiring diagram. Make a little check mark on the diagram as you confirm the proper placement of each conductor. It really is hard to avoid making some wiring errors, especially in relatively complicated circuits. But, most errors can be avoided by making that little check mark on the schematic each time a new wire is fixed into place.

Another way to reduce errors is to plan your time so that you can wire the entire circuit at one sitting. This isn't always possible, of course. But, wiring a circuit piecemeal—making some connections one day and then a few more a couple of days later—invites wiring errors and wastes time. If you are working with a finished PC board, carefully doublecheck the routing of the conductors and look for hairline breaks and shorts between parallel tracks.

Poor solder connections

Poor solder connections, especially when working with field-effect transistors and MOS/CMOS ICs can cause a lot of headaches. Inspect all the solder connections visually, making certain they are clean, shiny and complete. Redo any questionable solder joints—all of them if necessary. Using the right kind of iron, solder, and technique in the first place makes it highly unlikely this kind of trouble will ever occur.

We tend to get the pin numbering on IC packages confused more often than many are willing to admit. Most ICs have a dual in-line package configuration that makes it possible to plug or wire them into a circuit two different ways. Unfortunately only one way is right.

The chances of making careless pin-numbering mistakes is even greater when wiring the socket. Where is pin 1? Are the pins numbered clockwise or counter-clockwise from the top? From the bottom? Now I suppose a monkey could be trained to find pin 1 and count the pins in the proper direction, depending on whether the package is viewed from the top or bottom. But we aren't talking about stupidity or ignorance here. We're dealing with common, careless mistakes. And one of those common, careless mistakes is counting the pins incorrectly on an IC.

Check the wiring and the orientation of the ICs against the circuit diagram. Make certain that the wiring that is supposed to go to each pin does indeed go there. When wiring your own circuits, mark the position of pin 1 for each IC on *both the top and bottom of the PC board*. The ink in a PC etching pen is quite suitable for this little trick, even if you are using point-to-point wiring.

It is a bit easier to check the wiring and orientation of transistors and other types of discrete semiconductor devices because they have fewer terminals than ICs do. A common error circuit builders make, however, is assuming they know the proper pin designations for discrete devices when indeed they do not.

Transistors in the popular old T0-5 metal case, for instance, are all laid out with a well-known pattern of emitter, base and collector connections. Other transistor case styles, however, often use alternate layouts, giving rise to possible confusion and wiring errors. What one happens to know about T0-5 cases is practically useless when it comes to other package styles.

Doublecheck the wiring and the orientation of discrete devices, taking nothing for granted. If necessary, check the layout of the device's terminals against the information in a reputable data book.

Circuit builders make certain kinds of errors, and so do the people who write

and publish the circuit diagrams and related materials. It is unfortunate, but ever so true. A builder can exercise all the care in the world when following printed instructions, only to find the circuit doesn't work because of an error in the instructions.

Errors in printed materials

It is possible to detect and correct certain kinds of errors in printed drawings by consulting a reliable data book. Pin numbers on ICs and the layout of terminals on discrete semiconductors, for example, can be easily checked against the information in reliable data books.

I say "reliable data books" because some sources of information about pin numbers and device functions are not at all reliable. The most reliable sources of such information are the manufacturers' data books. Manufacturers of ICs and other semiconductor devices can hardly afford to make errors in their data books, so they go to great pains to make certain their error rate is very close to zero.

The same cannot be said for the little blurbs that come with semiconductor devices bought from some of the more popular electronics retail houses. The best advice I can offer as far as these data sheets is concerned is to throw them away before reading them—they can cause more trouble than they cure. Ignore suppliers' data sheets and use manufacturers' data books for doublechecking pin numbers, package configuration and the layout of IC and other semiconductor terminals.

While it is rather easy to pick out printing errors as far as pin numbers go, detecting drawing errors in a schematic calls for a good understanding of basic electronics. Many circuit builders haven't the experience and background to make a thorough critical analysis of a schematic. The only recourse is to write the publisher, requesting a list of corrections.

Inadequate Power Supply

Quite often a circuit builder puts a lot of work and care into building a circuit, only to botch the whole job by connecting it to a lousy power supply. Maybe the instructions call for using a 6-Volt lantern battery. The assumption is that the reader will use a *fresh* 6-Volt lantern battery. So, the circuit may not work with a tired old battery taken from a camping light that went on a 4-week fishing trip last year, or with four little 1.5V AA batteries connected in series.

A general purpose, laboratory-type power supply can be useful for trying out homemade circuits, provided it supplies both the right voltage and current. Don't forget about the current! Few projects listed in books and magazines bother to state the circuit's current requirements. If you can't figure it out for yourself, you're better off powering the circuit exactly as specified in the instructions.

Get the circuit working according to the instructions. After that you can get clever with some power supply designs and other modifications of your own.

Circuit components are the first to be blamed for a problem, and yet they are the least likely cause. Of course, this principle presupposes the parts are guaranteed, top-of-the-line, unused parts acquired from a reputable dealer. The idea further assumes the parts aren't being cooked by a wiring error.

Go through the other possible causes of troubles already listed before thinking in terms of a defective part. This may take some training and self discipline. There seems to be an ever-present, nagging tendency to suspect defective components out of hand.

Digging into a circuit and trying to test all the components before all other procedures have been tried is a waste of time. And it risks ruining some otherwise good wiring and solder connections. Blame a component only by default. If it gets down to checking parts, check the semiconductors first. The best way to test them is by substituting identical devices fresh from the package. If that isn't possible, you'll have to get very clever about it and use some testing procedures that are beyond the scope of this particular discussion.

workbench

BY BOB MARGOLIN

Modern Electronics introduces a new column for the beginning experimenter who needs help in building and testing electronics projects.

All of us tend to take for granted the basic building blocks of our life—they're just there. Except, of course, when they're not. Then you'd sell just about anything you owned to get whatever it is you need. And the tools on your workbench are no exception. You just take for granted you've got what you need to build the latest widget. And, in fact, chances are that you do have a basic set of tools—a few screwdrivers, a pair of pliers, a diagonal cutter, a soldering iron and perhaps even an electric drill with a few good drill bits.

If you're like most beginners in the hobby, you've already figured out how to make each tool do double and triple duty. Like using a small straight-slot screw driver to get at Phillips head-screws, for example. After all, why spend money buying tools that you can do without when you could spend it on important things—ICs, transistors, resistors and capacitors, printed circuit board material and other odds and ends?

In the early life of most hobbyists it probably makes sense to use the tools on hand and spend money for components. But once you've gotten past the beginning stage, you'll find yourself spending more and more time cursing your limited tool collection. For one thing, you'll find that set of oversized gas pliers a little difficult to use for inserting terminals in a perfboard. And that's when you'll decide you just have to have a set of needle nose pliers.

As you start to add tools to your work bench collection, you'll be inclined to buy cheap. Radio Shack, for example, will sell you a pair of flat nost pliers for about $3 that will get those terminals into that perfboard. And, in truth, they'll do everything you need done.

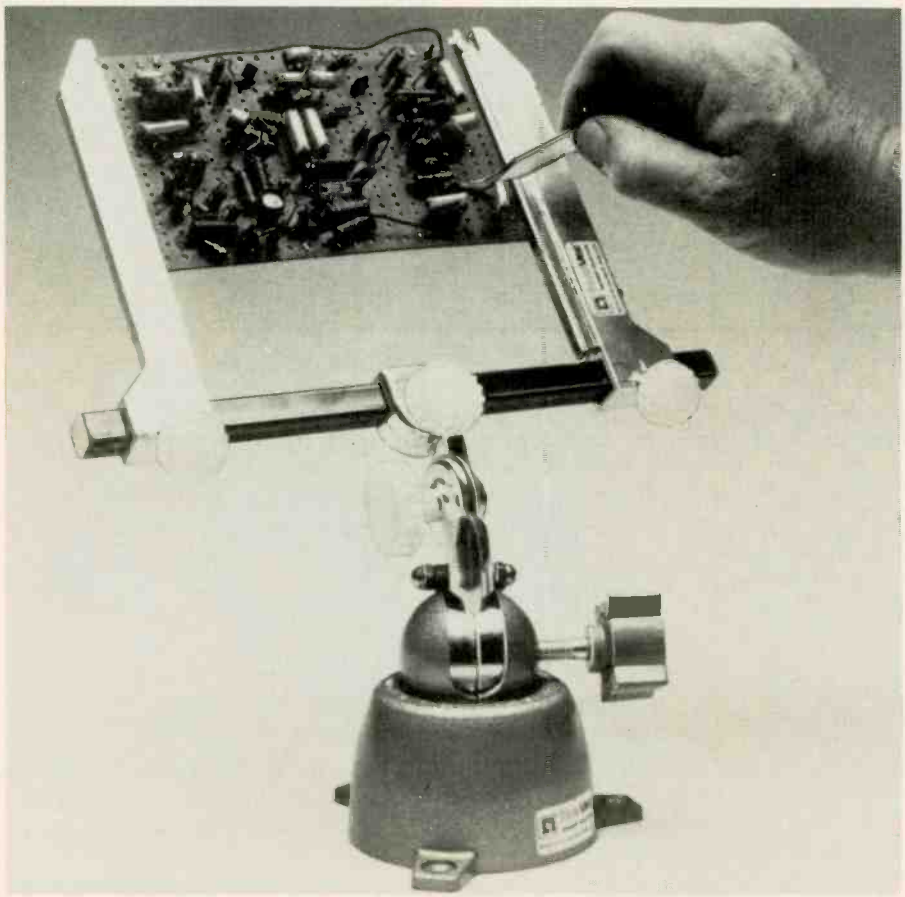
Before too long, you'll find yourself with a reasonably complete set of electronics tools. You'll most likely have small, medium and large screw drivers in both straight slot and Phillips head, medium length needle nose pliers, diagonal cutters, and perhaps a wire stripper. You'll also have added a small soldering iron designed for printed circuit work.

As you get more and more involved in circuit construction, you'll wish you had some specialized gizmo that could . . . Well, you can have that gizmo, and many more if you know where to look.

One of the most useful additions to any electronics hobbyist's work bench is a *third hand*. As the name implies, this handy gadget holds your circuit board or component in place, freeing your hands to hold both the solder and the iron.

Third hands come in a variety of sizes and shapes, and with a variety of prices. Some, such as the PanaVise Circuit Board Holder, have a pair of grooved brackets mounted on a 10-inch crossbar. All you have to do is position the brackets on the crossbar and slip your board into the grooves.

If you'd like a little more flexibility in your third hand, PanaVise also makes a clamping hand consisting of two neoprene covered plates on a set of rails. By turning a crank, you can move one of the plates towards or away from the other, stationary, plate. The design lets you hold just about anything between the plates. It is, in a sense, a bare-bones vise. For more information about PanaVise products, circle number 182 on our reader service card.



The PanaVise Circuit Board Holder has a pair of long, grooved arms into which you slip your circuit board. The optional pan-head base lets you set the board in any position

This is the first of what we hope will be a long list of monthly Work Bench columns. It's really your column because in its pages we'll be answering your questions about test equipment and construction techniques. We'll cover everything and anything having to do with building and testing circuits—the right tools for the job, the best test gear for the measurement, how to work with metal chassis and panels, how to use perfboard, even how to design and fabricate PC boards.

Work Bench will appear in a variety of forms. Some columns will be question and answer sessions similar to the ever popular Clinic. But where Clinic deals with circuit design, Work Bench will deal with circuit construction. So if you have a question about how to build something, or how to make a measurement, send it to Work Bench here at ME.

Some of the Work Bench columns will be devoted to describing how to do something. For example, a future column will deal with punching various sizes and shapes of holes in chassis and cabinets. Another will deal with custom painting and lettering.

Other columns will discuss how to use things commonly found on the average work bench. The best way to describe these columns is to call them tricks of the trade. And since you no doubt have a few of your own tricks, we invite you to share them with the rest of our readers. If we can use your idea, we'll give you full credit *and* a one-year subscription to ME. If you already have a subscription, we'll extend it a full year. Of course, the first submission of any given idea gets the goodies, and all decisions regarding publication made by the editors will be final.

Work Bench will occasionally feature an article submitted by an ME reader. If you've been thinking about writing an article for publication in a national magazine, and you have some expertise around a work bench, why not give it a try. Worst that can happen is that we'll return your manuscript unpublished. And of course, there's always the chance we can use it. And we'll pay you the same as we would if your article had come from a *professional* writer.

Let's hear from you

As you can see, Work Bench really is your column. Not only will it cover the topics you want covered, it will give you a chance to share your knowledge and experience with others. So let's hear from you, even if it's criticism. Remember, we can't give you what you want unless you tell us what that is.

One note of caution, however, should be mentioned. As you can imagine, we receive a large volume of mail each day, much of it requests for information. As much as we'd like to answer each letter individually, we just can't. So, letters sent to Clinic and to Work Bench will be answered only in those columns.

Sometimes we receive several letters asking about the same subject. Chances are that we'll pick the best letter of the group for publication. So, it's quite possible that you'll find the answer to your question appearing under another reader's letter.

Tools and things

When most of us think about our work benches, we usually think in terms of how many components we have in our junk boxes, and the latest addition to our inventory of test equipment. We almost always overlook the most essential elements of any work bench—tools.

Tools, which can cost as little as 39¢ or as much as $100, are what make it possible for us to build our projects. Without them, it would be near impossible. Even so, most hobbyists hardly ever give tools a second thought—except when you can't find the one you need.

Tools aren't the only items often overlooked on the average work bench. There are also some small parts that never seem to be thought of at all—except when you need them—parts such as pilot lamps and terminal strips and other miscellaneous hardware.

Because these often overlooked items are so important to your work bench, we've decided to kick off the column with an article covering the subject. Let us know what you think of it and its place in the Work Bench column.

—*Ed.*

There are times when you need a third hand, but one that's quite different from the two just mentioned. Adding an extra component to a printed circuit board is a good example. Rather than drill extra holes, and risk damaging the foil or other components already mounted, you'll probably solder the extra component directly to the foil. The problem is how to hold the component in position on the foil while at the same time holding the solder and the iron.

Dixon Tool has the answer in their Tweezer Mounted Work Positioner. It is, as you might guess, a tweezer mounted to a stand through a swivel coupling. Just grip the component in the tweezer and position it where you want it on the board. Then, with your free hands, solder it in place. For more information about Dixon tools, circle number 181 on our reader service card.

X-acto also makes a third hand, which they call the *X-tra Hand*. It differs from the PanaVise model in the use of alligator clips in place of slide-in rails. But, it does have two of them that can be positioned on the crossarm in a similar manner to the Panavise. One nice option X-acto offers for the X-tra Hand is a magnifying glass, which also can be positioned anywhere along the crossarm.

Third hands, unfortunately, aren't cheap. Depending on brand and construction, you'll have to pay between $15 and $30 for a large version. Even Dixon's tweezer wll set you back about $7. But, these gems can be worth their weight in gold when you absolutely have to have one to get your project finished.

Of course, all third hands are really nothing more than streamlined versions of the standard bench vise. There will be times when you can really use the heavy duty holding power of the standard vise, so you shouldn't overlook adding one for your work bench.

The genuine article

Bench vises, like most everything else, come in a wide variety of sizes and shapes. It's unlikely, though, that you'll need the monstrous vises you'll find sitting on your plumber's bench. X-acto, famous for their hobby knives, makes a pair of hobby-size vises that opens to about 1¼ inches and sells for about $5. One model is built to be permanently bolted to your workbench. The other is a portable design using a lever-operated vacuum suction plate that lets you stick it where it's needed.

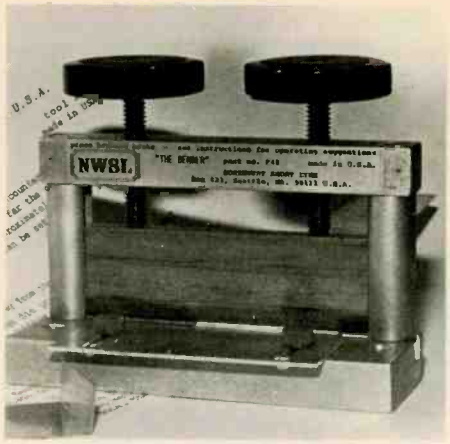
Dremel and PanaVise, among others, make small vises mounted on ball joints that let you lock your work into any attitude you wish. In operation, they're very much like the pan head on a camera tripod. Dremel's model, called the *D-vise*, can hold objects up to 2½ inches thick, and sells for about $25. PanaVise makes several models, available with or without base. Prices range from about $10 without mounting base to over $50 for a professional model with surface plate and low profile base.

Another source of hobby-type vises is Model Power, an importer of plastic HO and N guage model trains. Included in their line are three small vises with lever operated vacuum suction bases. The least expensive of these is about $5, for a plastic model. Though it won't be of much help in heavy-duty applications, it should work well where all you need is an insulated holder. And with its price-tag, it's quite a bargain. The Model Power line also includes a pan-head vise, their Model #5373.

You can find Model Power products at most large hobby shops. For more information, circle number 179 on our reader service card.

Another useful gadget you may have need of is the face plate. Although intended for machine shop use, a tilt-and-turn face plate can save you much cursing and swearing. Essentially a smooth piece of iron or steel with a series of holes drilled through it, the face plate lets you bolt down your project so you can drill it, file it, paint it, solder it, or braze it. It serves the same function as a vise, but doesn't have jaws to get in the way.

PanaVise makes a set of hobby-type face plates that should meet any need you're likely to have. Their tilting face-plate runs about $9. Another two dollars will buy you the tilt-and-turn model that



Northwest Short Line's miniature sheet metal brake, The Bender, is ideal for making interstage shielding and mounting brackets. It can bend half-hard brass, copper and aluminum up t .02 inches thick and up to three inches wide to any angle up to 90 degrees.

lets you position the work in any attitude you wish. If you already have a pan-head base, perhaps from a swivel vise, you can get a rigid face plate for about $6.

Northwest Short Line

Small vises, face plates, and even third hands are available from larger hardware stores and industrial tool distributors. But an excellent source of these hobby-sized goodies is a well-stocked hobby supply store. You'd be surprised how many really nifty gadgets you'll find there.

A well-known importer of hand-crafted brass models of steam locomotives, Northwest Short Line, is a good example. In addition to their models, NWSL also markets a miniature sheet metal brake that is ideal for the electronics buff.

Called *The Bender* by NWSL, this handy gadget will neatly bend up to .02-inch thick, three-inch wide, half-hard brass, copper or aluminum to any angle up to 90 degrees. Unlike standard brakes which fold the tab over, The Bender works by pressing a bar across the metal into a die, which causes the metal to fold itself up around the bar. With The Bender, you can form just about any shape shielding or bracket you need.

You should be able to get The Bender at any train store that carries NWSL products. If you can't find it, you can order directly from Northwest Short Line, P.O. Box 423, Seattle, WA 98111. It costs $19.95 plus $1 for shipping.

Every once in while you'll need to drill some very small holes—perhaps only large enough to get a transistor lead through. Well, you can get drill bits that small. Machinists use two classes of drill bits—fractional and, numbered. Fractional drills run in 64ths from 1/16th of an inch to a quarter-inch, and in various larger sizes. Numbered drills, as the name implies, are identified by a number, rather than a dimension—much like screws and bolts.

In the world of numbered drills, the No. 52 is the equivalent of the 1/16th-inch fractional, being only one-thousandth of an inch larger in diameter. As the drill numbers get larger, the drill size gets smaller. The smallest in common use is the No. 80, which is about the diameter of a human hair. Finding these tiny drill bits can be a problem. Some hardware stores don't carry numbered drill bits at all, and those that do usually carry them down to only No.60 or so. But, you can get them at most well-stocked hobby shops and at industrial tool distributors.

In addition to the grooves cut in the length of the circuit board holder's arms, notches at the end of the arms let you hold your work crosswise in the jaws.

One source of these hard-to-find bits is Arvid Anderson, Frederick, WI 54837. Anderson will sell you any two numbered drills from No. 50 to No. 80 for $1.50. You can also get a complete 31-bit set, stock number 258HS, for $18.35 complete with Drill Saver lubricant and a unique bit replacement guarantee.

Like most drills, Anderson's are made from high-speed tool steel. But, with such small diameters, these drills tend to snap off in very dense materials. If you're going to be drilling into really hard substances, you'll be better off ordering Anderson's cobalt steel set, the 258CS, which costs $25.80. It too comes with a replacement guarantee and lubricant. If you'd like more information about Anderson's drill bits, circle number 180 on our reader service card.

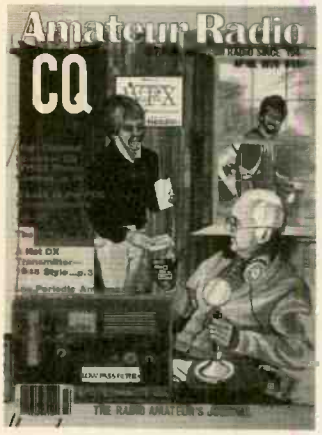
An excellent source of reasonably priced tools is Sears, Roebuck & Company. Although Sears has its detractors, most people agree their Craftsmen tools are first rate.

If you do a lot of drilling in hard materials, your bits will soon loose their sharpness. Sears has a drill bit sharpener, catalog number 9 H 6680 in the current edition, that fits on your electric drill. Once you've got it mounted, you just turn on the drill and insert the bit into the opening at the end of the sharpener. It'll handle bits from ⅛th to ⅜ths, but can't handle carbide-tipped bits.

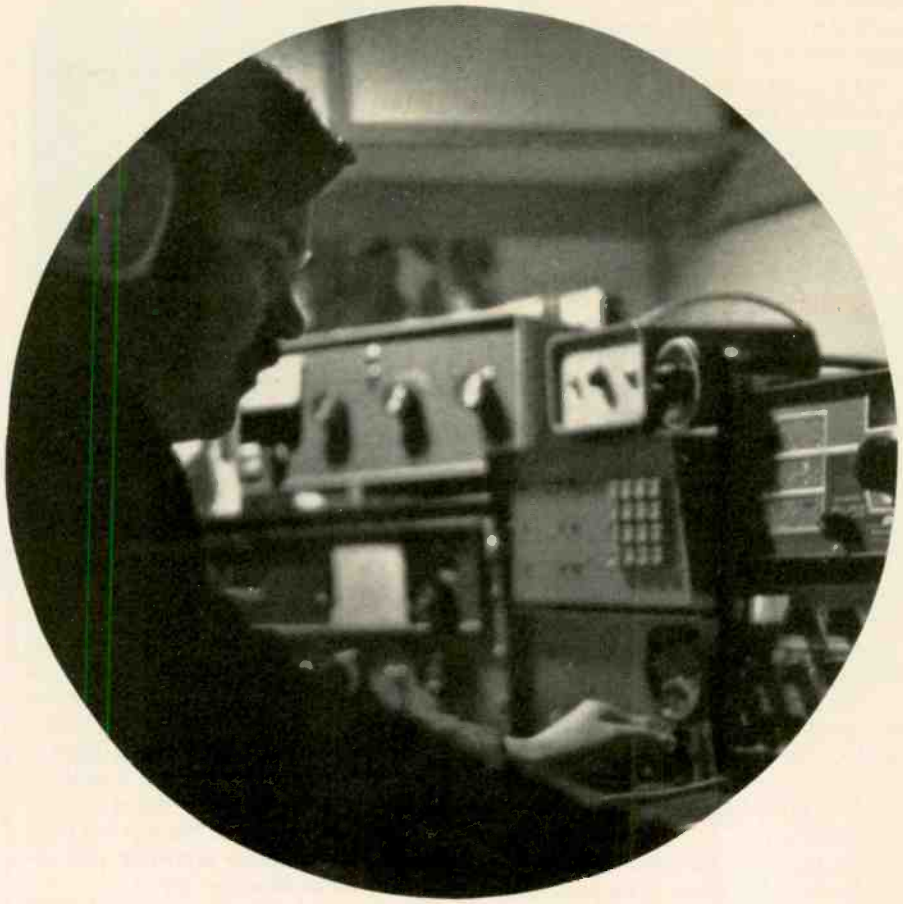
As mentioned at the beginning, most of us don't give much thought to our tools. But as you can see, there are quite a few tools around that can make your construction projects go together easier, faster, and with more professional-looking results. While their cost may seem high, the results are well worth it.

Interested in Ham Radio?

Then CB RADIO S9's Sister Publication



is for YOU



A recent survey of CB Radio/S9 readers indicated that two out of every three replying to our questionnaire would like to become an amateur radio operator. And we're all for that, because CQ, the Radio Amateur's Journal, is the oldest magazine in our company's stable.

CQ is not just another ham publication; it's the only ham publication aimed at the beginner as well as the old timer. It's the only ham magazine that recognizes that every new ham isn't an electronic engineer. The editorial features in CQ are aimed at people – people like yourself who turn to amateur radio as a means of having fun.

CQ caters primarily to the operating end of radio, with just a smattering of technical material to keep you up to date on what's happening. And even the technical portions of CQ are presented in a manner that every new amateur will understand.

In other words, CQ is the fun magazine in the amateur radio field. It's the amateur magazine that you'll enjoy from cover to cover. And remember, CQ is brought to you by the same folks who bring you CB Radio/S9. What more could you ask for?

CQ

The Radio Amateur's Journal 812-F

14 Vanderventer Avenue, Port Washington, L.I., N.Y. 11050

		Domestic	Foreign	Foreign Air Mail
☐ NEW	One year.....	☐ $9.95	☐ 12.95	☐ 47.95
☐ RENEWAL	Two years.....	☐ $16.95	☐ 22.95	☐ 92.95

Dear OM:

Enclosed please find $_____ for_____Year(s) Subscription to CQ, The Radio Amateur's Journal.

Name_____ Call_____

Address_____

City_____ State_____ Zip_____

Signature_____

master charge BANKAMERICARD

Interbank No. _____ Exp. Date Mo. Year

☐ BankAmericard ☐ Mastercharge

Please allow approximately 8 weeks for the first issue.

Computers

continued from page 11

can be used for temporary storage just like a RAM, but with two differences. Erasing and writing is much slower than for a RAM, and memory contents are not erased when power is turned off.

One you know the characteristics of the different memory IC's, it's not hard to understand which one is best for which job. But some applications are interesting anyway.

Take, for instance, an electronic cash register. It usually contains three different kinds of memory: ROM, RAM, and EAROM. Most modern electronic registers contain a small computer, which does all of the calculations and storage required. The program to control this computer is usually in a ROM, although it might be in a PROM if the production volume is not large enough to justify the purchase of many ROMs. One interesting part of such a device is that changing just one part, the ROM, can completely change the entire register. Thus the register manufacturer can produce an entire line of models having a range of different functions, which differ only in the case and in the ROM.

The RAM is used to store temporary data for each sale, including quantities, models, and prices of each item a customer buys. It is also used to hold the total price and other quantities needed to print a receipt.

Finally, there are some items which must be stored in memory for some time, but not permanently. For instance, the cash register in a hamburger restaurant might have the price of each kind of burger stored internally, so that the clerk need not enter it each time. Since the price may change several times a year, this should be in a memory which will retain the information for months, even when the register is unplugged or turned off at night, but not permanently. The EAROM is a popular IC for this purpose, since it is semi-permanent and yet can be easily changed.

Another important item is the daily total amount handled by the register, which should be updated after each sale. This is very important, since at the end of the day the clerk must match the money in the drawer against the money rung up on the machine. The store owner would be very unhappy if this daily total could be erased from the register by simply pulling out the plug, since he would then have no way of checking on his staff. In many registers, this total is available since a carbon copy of the paper register slip is stored inside, but often this data is also stored in the EAROM along with other data as well.

As you can see, each of the different memory types has its own very specialized purpose. Keep that in mind whenever you see any of the letters RAM, ROM, PROM, EPROM, or EAROM.

Mobile

continued from page 20

need help a few miles offshore.

The purchase price for a typical 40-channel CB transceiver, which falls somewhere between $50 and $250, puts this system well within the budgets of most boaters. Also, the installation is exceptionally easy and can be handled as a do-it-yourself project. You supply a fused hot wire and a ground, install an antenna, route coax cable from the antenna to the unit itself, mount the unit, and you're ready to transmit and receive. It's that simple.

There are, however, two important considerations you'll have to take into account. First, the transceiver *must* be installed in a spot that is well out of the way of potentially damaging spray. These transceivers are not water resistant and can be permanently damaged in an instant. A good spot is underneath the boat's deck or dashboard. Of course, each individual boat will offer its own perfect spot for such an installation. The second thing you'll have to look at is the type of antenna you'll be installing. Wood and fiberglass boats do not possess the ground plane necessary to make a standard car-type mobile antenna work. Many manufacturers offer citizens band antennas specifically designed for wood or fiberglass boats at a reasonable price. Or, you can supply your own ground plane for a standard car-type antenna by attaching wire mesh screening inside the boat underneath the spot where the antenna is being installed.

Now that you have the whole story, there is no longer any excuse for boating offshore without the aid of a two-way communications system. Granted, citizens band is not as efficient a system as standard marine FM radio, but it's a darn sight better than being without any communication capabilities. It's definitely the best low-buck approach to marine radio going!

Why SSB?

continued from page 65

viding the radio is properly adjusted and has suppressed the carrier, as it should). Since there is no carrier, there is nothing to beat or heterodyne against other carriers. Hence, no howling or heterodyning on a channel occupied by two (or two dozen) SSB radios. What a relief!

To measure the power output of an SSB radio a different concept must be used. It's called P.E.P., which means *peak envelope power*. If you look at Figure 1 again, you can see that the lines within the modulated carrier form an envelope that contains the modulated waveform. It is the peak of such an envelope that will contain the maximum power being transmitted. For SSB radios the peak is allowed to reach 12 watts, the specification you have seen.

This method of measuring power gives the SSB radio one more edge over the AM radio. It is generally conceded by communications experts that the SSB mode of transmission has an 8 to 1 advantage over the AM mode.

The SSB mode has other inherent advantages: freedom from selective fade; ability to use sharp filters to cut down interference; the possibility of higher average voice power; and others.

SSB and AM radios are not truly compatible. An SSB radio can receive an AM signal if it is tuned precisely to the frequency of the carrier. When it is dead on, it's said to be *zero beat*. The SSB radio supplies its own carrier inside the set. When at zero beat the SSB receiving circuit ignores the incoming carrier and processes one of the AM sidebands, using the internally generated carrier. In short, it treats AM like an SSB signal that has no carrier.

An AM receiver, on the other hand, needs a carrier before it can do its demodulating. Without a carrier as a reference point all you hear is garbled sounds.

What does it all mean?

The answer to the original question might be that a sideband radio has the capability of communicating with eight times the effectiveness of an AM radio. But it will cost more.

PERRY PEOPLE

BY HAROLD PERRY

TONY SELNIK IS THE TYPICAL AMERICAN MALE – HE WENT TO COLLEGE, GOT A JOB, MARRIED, HAD TWO KIDS AND NOW, AT 30, IS DIVORCED. OUR STORY BEGINS AS TONY IS TRYING TO GET BACK INTO THE 'SINGLES SCENE', AFTER A TEN YEAR ABSENCE.

LIKE, PEACE, BABY. WHY DON'T YOU AND ME HIT THE DANCE FLOOR, DO OUR THING AND SOCKIT TO THIS PLACE. CAN Y'DIG IT?!

WHY DON'T YOU GO TO YOUR COSTUME PARTY AND LEAVE ME ALONE!

PAX

...AND ALL NIGHT I WAS BATTIN' ZERO! BRIAN WHAT WAS I DOING WRONG.

YOUR CLOTHES, YOUR ATTITUDE, THE WAY YOU TALK. MAN, YOU'RE BEHIND THE TIMES. I BET YOU STILL TRY TO PICK UP A CHICK BY LAYING SOME HEAVY POLITICAL RAP ON HER.

YEAH! HOW'D Y'KNOW?

PARKIN

PAX

IN THE SIXTIES, WE GREW UP IN AN ERA OF EXTREME TURMOIL, AND DRASTIC CHANGES. A LOT OF NASTY THINGS WERE SAID ABOUT THE GOVERNMENT BY THE PEOPLE. TODAY, PEOPLE MAKE JOKES ABOUT THE GOVERNMENT.

I DIG! INSTEAD OF THROWIN' ROCKS AT THE PENTAGON, Y'THROW 'ONE LINERS' AT THE PRESS.

NOW YOU'RE CATCHING ON!

LATER AT BRIAN'S APARTMENT.

THIS IS GONNA SOLVE ALL YOUR PROBLEMS. IT'S A SONY BETA-MAX VIDEO RECORDER. YOU CAN TAPE A TV SHOW ON ONE CHANNEL WHILE WATCHING A SHOW ON ANOTHER CHANNEL. WITH THIS CAMERA YOU CAN MAKE YOUR OWN LITTLE TV SHOW.

AND YOU'RE GONNA TAPE ME TELLIN' OLD WATERGATE JOKES AN' THEN I SHOW IT TO THESE GIRLS AT...

NO, DUMMY!

SONY

THIS IS A CASSETTE OF THE MOVIE "SATURDAY NIGHT FEVER." I WANT YOU TO WATCH IT OVER & OVER AGAIN, UNTIL YOU GET THE HANG OF THE DISCO SCENE. YOU CAN WATCH IT HERE IF YOU WANT. NOW BRIAN, SAY GOOD NIGHT TO TONY. WE'LL SEE YOU IN THE MORNING.

FOUR HOURS LATER, TONY WAKES UP HIS FRIENDS.

BRIAN, I WATCHED THE MOVIE *TWICE*. AND I'M HEP TO WHAT THEY'RE TRYING TO SAY. ON THE OUTSIDE, THE MOVIE IS A FANCY GLITTER, BUT, DEEP DOWN IT MAKES A STATEMENT ABOUT THE MEANINGLESS RE-DUNDANCY OF THE...

TONY! WHAT ARE YOU DOING? NOBODY LOOKS FOR MESS-AGES IN A MOVIE ANY MORE. MOVIES ARE WATCHED FOR THEIR GLITTERING FANTASY. SOCIALLY REDEEMING VALUE AND REAPPRAIS-AL ISN'T A MONEYMAKER.

WAFSAMATA?

HOUR AFTER HOUR. DAY AFTER DAY, TONY WATCHES THE MOVIE AGAIN AND AGAIN.

SONY

THE SONY BETAMAX STANDS UP TO THE CONSTANT USE, BUT HIS GLASSES MELT ON THE THIRD DAY.

THEN FINALLY...

EUREKA! I'VE GOT IT. DISCO FEVER IN MY BLOOD!! NOW, I'LL GET ME A WHITE THREE PIECE SUIT, HAVE MY HAIR STRAIGHTENED AND STYLED....


WHOA! WHAT KINDA TRIP ARE YOU?
LIKE DAD, I'M YOUR CONSCIENTIOUSNESS, REMEMBER WHEN YOU HAD TO FIGHT FOR THE RIGHT TO DRESS DIFFERENTLY AND WEAR YOUR HAIR LONGER. NOW YOU WANNA GO AND...
YEAH, I DIG WHERE YOUR COMIN' FROM.
THAT NIGHT AT THE LOCAL DISCO.
Y'SEE MAN! Y'GOT THAT DISCO LOOK, BUT YOU'RE STILL YOU, AND NOT ONE OF THE MILLION TRAVOLTA DRESS ALIKES.
I'M A DANCIN' FOOL! YEAH, YEAH.
DOESN'T ANYBODY IN THIS GO-GO CLUB EVER BUTTON THEIR SHIRTS?
HEY MARIA, LOOK AT THE DYNOMITE MOVES ON THAT GUY OVER THERE!
OH WOW! OUTTA SIGHT! I THINK I KNOW THAT CAT.
TONY?!
MARIA?!
FAR OUT! TONY IT'S REALLY A GROOVE TO SEE YOU AGAIN. OH WOW, IT'S BEEN YEARS. REMEMBER THAT NIGHT DURING THE SIT IN AT COLUMBIA UNIVERSITY? IN '68. YOU TOOK MY HAND AND LOCKED US IN THE DEAN'S OFFICE.
AHH. YES. RED WINE BY CANDLE LIGHT - THE SOUND OF ACID ROCK - ANTI-WAR SLOGANS AND POLICE BULL HORNS. OH MARIA, WHY DID I EVER LET YOU SPLIT THE SCENE WITHOUT ME WITH YOU.
SO AS THE TWO LOVERS WALK INTO THE STROBE LIGHTS WE THANK 20TH CENTURY TECHNOLOGY FOR PUTTING SOME NEW SPARKS INTO AN OLD FLAME.
Y'KNOW IT'D BE A GAS TO GET THE OLD GANG TOGETHER AND GET DOWN ON THE MILITARY INDUSTRIAL COMPLEX. THEN, HAVE AN OLD FASHION 'LOVE IN!'
I'M AFRAID THOSE DAYS ARE GONE FOREVER, YOU KNOW WHAT REALLY IS A BUMMER?! JUST AS I'M TUNIN' INTO THE SEVENTIES I JUST REALIZED THAT WE'RE ALMOST INTO THE EIGHTIES.
COOL IT!

IF YOU'RE NOT DESIGNING WITH A CSC PROTO-BOARD,® LOOK AT ALL YOU'RE MISSING.

Utility—Models are available with or without built-in regulated power supplies (fixed or adjustable).

Accessibility—All parts are instantly and easily accessible, for quick signal tracing, circuit modifications, etc.

Variety—A wide variety of models are available with capacities ranging from 630 to 3060 solderless tie-points (6 to 32 14-pin DIP's), to fit every technical and budget requirement.

Economy—Eliminate heat and mechanical damage to expensive parts. Save money by re-using components.

Versatility—Use with virtually all types of parts, including resistors, capacitors, transistors, DIP's, TO-5's, LED's, transformers, relays, pots, etc. Most plug in directly, in seconds.

Durability—All Proto-Board models are carefully constructed of premium materials, designed and tested for long, trouble-free service.

Expandability—Proto-Board units can be instantly interconnected for greater capacity.

Visibility—All parts are instantly and easily visible, for quick circuit analysis and diagramming.

Speed—Assemble, test and modify circuits as fast as you can push in or pull out a lead. Save hours on every project.

Adaptability—Use in design, packaging, inspection, QC, etc. Works with most types of circuits, in many, many applications.

Flexibility—Use independently, or in conjunction with other accessories, such as scopes, counters, CSC Proto-Clip™ connectors, Design Mate™ test equipment, etc. One Proto-Board unit can serve a thousand applications.

Whatever type of electronic circuits you work with, you can do more in less time with CSC's solderless Proto-Board systems. As fast and easy as pushing in or pulling out a lead, you can design, test and modify circuits at will. Components plug into rugged 5-point terminals, and jumpers, where needed, are lengths of #22 AWG solid wire. In the same time you took to read this ad, you could be well on your way to assembling a new circuit.

CSC PROTO-BOARD SOLDERLESS BREADBOARDS

MODEL NUMBER	NO. OF SOLDERLESS TIE-POINTS	IC CAPACITY (14-PIN DIP'S)	MANUFAC. SUGG. LIST	OTHER FEATURES
PB-6	630	6	$15.95	Kit—10-minute assembly
PB-100	760	10	19.95	Kit—with larger capacity
PB-101	940	10	22.95	8 distribution buses, higher capacity
PB-102	1240	12	26.95	Large capacity, moderate price
PB-103	2250	24	44.95	Even larger capacity; only 2.7¢ per tie-point
PB-104	3060	32	54.95	Largest capacity; lowest price per tie-point
PB-203	2250	24	75.00	Built-in 1%-regulated 5V, 1A low-ripple power supply
PB-203A	2250	24	124.95	As above plus separate ½-amp +15V and −15V internally adjustable regulated power supplies

Order today. Call 203-624-3103 (East Coast) or 415-421-8872 (West Coast): 9 a.m.-5 p.m. local time. Major credit cards accepted. Or see your CSC dealer. Prices slightly higher outside USA.

CONTINENTAL SPECIALTIES CORPORATION

70 Fulton Terrace, Box 1942, New Haven, CT 06509
203-624-3103 TWX 710-465-1227
WEST COAST: 351 California St., San Francisco, CA 94104,
415-421-8872 TWX 910-372-7992
GREAT BRITAIN: CSC UK LTD., Spur Road, North Feltham Trading Estate, Feltham, Middlesex, England, 01-890-0782 Int'l Telex: 851-881-3669


Announcing the sound combination.
dak® Mark IX and Astatic
The dak® Mark IX professional-presence transceiver and the Astatic noise-free, click-free microphone — the status symbols of the industry — are together now, to make the industry's most outstanding base station value. dak® Mark IX/Astatic features operating conveniences and read-out information considered essential for a truly professional quality radiotelephone base station. If you like the way dak® Mark IX/Astatic sound together, see your CB dealer or write . . .
SCOTT
M. H. SCOTT CO.
Manufacturers of dak® line of
fine communications equipment
Limited distribution opportunities
P.O. Box 277 Columbia, MD 21045 (301) 995-0100
CIRCLE 8 ON READER SERVICE CARD
DAK MARK IX RADIOTELEPHONE
TRANSMIT
CALIBRATE
RF POWER
ANL
NOISE BLANKER
POWER
OFF
STAND
SWR
PLATE CURR
dak
RF GAIN
SQUELCH
VOLUME
MIC GAIN
SWR CALIBRATE
DELTA Δ TUNE
MIC.
CHANNEL SEL