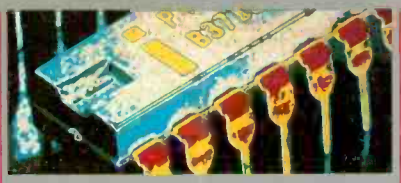
How radio teletype works

page 43



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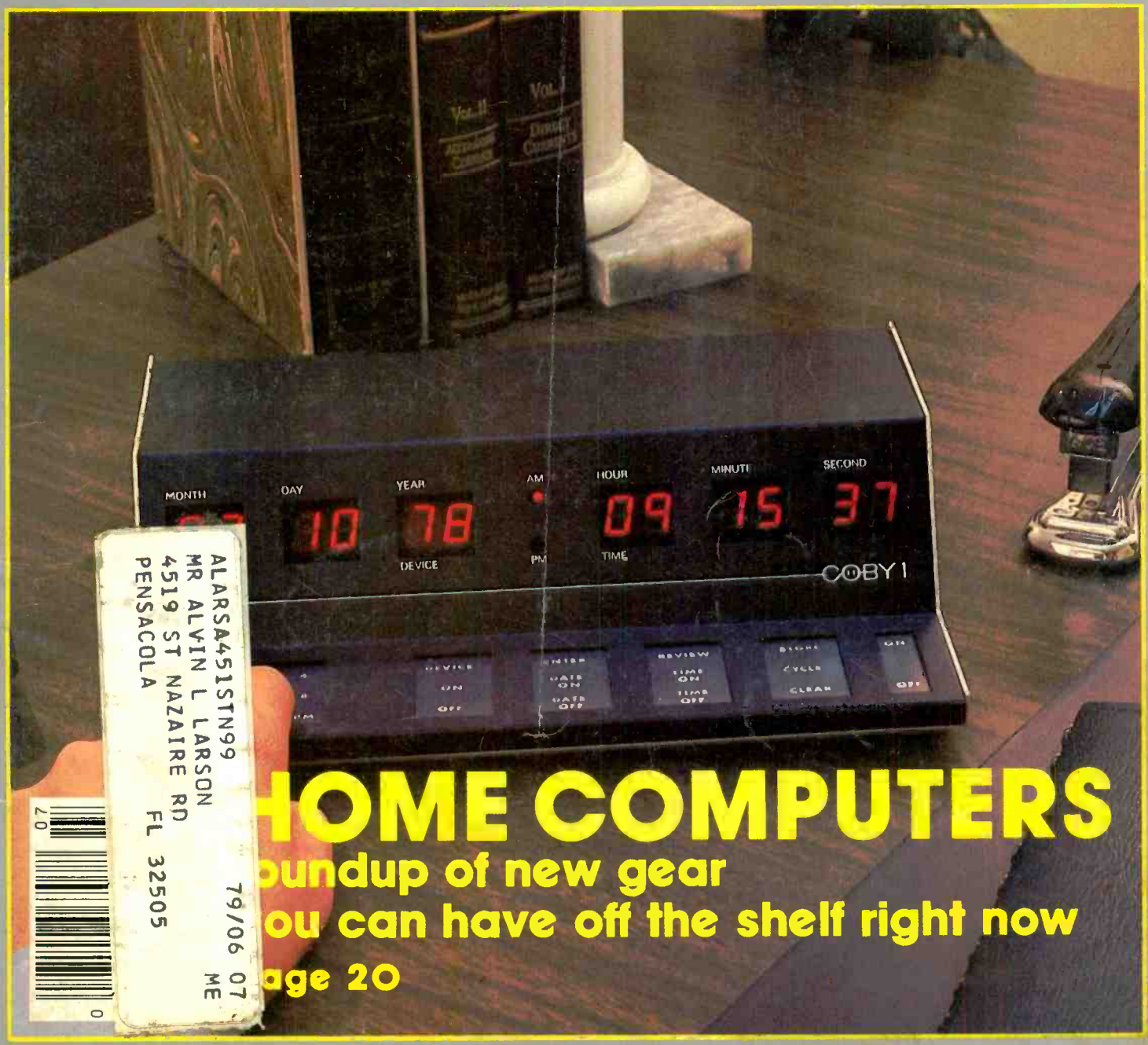

HOME COMPUTERS

oundup of new gear
ou can have off the shelf right now
age 20

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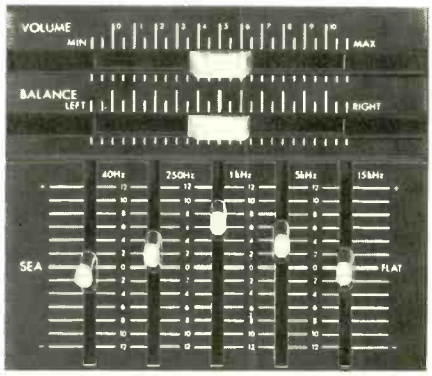

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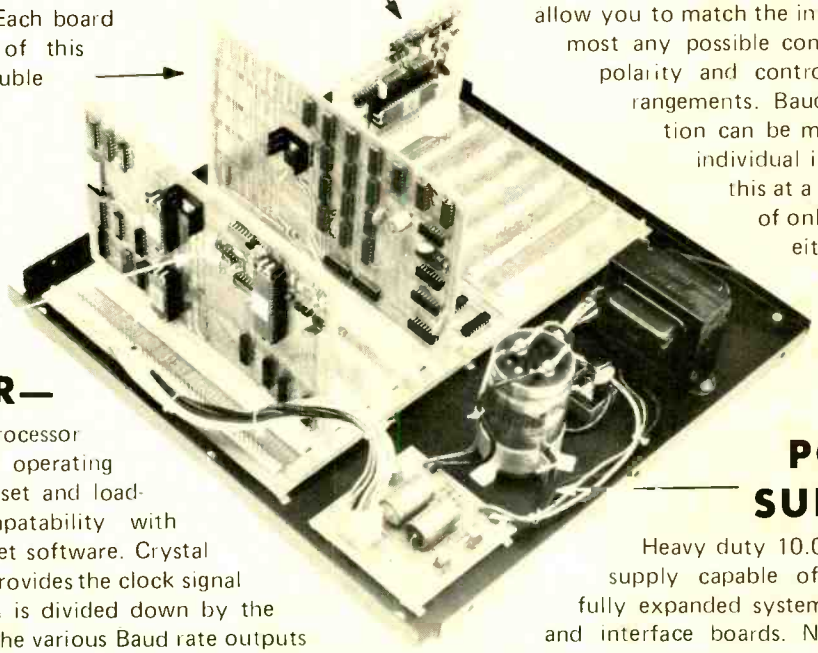

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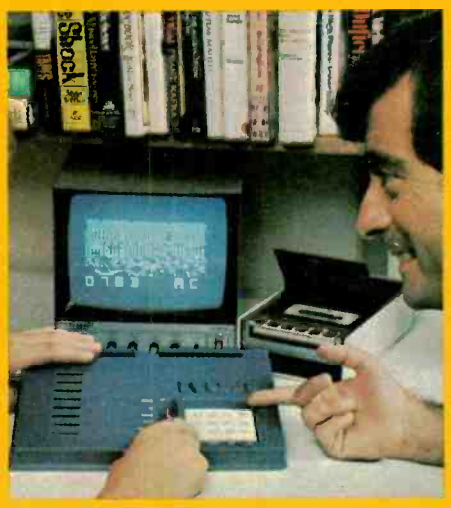

Everything you need to know to get started

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OUTPUT FROM MODERN ELECTRONICS' EDITOR

by Anthony R. Curtis
Editor, Modern Electronics

Computers in the space age. Space in the computer age. Whichever, they go together like wire and solder. And we're celebrating these two giants of the world of electronics this month with a spectacular roundup of everything-you-ever-wanted-to-know about the present state of the art in microcomputers for the home. And a colorful exposition of two of the exciting developments recently in space science.

Dava Sobel's fascinating account of our efforts to communicate with *Others* from Arecibo, **page 69**, will make your spine tingle.

Norm Chalfin's report on our recorded message of the Universe, **page 50**, will make you want to be out there.

Assistant Editor Bob Margolin threw in the kitchen sink in our computer roundup, **page 20.** The Coby on our cover is explained on **page 28.** If you've been holding back on getting your own home microprocessor, now's the time. There are many models on the market and, with your imagination, they'll do anything you ask.

If you 've been following Perry's zany folks each month, you'll probably think Harold has flipped this month. In a special double-length feature, **page 46,** his heros mysteriously use a 1978-model video game to turn back attackers threatening Earth. Nobody said Harold didn't have a vivid imagination!

Other goodies this month:

- Been following our series on OSCAR, the ham radio communications space satellites! The story concludes this month, **page 94,** with the successful launch of a new bird.
- Build your own private telephone system, **page 32,** smart battery charger, **page 64,** or any of nine projects under $9, **page 53.**
- Worried about the dangers of microwave radiation from transmitters such as police speed-radar units? Keep personal watch out for such signals with a radar detector for your car, **page 35.**
- Teletype, the mystery bleep-bleep signals heard across the shortwave radio bands, is deciphered on **page 43.**
- And we've a colorful assortment of new and different gear for summertime fun displayed on **pages 75 and 80-84.**

Stay tuned. You're going to find something that really turns you on in this July issue of *Modern Electronics.*

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READERS WRITE FOR HELP WITH TECH PROBLEMS

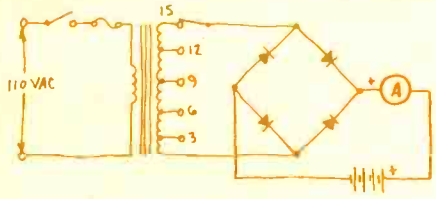
BY JEFF SANDLER

Ten the easy way

I've been looking for an inexpensive battery charger that can handle up to 12 volt batteries and provide as much as 10 amps of charging current. I haven't been able to find anything ready-made at a price I can afford. Do you have a circuit I could build for around $10?

J.F., Hammond, IN

It's very hard to make a high-current, variable voltage charger for $10. The biggest problem is the transformer. The best one I know of is a 3 to 15 volt, 15 amp unit available from Delta Electronics, P.O. Box 2, Amesbury, MA 01913. The last time I inquired, the unit, cataloged as number 6481, was about $9 plus shipping. Add to that the cost of four 15-amp diodes and the miscellaneous hardware you'll need, and the price goes up pretty fast. But, the total should be well under $20. If you have an ammeter kicking around, put it in series with the charging lead. No filtering capacitor is used, so the voltage across the battery is raw, pulsating dc. Then, select the voltage tap that gives you



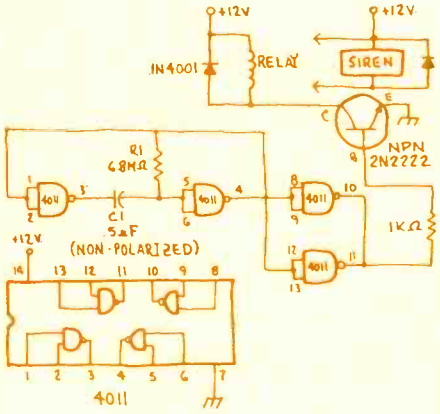
the desired charging current. Don't worry about the pulsations. Some battery makers believe that the pulse charge may actually be more effective than filtered dc.

Three-second siren

I have a 12-volt antique police siren and would like to make an automatic switch that will turn it on and off at three second intervals. What's the easiest way for me to do this?

B.H., Sanford, ME

This circuit should do the trick. It uses half a 4011 quad NAND gate to generate a symetrical on-off signal. The time period for each state is controlled by the time constant of R1 and C1. The values shown will give you about three seconds each. C1 must be non-polarized. You should be able to get a paper or mylar cap that size, but you can parallel five



0.1 mfd ceramic disk capacitors too. You didn't mention how much current the siren draws. If it's less than an amp, you can connect it directly into the collector circuit. If it draws more, use a relay as shown.

Battery crash

My hobby is flying radio-controlled model airplanes. Inside the plan is a radio receiver and escapement powered by batteries. The escapement current drain is high, and the batteries go dead after only a short time. Once they gave up while the plane was flying, and when they did, the plane didn't. Is there a really long-lasting battery that has enough power to run the escapement.

A.V., Terre Haute, IN

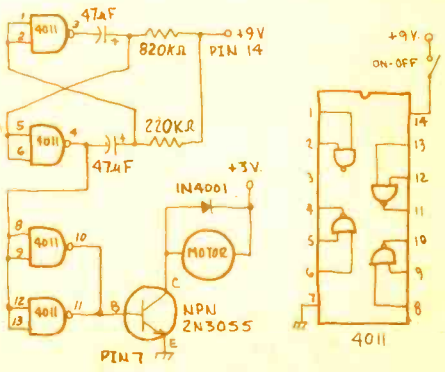
Carbon zinc and alkaline batteries all have reduced power output as they age. If your escapement is hanging up, the current drain can be very high, causing the voltage to drop to a point where there just isn't enough power to overcome whatever is hanging up the escapement. A new battery, called the sintered-electrode nickel cadmium, is now becoming available to the general public. These batteries can supply up to one ampere with virtually no drop in the output voltage. You didn't mention the size of your plane, so it's hard to know the size batteries you use. But, a pair of D cells will give you almost 2½ amp hours of service. That should be more than enough to handle that escapement.

CMOS turn-on

I enjoy your Clinic column very much. I wonder if you could suggest a CMOS circuit that would turn on a small dc motor for short periods of time. I'd like the motor to run for about 10 seconds, then remain off for between 20 and 30 seconds. The motor has a resistance of three to six ohms, and runs on three volts. The circuit should be physically as small as possible, and have no relays.

P.A., Georgetown, KY

Thanks for the kind words. Here's a circuit I think will meet your requirements very well. It uses a single 4011 CMOS quad NAND gate and a 2N3055 transistor. Two of the gates are connected as a free-running multivibrator providing the on and off time periods. You can change these times by changing the component values. The output of the multivibrator is passed through the remaining two gates into the base of the NPN transistor. Your motor is connected in the collector lead to your three volt power source. An on-off switch between the IC power source, such as a nine-volt transistor battery, starts and stops the operation.



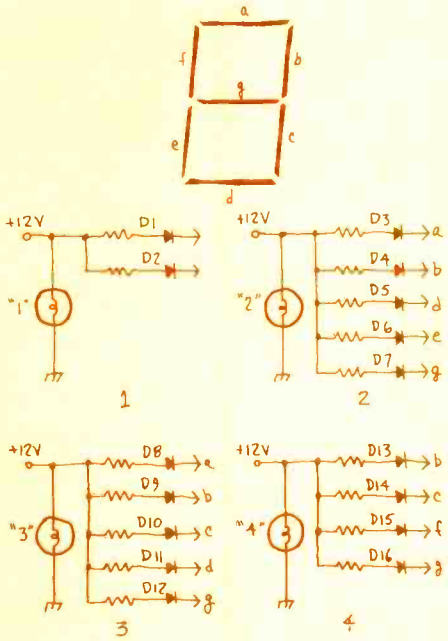
One, two, three, four

I have an eight-track tape deck that has small green lamps to indicate the track in use. I'd like to replace them with seven-segment digital LED readout. Is there an

easy way to connect the readout to the four lamp sockets? I'd rather not get involved with a complicated circuit using ICs.

M.E., Atlanta, GA

I think you'll really like this circuit. It uses 16 1K resistors and 16 small signal diodes. Depending on the parts you have in your junk box, the whole project shouldn't cost more than three or four dollars. Each of the four bulbs is connected between the tape deck's power supply, usually less than 12 volts, and ground. Just connect the summing point of the diode-resistor networks to the power supply side of the bulb sockets. Then connect the diodes to the indicated terminals of the seven-segment display. You should have D3 and D8 connected to a, D1, D4, D9 and D13 connected to b, D2, D10 and D14 connected to c, D5 and D11 connected to d, D6 connected to e, D15 connected to f, and



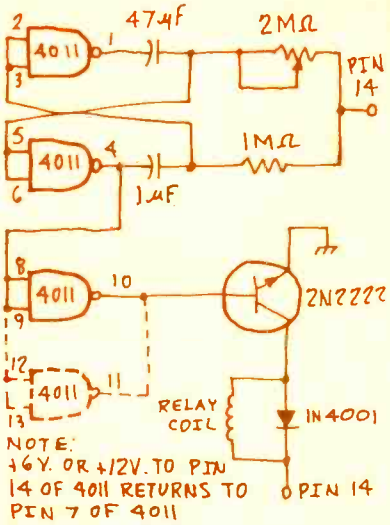
D7, D12 and D16 connected to g. Then, as each bulb goes on, the corresponding segments of the display will go on, giving you a digital readout of the track number.

One on, 60 off

I need a circuit that will energize a relay for about one second each minute, but with a control so I can set the period between relay closings from 57 to 63 seconds.

M.K., Jamestown, NY

Here's a straightforward free-running circuit built around a single 4011 IC. Two of the gates are connected to form a multivibrator that sets the on and off time periods. The variable resistor lets you trim the off period. If you need precisely one second of on-time, you may want to substitute a variable resistor for the 1 meg fixed resistor. The output of the multivibrator is buffered by a third gate, the output of which controls a 2N2222 switch. If the relay coil you're using requires more current than the single gate can provide, you can parallel the fourth gate as shown in dashed line. If you don't use the fourth gate, make sure to tie the two input lines to pin 14 or pin 7 of the IC. This will prevent unwanted self-oscillation of the gate.

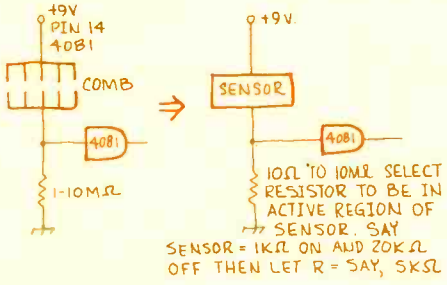


Rain, rain, go away

I picked up the March issue of *Modern Electronics* and came across your raindrop counter. It's a neat idea. I'm not interested in counting rain drops, but I would like to use the counter circuit. Can it be triggered by another source such as a broken light beam?

G.M., Niles, OH

You bet it can. It will operate with any detector that has an on resistance of less than one-third R1, and an off resistance at least three times R1. The value of R1 can be between 10 ohms and 10 meg., provided it falls between the on and off resistances of the detector. You didn't mention how you planned to detect the light beam, but a photocell seems the most obvious. It should work as a direct replacement for the comb used in the raindrop counter. You may, however, have to add a few extra parts to get the circuit operating the way you want it to.



TV fm

I would like to receive the audio portion of tv programs on my fm radio. Could I build a converter similar to those that put CB into am radios?

L.W., Auburn, IL

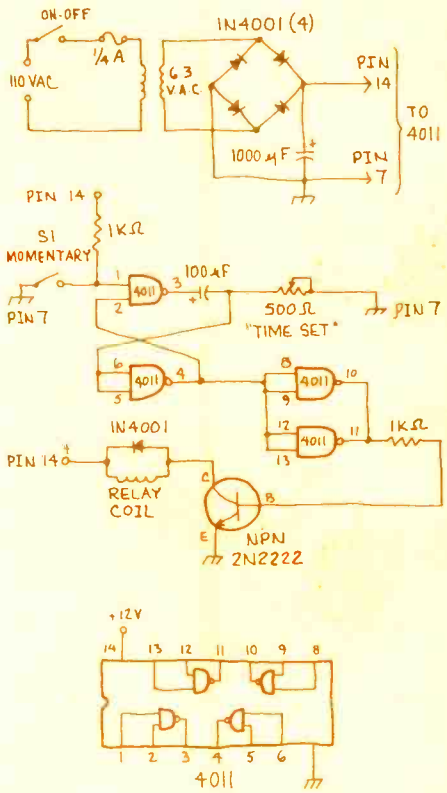
There's no question that such a converter can be built. But working at the very high frequencies of tv requires special wiring and layout techniques most hobbyists don't know. Channel 13, for example, has a frequency of 214 to 220 MHz. At those frequencies, even a short piece of wire acts like a tuned circuit, which can cause no end of problems. Unless you really know your way around rf circuits, I'd advise you stay away from the project you have in mind. In fact, by the time you obtain the special parts you'll need, you'll have spent as much or more than a ready-made fm-tv portable radio costs. Radio Shack, for example, has an am-fm-tv portable for $40. Many other similar radios are available, some for considerably less.

20-second egg

At my restaurant, I need a small 20 second timer. Being a beginner in electronics, I need a very detailed diagram to follow. Could you possibly set one up and send it to me? Oh yes, it must run on 120 volts ac.

K.S., Morristown, NJ

I'm really sorry to have to say that it's totally impossible for me to build projects for Clinic readers. I just don't have the resources to handle the hundreds of requests I receive each month. As far as your timer is concerned, the diagram shown is relatively easy to build.



However, because you want to power it from your ac power lines, I'd suggest finding a local electronics hobbyist who can take you by the hand through the construction process. Although the circuit diagram is complete, only the coil of the relay is shown. Explain to your electronics mentor what you want the timer to do and he'll show you how to connect the timer to do the job.

stereo

AUDIO, VIDEO, RECORDING, PLAYBACK

BY HANS FANTEL

Capture ratios? uVs of sensitivity? dBs of rejection? Multipath distortion? What does it all mean and why is it important to know?

To follow up last month's roundup of recent development in fm tuners, it may be a good idea to explore some of the other basic quality factors in tuner design. Our concern here is only with fm, because under current government regulations, only fm transmits in stereo and with a wide enough frequency range—up to 15,000 Hz—to qualify as high fidelity. There has been talk in the audio industry and in Washington about introducing stereo on am as well as upgrading am sound to the quality of which it is inherently capable. But unfortunately these prospects are uncertain and high-quality stereo am still seems far in the future.

Among fm tuner specs, sensitivity usually gets top billing. A tuner's sensitivity rating describes its ability to pull in weak or distant stations, and that's an important factor if you live out in the country, far from the fm stations you want to hear. It's also important where hills or mountains obstruct the signal path between you and your favorite station, greatly weakening the incoming signal.

You'll find sensitivity listed in the specs as a certain number of microvolts, usually abbreviated uV. This indicates the minimum strength the incoming signal must have to override background noise by 30 db, so lower numbers mean higher sensitivity. Thanks to such fairly new devices as field effect transistors (FETs) in the front end of nearly all component-grade tuners, sensitivity has been greatly increased in recent years. Even in the economy bracket of tuners or receivers, you can expect a sensitivity rating from about 3 - 2 microvolts, and in top-grade models sensitivity is typically around 1.5 microvolts. In general, a sensitivity rating of 2 uV will give satisfactory reception up to about 60 miles, and with a good roof antenna you can stretch that even further.

If you happen to live in or near a city, close to the transmitter, sensitivity usually isn't your main problem. City dwellers have other troubles. Urban environments crackle with static from appliances, elevators, and spark plugs from passing cars. Just about anything that runs of electricity can make an fm tuner sputter. That's why a good tuner must be designed to silence such interference. Because all this crackling is, electrically speaking, of am character, the tuner must be able to reject such am signals. So look in the specs for an item called am rejection. A rating of 45 db is usually satisfactory (meaning that the am noise is suppressed 45 db relative to a standard reference signal), but if you live in a neighborhood troubled with lots of electrical interference, an am rejection rating as high as 60 db might be needed to get rid of all the noise.

Most obstinate of all urban fm troubles is something called multipath distortion. This is the equivalent of "ghosts" on tv and is caused in the same way. The signal from the transmitter bounces off skyscrapers or other large steel structures so that your tuner actually receives two separate signals—one directly from the station, the other a mirror image—a "ghost" reflected from somewhere else. The ghost arrives just a fraction of a second later than the direct signal because the reflected signal path is longer than the direct line. On tv, the result is double vision. On fm, it's blurred sound and loss of stereo separation. (Incidentally, multipath distortion is not exclusively a city problem. Sometimes signal reflections from a mountain range can also cause problems in rural settings).

Capture ratio

To cope with these difficulties, the tuner must be able to suppress the weaker of two signals coming in on the same frequency so that the stronger is clearly received. In other words, the tuner must admit the direct signal while shutting out the ghost. The tuner's ability to do this is measured by the so-called *capture ratio*.

Typical capture ratios in current equipment range from about 3.0 db in economy models to 1.3 db in top designs. The number expresses the minimum difference in signal strength needed for the tuner to tell apart the direct signal from the unwelcome ghost.

Multipath distortion can also be counteracted by a suitable antenna. A highly directional antenna can be pointed toward the transmitter so as to reject multipath reflections coming from other directions. Good roof antennas of this type—optimized for fm reception—are available from Radio Shack, Finco, Winegard, and JFD. Apartment dwellers without access to the roof can benefit from a new kind of indoor antenna known as the Beam Box ($90), recently introduced by B.I.C. It is a compact box (about the size of a small stereo receiver) that can be kept on the shelf next to the tuner and contains an antenna that can be electronically aimed in different directions simply by turning a knob.

Some of the more elaborate tuners and receivers—notably those by Sony and Yamaha—now feature special multipath meters that are a great help in orienting the antenna for minimum multipath input. The principle of the multipath meter is quite simple. It is connected to the output of a phase discriminator circuit. Since the reflected signal is always out of phase with the direct signal, the out-of-phase portion of the signal is then subtracted from the total signal input and displayed on the meter. That way, you get an exact measure of the reflected multipath input. You then rotate the antenna until the multipath meter reaches a minimum. I have used this procedure in New York City, where tall buildings create stubborn multipath problems, and in many cases was able to clear up fm reception.

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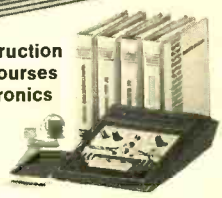

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BY RON COGAN

Let's see, I know I put it somewhere. Vest pocket? Wallet pocket? No, here's the pocket CB in my slippers!

Whether you're out driving, camping, boating, or hiking the backwoods, communication can make the difference between a good or bad day, tragedy or a happy ending. However, an emergency situation is not required to prove the value of basic communications. It can prove helpful in keeping track of your kids during vacation excursions, and even helps ease boredom experienced during long drives. Just flip the unit on and grab some companionship.

One of the handiest forms of communications gear for mobile use is the hand-held "walkie-talkie". They are relatively small, lightweight, and easy to carry on hikes; additionally, their small size makes for easy storage in the glove compartment of a car or whatever other nook or cranny is available. There are some limiting factors, however. Even the lightest of expendable gear can prove a burden on a long hike, and the price of most quality hand-held transceivers is nothing to sneeze at.

Recent innovations in the citizens band field have produced several miniature transceivers that are both affordable and easy to carry. One of these, the PocketCom (which is a product of MEGA Corporation of Northbrook, Illinois), almost reminds one of Dick Tracy's wristwatch transceiver because of its extreme compactness. This 100-milliwatt wonder not only is featherlight and small enough to carry in your pocket, but boasts a few features that

even its more expensive conventional counterparts don't possess.

For starters, the PocketCom is equipped with a belt clip so it can be clipped to pocket, belt, or backpack, and it has a call button that allows you to beep-page a companion unit. Other features include two-channel capabilities, an LED that informs you of battery condition, telescoping antenna, on/off/volume switch, and squelch control.

And now for the drawbacks, of which price is not one of. Normally retailing for about $40, these units were nationally advertised recently for just $20 each. One of the inherent drawbacks is due to its 100-milliwatt power; range, of course, is limited to a few miles depending upon conditions. The only other problem is lack of clarity in the built-in speaker, but that can be expected from a speaker that measures about an inch in diameter. This is only on the receiving end of the PocketCom, though, as a message transmitted from PocketCom to a standard CB is crystal clear.

The real beauty of this transceiver is that it's handy to carry along anywhere. No bulky hand-held to contend with, no extra weight to worry about—just a miniaturized package of circuitry and convenience. And when it comes down to what gear you'll be taking along on that next trip, it's just like carrying an extra pack of cigarettes or a couple of candy bars. That's convenience.

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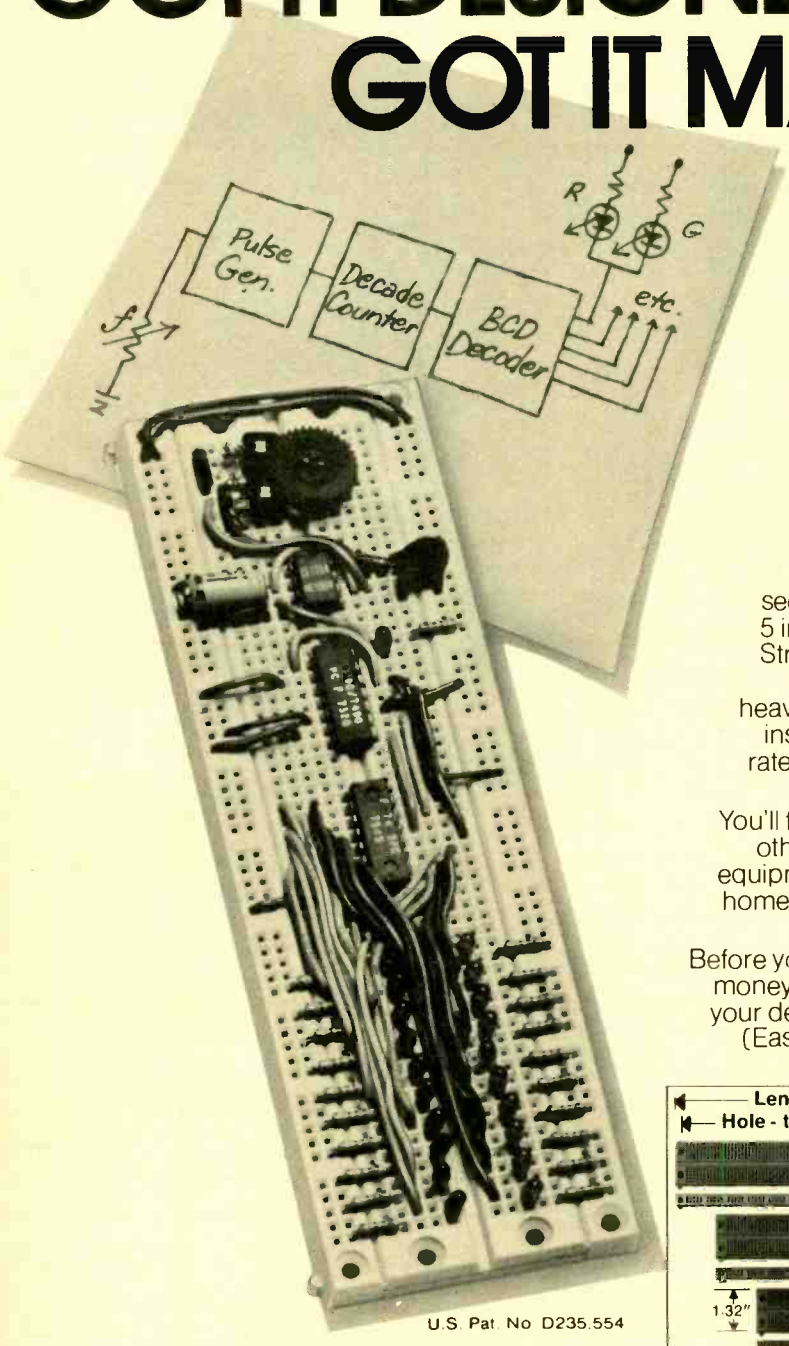

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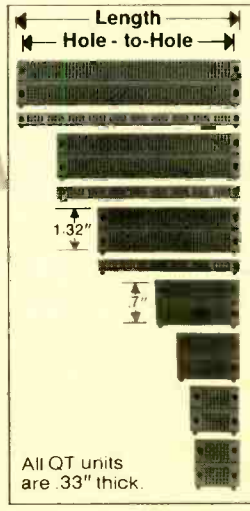

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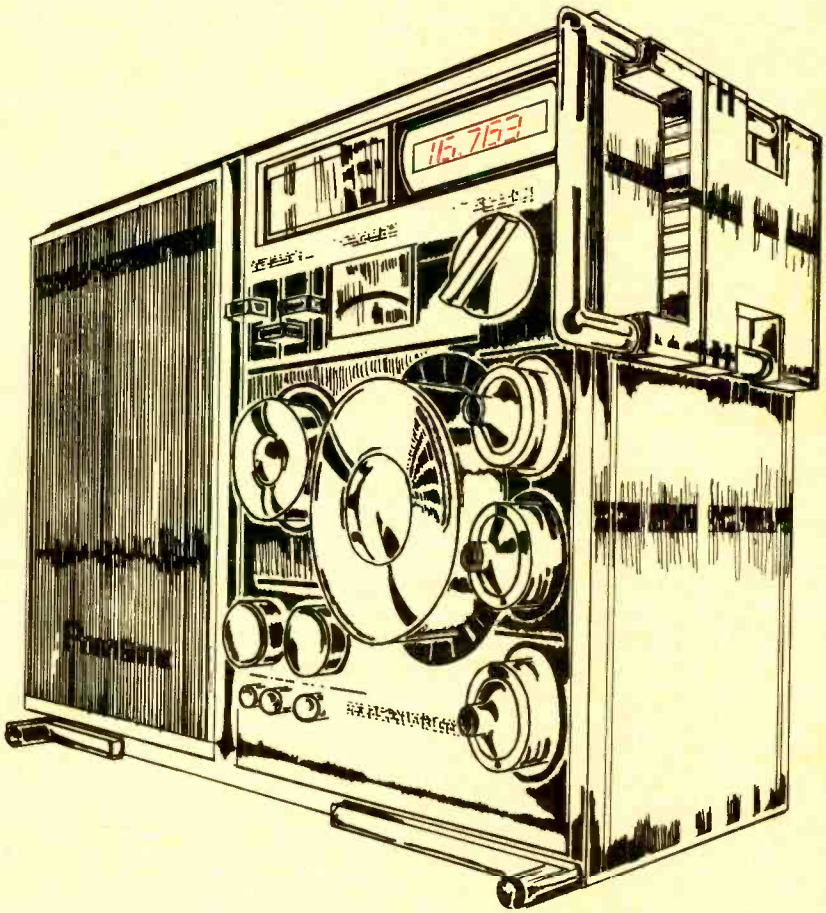
BY JUDY CURTIS, WB3AIQ

The magic dazzle of flashing red LEDs is the hottest news in gear for eavesdroppers on the shortwave bands



What a great July idea! Pack your shortwave listening post into a picnic basket, right down their amidst the cold-cuts and cheese and little bottle of hot brown mustard, and head for the sunny countryside.

It came up on a sunny Sunday in Pennsylvania last month. Tony was twirling the dial on a Panasonic RF-2800 all-band portable radio, lazily listening in on some ham-radio yachtsmen talking on the 20-meter band. They were sailing their pleasure craft on the great blue waters of the Atlantic and Caribbean when he remembered how close we were to a giant-economy-sized inland body of water in a lake near Huntingdon.

Grabbing the portable's built-in carrying strap to keep the catsup and bread crumbs out of switches and knobs, we stuffed our old oilcloth spread into the basket instead and headed for Raystown Dam.

Lots of folks were catching the sun's rays as we plunked our gear down on a knoll overlooking the water. Temperature and humidity were up but so was a nice breeze which brought us snatches of music from a young couple's battery-powered 8-track tape player a hundred yards away.

The Panasonic went in the middle of the oilcloth on the ground, surrounded by our deli delights. It's an excellent rig for all sorts of shortwave listening, from beginners who know only of the famous brand name to experienced listeners who recognize the world-wide coverage available today in solid-state multiband portable radios.

The RF-2800, whether at home hooked to an antenna strung from your attic to a tree, or in the field with its telescoping aerial pulled up, can bring in signals from the four corners of the Earth. Want to hear Peking? London? Moscow? The Middle East? They're there, with a hoarde of other stations around the globe competing for your ears.

Radios by Sony and Sanyo and Yaesu and Radio Shack and Drake all have become brand names in modern shortwave listening circles. Now Panasonic has made serious entry into the field with the 2800. It's unique in having *digital frequency readout*.

No more analog dials to guess where you are tuned in the radio spectrum. No more interpolating to the nearest 100 kHz or 10 kHz as you look between marks on a plate. Now if you want to tune in the *British Broadcasting Corporation* (BBC) on 7.325 MHz you turn the knob on the Panasonic until the digital readout says 7.325. It's as easy as that.

Precision tuning helps a receiver be more selective since the operator can be sure he has set up the rig for the correct frequency. Shortwave listening bands are jammed with signals wanting to be heard. Suppose you are trying to reach that magical mark of 100 countries heard as an SWL (shortwave listener)? You have 98 and know that a 99th will be on the air tonight at 8:15 on 9.755 MHz. As you tune across that band beforehand, strong signals can be heard at 9.750 and at 9.760.

If you were listening casually, you might never stop on 9.755, awaiting that special signal to appear. You probably couldn't even be sure you were on 9.755 if your set had an old-fashioned dial with little lines marking off each 10 kHz of the spectrum.

But a receiver with built-in frequency counter displaying a digital readout lets you manuever right down onto 9.755

and stand by for country number 99 to start its broadcasts.

Counters providing digital frequency readout are popular elsewhere too. Hams lately have been rushing out to trade in their older transceivers (transmitter and receiver in a single package) on flashy new rigs with digital frequency display. A popular accessory for CBers is the add-on frequency. It tells the exact frequency your CB set is transmitting on, rather than the old-standby channel numbers. For instance, channel 40 is 27.405 MHz.

When you get down to tuning in a station heard on a receiver with digital readout, you need a very slow-turning knob. Panasonic gets the effect with a two-speed tuner. Push the knob and it clicks into a fast-dialing mode. Pull it out and it changes to slow-speed tuning.

You need the ability to change because the readout can't keep up with quick changes at the fast rate.

Tuning the CB band, you might see numbers displayed in some order: 27.205, 27.260, 27.330, 27.375, 27.405.

Pulling the knob out for a slower tuning rate will let you see numbers like 27.260, 27.261, 27.262, 27.263, etc.

There are a lot of other good features on the RF-2800:

■ Its *shortwave* reception is from 3.2-30 MHz in three bands. It also switches to the 88-108 MHz *fm* band and the 525-1605 *am* broadcast band.

■ The digital display operates only when you are tuned to shortwave bands. Tuning the other bands, you read frequency on the redundant *analog* dial, there to back up the digital readout. The digital display can be turned off to save batteries.

■ Like all good shortwave sets today, RF-2800 has an *S meter* showing the relative strength of incoming signals. The meter doubles as a battery checker.

■ The gigantic *volume* knob may seem odd but it is convenient and smooth.

■ A switch, marked *fm AFC/bandwidth*, turns on the automatic frequency-holding control when you are tuned to the fm broadcast band. And it lets you cut down on interference from unwanted signals when you are listening to shortwave. Tune in shortwave signals in the *wide* position. When interference makes listening unpleasant, switch to *narrow*. Unless the interfering station is right on top of the station signal you want, you'll help reception.

■ No frequency counter is 100 percent accurate all across the shortwave portion of the spectrum. Panasonic has added a dial *calibration* control. Tune in standard-frequency station WWV at 5, 10 or 15 MHz. Turn on the bfo switch and zero beat WWV. If the digital readout is not indicating exactly 5, 10 or 15 MHz, the counter is off slightly. Tune the dial to read exactly 5.000 or 10.000 or 15.000 MHz. The WWV note will not be at zero beat. Turn the *SW cal* knob to zero beat WWV. The digital dial then will be very accurate.

■ Of course, the Rf-2800 has an *rf gain* control. That lets you knock down the sensitivity of the receiver when stations near your home become so loud they sound distorted. Or when you are listening to CB channel 19 and a clown down the street fires up on 16 and bleeds over onto 19.

■ The *bfo* switch lets you tune in International Morse code (CW) signals and single-sideband (SSB) voice stations. And there are a ton of those. Start looking in the 80, 40, 20, 15 or 10 meter ham bands. You'll find plenty of stations transmitting CW. You can eavesdrop and practice translating the code.

Important connections to the RF-2800 include terminals where you can hook up an external antenna. (See *How To Build Your Own Dipole Antenna*, page 71, February 1978 *Modern Electronics*.) And you can plug in an external loudspeaker or earphones. Or a tape recorder. The radio runs on 120-volt ac house power or six D batteries.

One thing's for sure: wherever you go today, you can tune in on the world!

computers me

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

BY PETE STARK

Keep those cards and letters coming so Pete can unknot your hardware problems and unbefuddle your software

I love to read the mail; one of the joys of writing a monthly column is the fact that I now have more mail to read. After appearing for a few months, the column has now started to draw an occasional letter or two from our readers, and this month I will take the opportunity to answer a few of them.

What potentiometer?

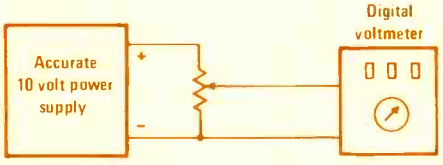
Several readers wrote about the computers column in the May 1978 issue of ME. Specifically, they wanted to know what I meant when I suddenly started a paragraph with words "Starting with an accurate 10-volt power supply, the potentiometer divides this voltage down into a smaller value whose voltage depends on the exact position of the potentiometer knob. The precise output voltage then can be measured with a digital voltmeter. . . ." This whole paragraph, as well as the next two or three, dealt with a diagram which was accidentally skipped. In essence, it showed the output voltage from a precision 10-volt power supply being applied to a potentiometer voltage divider, then tapped off a small portion of the voltage and sent it to a digital voltmeter which measured its value.

The idea behind the diagram was that this is how an analog computer generated voltages proportional to numbers. By merely turning the potentiometer knob, the output voltage can be varied from 0.0 volts up to the maximum of 10.0 volts, and each particular voltage value can stand for, or be an analog for, some physical quantity. Using two such potentiometers and an adder circuit, we can produce two voltages, add them, and display their sum. Other circuits can subtract or multiply voltages, so that calculations can be done relatively easily. In any case, if you felt that you missed something while reading that column, perhaps this explanation helps. Another reader comment can be summarized like this: "In March, you told us that programmable calculators were almost as good as computers. In May, you said that analog computers were better than digital computers. In June you tried to confuse us with talk about binary numbers. Are you trying to scare us away from the new hobby computers?"

Though it sure may look like it, that is not my aim at all. The intent of the first few computers columns was simply to put the new hobby computers into context, and show where and how they fit into the overall picture. It's simply a case of trying to tell it like it is—or at least, how it looks to me.

There is an interesting change happening in the small computer market. The very first small micro-computers which appeared were introduced in hobbyist magazines as kits. The leading small computer magazines were all aimed at the hobbyist. Even the first computer stores catered to the hobby or home computer purchaser. But that is now changing.

The words home computer or hobby computer are being replaced by terms such as personal computer or the appliance computer. At the same time, there is frenetic activity by many companies in both the low-priced and high-priced computer products. On the one hand, we have MITS-Altair, Imsai, and others, who once specialized in computers kits in the $300-600 range, introducing a variety of assembled computers in the $1000-3000 range, aimed squarely at the small business user. Even Southewest Technical Products (SWTP) has added several assembled products to what used to be a strictly kit line. At the other end of the price range, we have Radio Shack offering an extremely economical take-it-home-and-plug-it-in computer aimed at the beginner, but with a variety of add-ons which make it useful for the small business as well.



The output of an analog computer can be thought of as a regulated power supply and computer-controlled voltage divider.

You can see the same trend in the computer magazines as well. Starting with the slogan "Computers—the World's Greatest TOY!", they have started to include more and more articles aimed at the businessman; even the advertising is aimed at this segment of the market. The stress on Toy is slowly disappearing.

Or go into your local computer store. A year ago, you would have most likely met another hobbyist or two, milling around the displays, pushing buttons, playing Startrek, and in general bending the storekeeper's ear. Today, you are likely to find the salesman sitting in the back of the store, working on a payroll or inventory program for a local business to support a computer system that he is about to sell. The hobbyist is tolerated, but not really welcome.

It's not that the computer is any the less of a toy now than it was before; it is just as much fun, just as useful—if not more so—than it was a year ago. It is simply the sudden realization by the industry that the number of hobbyists is limited. There are simply not enough dyed-in-the-wool computer addicts around who want to get invovled in the nitty-gritty operations of their computers; if the computer field is to grow it must attract new customers among those who simply want to use the computer, for whatever purpose, rather than just play with it.

The market has to grow in two directions. On the one hand, in the higher-priced area, are the business customers who need a sizable, reliable, simple-to-use system for routine business applications. They are not interested in the internal operation of the

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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
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computer, but merely want to type their problems into the computer and have it output answers. On the other side are the people who want to play on the computer, not with it. For them, the computer can be simply a powerful tv game. Besides playing hockey, it can also play tic-tac-toe, chess or checkers, hangman or solitaire. And in its spare time it can also balance the checkbook, or plan dietetic meals.

But these new customers are not interested in intricacies of the computer. They don't want to know about programming, about binary numbers, about read-only memories, or any of the other hardware or software aspects of computers. They just want to get their answers. And so part of the effort to sell computers to this new kind of customer must involve making it appear simple and immediately useful. Otherwise they will be scared off.

The trouble is that all is not peaches and cream in computerland. Computerizing any business is a risky and expensive proposition. And there is no reason to suppose that it is any less difficult for a small business than for a large one. A large business may have more to computerize, but it also has more staff and money to do it with. It may have more to lose if it does it poorly, but it is just as painful for a small business to lose its shirt as it is for a large one.

On the surface, it always seems as though installing a computer will make things run smoother. What usually happens, though, is that a small business with perhaps ten people in accounting and no computer, eventually winds up with five people in accounting, an expensive computer, and another five people in the computer center. Unfortunately, the computer people get paid more than the accountants did. The computer center now does much more work than accounting alone did before, but much of this work is not really needed and is only done because 'the computer makes it easy.' As soon as the company president finds out how easy it is for the computer to furnish a printout of the number of widgets left in the warehouse, he naturally asks for a daily printout so he can keep tabs on them. This kind of situation easily snowballs out of hand, especially when the people who give the computer center jobs to do are not the same ones who eventually pay the bill.

This is where perhaps the small computer has a chance. In a small business—the corner pharmacy or the local medical group perhaps—the person who decides what the computer will be used for is quite likely the one who also has to pay for it. Perhaps this is one case where the computer will not wind up being the tail wagging the dog.

There is yet another good aspect of the small computer. In large businesses, the

Combining a low-cost mainframe such as Southwest Tech's 6800 or the PolyMorphic Poly 88 and a video terminal with input keyboard, such as this Southwest Tech CT-64, gives you a full-function active computer for less than $1000.

usual approach is to buy or rent a computer system, and hire a staff to put it to work doing whatever needs doing. But suppose the computer is wrong for the job, or the job is simply too big to be done—who gets the blame? Obviously, the computer staff is blamed, and gets fired. The computer manufacturer and his salesman are off the hook. You see, the large computer market is the only place where you may buy a multi-million dollar item of equipment without getting any guarantee whatsoever that it will do your job. All the computer manufacturer guarantees is that the computer will run, its lights will blink, it will punch the right holes in cards, etc. It's as if an automobile manufacturer guarantees that his car will have a functioning motor, the steering wheel will turn, and the gearshift will engage properly—but not that the car will actually move under its own power. All the parts are guaranteed to work, but not necessarily in such a way as to get you where you want to go.

But the small computer promises to be different, partially because of the fact that it is often sold through a computer store, not directly from the manufacturer. Thus a businessman can go to the store, order a system, and specify that he wants it programmed to do a certain job. If it doesn't do the job, he simply doesn't pay the bill. There is obviously a lot of good in this for the businessman, even though it may occasionally leave the computer store holding the bag. In the long run it can only benefit the industry.

So where does this leave us hobbyists? For one thing, we can sit back and enjoy the view as the industry expands into the small business area. But let's not lose sight of the fact that there is a lot of fascinating electronics inside the computer even while everyone else is trying to play down the complexity of the computer. Quite aside from enjoying what the computer can do, let's also have fun with it for its own sake. To paraphrase an old saying, let's not get so involved with the forest that we lose sight of the trees.

letters

INPUT FROM MODERN ELECTRONICS' READERS

Dear ME:

I believe that in my twenty some years of reading magazines and other periodicals this is the first time I've ever been able to read the very first edition of a new publication.

I was very excited when I saw the cover of your magazine on the book rack. I'm just starting to fully enjoy the possibilities of the home computer. Your magazine was crammed full of very informative stories and articles that I enjoyed very much.

I also like to tinker with electronic projects that are a benefit to my every day life. I couldn't believe it when I saw the electronic combination lock project on page 50. The first thing I thought of was for using it for an operator of my electronic garage door opener. Instead of having to get my key out every time I want to open the door, if I don't have the transmitter, I'd be able to push a few buttons and the door would open.

The first thing I noticed after reading the article was that there were no pin numbers on most of your circuits. If your magazine is to be directed towards the budding electronics hobbyist then I'm sure they'd appreciate you including the most complete diagrams you can. I'd love to try to build this electronic lock, but I'm not sure I could figure out the pin configuration. I'd appreciate it if you could send me this information and maybe include them in your future publications. I hope this is not too much to ask. Please try to help us that are not as well educated in electronics as others to become better trained and educated.

Jerome W. Helfrich
Springfield, IL

You want pin numbers, Jerome, you got 'em. We want to be as basic as we can so nobody gets left out. After all, our prime directive is to show new people all the fun in the many electronics hobbies.

Dear ME:

I appreciate the bingo cards very much when they are located at the last page so they are not bookmarks. I strongly dislike and am antagonistic towards advertiser cards scattered throughout the magazine, that, for the majority of readers serve only to be bookmarks forcing the magazine to open up at unconvenient places. My first task when picking up a new magazine is to leaf through and tear out all the bookmarks and throw them in the wastebasket, without reading any. Then I can enjoy the magazine!

Second, a much desired electronic project for me is an interface to use a general purpose oscilloscope for personal auto diagnosis.

Third, I am proud to be a charter subscriber to what looks to be a fine new publication.

Noel. S. Ripley
Souderton, PA

Dear ME:

Congratulations on one of the best electronic magazines I have ever read. I have found all the articles informative and interesting. Please accept my subscription. Keep up the good work.

John Calcafuoco
Sault Ste Marie, Ontario, Canada

Your subscription is accepted, John. Thank you!

Dear ME:

The March issue is quite interesting and covers a wide scope of varied interests in the broad field of electronics. There are, however, some points in the article by George McCarthy (pages 82 to 85) that merit some adverse comment.

Mr. McCarthy makes the totally false presumption that spark is CW! Nothing is farther from the truth! Spark is the transmission of damped or discontinuous waves. CW, of course, stands for continuous waves.

From about 1914 to the later 1920s a fierce battle waged between the proponents of Spark and CW. Marconi fought to the bitter end but finally had to come around to accepting CW as the better of the two. CW was generated by arc transmitters, by high-speed alternators, and by vacuum tubes; each of these requires more complex equipment than the relatively simple spark transmitter.

Mr. McCarthy's other goof is the billion-to-one mix-up between a millihertz (mHz) and a megahertz (MHz).

Carl C. Drumeller, W5JJ
Warr Acres, OK

Dear ME:

I have just read your first issue of ME and wish to convey compliments for such a fine publication. The diversity of articles is quite impressive and seems to fill the gap left by many other technical publications.

I would also like to propose a future article which would possibly be of interest to your magazine. Concepts and Sciences International is a consultant in the field of environmental technology/psychology. Our present efforts lie mainly in the area of ionisation, acoustics, and lighting. Many factors are involved in the proper design of a comfortable living or working milieu.

Most of the tools used in this field are tools which are electronic in nature. For example, negative ionisation in an office is accomplished by the use of high voltage corona discharge. The effects of this air-electricity has been widely studied and applications include uses in burn-therapy, odor and static control, etc. (see Fred Soyka *The Ion Effect* Dutton Co. 1977.)

The use of white noise and pink noise oscillators is used to create work environments in which noise is eliminated, employees are in contact with each other rather than being "architecturally isolated", and in which the area becomes more pleasant.

The use of fluorescent lighting in offices is often a source of employee fatigue and eye strain. Use of such instruments as Vitalites® manufactured by Duro-Test of New Jersey artificially recreate the colour spectrum of natural sunlight and seem to eliminate or reduce these problems.

Such an article would be about 1-2 pages in length and focus on the area of electronics in the environment. The tone of the article may be along the lines of Paul Brodeur's *The Zapping of America* and would be a general interest feature.

Your comments as to the appropriateness of this article in a future edition of ME would be appreciated.

Stephen L. Klincewicz
Concepts and Sciences International
Norristown, PA

Frankly, Stephen, pink and white noise may be fine for your office but we prefer earth colors here.

Dear ME:

I want to tell you that you have a very good magazine and am wondering if I could have some information about it.

First of all, I recall you advertised that you would have an article on robots. I would like to know when I can look for this in your magazine. I hope that you put out a lot of this type of article as I am very interested in this field.

Also I am very interested in personal computers, and would like to know if I could have some information about them. Like: what is the best personal computer on the market for the cheapest amount of money and what it costs; what would the quality of such a computer be and what would it's programming capacity be, or how much information could it store or use. I really appreciate this!!

Bill Don Carlos, Jr.
Scottsdale, Az

Look on page 21 in this issue of ME, Bill Don. You'll find assistant editor Bob Margolin has thrown in just about everything there is to tell about home computers including the kitchen sink. And we had the first of many robot stories in our March 1978 issue.

Dear ME:

I have a grandson who is trying to make a levitator without much luck.

Could you please suggest a place to get this information?

Coy L. Gail
Cody, Wyoming

Well, obviously, the corner magic store.

Dear ME:

Recently, I happened across your article concerning your ideas on the philosophy of robot development, which was printed in the March 1978 issue of ME. I found this to be a very interesting and informative story. It was of particular interest to me for two reasons.

First, I am involved in electronics both as a hobby and a profession and second, because I am a Science Fiction writer.

I am now considering writing a story concerning the possible relationships between man and robot. I am writing this letter to ask one particular question of you.

You classed robots into four classes of development: Alpha, Beta, Gamma, and Delta. What I am wondering is if you are losing these words into the general vocabulary for use by the public-at-large. In other words, may I use these terms in my writings.

I would appreciate your reply as early as possible. Again, it was a very interesting article.

Larry R. Gilbert
Picayune, MS

Men can't own ideas, Larry, only the manner in which they are presented.

Dear ME:

Having recently read the first two issues of your fine magazine, I have found it a unique and enjoyable alternative to the established electronics, ham, CB, and computer magazines. I am well aware of the difficulties in getting such a project started and wish you continued success in the future!

In particular, I liked the sections on: programming, Newscheck, Clinic, and the Puzzle. Moreover, the great graphics and uncomplicated approach are refreshing.

However, a magazine (like most other forms of media) should be a vehicle for two-way communication. Good examples of this are some of the better European hobby magazines. It is in this light that I direct my following comments to you.

In your March issue, there is a circuit which is ambiguous if not down-right dangerous, especially in view of the level of knowledge and experience which your average reader probably has. I am referring to the "Power failure detector" on page 67. The basic problem is that the circuit is directly (i.e. no isolation transformer) connected to the 120 vac power line!! This is, in general, a poor procedure, and is amplified by the fact that this circuit will be constructed by amateurs.

First, one end of one of the two Megohm input resistors is shown going to ground. Clearly, this should be labeled to indicate that this is not a ground to the circuit case, the 120 v power supply line, or any where else; but is in fact a *floating* current return line.

Second, supposing that the circuit was assembled correctly, there is still the possibility of leakage current through the input resistors. Although this current would be small, it is still in the range where it could be lethal under some circumstances.

Finally, it should have been mentioned that the circuit should be constructed in a totally insulated container. Not only to protect against the possibility of leakage, but also against faulty construction and defective parts. Imagine if one of the input resistors shorted. But, I still feel that an isolation transformer would be the best solution to this problem.

My second comment concerns the cartoon on page 58-59. My first disagreement with this article is my opinion that rationalizations and glorifications of hunting belong better in hunting magazines than in ME.

Second, I believe that technology should be used to better our environment, not to dominate it as this article suggests: "This is the life, Ralphy, man against nature. Using nothing but his hands and brains. Plus a Remington 30-30 and a Wilson vhf fm 2-meter transceiver."

In addition, a Wilson transceiver is displayed twice in this article, once verbally, and once pictorially. Besides my view that publishers should not endorse a particular product, especially if that product's manufacturer carries advertising in the publication, unless it is tested objectively against competitive products, your other advertising clients might be disquieted (to say the least!) by this approach.

Although it is probably too much to expect that you would create a column to deal with letters of this sort. I truly hope that you will keep some of my points in mind.

James Abbott
Worcester, MA

Two-way communications is hard to achieve in a one-way mass magazine, James. Our best possibility is to print letters and critiques from readers like yourself. We're always open to criticism, whether we agree or not. For instance, what good is a magazine if it doesn't let readers know about good products on the market? Although we don't always like products which turn out to be the best on the market, the example you selected was a bad choice for your argument. The Wilson vhf fm gear is as good as any on the market. We wanted to show the excitement of ham radio today. Two-way vhf fm radio is at the core of the hobby. We knowingly selected the Wilson unit as our model for the Perry People cartoon strip.

Dear ME:

As a novice subscriber to the young "Modern Electronics", I took great interest in your article dealing with the computer revolution.

You state, "They now are small, so easily built, so simple to operate . . .," further "shop carefully for prices compared with specs." Suppose I know nothing about specs and have, nevertheless, decided I want one of those marvelous machines.

To start off, I have defined the major use I want to make of my home computer, next to all the possibilities mentioned in ME.

My machine will help me in a tedious activity linked to my professional activity as a translator. I want to enter on one line a key work in English and enter underneath the French and Spanish equivalent. Each English key word can be followed by various expressions and translations and the memories would be fed with data English to French or English to Spanish and would have to be questioned with a code for each language; for example, "keyword"? S= to obtain the Spanish equivalent to the English term "keyword."

Entries would be made through a keyboard and answers provided on video display. Further, at the time of entering the data into the memory, data would have to be reordered by the computer to be stored in alphabetical order; i.e. random access to allow feeding new keywords into the memory which would

automatically be sorted out alphabetically. Further, I would need a printer to obtain a print out that could be used as a sort of dictionary by others, not linked to the computer.

In as far as feasible, it should be possible to connect four or five video displays and keyboards so as to permit working use by two or three of my colleagues who would not enter data but only read out information from the memory.

Now, having no notion of specs and starting with a base of 2500 keywords to be fed into the memory in English, which model or make would you recommend for this specific use, keeping in mind the possibility to add on modules with no future connection problems and of course, on the base of a household budget???

Sorry for the long explanation but I am at a loss with all the possibilities offered and rely on your help and Pete Stark's imagination. Thanks in advance.

Very best regards to you all and best wishes and long live ME.

Jean-Pierre Isore
Montreal, Quebec, Canada

Dear ME:

I am a Cornell University physics major graduate. I am writing to you because as a result of a long history of debating on fundamental physical topics I have conceived a solid, non-abstract possibility upon which your expertise may bear as far as evaluation is concerned. Perhaps it is one of which you have thought yourself. However, there is much that I can bring up on this of which you may never have heard in any context. The idea is simple and was probably first run upon by some lesser contemporary of Edison. It is: can the behavior of the characteristic currents, electrons, potentials, etc., in a comparatively simple unit device be made to control themselves in such a way that the unit device becomes internally the equivalent in function of many unit devices configured together in a usual circuit arrangement? The basic item is, to me, that a unit device can have more than one characteristic at once without either instantaneous physical failure or violation of any of a list of mathematical niceties.

The key to visualizing the existence of simultaneous characteristics is to realize that the usual two-dimensional representation of a characteristic is actually an approximation. In reality we deal not just with I - vs - V coordinates but with other variables: Joule heating, applied external field, frequency, phase. Indeed, even if we confined ourselves to two variables a closer look at the conventional representation would certainly show it as rough, particularly in the extreme regions. There is another matter to take into account: basically the principle that prevents two simultaneous characters as line graphs in a plane is that a line is, in a natural mathematical sense, what 'belongs' in a plane. If we move even to just three dimensions, even if we do not have a line all the time, the mathematical difficulties practically disappear.

Restricting ourselves to three dimensions, what would a characteristic look like? I prefer to visualize it as a narrow perforated tube, at least in the above-mentioned non-extreme regions. This allows for two coincident characteristics to interpenetrate each other, a situation which otherwise would prevent permissible simultaneties from being allowable. Then, allowing for the limitations of the device, we could have lines of characteristics with all the leisure of a box full of yarn. Of course, there is an obvious limitation to all this: the biasing circuitry for each 'characteristic element' used in this manner must take into account whatever our third dimension factor is; in other words, we would not be dealing with normal circuit design and the typical bias configuration would have to be re-formulated before we could take bench step one.

You have probably thought of the other major hang-up: how are we going to feed signals to this construction? Whatever the innards of the individual device is imitating, it would have to take care of its own isolation too. Indeed, whatever else it did, there would have to be complete multiplexing to sort out incoming signals, and, as a basic physical afterthought, internally compensating multiplexing to keep things in order within each unit device. One shortcut appears: if we designed our 'one-pentode-minicomputer' as a typical example, a small number of inputs would be guaranteed inasmuch as we are duplicating a specific, as opposed to a general, circuit application. Yes, it is starting to look complicated—like trying to replace some unit using a number of Gunn Effect devices with a single programmer—controlled klystron. It is sort of like trying to get the whole bedroom floor painted by assuming beforehand that you have painted yourself into a corner and thus have to invent a way of painting yourself out. And all of this assumes that the typical unit device is completely physically capable of supporting such electronic behavior.

However, let us take a step backward for historical perspective: much of what we have today is due to this sort of strategy, albeit not always consciously arrived at. We had to wait for multiplexing before we had the multi-signal telegraph—but that is really what Bell was trying to invent, and many of his prototype microphones resembled Marconi's coherer elements. No, remember again the perhaps—lesser—contemporary-of-Edison, and see that this is really a simple situation; there must actually be a basic, relatively simple physical way of doing this; there is so much that has been accomplished since then that the maybe friend of Edison's would have thought folly in comparison. If nothing else, think of that pentode as an entity created from a selection of special high-voltage semiconductor units. That is, ones worked with high concentrations of metals, oxide layers, high exciton densities, structures like travelling-wave tubes—in other words, if we could get the right kind of sensibly modulated high frequency waveforms in there, articulated regions could be created as subsections of the electron-valve activity of the entire device.

Perhaps in the meantime of all this you've come up with some smart answers to make all my speculations useless and meaningless. No matter. Usually a single device cannot substitute for two in a Wien Bridge or astable application because the gain is not high enough for the necessary phase-shifting networks. Of course, tetrodes of FET pentodes can get around this but in a sense they are multi-function units, not a fair test of the hard fundamentality of what I have proposed. There is a way—a negative resistance arrangement fits into the L and C reactances of the passive components and makes the resonant resistance minimum more favorable than otherwise possible. Similarly, a much more sophisticated negative resistance setup could use the reactance characteristics of the negative resistance to pull out part of what gain was there when the circuit was first energized, let it be amplified itself in turn, and then put it back into the system, so that at the very least this technique would be good for a degenerate oscillator application. What you would be doing would be storing energy in an electron plasma when it was not going to be used immediately. This is not much better than the pentode Wien Bridge because if you tried to substitute for five hundred components instead of five you would have something more like Tokamak than a microprocessor and it certainly would be no fun to have around you at your workbench. What is really needed is a means of restraining electrons without using massive, high-power magnetic fields. It would seem from basic relativity that this is an automatic absurdity—but wait a minute; follow the next argument and, even if you do not believe in it, it will surely strike a chord in elements of your professional and practical experience.

An antenna is not the same thing as a resonant LC array. It is, of course, ridiculous to try to prove this by saying that, unlike the case with a coaxial cable, you cannot replace it with a string of properly connected discrete components—but the point still exists. It goes

please turn to page 64

Home computers: what's new for you

All of a sudden, hundreds of computers and accessories are available for the home hobbyist. There are so many pieces of gear and gadgets around that it's hard to keep up. Here's a complete rundown on the best new equipment you can have right now and what it'll do for you.

by Bob Margolin
Modern Electronics
Assistant Editor

Home computers—without doubt they're the biggest thing in personal electronics today. With a home computer you can balance your checkbook, plan your daily menus for a month in advance, work out a budget, solve math problems, play games, even learn music. Although the digital computer dates back to the *Univac* of the fifties, it took Magnavox's *Odyssey* video game to bring it into the home.

Video games are really nothing more than pre-programmed microcomputers. And if they're accepted by the general public, the computer industry reasoned, why not a full-fledged computer for the home too!

From the very beginnings of the digital computer, there have always been buffs who built and programmed their own machines. Over the years an entire industry grew to cater to their needs. And when the market for home computers appeared, the personal computer industry was in place and ready to produce the machines the public wanted.

The first of these was the MITS Altair 8800. It was little more than a box to which the user had to connect a keyboard and printer. But it was a computer. Of course, you still had to know how to program it.

Things have really changed. Today, you can buy a complete, ready-to-use computer with input keyboard and video terminal, and prerecorded programs on cassette tape from your local Radio Shack store. Even Heathkit offers computer kits, complete with programming.

Southwest Technical Products' 6800 Computer System is typical of the many mainframe units available to the hobbyist. These mainframe computers contain the processor and memory circuits, but require additional input and output terminals.

A silly little millimeter

The heart of a microcomputer, the technical name for home-type machines, is the microprocessor integrated circuit—the so-called computer on a chip. There's much more to a computer than just the microprocessor, as explained by contributing editor Pete Stark in the March issue of *Modern Electronics*. The microprocessor does, however, control just about everything that goes on inside the computer.

Today, there are a half-dozen or so microprocessor chips available to the personal computer industry. The most widely used is the 8080 and its more powerful near-twin, the Z-80. Introduced in 1973 by Intel, the 8080 made possible the MITS Altair 8800, the first fully-functional home computer.

A year after the introduction of Intel's 8080, Motorola introduced its own version, the 6800. Today you'll find 6800 chips in products from several firms, including The Digital Group, Ohio Scientific and Southwest Technical.

MOS Tech joined the 8080 parade a year later with its very similar 6502.

The Apple II integrated computer comes with a built-in keyboard you can use to program and input data. Computers of this type still require an output terminal such as the video monitor shown. Unlike the mainframe computer, designed for the computer buff, these integrated units can be used by the whole family to balance checkbooks, learn math, even plan the menu weeks in advance.

Though comparable in performance with the 8080 and 6800, and slightly less expensive, it is not as widely used. But you will find 6502s in some Ohio Scientific units as well as MOS Tech's own computers.

In addition to these chips, you'll also find home computers built around Intersil's 6100, RCA's COSMAC, Signetics' 2650, National's PACE and others. Although these latter microprocessors aren't as widely used as the 8080 family, they do have certain advantages. The 6100, for example, is similar in function to Digital Equipment's PDP-8, one of the most widely used minicomputers in the world. So, although most are scientific and technical in nature, there are more programs written for 6100-based computers than any other system.

Which chip is best?

The choice of microprocessor can be very important, or totally unimportant. It really depends on the way you intend to use your computer. If you're into writing your own programs, it really doesn't matter much which chip you use. But, if you want to use as much existing home-oriented programming as possible, you'll find the 8080 or 6800 your best choices.

Another big consideration is peripheral equipment—displays, printers, memory units and the like. Here there are two considerations. First, much of the peripherals available today are compatible with one or possibly two microprocessors. Again, there is more available for use with the 8080 than all the others combined. But, you may find everything you need available for other chips as well.

In addition to the electronic compatibility, you'll also have to worry about physical compatibility. Even if two computers use the same connector to mate with a peripheral, the data carried on each pin, and the method of transmitting that data may be different. So, you may not be able to mate your computer with a peripheral you need.

Computer input/output formats are called data busses. The most popular of these is the S-100 bus, originated in the MITS Altair 8800. The S-100 bus is usually employed in computers built around the 8080 or Z-80 chip. So, if you expect to use a variety of peripherals, the S-100 bus is a must. And that will, for the most part, limit you to the 8080-based computers. But, you will find some non-8080 computers that are S-100 compatible as well.

Different strokes

If you're interested in a home computer because you have a specific job in mind, you may not need the expandability of an S-100 bus computer. You may find that another computer offers features more important to you with enough hardware and software support to do the job you need done.

In the final analysis, choosing the right computer involves matching the available features against your needs and desires. If you're a hobbyist interested in computer games and video displays, a small system with a video terminal may be sufficient. If you need a written record, though, you'll want a computer with a printer. If you're more interested in problem solving than game playing,

The Intecolor 8031 is typical of the fully integrated office computer that's finding its way into the home as well. This one gives you a 13-color display, which makes reading bar charts much easier.

you'll be more interested in memory than the output terminal.

Once you've settled on the kind of machine you want, based on its microprocessor chip and data bus, you'll still have to choose between the many models available from several different manufacturers. Part of that decision will be based on the physical packaging of the computer. Some computers, such as the Compucorp 625, Intecolor 8031 and Radio Shack TRS-80, have built-in input and output terminals. Others such as Southwest Tech's 6800 and the Digital Group's Series 2 provide only a *mainframe* containing the processor circuitry, but require input and output terminals.

Choosing between integrated computers and component building-block systems is very much like choosing a stereo system. You can choose an entertainment center with built-in tape deck, turntable, tuner and amplifier, or you can select separate components.

An entertainment center offers convenience, compact packaging and simplified operation. Component systems, on the other hand, give you the flexibility to tailor your system to meet your specific needs, and to choose each component based on its operation, rather than on its manufacturer.

Just as in stereo, an integrated system usually costs less than an equivalent component system. But, the saving is made at the expense of flexibility, and more often than not, performance. You may find, however, that the performance of even an inexpensive integrated system may be all that you need. And not having to worry about peripheral interfacing may more than compensate you for any loss in flexibility.

If you're more interested in what goes on inside the box than in what it does, you may find the computer kit more to your liking. Several manufacturers, including Heathkit, offer complete, functional computer kits providing all the parts needed and complete assembly instructions.

Do it yourself

Choosing a kit involves most of the same considerations as choosing an assembled unit. You'll have to pick the microprocessor and data bus, and choose between integrated and component systems. The Heath H8, for example, uses the 8080 chips, its own "Benton Harbor Basic" language,and its own data bus, which is incompatible with other systems. You'll find a complete review of the H8, by contributing editor Carmine Prestia, in the June issue of *Modern Electronics*.

If you prefer to go it alone, you have available a large selection of processor and memory circuit boards to choose from. Even here, you can get assembled and tested boards,or you can build your own from kits. There are even blank circuit boards available you can stuff with your own components.

Remembering it all

The ability of a computer to run a program is dependent on its memory. As you input your program to the computer, it has to file your instructions in its memory for future use. Once you've told the computer what you want it to do, you'll have to give it the data you want the computer to use. This too it must file away in its memory. And, it may need additional memory to remember other data you fed into it in the past, which it must recall to do your present operation.

The amount of memory you need depends on how you intend to use your computer. If you're doing relatively simple work, you won't need much memory. If you're involved in complex, scientific programs, however, you may find your computer's entire memory can just barely contain the program—leaving almost no room for the data.

Most of the computers available for personal use come with a small built-in memory, usually able to store 32,768 bits of information. Each bit represents one binary digit, several of which are needed for each action the computer takes. Most home computers are built to process eight bits at a time. These eight-bit groups are called bytes. So, a 32,768 bit memory is able to hold 4,096 bytes, or 4K as its called.

The maximum number of bits a computer can process in each gulp of data is called a word. Since most home computers can process up to eight bits at a time, each word consists of eight bits, or one byte.

A few home computers can process 16 bits per gulp. For these computers, a word is 16 bits of data, which is equal to two bytes. So, when you investigate memory capacity, make sure of the units being used. Most 16-bit memories are specified in terms of words. But a few eight-bit memories are also specified in words.

If you intend to limit your computer to a single unit having built-in memory and input/output terminal, the memory can be a critical factor. Some computers, such as PolyMorphic's Poly 88 System 16 have as much as 16K of memory built-in. Virtually all home computers have extra sockets built-in for adding plug-in memory boards.

All you have to do is plug in the memory boards and you've doubled,

PolyMorphic Systems' Poly 88 is a very low cost mainframe computer. Adding plug-in memory boards and the peripheral equipment shown here gives you a fully functional, reasonably powerful computer system.

even tripled, your computer's inboard memory. Physically, these boards look just like any other printed circuit board stuffed with a fist full of ICs. Each of these ICs, however, contains hundreds of memory cells, each of which can store a bit of data.

The ICs used are either pre-programmed or can be programmed by the user. Pre-programmed memories are called ROMs, or read only memories. They contain instructions needed by the circuit board to properly search out specific data, control a specific function, or run a specific program.

You can buy unprogrammed ROMs and program them yourself by applying a voltage to the appropriate pins. By so doing, you can permanently etch into the ROM a specific program of your own. These programmable read only memories are called PROMs.

Although you can burn in just about any information you wish, within the memory capacity of the PROM, once it's in, it can't be changed. If you plan to use the same material many times, this isn't a problem. But, if you want to use it just a few times and then change it, you'll need an EPROM. These erasable programmable read only memories can be reprogrammed as often as you wish. Once installed in your computer, however, they act like a ROM.

Processor Technology's Sol-20 integrated computer isn't much larger than a keyboard terminal, but houses a powerful computer contained in a fist full of integrated circuits stuffed into a printed circuit board.

ROMs, PROMs and EPROMs

While EPROMs can be reprogrammed, their contents can't be changed during computer operation. If you need a memory that can unload its contents, then reload with new data during a run, you'll need a random access memory, or RAM.

These chips can be thought of as containing hundreds of memory cells, each of which can be loaded or unloaded independently. However, if the computer power is turned off, all of the memory cells will discharge. So, while RAMs can be reprogrammed during computer operation, which ROMs, PROMs and EPROMs cannot, they do not hold their contents when power is turned off, which the various ROMs do.

Each of these memory systems has its place. You can buy plug-in cards loaded with ROMs programmed to provide computer music, games and other functions. You can use PROMs and EPROMs for a variety of repetitive operations. And you can use RAMs to expand the changeable memory of your computer.

Technical Design Labs' Xitan Alpha 2 is built around the Z-80 microprocessor, a more powerful version of the 8080.

If you expect to put your computer to heavy use, with several lengthy programs, you'll need much more memory than you can get on a plug-in board. You'll have to turn a peripheral device to provide the additional memory.

The simplest of these outboard memories is the cassette tape deck. Very similar in appearance and operation to the portable cassette deck you've had for years, the cassette memory system stores data on magnetic tape. The tape, contained inside a standard cassette, stores your data until you need it. Then, you just drop the cassette into the tape deck and hit the play button.

A big problem with cassette memories is the very slow data acquisition rate. Because each bit of information has to be recorded in turn, or serially, it can take several minutes to record or playback a program. And finding a specific piece of data buried somewhere in the middle of the tape can be a nightmare. But cassette memories are relatively inexpensive, and are simple to use.

There is another outboard memory system that can provide almost instantaneous retrieval of data, and can load an entire program in just a few seconds. It's the floppy disk, so called because of its appearance. A floppy disk looks like a phonograph record, but is made from a very thin, flexible material that gives it a floppy look.

The surface of a floppy disk is divided into thousands of discrete locations, any one of which can be read out on command. This allows the computer to locate and retrieve specific data buried in the middle of a program or set of instructions in just a second or two. And because the surface of the disk moves at a greater speed than the tape in a cassette, data can be entered much faster in a floppy disk memory system.

Mini floppies too

Floppy disks were developed for use with industrial computers requiring megabyte storage capacity. Because of the huge memory requirements, the standard floppy disk is quite large, and the record/playback unit, called a drive, is very expensive.

More recently, a smaller disk has been developed for the personal computer user. Called a mini floppy, or diskette, it's about half the size and much less expensive. Depending on the brand and format used to store the date, diskettes can store between 50K and 315K of data.

Using a cassette or floppy disk memory requires a special interface and control program. Computers with tape or

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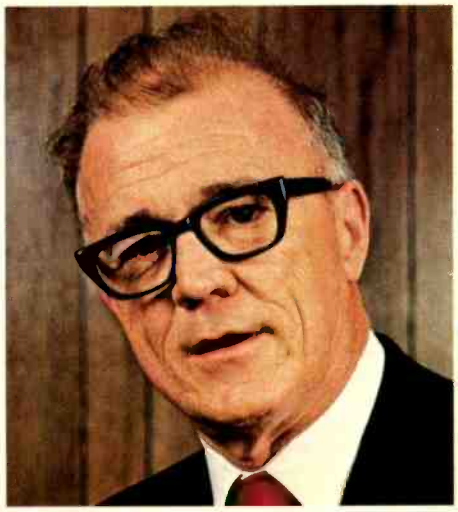

John E. Cunningham

Special Projects Director
Cleveland Institute of Electronics

My father always told me that there were certain advantages to putting all your eggs in one basket. "John," he said, "learn to do one important thing better than anyone else, and you'll always be in demand."

I believe he was right. Today is the age of specialization. And I think that's a very good thing.

Consider doctors. You wouldn't expect your family doctor to perform open heart surgery or your dentist to set a broken bone, either. Would you?

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disk systems have all the required circuitry and programming built-in. Some computers are sold without the tape deck or disk drive, but with the necessary interface. A few even have the programming.

You can add a tape or disk system to computers not equipped for them by adding the appropriate interface. The controller programming is usually available in ROM on a plug-in board. Some computers, however, will require you to actually input a controlling program.

Having all the hardware you need won't do you much good unless you can communicate with your computer. To do this, you need a language your computer can understand. Although there are several computer languages in use, such as Fortran, Cobol and RPG, most are far too complex for the user of a home computer.

In the early 1960s, Dartmouth College created a simple computer language designed for relatively simple programs. Called BASIC, the new language was intended to be used with keyboard inputs, rather than the punched cards required for the other languages. You'll find a complete rundown on Basic, by contributing editor Pete Stark, in the May issue of *Modern Electronics*.

Input/output

Although all of the home computers on the market today use BASIC, the actual sequence of instructions and method of inputting the instructions differs from computer to computer. This shouldn't cause any problem if you do your own programming. However, if you plan to use purchased programs, you'll have to make certain the program you want is designed for the computer you have.

Once you have the computer, a memory large enough for the job you want done, and a programming language, you'll need a means of putting data into and taking data out of the computer. If you've bought an integrated computer that has input and output terminals, you're in business.

If your computer has only an input keyboard, you'll still have to add an output terminal. And if you have only a mainframe, you'll need both an input and output terminal.

Although you can buy a plain keyboard, a video terminal with a keyboard built-in is a better bet. For one thing, you'll be able to see your instructions on the screen as you type them in. Another advantage is that by combining input and output functions, you'll have one less component to worry about.

Video terminals are ideal for video game playing and for problem solving where you're only interested in determining an answer. If you want a permanent record, you'll need a printer which can give you a hardcopy of your program and results.

Another peripheral you might find interesting is the paper tape reader/punch. Paper tape is another form of bulk storage memory, like cassette tape and floppy disks. It stores data in a long strip of paper tape into which hundreds of holes have been punched. Although considerably slower in operation than tape or disk, it is inexpensive to use.

A roundup of terminals, software, plug-in boards and hardware will be featured in a future issue of Modern Electronics. In the meantime, make certain the peripheral you want will work with the computer you have.

The Challenger IIP by Ohio Scientific is an intergrated computer with built-in video interface. Just plug in any video monitor and your Challenger is ready.

The home computer field is very dynamic, with new firms entering the market every day. And old computers are constantly being upgraded and improved. Because of this, it's very difficult to know what's available from one day to the next, which makes any listing incomplete.

Who makes what

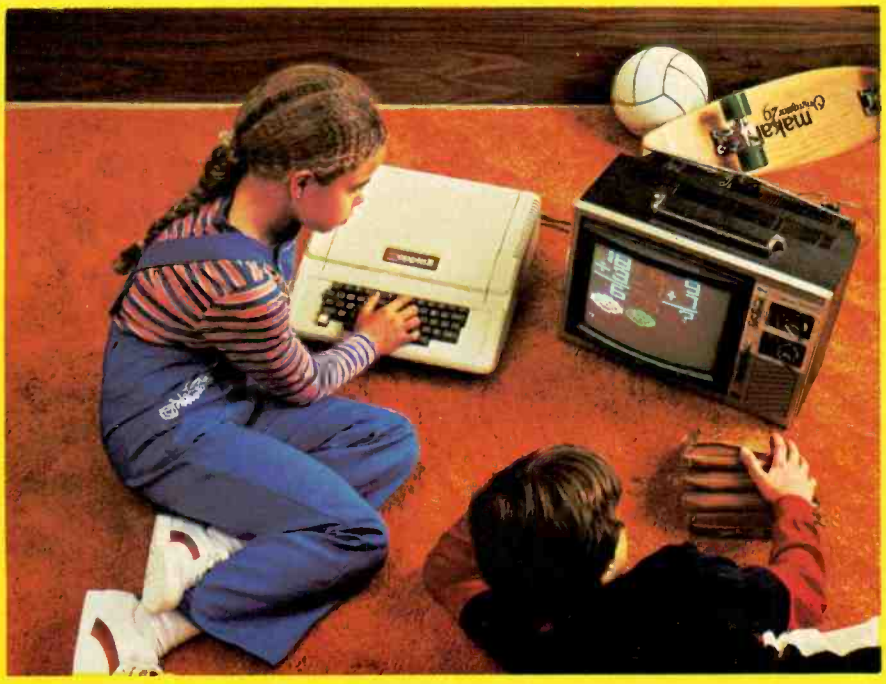
The following listings do include virtually all of the major home computer makers, and a few not nearly as well known. Where known, each listing gives the model name or number, the microprocessor used, the resident memory and expansion capacity, the standard equipment provided, the interfaces and data ports, and indicates the presence of an S-100 data bus. If the computer is equipped with a video terminal or video interface, the number of lines and characters per line is also given. The prices shown are subject to change without notice.

No listing, such as those given here, or advertisement can provide you with enough information to make an intelligent choice of computer. But they can be used to provide an initial screening.

Once you've narrowed the field down to a handful of computers, write the manufacturers for more information. If there's a store in your area specializing in computers, pay it a visit. Only when you have all the facts should you commit your hard earned money to the purchase of a computer.

Apple Computer Company, Inc., 10260 Bandley Drive, Cupertino, CA 95104

■ *Apple II*—Mainframe with built-in typewriter-style keyboard. Uses the 6502 processor. Has 4K of RAM memory expandable to 48K, and 8K of ROM expandable to 12K. Uses special Apple game input/output connector and has provisions for up to eight plug-in memory boards, a cassette memory, keyboard, speaker and video terminal. Software includes fast extended Interger Basic with color graphics for video terminal in the ROM. Complete Apple II system including two game paddles and a demonstration cassette tape is priced at



Home computers have brought modern digital processing techniques from the laboratory into the kitchen, den, living room, and even the game room.

$1300. A boards-only kit is available for $800.

■ *A2B0002X Intelligent Printer Interface*—Allows Apple II users to obtain hard copy output from many popular priced printers, such as those offered by Axiom, Centronics, Qume, Printronics, Southwest Technical and others. Comes with instructions for connecting printer to the Apple II. $180.

■ *A2B0003X Intelligent Communications Interface*—Connects the Apple II to any modem accepting an RS-232C serial interface, including those made by Anderson Jacobson, for computer-to-computer communications via telephone lines. $180.

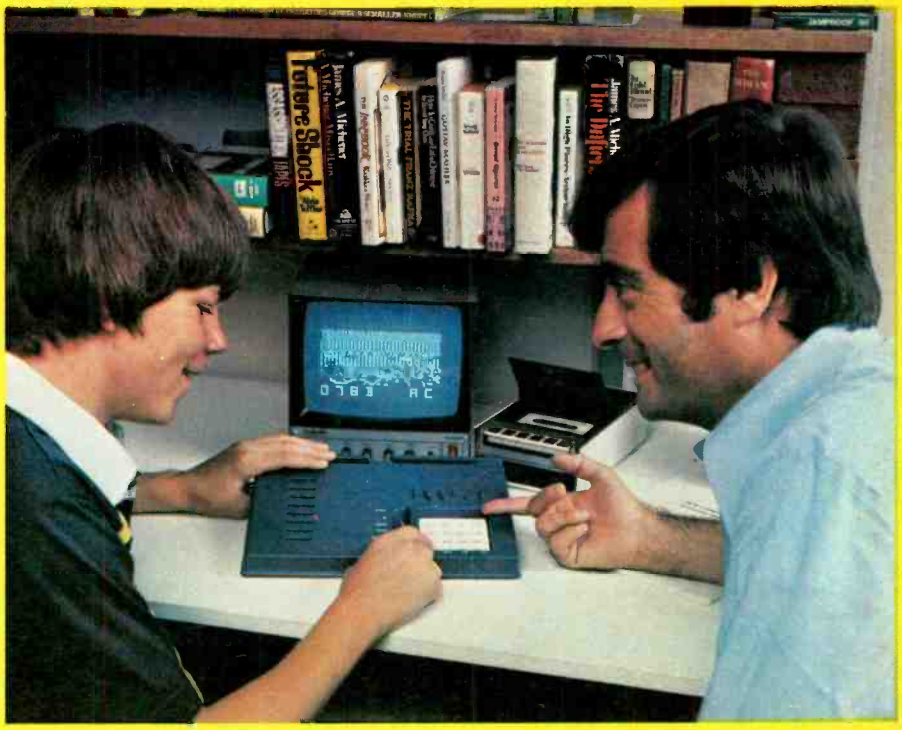
Central Data, P.O. Box 2484, Station A, Champaign, IL 61820

■ *2650 Computer System*—A boards-only computer requiring power supply, and input and output terminals for operation. Uses the Signetics 2650 microprocessor. Comes with 1K ROM monitor and 2K RAM. Has one parallel input port and a one-bit settable output port. Expands to S-100 bus. The 2650 computer board is priced at $275 assembled. 16K, 24K and 32K RAM boards are available at $290, $400 and $475 respectively. A BASIC software package is available for $20.

Commodore Business Machines, Inc., 901 California Avenue, Palo Alto, CA 94304

■ *Pet Computer 2001*—Integrated computer with 73-key keyboard, cassette drive and video terminal. Comes with 4K RAM memory, with 8K optional, expandable to 32K, of which 24K are external. Also has 14K of ROM memory including 8K of BASIC, 4K of operating instructions, 1K of diagnostics, and 1K of monitoring. The video unit provides up to 1000 character display arranged 40 columns by 25 lines using an 8 x 8 dot matrix, with automatic scrolling. Has unique data bus. Input/output port uses IEEE-488 instrument interface. Uses Commodore BASIC. The Pet Computer with 4K memory is $600, with optional 8K memory, $800.

The Zentec ZMS line of desktop computers gives you in a single package everything you need in a computer—processor, memory, input keyboard and output video terminal.



RCA built its COSMAC VIP computer with the beginner in mind. All the circuitry is on a single printed circuit board, and the empty sockets reserved for additional memory are plainly marked. The COSMAC's language makes programming a snap.

Computronics, 19824 Ventura Boulevard, Woodland Hills, CA 91364

■ *Model 1080 Microcomputer*—A board-only computer built around the F-8 microprocessor. Has 2K RAM and 1K EPROM memory with provisions for 4K additional EPROM circuits. Uses the S-100 bus. Requires -5, +5 and +12 volt power supplies, and a 110 or 300 BAUD ASCII terminal for operation. Has four 8-bit bidirectional ports. Uses six-pin Molex connector for RS232 serial interface and two 40 pin connectors for the parallel ports. The 1080 in kit form is $275; assembled and tested it is $325. The printed circuit board is available without components for $60.

Compucolor Corporation, P. O. Box 569, Norcross, GA 30091

■ *Compucolor II*—Integrated computer system including color video terminal, built-in mini-floppy disk drive, and remote keyboard. Uses the 8080 microprocessor. Comes with 8K of RAM and 16K of ROM. Has provisions for additional 16K of RAM and 16K of EPROM. Uses standard mini-disk with memory capacity of 61K unformatted, 51K formatted, per disk. An RS-232C serial interface is available as an extra cost option. Uses DISK BASIC. 17 programs currently available include several video games, biorhythms and menu planning. The Compucolor II is $1000.

Compucorp, 1901 South Bundy Drive, Los Angeles, CA 90025

■ *Compucorp 625*—Integrated desktop computer with built-in video terminal, keyboard, mini-disk drive and 40-column printer. Uses the Z-80 microprocessor. Comes with 10K RAM and 26K of ROM. Can be extended in 8K or 16K increments to 64K. The video terminal has a nine-inch screen with 16 lines of 64 characters each. Optional 80 character per line display is available. Two built-in mini-floppy disk drives accomodate standard square diskettes with 315K of memory per disk. The printer uses a moving head, dot matrix impact head with a writing speed of 80 characters per second. Uses plain, unsensitized paper, and can produce up to three copies with either carbon or carbonless sets. Uses the S-100 bus. Price on request.

Computer Data Systems, 5460 Fairmont Drive, Wilmington, DE 19808

■ *Versatile 3B*—Integrated desktop computer with built-in video terminal, keyboard and mini-floppy disk drive. Uses the 8085 microprocessor. Has 24K of RAM memory. The video terminal has nine-inch screen with 24 lines of 80 characters each. Built-in mini-disk drive uses standard square diskettes with 315K of memory. Has S-100 data bus. Comes with 20K Extended BASIC, games package, home accounting package, and small business accounting package program diskettes and one blank, formatted diskette. Has two RS-232 serial outputs. The Versatile 3B is priced at $3300.

Cromemco Incorporated, 2400 Charleston Road, Mountainview, CA 94043

■ *Z-2 Computer System*—Mainframe computer requiring input and output terminals for operation. Uses the Z-80 microprocessor. Has provisions for up to

The ultimate electric timer

It may look like a calculator and do the work of a timer, but the Coby I is all computer—from its 8085 to its 4K memory.

It's been said many times that this is an age of specialization, and Energy Technology's Coby I System is a good case in point. Built around the 8085 microprocessor, it's a full-fledged computer complete with 2K of system ROM and 2K of user RAM. But the Coby I is a specialist. It's dedicated to one task—controlling electrically powered devices.

The Coby I is a lot more than just an on-off timer, though. Using its built-in memory, you can tell it not only what time of day, but what day of the month and what month of the year you want some electrical appliance to function.

And you can tell it how long the appliance should remain on.

And how long it should wait until turning on again.

And what hour, day and month you want it to stop cycling on.

If you want, you can tell the Coby I to change the length of time the appliance stays on. Or the time period between cycles. Or you can have it cycle the appliance according to one program, then wait several days, or even months, and begin a new program.

Looks are deceiving

At first glance, the Coby I looks more like a desk model digital calculator than a computer. Although 10½ inches wide, it stands only a little over 2½ inches high, and is just 6½ inches deep. And to further add to its calculator-like appearance, there's a row of seven-segment LED displays and a rather unusual keyboard.

The Coby I may look like a calculator, but it's very definitely a computer—complete with data entry, storage, review and clear functions. However, because it's dedicated to a single task, all of the required machine programming is built into the ROM.

Entering a program requires just five easy operations:

- Push the *device* key, then enter the device number.
- Push the *enter* and *date on* keys, then enter the month and day you want the operation to begin.
- Push the *time on* key and enter the hour, minute and second, and am or pm.
- Push the *time off* key, if required, then enter the hour, minute and second. Then push the *date off* key and enter the month and day, and am or pm.
- Push the *store* key, and the operating instructions will be filed in the RAM.

You can review the contents of the RAM at any time without affecting the program. Just push the *device* and *review* keys, then the *date on*, *date off* or *cycle* key. This last key will give you a review of the period between the off-time of one cycle and on-time of the next.

Because the operating information is stored in RAM, it could be lost by turning off the Coby I. Or, if there's a power failure. To minimize the likelihood of loosing memory because of a power failure, the Coby I has a built-in battery supply.

The rechargeable battery used is part of the Coby I's power supply, and can maintain operation for four hours or more. However, if the power outage lasts longer than the battery can handle, the display will recycle to show all zeros—similar to a digital clock's display of eights.

21 plug-in cards for input/output interfaces and memories. Uses the S-100 bus. The Z-2K kit is priced at $600; the assembled Z-2W is $1000. 4K RAM memory cards are $200 in kit form; $300 assembled and tested. 16K RAM memory boards are $500 in kit form; $800 assembled and tested. 8K and 16K PROM boards are available for $145 in kit form; $245 assembled and tested. Other peripherals include a disk drive, tv interface to convert any color set into a computer terminal, and joystick controllers for game playing.

The Digital Group, P.O. Box 6528, Denver, CO 80206

■ *The Bytemaster*—Integrated computer with built-in video terminal, a choice of cassette or mini-floppy disk drive, and detachable keyboard. Uses the Z-80 microprocessor. Comes with choice of 18K or 34K memory in cassette or diskette. The video terminal has nine-inch screen with 16 lines of 64 characters each; full upper and lower case with Greek and symbols. Uses DISKMON language for disk drive models, and PHIMON for cassette models. Optional plug-in I/O board provides for four additional parallel input and output ports. The Master-1 18K cassette model is priced at $2000 in kit form and $2500 assembled. The 34K cassette Master-2 kit is $2350; $2950 assembled. The 18K mini-floppy disk Master-3 kit is $2400; $2900 assembled. The 34K mini-floppy Master-4 kit is $2700; $3250 assembled.

■ *Series 2*—Component system built around a Z-80 microprocessor mainframe with from 10K to 64K memory. The mainframe ranges from $1100 to $2200 in kit form, and $1500 to $2650 assembled, depending on memory. Peripherals include a keyboard and video terminal at $250 each, assembled only, and an assortment of cassette and disk drive units. Prices range from $550 for a two-drive cassette kit to $1800 for an assembled two-drive standard floppy disk. A printer is also available for $800 assembled and tested.

Equinox Division, Parasitic Engineering, Box 6314, Albany, CA 94706

■ *Equinox 100*—Mainframe computer with 12-key keyboard requiring output terminal for operation. Uses the 8080A microprocessor. Uses the S-100 bus. Has provisions for up to 19 plug-in memory and interface board. The Equinox 100 is priced at $800 in kit form and $1100 assembled.

The actual point in time the memory is erased depends on the particular battery involved and the amount of switching that is done during the outage. The memory clearing function acts to prevent the marginal operation that could be caused by a partial memory loss.

Because the memory is arranged to accept dates and times, talking about the Coby I's RAM in terms of its 2K capacity is meaningless. A much better standard of measure is the number of devices that it can control.

The Coby I can control up to 100 devices. However, its memory can only store 100 operating programs. This means that each device can be programmed to follow only one set of instructions. But, by reducing the number of devices, you can increase the number of programs some of the devices can follow.

The limiting factor is the memory assigned to future-date instructions. Only 50 programs can be written to turn on and off some device in the future. These programs can, however, be split between the devices in any manner you want. The remaining 50 programs are reserved for operations beginning and ending during the immediately following 24-hour period. These operations, however, can be repeated endlessly throughout the future days.

How many and when

The manner in which you use the programming potential of the Coby I depends on your needs. A typical application might be controlling a swimming pool circulation pump. You might program it to turn on for 10 or 15 minutes each hour between nine pm and eight am, then run continuously during the daytime hours. Using the program, you'd have continuous circulation during the day when you need it, but intermittently during the dead of night when only a little circulation is required.

Programming the circulation pump in this manner would require two separate programs. If you want the program to begin on the day you enter it into the Coby I, you won't have to use any of your 50 future date memory. Just set the cycle time for each program to the period during which the other program is running. Once you start the operation, it will continue to alternate programs endlessly.

If, however, you'd like the pump to operate continuously over the weekend, you'll have to use future memory. And if you want the alternating programs to pick up the following Monday, you'll need more future memory. But with 50 locations available, you'll have more than enough to last the swimming season. And you'll still have 48 immediate-use memory locations left for other tasks.

The other end

The controller is only half of the system. The other half is made up of remote-control units which actually regulate the electric power feeding the device being controlled.

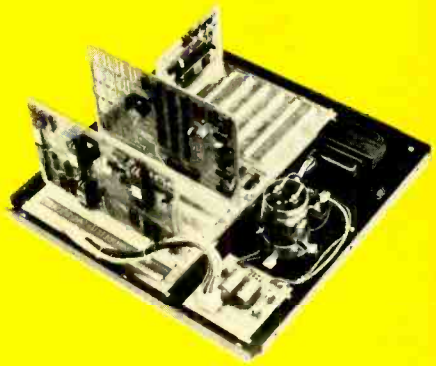
Presently, only the 100-volt plug-in remote is available. Energy Technology expects to release a 200-volt in-line model for controlling water heaters and other major appliances, and a 24-volt control voltage model shortly.

Each remote unit is equipped with two binary switches. One is used to program the device code number; the other to program the system number. The latter is used only when more than one controller is in use. The controller communicates with the remote units by means of a binary-coded message impressed on the house wiring. The method used is similar to the wireless intercoms you've seen.

All you have to do is program the device code, plug the remote into the wall socket, and the line cord of the device being controlled into the socket on the unit. Then program the controller, and you're in business.

You can also use the controller as a remote on-off switch. Just push the *device* key and enter the device code. Then when you push the *on* key, the device will turn on. When you push the *off* key, the device will turn off. It's ideal for controlling outside lighting, especially if you think there's a prowler skulking about.

The Coby I System controller is priced at $600, with each remote unit $60. You can get more information by writing Energy Technology, 1601 South Main Street, Box Q, Las Cruces, NM 88001.



Inside your computer, you'll find a large printed circuit board, called a mother board, containing the power supply, processor and memory boards, and empty sockets for additional plug-in memory and interface boards.

Heath Company, Benton Harbor, MI 49022

■ *Heathkit H-8 Computer*—Integrated mainframe with built-in 16-key keyboard and 9-digit octal display. Uses 8080A microprocessor. Kit does not include memory, which must be added for operation. Uses Heath-designed H-8 bus. Available only in kit form. The H-8, including assembly instructions and cassette program using the unique Benton Harbor BASIC, is $375. Memory board comes with 4K RAM for $140. Can be expanded to 8K with additional 4K IC set priced at $100. A parallel interface for use with Heath's output terminals is available in kit form for $150. A serial interface kit compatible with any RS-232C modem is also available for $110. Complete systems including the H-8 and input/output peripherals are available at a 5% discount from the total component prices.

■ *Heathkit H11 Computer*—A 16-bit mainframe using Digital Equipment Corporation designs similar to the DEC PDP-11. Uses an LSI-11 microprocessor. Comes with 4K 16-bit word memory, which can be expanded to 20K with plug-in boards. Uses PDP-11 software. Available in kit form only for $1300. Additional 4K word memory boards are available in kit form for $275 each. Parallel and serial interfaces are available in kit form for $100 each. An arithmetic chip kit is also available for $160 that provides complete arithmetic capability to the H-11.

■ *Heathkit H9 Video Terminal*—Complete with 67-key keyboard and 12-inch screen with 12 lines of 80 characters each. Has autoscrolling. Available only in kit form for $530.

■ *Heathkit H10 Paper Tape Reader/Punch*—Uses standard one-inch roll or fan-fold paper tape. Has transfer rate of 50 characters per second. Available only in kit form for $350.

IMSAI Manufacturing Corporation, 14860 Wicks Boulevard, San Leandro, CA 94577

■ *IMSAI 80/30 Integrated Video Computer*—Integrated computer with video terminal and remote keyboard. Uses the 8085 microcomputer. Comes with 2K RAM memory, expandable to 64K. The video terminal has five-inch screen 4MHz resolution with 24 lines of 80 characters each. Uses the S-100 bus. The 80/30 is priced at $1500.

■ *IMSAI 80/35 Minifloppy Computing System*—Similar to the 80/30, but has two mini-floppy disk drives in place of the video terminal. The 80/35 is priced at $2000 in kit form; $2250 assembled and tested.

■ *IMSAI VDP-80 Video Data Processor*—Integrated desktop computer with built-in video terminal, 86-key keyboard and two mini-floppy disk drives. Uses the 8085 microprocessor. Comes with 2K of ROM and 64K of RAM, expandable to 196K in 16K increments. Each diskette provides 516K of additional memory. The video terminal has a 12-inch screen with 24 lines of 80 characters each. Available software includes Commercial BASIC, Fortran IV and DOS. The VDP-80 is priced at $6750. Economy model is available at $6000.

Intelligent Systems Corp., 5965 Peachtree Corners East, Norcross, GA 30071

■ *Intecolor 8031*—Integrated desktop computer with built-in mini-floppy drive and video terminal, and detachable keyboard. Uses the 8080 microprocessor. Comes with 15K of ROM with sockets for additional 21 or EPROM, and 16K of RAM expandable to 32K. Built-in

IMSAI's 80/30 is an integrated computer that comes complete with its own detachable video terminal. Just connect the terminal to the keyboard/processor unit, plug it into any 120 volt wall socket, and the 80/30 is ready to accept your programming.

mini-floppy drive provides additional 80K of memory per diskette. Comes with one RS-232C serial interface and one 8-bit parallel port. Video terminal has 8-color 13 inch screen with 25 lines or 80 characters each. The 8031 is priced at $4500 assembled.

Midwestern Scientific Instruments, 220 West Cedar, Olathe, KS 66061

■ *MSI 6800 Computer System*—Mainframe requiring input and output terminals for operation. Uses the 6800 microprocessor. Comes with 8K of RAM memory. The MSI 6800 in kit form is priced at $600; $900 assembled and tested. Additional 8K RAM memory boards are available for $225 in kit form and $335 assembled. Parallel and serial interface boards are also available for less than $90 assembled.

■ *MSI FD-8 Floppy Disk Memory System*—Uses standard five-inch diskette to provide 315K of memory. Requires special interface board, model PIA-1 priced at $65 assembled, to mate with MSI 6800 or Southwest Tech 6800 computer. The single-drive FD-8 kit is priced at $1150; the dual-drive FD-8D kit is $1950. Assembled and tested, the FD-8 is $1400 and the FD-8D is $2300.

■ *MSI B-100 CRT Terminal*—A 12-inch video terminal with 24 lines of 80 characters each. The B-100 is priced at $1400 assembled and tested.

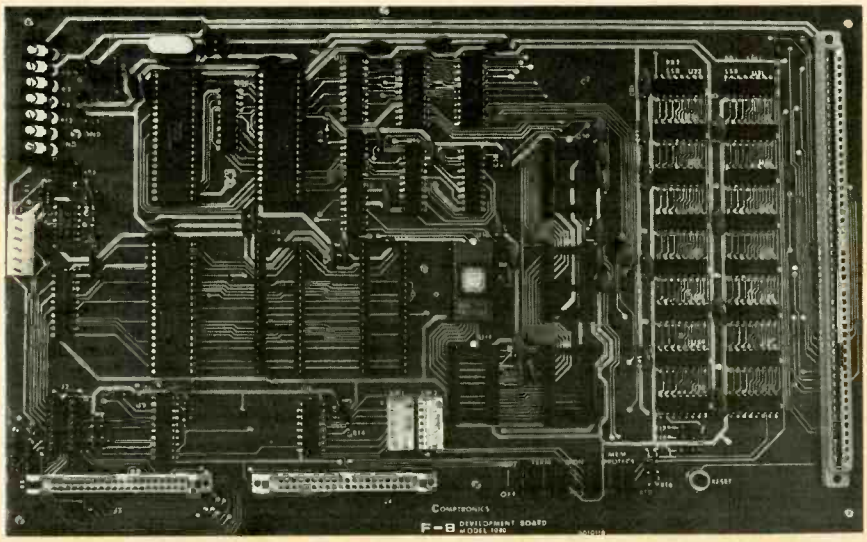
North Star Computers, 2547 Ninth Street, Berkeley, CA 94710

■ *Horizon*—Mainframe computer with built-in mini-floppy disk drive requiring input and output terminals for operation. Uses the Z-80 microprocessor. Comes with 16K RAM memory. The disk drive provides an additional 90K memory per diskette. Comes with extended BASIC on a diskette. Uses the S-100 bus. Plug-in boards are available for serial interface and memory expansion. The Horizon-1 with single disk drive is priced at $1600 in kit form and $1900 assembled. The dual-drive Horizon-2 is $2000 in kit form and $2350 assembled.

Ohio Scientific, 11679 Hayden, Hiram, OH 44234

■ *Challenger IIP*—Integrated computer with built-in keyboard and cassette interface. Uses the 6502 microprocessor. Has built-in BASIC in 8K ROM, and 4K of RAM. Can be expanded to 36K. Has built-in video interface permitting any tv set to be used as video terminal. Video output is 32 lines of 64 characters each. The Challenger IIP can be used with any Ohio Scientific 400 series peripherals and is priced at $600 assembled and tested.

■ *Challenger III*—Mainframe computer with dual floppy disk memory uses new triple processor that can run programs written for the 6502, 6800, 8080 or Z-80 microprocessors. Comes with 32K or RAM. Requires additional input and output terminals. The Challenger III is priced at $3500 assembled and tested.



Not all computers come in fancy cabinets. You can also buy your computer in boards-only form from several manufacturers. Among these is Technico, which in addition to a complete computer in a box, also offers its 9900-SS computer board. Although lacking a power supply and packaging, the 9900-SS can process 16-bit words and comes compete with a 3K-word built-in memory.

Pertec Computer Corporation, Microsystem Division, 20630 Nordhoff Street, Chatsworth, CA 91311

■ *iCOM attache*—Integrated computer with built-in keyboard, requiring output terminal for operation. Uses the 8080 microprocessor. Comes with 1K RAM with provisions for three 256-byte PROMS on the board. 16K RAM is available as extra cost option, expandable to 64K. Has built-in video interface providing 16 lines of 64 characters each. Has RS-232 serial interface. Price on request.

■ *MITS Altair 8800b*—mainframe computer requiring input and output terminals for operation. Uses the 8080 microprocessor. Comes with 1K RAM with provisions for 1K PROM. Has serial input/output interface port. 16 slots are provided for additional memory and interface boards. Price on request.

■ *MITS Altair 680b*—Mainframe computer requiring input and output terminals for operation. Uses the 6800 microprocessor. Comes with 256-byte PROM monitor and 1K RAM, with 16K available as extra cost option. Has RS-232 serial interface. Price on request.

PolyMorphic Systems, Inc., 460 Ward Drive, Santa Barbara, CA 93111

■ *Poly 88*—Small, personal mainframe computer. Uses the 8080A microprocessor. Comes with ½K RAM and 1K ROM, with provisions for an additional 2K ROM. Accepts up to five additional memory boards. Uses the S-100 bus. Several Poly 88 mainframes can be combined to form a higher capacity mainframe. Has built-in video interface permitting any tv to be used as a video terminal with 16 lines of 32 characters each, expandable to 64 characters. Cassette interface board also included. The Poly 88 is priced at $750 in kit form, and $950 assembled and tested. A disk upgrade kit providing full floppy disk memory is available for $1450.

■ *System 8813*—Integrated computer with remote keyboard, remote video terminal and built-in single mini-floppy disk drive. Uses the 8080A microprocessor. Includes 17K RAM and 3K ROM memories. The disk drive provides an additional 90K of memory per diskette, and can be expanded to dual or triple drive. The video terminal has a nine-inch screen with 16 lines of 64 characters each. Comes with 11K BASIC. The System 8813 is priced at $3250 assembled and tested. Additional disk drives are $600 each.

Processor Technology Corporation, 6200 Hollis Street, Emeryville, CA 94608

■ *Sol-20*—Mainframe with input keyboard requiring output terminal. Uses the 8080 microprocessor. Comes with 8K memory, expandable to 32K. Uses Sol BASIC. Uses the S-100 bus. The Sol-20 is

priced at $1350 in kit form; $1850 assembled and tested.

Radio Shack, 2617 West Seventh Street, Fort Worth, TX 76107

■ *TRS-80 Micro Computer System*—Integrated computer system with remote keyboard, remote video terminal and remote cassette memory system. Uses the Z-80 microprocessor. Comes with 4K ROM and 4K RAM memories, expandable to 12K ROM and 16K RAM. Video Terminal has 12-inch screen with 16 lines of 64 characters each. Comes with Level-1 BASIC in ROM and one game program in cassette. Payroll, mathematics, kitchen menu and personal finance programs in cassette are available. The TRS-80 is priced at $600.

RCA Corporation, RCA Solid State, Somerville, NJ 08876

■ *VIP*–Integrated hobbyist computer with built-in keyboard requiring an output terminal for operation. Uses the RCA COSMAC CDP1802 microprocessor. Comes with half-byte ROM operating memory and 2K of RAM, expandable to 32K. Has video interface for use with tv monitor terminal, and 100-byte-per-second cassette recorder interface. All of the circuitry is on one printed board with each empty socket identified by number. Uses unique CHIP-8 language developed for VIP computer. Has unique 44-pin input/output interface. The RCA VIP computer is priced at $250 in kit form and $300 assembled. A video monitor, model TC1210, is available for $170 additional when purchased with the VIP.

Southwestern Technical Products, 219 West Rhapsody, San Antonio, TX 78216

■ *SWTPC 6800 Computer System*—Mainframe computer requiring input and output terminals. Uses the 6800 microprocessor. Comes with monitor ROM and 4K of RAM, expandable to 32K. Input and output data is in base-16 hexadecimal. Has built-in RS-232 serial interface. The SWTPC 6800 is in kit form for $400 and assembled for $500.

Technical Design Labs, Research Park, Princeton, NJ 08040

■ *Xitan Alpha 2*—Mainframe computer requiring input and output terminals for operation. Uses the Z-80 microprocessor. Comes with 2K ROM and 18K RAM, expandable to 64K. An 8K zapple BASIC cassette is also included. Uses the S-100 bus. Has one parallel and two serial input/output ports. The Xitan Alpha 2 is $900 in kit form and $1150 assembled.

Technico Incorporated, 9130 Red Branch Road, Columbia, MD 21045

■ *TEC-9900-SS Super Starter System*—A board-only computer built around the 16-bit TMS-9900 microprocessor. Requires power supply, and input and output terminals for operation. Comes with 1 K-word ROM, 1 K-word EPROM and 1 K-word RAM, equal to 2K bytes of each. Uses 16-bit bidirectional data bus. Has built-in EPROM programmer and RS-232 serial interface. The TEC-99-SS is available in kit form for $300 and assembled for $400.

Vector Graphic Inc., 717 Lakefield Road, West Village, CA 91361

■ *Vector 1*—Mainframe computer requiring input and output terminals for operation. Uses 8080A microprocessor. Comes with 1K RAM and space for user-added 2K or EPROM. Has ½K ROM monitor. Uses the S-100 bus. Space provided for up to 18 additional memory boards. Also available with provisions for built in mini-floppy disk drive as Vector 1+. The Vector 1 is priced at $620 in kit form and $820 assembled. The Vector 1+ is an additional $40 less disk drive.

VideoBrain Computer Company, 150 Wolfe Road, Sunnyvale, CA 94086

■ *VideoBrain*—An integrated computer with built-in keyboard. Uses any black and white or color tv set as the output terminal. Uses an Umtech 8-bit microprocessor. Very similar to video game but has full computer function as well. Comes with 4K ROM and 1K RAM. Programming is available in plug-in cartridges containing up to 13K of RAM and ROM, as required by the program involved. Comes with two joystick controllers for video games. Program cartridges currently available include finance, cash management, real estate analysis, music instruction, math, work skills, and many video games. The VideoBrain is priced at $500. Program cartridges are $20 each.

The VideoBrain home computer is a first cousin to the video game. It uses the same cartridge programming as do the programable games, but also has a built-in keyboard that lets you enter your own programs and data. Although not as versatile or expandable as some of the conventional computers, the VideoBrain is ideal for handling the kind of computer jobs most families are likely to need done.

Zentec Corporation, 2400 Walsh Avenue, Santa Clara, CA 95050

■ *ZMS-50 Intelligent Terminal*—Integrated desktop computer with built-in keyboard and video terminal. Uses the 8080A microprocessor. Comes with 8K ROM/PROM and 4K RAM and 16K optional. Has 96-key upper and lower case ASCII keyboard with 12 additional function keys. The video terminal has a 12-inch screen with 24 lines of 80 lines each, with additional 25th control line. Has RS-232C serial interface with half or full duplex operation. Price on request.

■ *ZMS-70*—Integrated desktop computer with built-in video terminal, keyboard and dual mini-floppy disk drive. Uses the 8080A microprocessor. Comes with 12K ROM/PROM and 16K RAM, expandable to 64K. Dual disk drives provide additional 71.5K of formatted memory per diskette. Has 96-key upper and lower case ASCII keyboard with 16 additional function keys. The video terminal has a 15-inch screen with 25 lines of 80 characters each. Has RS-232C serial interface. A parallel interface for use with correspondence printer is available as an extra-cost option.

Private telephone:

simple two-station intercom

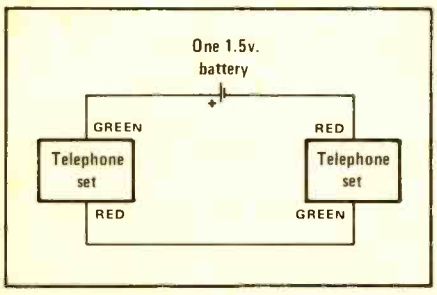
Got a couple of extra unused telephones around the house? Build this easy one-night project and make your own private intercom system. Your kids will love it. And you will too.

ME photos: Pete Stark

BY PETE STARK

Even though it's only been legal for a few months to connect your own extension phone to your telephone line, subject to some stringent rules, extra telephones have been sold by many electronics and department stores for years. If, like many people, you have an extra phone or two just gathering dust, why not use it for a *private* telephone system of your own?

A two-phone telephone system is just like an intercom, except that regular telephone sets are used at each end instead of speaker-type "squawk boxes." You can use it between parts of your house, or even between adjacent houses. Better yet, your kids will just love having their own telephones which they can use to their heart's content.



The simplest form of telephone intercom consists of two phones in series with a battery. When both phones are off the hook, the circuit is powered. When both or either one of the phones is on the hook, the circuit is dead.

The telephone system described here is a two-station hook-up. It uses just one talking circuit to connect the two phones. A separate signaling circuit shares the same two connecting wires with the talking path. Signaling the other party to answer the phone is automatic. Just pick up the phone, and a small tone generator at the other end of the connection goes *beep beep beep*. When the phone is answered the beeping stops.

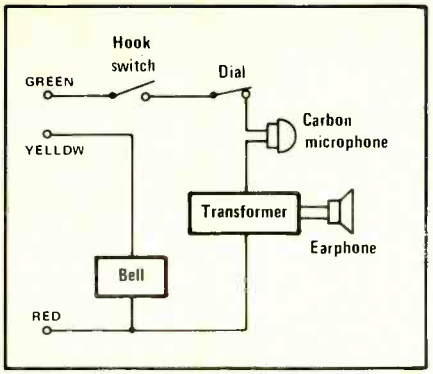
Easy to build

Most modern telephones use three wires. The internal bell is connected to the yellow and red leads. The rest of the phone is connected between the green and red leads.

Although there are many parts to a telephone set, in a simplified circuit there are four components in series: the hook switch, which opens the circuit when the handset is placed in the cradle; the dial; a carbon microphone in the handset; and a complex transformer circuit feeding the earphone. In a rotary dial telephone, the dial switch is normally closed and completes the circuit. Pushbutton phones have a slightly different connection for the dial, but the rest is quite similar.

Since the microphone is a carbon type, a source of direct current is needed for its operation. In the regular telephone system a 48-volt supply is used, but even a 1.5-volt dry cell can provide enough power for talking. If the dry cell battery is connected between the red and green leads, current will flow through the microphone and transformer, with the result that sounds picked up by the mike will be heard in the earphone. The simplest telephone intercom consists of just two telephone sets and one battery, all connected in series.

In a series connection, a small current flows from the battery and through the two phones, so that both phones carry the same current. Each earphone will then reproduce the sound picked up by both microphones, and two persons can talk to each other. No extra on-off switch is needed by the circuit, since hanging up either telephone breaks the series circuit as the hook switch opens. A tiny



The typical modern telephone has four major components connected in series. The hook switch, which is open when the phone is on the hook, the dial mechanism, microphone and earphone. The bell is independent of the voice circuit.

current flows only when both phones are off the hook, and so a single C or D cell can last a year or more.

Answer the phone

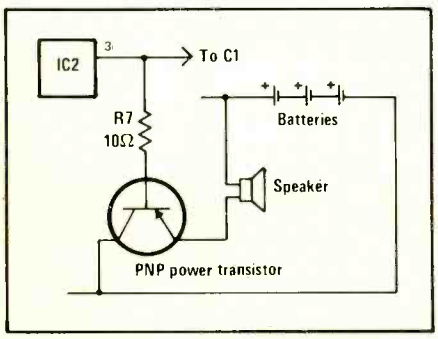
Although this system can provide useful conversation for two or more persons, there is no easy way of ringing the built-in bells in each phone. The normal bell in the telephone won't work on direct current. It requires a voltage of about 100 volts at 20 Hertz for its operation. Generating such a high voltage at 20 Hz is difficult and expensive.

If the bell worked at 60 Hz, some kind of transformer could be used to provide the bell voltage. But, it might not be very safe to do so!

A simple alternative is to provide a separate bell or buzzer with a pushbutton at each end of the system. It involves adding either a third wire to connect the two telephones, or an elaborate switching circuit to share the same two wires for both talking and ringing.

By using a few transistors and integrated circuits, you can build a completely automatic tone "beeper" which replaces the bell. Two beepers are needed, one at each end of the circuit, connected directly across the telephone set. But you'll still need only two wires to make the complete circuit path between the two phones.

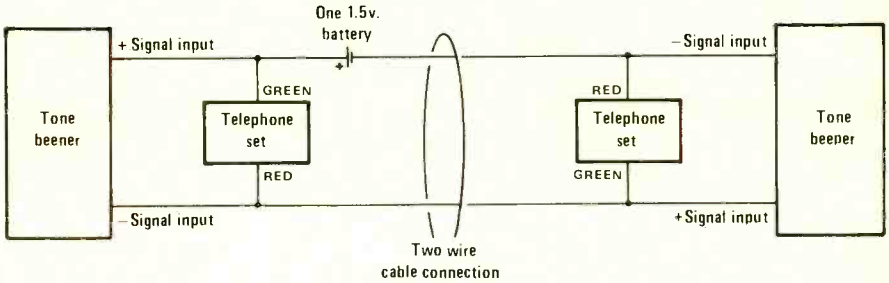
Almost any kind of inexpensive wire can be used—line cord, bell wire, speaker wire, even tv antenna wire. Over short distances, a radiator pipe or water pipe can be used instead of one wire. If speaker wire or similar two-conductor wire is used, the two telephones can be separated by thousands of feet and still work.



The volume level of the beeper can be increased by adding a PNP power transistor between the output of IC2 and the speaker. Although battery life will be shortened, they should still provide months of service in normal use.

tant. The easist, of course, is to use the printed circuit boards available, or make some from the layouts shown. But, any other type of construction will work.

The addition of one transistor can boost the volume by several times, as shown in the diagram. An inexpensive PNP power transistor is simply connected between IC2 and the speaker, as shown. Although the modified circuit requires substantially more current during beeping, the batteries will still last many months in normal use.



Automatic signaling is provided by a pair of beepers connected across the two telephones. Lifting one of the phones off its hook causes the beeper on the other phone to signal the presence of an incoming call.

The beepers are completely automatic, and require no switches or pushbuttons. Each beeper has a simple circuit which monitors the telephone line and activates the tone generator which drives a small speaker. When both telephones are hung up, or both are picked up, the beepers are silent. But whenever only one telephone is picked up, the other beeper goes *beep beep beep*. So to place a call, all you need do is pick up your telephone handset and wait.

Its easy to build

The circuit is noncritical and the parts layout can be changed to fit whatever you have on hand. The capacitor and resistor values can be twice as large or half as large, and the circuit will still work. But, it may sound a bit different. Still, one *beep* is a good as another.

The electrolytic capacitors can have any rating from 6 volts to 35 or more, and either ½-watt or ¼-watt resistors can be used. The most critical parts are diode D1 and transistor Q1. D1 should be a silicon diode, not germanium, and should be of fairly good quality. A signal diode such as a 1N914 or 1N4148 is best. Transistor Q1 should be a silicon NPN signal transistor, not a power transistor, and should have fairly good gain.

Parts are easily obtainable at electronics or tv supply stores. The parts list gives Radio Shack parts numbers as well. If D1 or Q1 are marginal, the beeps may sound rather sick, if the gain of Q1 is low, or the speaker may beep or click even when both phones are hung up.

As shown in the photographs the tone beepers can be built in various ways. The exact style of construction is not important. The easist, of course, is to use the printed circuit boards available, or make some from the layouts shown. But, any other type of construction will work.

Another modification may be needed if you live close to a commercial radio transmitter or a high-powered CB radio operator. In the presence of strong radio frequency signals, some interference may be picked up by the telephone wires between the two phones. In mild cases, this will simply be heard on the telephone while speaking. In severe cases, it may trigger the beepers when they should be silent, or may even be heard through the speakers. Installing two or three 0.01 uf or 0.1 uf disk capacitors directly across the signal leads at the tone beepers, or directly across the red

Parts list

Part number	Description	Radio Shack number
C1	.001 mfd disk ceramic	272-126
C2, C5	0.1 mfd disk ceramic	272-135
C3, C4	25 mfd electrolytic	272-1026
D1	1N914 or 1N4148 diode	276-1122
IC1, IC2	555 timer IC	276-1723
Q1	2N2222A or equivalent	276-2014
R1	100 ohm	*
R2	100K ohm	*
R3, R4	27K ohm	*
R5, R6	4.7K ohm	*
R7	10 ohm	*
Spkr	8-ohm to 45-ohm speaker	40-262

Notes: All resistors can be ¼-watt composition type such as Radio Shack's 271-1300. series. Printed circuit boards can be made from template shown in the article. Etched, plated and drilled boards are available from Star-Kits, P.O. Box 209, Mt. Kisco, NY 10549 for $7 a pair.

Include self-addressed stamped envelope, and if a New York State resident, the appropriate sales tax. Any enclosure, batteries and battery holders and hardware can be used to complete the project.

How it works

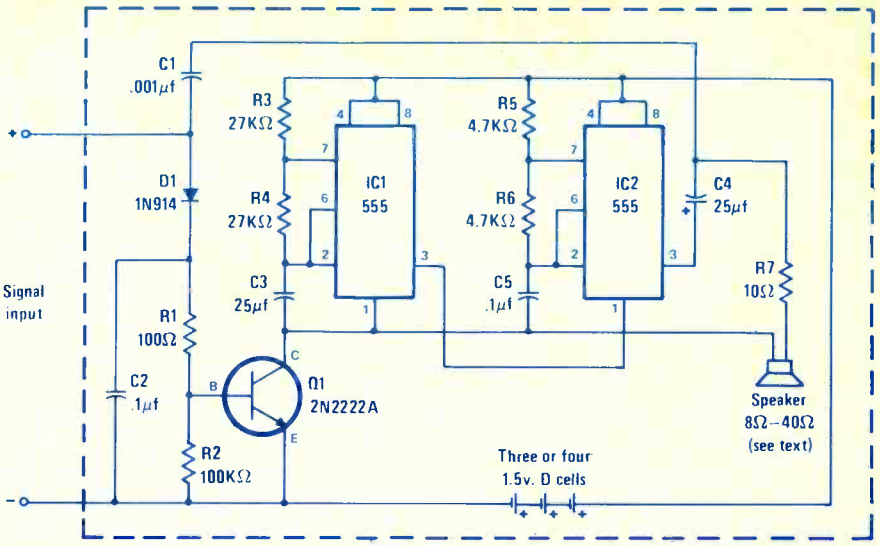
As the schematic diagram shows, each beeper consists of a transistor, Q1, two integrated circuits, IC1 and IC2, and a handful of small parts. The entire circuit is powered by three or four 1.5-volt dry cells, which provide between 4 and 6 volts dc power and should last many months in normal use. Both integrated circuits are 555 timers which are connected so as to oscillate. IC2, when operating, oscillates at about 1000 Hz, and its output drives a small speaker through capacitor C4 and resistor R7. When oscillating, it sends a constant *beeeeep* to the speaker at a moderate volume. But it does not oscillate continuously, because it is controlled by IC1.

IC1 is also an oscillator, but in this case it only operates about once every three seconds. The output from pin 3 of IC1 drives pin 1 of IC2, so that IC2 generates a *beep* for about one second, and is turned off for about two seconds. Thus the two IC's together generate a series of beep-beep-beep sounds, which drive the speaker. The sounds are also coupled back into the telephone line to let the caller know that the other phone is "ringing." This coupling is done by capacitor C1.

IC1 and IC2 are not connected directly across the battery supply. The only way they can obtain power for operation is if transistor Q1 is energized. This connects pin 1 of IC1 to the negative side of the battery through the transistor. Hence, the transistor acts as a switch to turn the beeper on and off.

To turn Q1 on, you must supply a voltage of about 1 volt or more between + and – signal input leads. When both phones are hung up, the 1.5 volts supplied by the single battery in series with the two phones splits up, with about 0.75 volts across each phone and its beeper. Likewise, when both phones are picked up and being used, the 1.5 volts splits up with 0.75 volts across each beeper. Either way, each beeper sees less than 1 volt, and hence transistor Q1 is turned off and the beeper is silent.

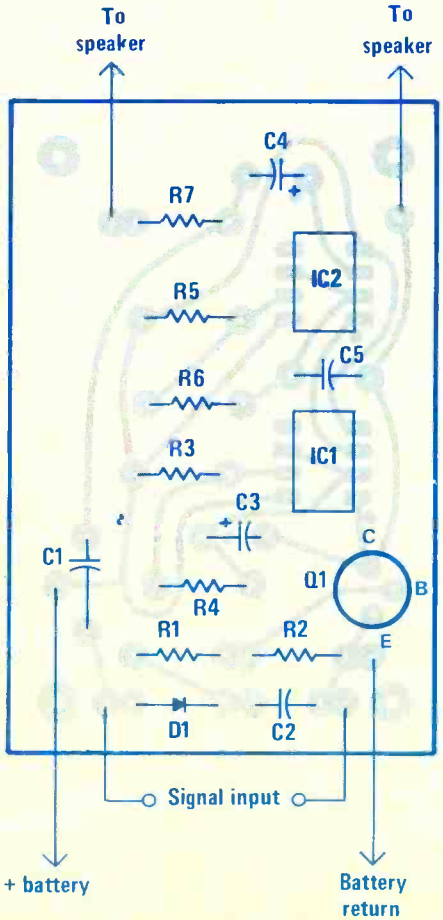
On the other hand, if one phone is picked up while the other remains hung up, the voltage splits unevenly. The phone which is hung up has a high resistance since its hook switch is open. The other phone has a low resistance. As a result, the beeper which is connected across the phone which has been picked up sees a very low voltage. The other beeper, however, sees close to 1.5 volts and beeps. In this way, when you pick up one phone you automatically cause the other to "ring." The beeping stops when the other party answers, or you hang up.

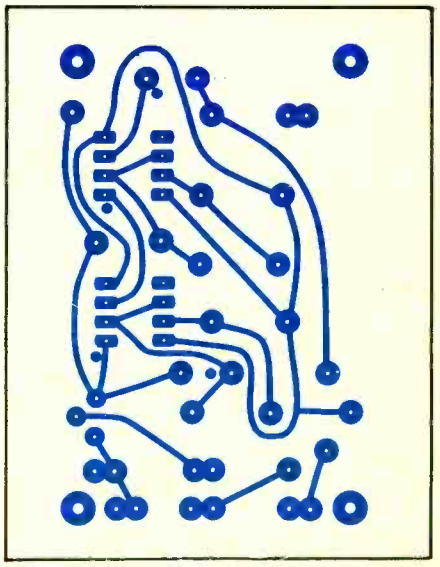


Each signal beeper consists of just two ICs, a transistor, and a handful of small parts, most of which you probably have in your junk box. The values shown are not critical. You substitute values up to twice as large, or half as large without affecting performance beyond changing the sound of the signal beeping.

and green telephone leads, should eliminate the interference. In very severe cases it may be necessary to experiment with exact placement of the capacitors.

An extension telephone can be connected in parallel with one of the existing phones, but one of the beepers may sound whenever all three telephones are picked up at once. If an extension beeper is needed, additional 8-ohm speakers can be connected in series with the speakers shown and placed in another room. As many as three or four speakers can be used with each beeper circuit without reducing the overall volume. Somewhat greater volume will be obtained if 20- or 30-ohm speakers are used.

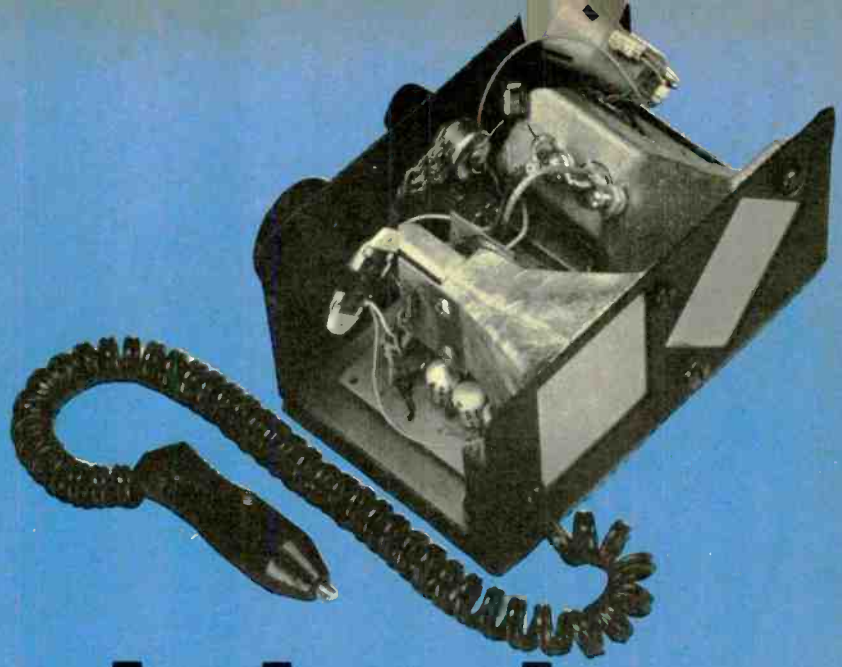




Using a printed circuit board will simplify construction. You use this layout to make your own boards, or purchase boards from Star-Kits. For details, refer to the parts list.

This circuit works best when two identical telephones or very similar ones are used. However, if a very new phone is used with a very old one, one of the two beepers may beep, or at least click, even though both phones are picked up. If you have a voltmeter, you can diagnose this problem by measuring the voltage across the two phones. There should be close to .7 volts across each. If one has substantially more voltage across it than the other, add a resistor in series with the phone having the lower voltage. Adjust the resistance so that the two voltages even out.

Bearfinder Two + Two offers both X and K band coverage with separate antennas for each band. Bearfinder, 221 Crane St., Dayton, Ohio 45403.



Radar detectors:

what's new, what works, what they'll do for you

Mad at the cops for spraying microwave radiation all over your body? Get a radar detector and be warned when those dangerous radio waves are nearby. Here's the story on the best new radar receivers you can use right now.

by Ron Cogan
Contributing Editor

Radar. In years past, this word would instantly bring to mind that sophisticated gadget used to track domestic aircraft by air traffic controllers, or perhaps the extensive network used by the military to ensure the safety of our country's airspace from hostile interests. Yep; visions of tracking apparatus swinging to and fro, occasional blips on a screen, and men intently scrutinizing the situation. But not anymore.

Radar has come to have a new meaning over the past decade—one which is not associated with a feeling of security or well-being. Specifically, we're referring to a *police radar* used in traffic enforcement throughout the world. In this country, radar use to enforce speed laws was, at one time, a viable tool that could do much in helping control traffic and ensure vehicular safety in high accident areas. However, many cities and municipalities have

Micro Eye Mk 1 by Bel offers X band radar reception, variable gain, and other features. Bel Sales USA, 32129 W. Lindero Canyon Road, Westlake Village, California 91361.

Convoy's Scout radar detectors is a sleek unit that boasts a parabolic antenna design, X and K capabilities, and a variable beep/flash rate that increases as you get closer to radar. Interstate Electronics, 1330 E. First St., Wichita, Kansas 67201.

Hawkeye detector covers X radar band, and offers sensitivity control, LED light, audio/visual warning selector, and more. Empire Machines, Shore Road, Glenwood Landing, New York 11547.

One of the newer detectors to emerge on the market is the Multi-Max dual band unit. The Multi-Max boasts separate antennas and circuitry for each band, individual fine-tuning, and standard or magnetic mount. APO Sales Co., 5201 S. Hampton Rd., Dallas, Texas 75232.

Micronta receiver is a low-cost X band detector that offers high gain antenna, sonar-alert that emits a high pitched warning of police radar, and more. Radio Shack, 2617 W. 7th St., Fort Worth, Texas 76107.

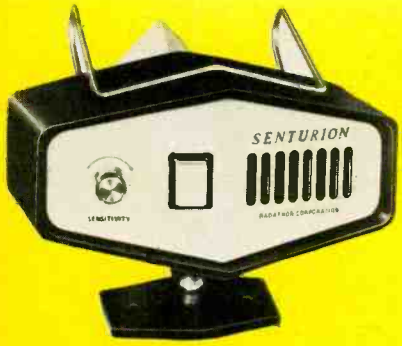
found that radar can also prove to be an invaluable aid in generating revenue. It's when radar is used in this way that motorists have a right to become indignant and take counter-measures.

Other than watching the speedometer like a hawk, anticipating abrupt drop-downs in posted speed limits, and keeping an eye peeled for radar traps, motorists have found the best answer to be a sophisticated black box called the radar detector. As most of our readers are already aware, these gadgets do quite a job in letting a motorist know that he is being monitored by police radar—before he is within range and can be clocked.

There has been a proliferation of X and K band radar detectors on the market because of the stepped-up police radar enforcement, and it's likely that the number will grow even larger as the months pass. It is estimated that over 3 *million* detectors will be in use by the year 1980 to counter the 100,000 police radars expected to be deployed. The following is just a sampling of the available detectors you can choose for your electronic arsenal—read on!

The Shadow is a unique product from Bel that converts all quality radar detectors into hidden detectors—a handy item since detectors have been outlawed in some states. Bel Sales USA, 32129 W. Lindero Canyon Road, Westlake Village, California 91361.

Electrolert's Fuzzbuster II, a great performer covering X and K radar bands. Electrolert, 4949 S. 25-A, Troy, Ohio 45373.



Senturion radar detector monitors X band and offers dash or visor mount, sensitivity control, permanent or plug-in electrical hookup. Radatron, 2424 Niagara Falls Blvd., North Tonawanda, New York 14120.

Autotronic's new Long Range Super Snooper boasts positive over-the-hill and around-the-curve detection, X and K operation, and variable speed beeping. Autotronics, 1399 Executive Dr. West, Richardson, Texas 75081.

Fantastic Offer

on the BEARCAT 210 Programmable Scanner

SPECIAL
$224.95

Bearcat® 210 Features

- **Crystal-less**—Without ever buying a crystal you can select from all local frequencies by simply pushing a few buttons.
- **Decimal Display**—See frequency and channel number—no guessing who's on the air.
- **5-Band Coverage**—Includes Low, High, UHF and UHF "T" public service bands, the 2-meter amateur (Ham) band, plus other UHF frequencies.
- **Deluxe Keyboard**—Makes frequency selection as easy as using a push-button phone. Lets you enter and change frequencies easily . . . try everything there is to hear.
- **Patented Track Tuning**—Receive frequencies across the full band without adjustment. Circuitry is automatically aligned to each frequency monitored.
- **Automatic Search**—Seek and find new, exciting frequencies.
- **Selective Scan Delay**—Adds a two second delay to prevent missing transmissions when "calls" and "answers" are on the same frequency.
- **Automatic Lock-Out**—Locks out channels and "skips" frequencies not of current interest.
- **Simple Programming**—Simply punch in on the keyboard the frequency you wish to monitor.
- **Space Age Circuitry**—Custom integrated circuits . . . a *Bearcat* tradition.
- **UL Listed/FCC Certified**—Assures quality design and manufacture.
- **Rolling Zeros**—This *Bearcat* exclusive tells you which channels your scanner is monitoring.
- **Tone By-Pass**—Scanning is not interrupted by mobile telephone tone signal.
- **Manual Scan Control**—Scan all 10 channels at your own pace.
- **3-Inch Speaker**—Front mounted speaker for more sound with less distortion.
- **Squelch**—Allows user to effectively block out unwanted noise.
- **AC/DC**—Operates at home or in the car.

Bearcat® 210 Specifications

Frequency Reception Range

Low Band	32—50 MHz
"Ham" Band	146—148 MHz
High Band	148—174 MHz
UHF Band	450—470 MHz
"T" Band	470—512 MHz

*Also receives UHF from 416—450 MHz

Size
10⅝" W x 3" H x 7⅝" D

Weight
4 lbs. 8 oz.

Power Requirements
117V ac, 11W; 13.8 Vdc, 6W

Audio Output
2W rms

Antenna
Telescoping (supplied)

Sensitivity
0.6μv for 12 dB SINAD on L & H bands
U bands slightly less

Selectivity
Better than −60 dB @ ± 25 KHz

Scan Rate
20 channels per second

Connectors
External antenna and speaker; AC & DC power

Accessories
Mounting bracket and hardware
DC cord

We've stocked up on a sizable inventory of these fine Bearcat scanners. But even our healthy inventory won't last long at this price. Place your order today and be certain of getting in on this exciting offer.

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

How many noises could a noise blanker blank if a noise blanker could blank noise?

Static in your mobile CB radio kills the fun. So you kill static with the noise blanker built into your radio. And hams and shortwave listeners use noise blankers too. Here's the straight scoop on what they'll do and how well they'll work.

by George McCarthy

A properly operating *noise blanker* can be a great asset to a receiver, particularly one operating in the high frequency and very high frequency ranges. One can, in fact, save a signal from complete obliteration and allow a ham or CB operator to make a contact that would otherwise have been impossible.

Before we look at *noise blankers* and how they do their job, we ought to take a good look at what we mean by *noise*. "Noise," you might say, "is just noise—anything coming out of the speaker that isn't the sound I want to hear, so what's to look at?"

If it were that simple, the task of the designer of radio receivers would also be simple. In fact, "noise" is quite a complex problem to deal with and the "noise blanker" is only one method of dealing with it, actually only a part of it.

Let's define noise in the general terms of any signal that we can hear that is not related to the generation and transmission of a radio signal. It is essential that we separate interference from other radio signals (QRM) from that generally referred to as static (QRN).

Interference from other radio stations is a common problem on both CB and ham band frequencies. About the only protection from that type of interference lies in the ability of the receiving system to reject signals that are very close to the frequency the receiver is tuned to. This will be a function of the directivity of the antenna, the receiver's immunity to front-end overload and its image rejection, and ultimately, its selectivity.

Interference of this type can be caused by another station being too close to the received frequency, so powerful that it is overloading the receiver's initial tuned circuits, or being operated in an improper manner—usually by overmodulation—so as to cause spurious signals, widely known as buckshot, splatter, or hash and trash.

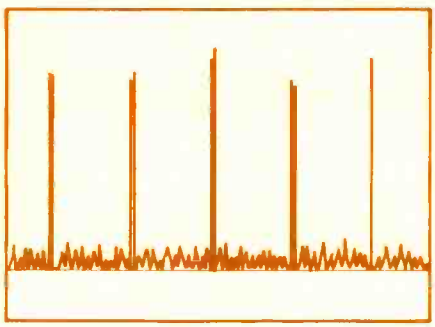


Figure 1 Showing noise spikes at intervals in a general low noise level.

If the bandpass frequency of the receiver can be made narrow enough, most of this type of interference can be either reduced or eliminated. Of course, if another station is right on top of the frequency, or in the same CB channel, there is not much any equipment or circuits can do to separate what you want to hear from what you don't want to hear.

Surprisingly, a good tuneable audio filter can frequently allow an operator to listen to either of two voices or code signals coming through with the same strength. It does this by enhancing certain audio frequencies over all others.

If we tune the signal carefully, we can select a certain limited range of audio to concentrate on. The rest is done by that marvelous mechanism inside of our heads that allows our brain to select and concentrate on one thing to the exclusion of all others—much as we can hear what our boss is saying at a cocktail party in spite of all the extraneous noise.

But the interference from sources other than other radio signals is another problem. Here it can come in all shapes, sizes and varieties and from numerous sources. We may be faced with power line leaks or arcing over, various household appliances, such as vacuum cleaners, mixers, heating pads, refrigerators, sewing machines and doorbells. Then there is ignition noise from automobiles and trucks, atmospheric disturbances, diathermy machines, industrial equipment, lighting, thermal agitation and finally, from the receiver itself.

The Southern California Edison Company has even made tape recordings of various types of interference which a

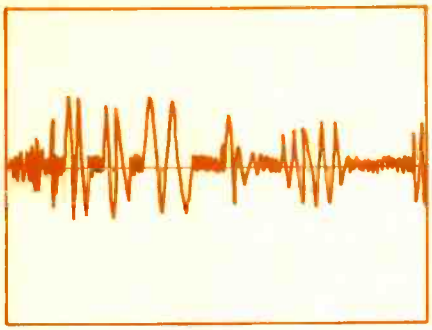


Figure 2 Showing a typical modulation pattern of varying amplitudes and frequencies of the human voice.

trained ear can usually identify as to source. It is true that there is a distinctive sound to certain noise sources and a person can often relate the sound to a specific item. Unfortunately, identifying the source does not necessarily help in eliminating the interference.

What would cause a particular noise to even be identifiable? To answer this we must examine the parameters that all noise sources have in common, amplitude, pulse frequency and pulse width.

In other terms, how strong are they, how often do they happen and how long does each individual bit last? Each type of noise will have all three of these characteristics, and it is the recognition of them that allows us frequently to identify the source of the noise.

We can not only hear the noise, but if the signals coming through the receiver are connected to an oscilloscope we can often see the noise. Now, there is always some noise present in any receiver, no matter how expensive or elaborate the design. We can start with the fact that the receiver itself generates a certain amount of noise.

The internal noise in a receiver is generated by electron movement, particularly in the input circuit resistance, and in the tubes or transistors used to amplify signals. It is known as the receiver's noise figure and is the ratio in decibels between the noise internally generated in a receiver and a so-called perfect receiver with a noise figure of 3 db.

Then we have noise that is a part of the antenna system. In fact, if we took an antenna and put it inside of a shielded room, free of outside signals, there would still be noise coming off of the antenna leads. This again is the result of thermal agitation of the molecular structure causing random movement of electrons which generate a small, but measurable, voltage.

By this time you may be wondering how in heck the receiver can discriminate anything if it and the antenna are the sources of noise before any signals are even received.

In fact one of the important measures of a receiver's performance is its signal to noise ratio. It is an expression of the principle that it will do no good to have a receiver of extreme sensitivity if, in the process of being so sensitive, it generates so much internal noise that it may obscure small signals by burying them underneath its own noise.

The internal noise of most receivers is not a real problem in the high frequency ranges up to about 50 MHz, for the external noise is usually so much greater as to obscure it. Above 50 MHz the noise figure of the receiver becomes more important, since there is less man-made noise in the VHF and UHF regions.

The sensitivity of a receiver is normally defined as the minimum signal with which a 10 db signal plus noise to noise ratio may be obtained.

Any good receiver (or transceiver) should specify this figure as so many microvolts of signal that will produce S+N/N ratio of 10 db. Many manufacturers use the less accurate S/N ratio, for by considering only signal versus noise and not adding the noise to the signal (when it obviously will always be there) makes their specs look better.

A modern receiver will meet this requirement with signals as little as one half of a micrvolt and, on the higher frequencies as little as one quarter microvolt.

This is normally far more sensitivity than is needed or used by a receiver, for

Figure 3 Showing the noise spikes rising above the level of the voice modulation. They will be heard as "popping" noises.

atmospheric and man-made static is of too high a level to make the utilization of this much sensitivity practical, but it is a measure of capability.

Okay, we said that the noises we may hear coming out of the loudspeaker could be seen on a scope. Figure 1 shows the typical noise spikes made by an automobile ignition system running at a fast idle. In this illustration we are showing only the general background level of noise as the grass that is at the bottom of the scope's horizontal line.

As soon as you turn your receiver on you can hear a hiss that represents the internal noise of the set. When you hook it up to an antenna, much more noise becomes apparent as intermittent bursts of static and, perhaps, other hash or grinding sounds. The total of this normal background level of noise is what generates the small peaks you see on the scope.

The vertical line on the scope represents the power or amplitude of the signal. The stronger it is, the higher the line will be.

The horizontal line on the scope represents the time element involved, actually a spot sweeping across the face of the cathode ray tube at intervals so quick that the retention of the image on the screen makes it appear as a solid line.

If you examine the lines on Figure I you can see that the amplitude (power) of the impulses from the ignition noise is much greater than the amplitude of the general background noise. You can also see that each pulse or spike rises rapidly to a maximum height and then drops back into the general level.

The shape of the pulse is determined by how quickly the amplitude builds up and how long it holds at peak power and the rate of decline.

Your ear would hear this noise as a continuous popping noise of fairly high intensity. You could, in fact, determine the approximate engine speed, and actually hear the changes as gears were changed. Some cars are more guilty than others of generating ignition noise. VWs are notoriously noisy and the Corvette, with a fibreglass body is a bear in this area.

What we are seeing, of course, is changes in amplitude. The problems start when we try to pass a radio signal through the same circuits. Figure 2 shows what a typical voice signal would look like on a scope. You will notice that the same characteristics are being displayed, amplitude, width and frequency.

Our voice patterns are infinitely complex, however, for they represent not only the basic tonal qualities of our voice, but also the mixing or beating of many frequencies together. Notice that the frequencies that are higher in the scale, changing many more times along the time scale, have less vertical power excursions than the lower tones, which, although cycling at a slower rate, have much greater amplitude. You are looking at amplitude modulation—even though it may be representing a single sideband signal.

Unfortunately, a noise happens also to be a form of amplitude modulation, since the power levels change rapidly in direct conformance with the pulse rate of the interference. When we have both signals present we are looking at a potential problem. Look at Figure 3. Here the noise spikes of the engine are coming in right along with the voice modulation of the station we are trying to copy.

If the source of the interference is quite close (maybe our own car if we are running a mobile radio) the intensity of the noise may be greater than the highest

point of amplitude of the voice signal. Certainly it will be greater than the average amplitude, which is typically only a third or less than the peak excursions.

What we will hear, if we are listening to the signal that is shown in figure 3, is an annoying popping sound that will distort the audio badly and might even cover up the modulation to the point that it is hard to tell what is being said.

What can be done about this situation? The easiest approach is to put in some kind of a device that will cut off the tops of those noise spikes to prevent them from being so much stronger than the tops of the modulation. This isn't too hard to do. We can accomplish the task by installing a couple of diodes and adjusting the bias voltage on them to control the point at which they will conduct. (see figure 4)

This circuit is simplicity itself and is called an automatic noise limiter or ANL. Such a circuit can be used at the radio frequency portion of the receiver or at the audio portion, after the signal has been demodulated (detected). Naturally, somewhat more complicated circuits are in use, but the basic principle remains the same—chop the head off of the interference monster so that it can't fight its way out of the speaker.

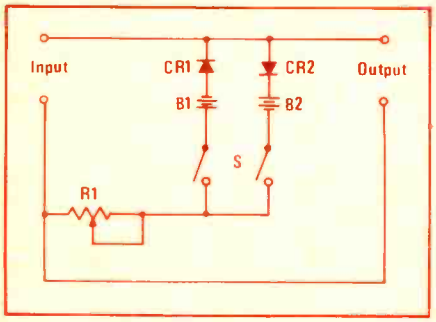


Figure 4 A simple noise limiter. The diodes can be biased by the batteries to "short out" voltage peaks made by noise spikes.

Unfortunately, there's a clinker in this scheme. Look at figure 3 again. Do you see what the problem is? The level of clipping can be lowered even further, so that even more of the noise spike is chopped off. But what is happening to the audio spikes of the normal modulation? Well, they get chopped off or clipped right along with the noise peaks.

We can only tolerate a certain amount of this clipping before we begin to generate a fairly severe distortion of the very audio we are trying to copy clearly. Now, the ANL has a very good use. It will do a reasonable job on almost any kind of noise that wants to poke its head above the audio level.

It can make copy much easier in the presence of a variety of noise pulses from the very fast to the fairly slow. But it is stuck with the fact shown in figure 5 that severe clipping of the noise pulse will also result in clipping of the audio too.

How can we give that radio signal at least an even break against that noise? Well, we know that, to a large extent, most noise is of the random type as far as frequency is concerned.

Noise from a vacuum cleaner or electric mixer will spread out over a very wide frequency, frequently creating havoc from as low as 3.5 MHz on up to 30 MHz. This means that we have no means of tuning it out at the front end of our receiver.

We can, however, use a receiver that has a good signal to noise ratio, and an antenna system that will give the received signal a good boost on its way to the receiver, and a sharply tuned bandpass that will let only as much frequency width come through as is needed to copy the signal. This is where CW (code) shines, for the width can easily be reduced to only a few hundred cycles—leaving only the smallest amount of room for that noise pulse to squeeze in with the code signal.

What we are trying to do is to increase the level of the received signal in relationship to the level of the noise. You see, the higher we can bring that signal up the vertical scale the more the noise will be obscured by the strength of the signal and the ANL will only have to deal with occasional spikes.

Now you see why we used the term receiving system rather than receiver when we began to talk about interference. A good beam antenna working into a moderate receiver will give you a better signal to noise ratio for a given noise condition than a good receiver attached to a moderate antenna system.

But, even with a good directive antenna, a receiver with excellent S+N/N ratio, very good selectivity, and minimum audio frequency response—we still get into situations where some local noise is so strong as to overwhelm the signal.

I should also mention that another circuit can come into play that causes problems. Your receiver will also have automatic gain control (AGC) in it. This circuit, which will be described in another article soon, acts automatically to keep very strong signals from blasting your speaker.

Like the governor on a motor, it acts to keep things leveled out to a constant volume—in fact, it used to be called automatic volume control (AVC).

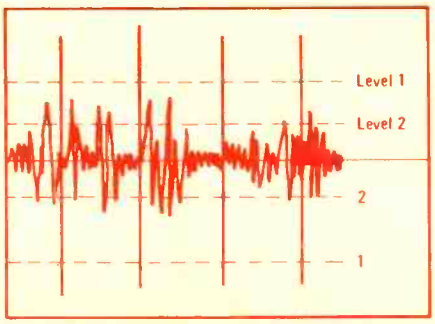


Figure 5 At level 1 the noise limiter will clip the noise spikes. At level 2 it will be clipping both spikes and modulation peaks, and distorting the audio.

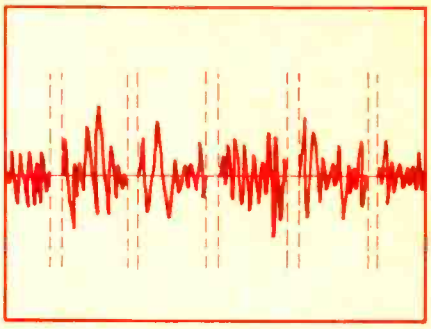


Figure 6 The blank spaces between the dotted lines represent the brief time when the noise blanker has turned off the receiver. We won't hear these "holes" in the audio, for they take place too fast.

But the very virtue of the AGC circuit that keeps a strong signal from sounding too loud can act against the radio signal in the presence of very strong noise pulses. The circuit will read the pulses as excessive signal voltage and it will take some of that voltage and send it back up to the front end of your receiver to cut down the gain of the receiver. Great, if it were a strong radio signal, but in this case it is the noise that is cutting down the gain, making our receiver less sensitive to the very signal we want to pick up!

"Holy smoke!" you now say. "Isn't there something that we can do to stop the damage that the noise spikes are doing?" Yep, we can put a noise blanker circuit into the receiver and cream that noise before it gets a chance to desensitize the receiver and argue with the modulated radio signal to see who is going to have the highest amplitude and wiggle the speaker cone the most. But how can we operate on those noise spikes when they are coming in right along with the radio signal and are, in effect, buried right in with the modulation?

Enter the noise blanker. This device selects those very pulses that are causing the problem.

It takes them and amplifies them. "Amplifies," you ask, "makes louder the very thing you are trying to get rid of?" Yes, amplifies the noise pulses. But we are leading them into a trap.

You see, we know that they have certain characteristics that we mentioned at the very beginning of this article. They have a certain pulse rate, and they have a certain amplitude and they can be shaped by our circuitry.

We can take the very energy that they represent and use it to trigger diodes that simply don't allow anything to pass for the length of time that the pulse exists.

But wouldn't that put a bunch of holes into the audio pattern and badly distort the audio, maybe even worse than the automatic noise limiter cranked too far down? If our hearing were so acute as to detect those extremely small gaps in

sound, your concern would be valid.

But, in point of fact, we don't even notice that anything is missing—except that the annoying popping noise is suddenly gone. Look at figure 6. It shows an exaggerated example of how the noise blanker works to remove the noise spikes completely.

Now, you should understand that noise blankers come in all levels of quality. I've worked with some receivers in which the so-called blanker was a laugh. I could detect no decrease in the noise level at all. Others work as if it were a magic switch.

A car drives past and the familiar popping noise starts to wipe out the signal. The NB switch is flipped on and the noise is gone—line g-o-n-e. I can't believe it, so I flip the switch off. Pop, pop, pop, goes the ignition, driving the meter up to over S-9.

You should be aware that because of the very principle that it uses, the noise blanker has its own limitations. It can't act with noise pulses that are very rapid to the point of being almost a continuous sound. Nor can it work with pulses that are not high enough in amplitude, but they won't be giving you much trouble anyway.

Also the very efficiency of the tuned circuits tends to alter the shape of the pulse, making it even harder to deal with, so a good place for the noise blanker is near the front end of the receiver.

Unfortunately, I've heard more complaints about noise blankers not operating properly than any other single part of a radio. There's no doubt that you get what you pay for in this area. For example, the noise blanker circuit in my Kenwood TS-900 contains two ICs, seven transistors, and five diodes, as well as a couple of crystals and seven tuned circuits. And it works very well.

Since the timing of the noise spikes is an important part of how the noise blanker functions you may find that there will be some pulses that the blanker doesn't seem to handle too well, while at other times it will completely wipe out the offending noise.

The dynamic pulse range over which a particular noise blanker works is a function of the component values that are selected in the design stage. Some manufacturers, such as the Stoner PRO-40 CB sideband radio, use two different timing circuits for the noise blanker, so the operator switches in the one which seems to fit the noise pattern best.

Because of the broad frequency coverage of most noise, and the limitations that we have discussed in both ANL and NB circuits, no receiver is ever entirely free from noise. The best solution is always to have a very strong signal at the antenna terminals of the receiver.

Such a signal will act to initiate AGC action which will cut down the gain of the receiver, making it less prone to picking up noise. In effect, the signal buries the noise, since the amplitude of the signal is much greater than the amplitude of the noise.

A good noise blanker is almost a must for comfortable mobile operation. Even if you have been successful in cutting down the noise generated by your own car, the ignition noise from other cars can cause problems. There is, of course, one other solution to the noise problem—fm. Frequency modulation, as the name implies, uses the shift in frequency to represent changes in power level, rather than changes in amplitude.

You can think of it as changes along the horizontal axis of our drawings. The noise that still exists as vertical lines is simply ignored by the fm receiver, which is designed to react to changes in frequency.

Before laying out any bread for a radio, you would be well advised to check the operation for yourself. Try the noise blanker under severe conditions to make sure that it works well. You should be aware that some types of very strong noise, such as the grinding hash of leaking high voltage power lines just can't be eliminated by any combination of automatic noise limiter or noise blanker, or if your wife decides to vacuum the hallway ouside of your radio room just as you are trying to drag in some rare DX station—you've got a domestic problem, not an electronic one.

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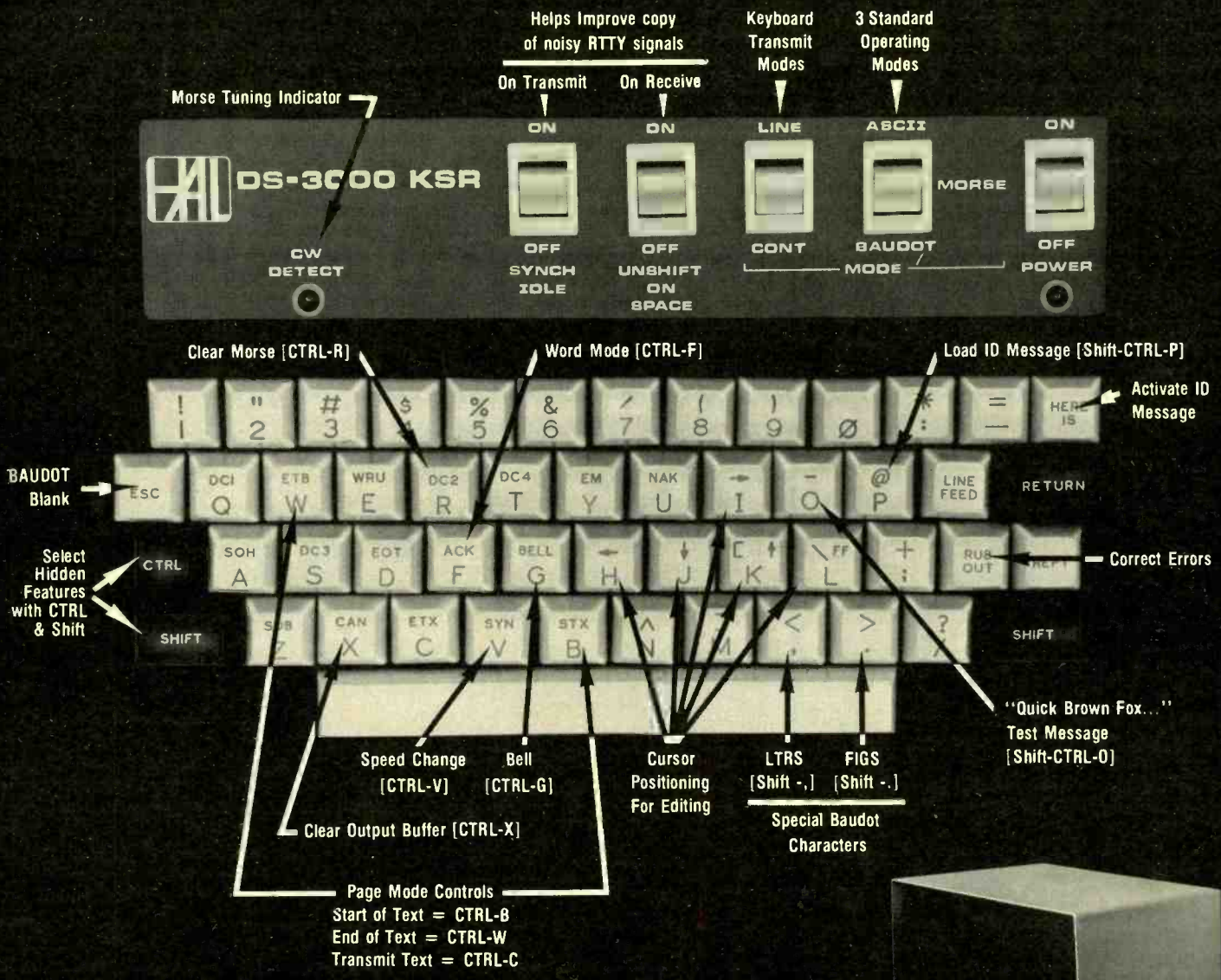

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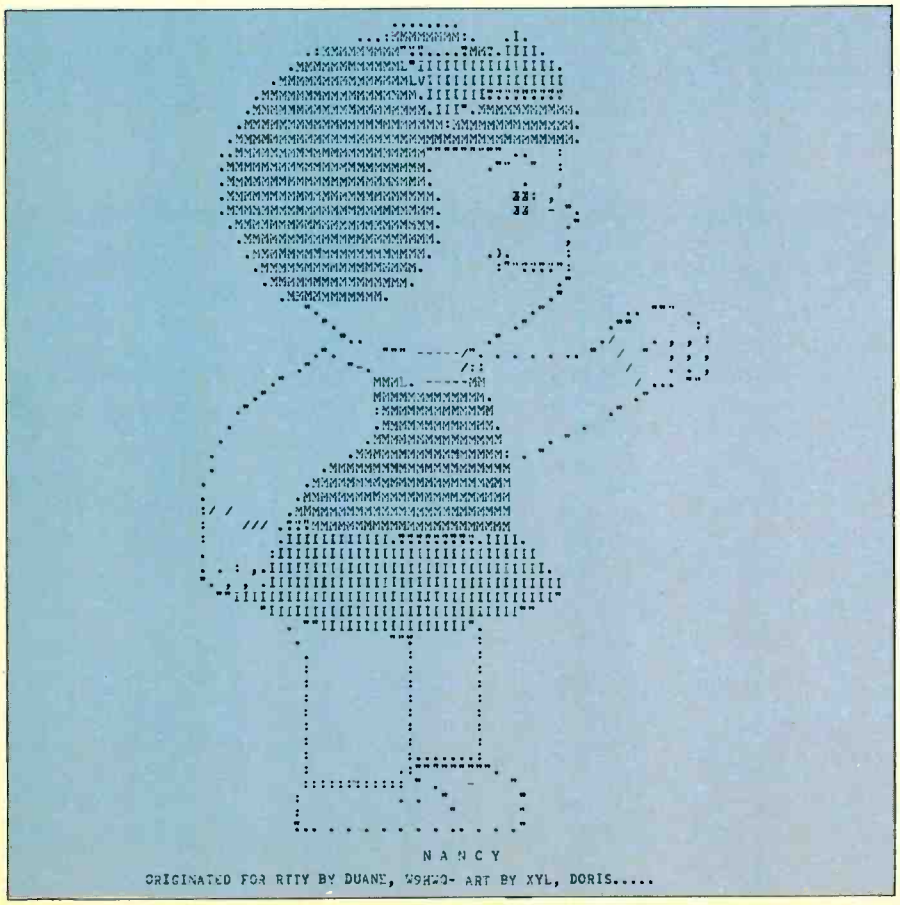
There's a new and different kind of signal catching the ears of shortwave radio listeners and ham operators around the globe: radioteletype. SWLs are firing up receivers, TUs and printers to decipher the mystery bleep-bleep transmissions. Hams are pounding away at keyboards, chatting across oceans. From an amateur radio operator who practices it every day, here's what RTTY is all about and how you can tune it in.

by Carmine W. Prestia
Contributing Editor

Did you ever stand in a Western Union Office, transfixed as their Teletype spat out messages from all over the country? Or watch the United Press and Associated Press teleprinters in your local newspaper office feed the latest national and international news into the newsroom? If you have, you may have been bitten by the same bug that has sunk its teeth into thousands of amateur radio operators and shortwave listeners in this country and overseas.

Teleprinters have been around for over 70 years. The first one was invented in 1906. Around 1930 the Teletype Corporation came into existence. They are so well known and have so many teleprinters in service that *Teletype* is mistakenly used to refer to all teleprinters even though it is a registered trademark of the Teletype Corporation. This mode of communication has since gained great use in commercial and military applicatons because of its speed and the automatic written record that it provides.



Amateur RTTY

Through radioteletype (RTTY), amateur radio operators throughout the world have gotten into the act and have teleprinters in their shacks pounding out messages from other amateurs. And shortwave listeners around the world have felt the thrill of decoding teletype messages as they listen in.

By now you're wondering how all this stuff works! The teleprinter looks like an oversized typewriter, but there are no mechanical connections between the keyboard and the printer. Instead, there are electromechanical circuits that make the printer reproduce what you type on the keyboard.

These circuits, with the proper interface devices, will also send that information over wires or radio waves. Commercial systems, like Western Union, usually use leased telephone lines. In the amateur service though, we send the information over *radio* waves.

The information that we're talking about is in the form of coded pulses. All of the characters in the *Baudot* code, which is used on amateur RTTY, are made up of a series of seven pulses, either *mark* or *space*. To keep the teleprinters synchronized, the first pulse is always a *space* (for the start of a character) and the last pulse is always a *mark* (for the end of a character). The other five pulses make up the code for the particu-

lar character being sent. A different code makes up each different character. Figure 1 is a graphic representation of the letter 'Y', showing the *mark-space* relationship to the *loop*.

"What's a *loop*?" you're asking. Well, RTTY machines are said to be on a loop, which is just an electrical circuit with current flowing. When current is on, the loop is in *mark* conditon; when off, *space* condition. To create the pulse series for the character we want to send, we interrupt the *loop current*.

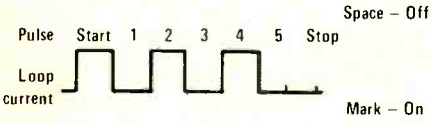


Figure 1 The pulses that make up the letter "Y" in the Baudot code. Mark is current on and space is current off in the loop.

The mechanics of the keyboard do the interrupting when you depress a key. Similarly the printer mechanics convert the pulses in the *loop* to the letter or character to be printed. The pulses are timed, but I won't confuse you with that now.

It is enough to know that the stop pulse is always longer than the others so that the machine knows it is a stop pulse and that the next pulse will begin a character. By convention, when nothing is being sent, the loop is kept in the *mark* state, causing the printer to sit silently. Otherwise the print head would continuously bounce up and down in a conditon known as "running open."

To send information over the air, we simply turn the transmitter on and off, just like Morse code. In fact, this was the way RTTY was sent in the early days. However, history and experimentation have shown that a better method is *frequency shift keying* (FSK). This method keeps the transmitter first on one specific frequency, then *shifts* the frequency a small amount. The main frequency is considered the *mark* and the shifted frequency the *space*.

Once again, convention has declared the shifts to use so that we are all doing the same thing and can talk to one another. Three shifts are in use. The most common one by far is 170 Hz although some stations use 425 Hz and others 850 Hz shifts.

FSK is usually used on the high-frequency bands (below 30 MHz), either by directly changing the frequency of the transmitter, or modulating a single-sideband (SSB) transmitter with two audio tones.

Both of these methods result in FSK output because modulating an SSB transmitter causes its output frequency to shift in proportion to the difference between the audio coming in. You must be careful though, that the SSB transmitter is not putting out any carrier or unwanted sidebands. On FSK these would become spurious outputs and are illegal.

On very-high frequencies (vhf), we use audio tones for direct am or fm modulation of the transmitter. This is called audio-frequency shift keying (AFSK). One other caution is in order here. Whatever transmitter a ham uses should be rated for *continuous duty* or you will have to reduce the output power. RTTY causes the output to run continuously, and some final tubes and transistors are not meant to dissipate heat and power over a long time. They burn out. The alternative is to run reduced output, which is what I do at my station, WB3ADI.

Hardware

So much for the basics. "What do I need to get started?" is your next question. Since I've already mentioned my station let's take a look at it. It is by no means typical. No station is. But it has everything necessary to communicate by RTTY; a transceiver, a terminal unit, and a teleprinter. Figure 2 is a block diagram of the station and how the different components are hooked together.

My transceiver is a Kenwood model TS-520S, a popular unit on the market today. It is, primarily, an SSB rig but I use the phone patch connections provided by Kenwood to connect the tone inputs and outputs of the *terminal unit*. It's a good transceiver so I don't have to worry about problems with spurious outputs unless I let it get out of adjustment. The final power amplifier tubes of the rig were *not* meant for continuous duty so I reduce my power by two-thirds to about 60 watts when running RTTY.

The part of the station that is the key to all of this is the *terminal unit* (TU). The TU that I use is the HAL ST-6000. The TU provides a loop for the teleprinter and tones to key my transmitter. When I'm receiving, the ST-6000 converts the tones from the receiver into on-off *(mark-space)* conditions of the loop to drive the teleprinter. When I'm transmitting, and switching the loop off and on through the keyboard, the TU supplies the shifting tones to the transceiver.

HAL has included many other features in the ST-6000 that make it a real Cadillac of TUs on the market. Mine has a small *oscilloscope* for tuning the RTTY signals correctly. When two crossed ellipses, with their axes perpendicular, appear on the scope, the received signal is correctly tuned. If they change position, the receiver is drifting in frequency.

The keyboard operated switch (KOS) is wired to the push-to-talk (PTT) line of my Kenwood and automatically keys the transmitter whenever I start typing on the keyboard. On the receive side there is an *autostart* circuit that turns off the printer motor unless there is a correctly-tuned RTTY signal coming into the St-6000.

There is also an input for a Morse key for CW code identification (required by the FCC) and connectors to hook up additional devices such as an electronic video display and keyboard.

On top of all this, there are two special circuits in the St-6000 that compensate for different reception problems that happen to RTTY signals on their way to my station. All of these features combine to make the HAL ST-6000 an excellent TU and to make my operating easier by eliminating manual switching of the transceiver, and the noise from the printer motor when there is no signal present.

Operating

The fun part of the station, and the part that really catches the eye of visitors, is the teleprinter. Mine is an old Teletype Model 19. It not only has a printer and keyboard but also a tape punch and a transmitter-distributor (TD). These things are all mounted on a metal desk that is part of the unit.

The tape punch allows me to prepare messages ahead of time on punched paper tape that can be transmitted through the TD. This way I can send an error free tape of information about my

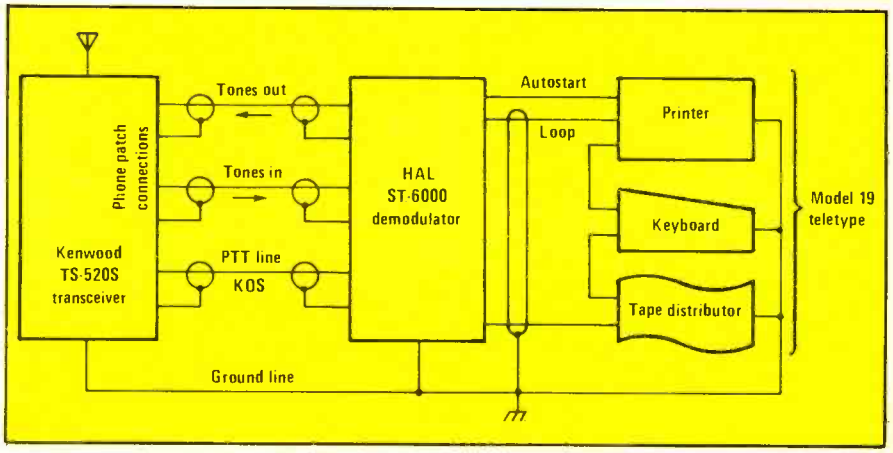


Figure 2 Block diagram of RTTY station at WB3ADI.

Teletype® model 19, right foreground, sends and receives typed conversations in amateur radio station WB3ADI.

station equipment and my personal background. Most of us call these a *brag tape*. I also can relay a series of messages received and prepared ahead of time.

Of course, the Model 19 is an old clunker. It first saw service in the military and I got it from another ham for $40. He was a member of the Military Affiliate Radio System (MARS) and had gotten it through surplus to use in handling messages for servicemen and their families.

So now, "What do you do with all of this stuff?" That's a good question, but it's not hard to answer. RTTY has just as many possibilities as other facets of ham radio. I can ragchew with the added convenience of being able to get up and get a drink without missing any of the other guy's message. A couple of hams that I have 'chewed the rag' with recently, are Joe, WB9ZRL, in Wisconsin and Otto, OE6KOG, in Austria.

If you're not into *ragchewing* like I am, there are lots of guys who engage in the RTTY art form, pictures. That's right, pictures. With time and patience, hams prepare pictures by typing strings of characters to make different shades of black and white.

They put their work on punched tape and then exchange it over the air using a TD, like my Model 19. Figure 3 is a good example of RTTY art that I received one day while 'copying the mail.' Pictures can be as simple, or as complex, as the artist wants to make them. The more complex ones take as much as 30 minutes or more to print.

For the more practically minded there is message handling. RTTY is a natural for this since you automatically get the message down on paper and don't get writer's cramp. As I'm writing this, my station is copying a series of amateur bulletins from W1AW, the American Radio Relay League (national organization of hams) station in Newington, Connecticut. There are hams who listen to the National Weather Service stations and then retransmit weather watches and warnings for their local area on RTTY via two meter repeaters.

Shortwave listeners (SWLs) tune in international transmissions of news, weather forecasts, messages from ships at sea and other little-known radio signals.

For technicians, there is much experimentation going on in *microcomputer control* of RTTY stations. Things like RTTY message generators, memories and station controllers are being built. RTTY-to-microprocessor interfacing is a broad enough subject for a whole book which we'll get into in a future issue of *Modern Electronics*

Getting Started

Now that you're interested, you'll want to know where and how to get started. The first necessity is a good receiver. A lot of old receivers are available at ham flea markets or from dealers. That will let you receive hams, news and weather transmissions on shortwave and other unusual radio signals. Just as some SWLs listen to voice broadcasts from London, Moscow or Peking, you'll be able to tune in RTTY signals from around the world.

The TU is next. HAL Communications of Urbana, Illinois, makes the most extensive line of amateur RTTY equipment. They have TUs that start as low as $125 in kit form (the ST-5K) and run all the way to $595 for the top of the line ST-6000.

Other manufacturers are Electrocom Industries of South Bend, Indiana, and Dovetron of South Pasadena, California. Your major considerations will be cost versus features, since you can pay over $800 for a TU such as the Dovetron MPC-1000R. If your a technical type and want to build instead of buy, there are many plans available in the amateur radio publications for building your own TU.

Like the terminal unit, a teleprinter can be very costly. Prices run from $25 to more than $1000. Remember, my Model 19 cost only $40 and it is giving perfectly acceptable service. You can shop around by asking hams and going to hamfests looking for what you want.

A Model 15 Teletype would be a good starting point and should go for under $50, depending on its age and condition. The 15 is the little brother of the 19 and is just a printer and keyboard. If you don't want to go *used*, Teletype Corporation will be glad to sell you a new Model 28 or 32 but your cost will be over $500.

Should the XYL absolutely refuse to put up with one of these machines making a racket in the house, you can also get *video displays* that put the information on a tv screen rather than printing it on paper.

HAL Communications once again enters the picture with a couple of units for the RTTYer who wants to go video. Their DS-3000KSR is a complete terminal with display and keyboard in one package (you still need the TU). It is controlled by an 8080A microcomputer chip. The price tage is $1195.

For quite a bit less you can get the RVD-1005 visual display unit and the DKB-2010 keyboard. Total price is just under $800. You'll need either a tv modified to accept direct video input or the RVD-2110 monitor/tv for $150. Info-Tech of St. Louis, Missouri, makes a video converter (Model 75) and a keyboard (Model 150), you supply the tv. Total cost is $640. Also available are units from Microlog Corporation, Electrocom and others. Just take the time to look through *CQ*, *The Radio Amateur's Journal*, or other amateur-radio publications.

An excellent publication explaining everything you ever might want to know about radioteletype is *RTTY Handbook* available at $3.95 including postage and handling from *Modern Electronics*. Also available from *Modern Electronics* is *RTTY From A to Z* at $5. You can address *Modern Electronics* or *CQ* at 14 Vanderventer Ave., Port Washington, NY 11050.

When you get set up, start looking for RTTY signals around 14080 kHz during the day and 3600 kHz during the evening. Listen a bit before you jump in to get the feel of how to operate the new mode.

As you want to know more, read and ask fellow hams. You'll be surprised how many RTTY enthusiasts there are when you begin asking. They'll be glad to help.

PERRY PEOPLE

BY HAROLD PERRY

OUR STORY BEGINS, AS DONNA MARTIN IS LISTENING TO HER HUSBAND, HARRY, EXPLAIN TO HER THE PRINCIPLES OF ATV (AMATEUR TV).

...AND SO, BY USING THE HAM EQUIPMENT I ALREADY HAVE, THEN ADDING THIS ROBOT MODEL 70 MONITOR AND A ROBOT MODEL 80 CAMERA, I CAN SEND AND RECEIVE TV IMAGES WITH MY FRIEND IN GREENLAND, WHO HAS THE SAME OUTFIT.

SOUNDS KINKY. LOOK! A PICTURE.

UHH, HARRY. DO PEOPLE IN GREENLAND *LOOK* LIKE THAT?

ONLY IF THEY'RE VERY, VERY UGLY.

THIS IS *LORD DUNG VENDOR* (PUFF) TO IMPERIAL HIGH COMMAND (SNORT) YOU ARE TO INFORM THE EMPEROR...

...THAT OUR WARSHIP {OINK} HAS TAKEN UP {SNORT} EARTH ORBIT. WE WILL ATTACK IN {PUFF} FOUR HOURS. {GURGLE}

DID YOU HEAR THAT, DONNA? WE'D BETTER CALL THE COPS, AND...

AND WHAT??! TELL THEM THAT SOME HEAVY BREATHER IN A PIG MASK IS GOING TO DESTROY THE PLANET WITH HIS SPACE SHIP. THEY'LL MAKE US AS SQUIRREL BAIT FOR SURE.

SUDDENLY, WITH A PUFF OF SMOKE & A SPARKLE OF LIGHT, THERE APPEARS...

HELLO THERE EARTHLINGS. I'M *GOUCHO* FROM THE PLANET *VILVAUDE*.

DO YOU FOLKS KNOW THAT THERE'S AN EVIL IMPERIAL WARSHIP ORBITING YOUR PLANET?

I DON'T BELIEVE THIS IS REALLY HAPPENING!

POOF

MY PEOPLE WILL DO EVERYTHING POSSIBLE TO STOP DUNG VENDOR. BUT, VILVAUDE HASN'T HAD A WAR IN OVER TEN THOUSAND YEARS AND WE'VE KINDA FORGOTTEN HOW TO DO IT.

OH IT'S A LOT OF *FUN*! WE'LL SHOW YOU HOW TO DO IT.

HARRY, GO HOOK UP THE 'ATARI' COMPUTERIZED VIDEO GAME AND SHOW MR. GOUCHO HOW IT'S DONE.

I'LL TURN YOU INTO A SPACE AGE GENERAL GEORGE PATTON, IN NO TIME.

OK, AS LONG AS I DON'T HAVE TO USE FOUL LANGUAGE OR SLAP WOUNDED SOLDIERS.


WAR IS VERY MUCH LIKE THIS 'ATARI' COMBAT GAME YOU SEE ON THE TELEVISION SCREEN.
Y'SEE MR. GOUCHO THE BASIC IDEA IS TO AIM YOUR SHIP'S WEAPONS AT THE ENEMY SHIP. THEN YOU PUSH THE 'FIRE' BUTTON, LIKE THIS, AND BLOW UP THE OTHER VESSEL.
SONY
IT LOOKS AS THOUGH, WAR IS VERY VIOLENT. BUT IT DOESN'T SEEM AS BAD AS ONE OF YOUR PRO-HOCKEY PLAYOFFS.
RIGHT! NOW I'LL SHOW YOU THE MORE COMPLICATED ASPECTS OF FIGHTING A WAR. TELL ME: HOW MANY SHIPS DID YOU PEOPLE BRING HERE?
WE ORIGINALLY HAD, THREE BATTLE CRUISERS AND FIVE, ONE MAN, STAR FIGHTERS. BUT NOW, TWO OF THE CRUISERS ARE UNMANNED.
WHAT HAPPENED?
WELL, THE CREW LEFT AND GOT JOBS DOWN HERE AS ACTORS ON TV IN SITUATION COMEDIES
HEY! I'VE GOT A GREAT IDEA!
AFTER THREE HOURS OF PLANNING AND PREPARATIONS, THE BRAVE VILVAUDIANS HURL THEMSELVES AGAINST THE GIGANTIC WARSHIP.
BUT THE VILVAUDIANS ARE NO MATCH FOR DUNG VENDOR.
THAT VIDEO GAME DIDN'T SAY THAT THESE BIMBOS WOULD BE SHOOTING BACK LIKE THIS!
BIMBO
A BEATEN VILVAUDIAN BATTLE CRUISER RETREATS INTO DEEP SPACE WITH DUNG VENDOR'S WARSHIP IN HOT PURSUIT.
CONTINUED ON NEXT PAGE


BACK ON EARTH, HARRY HAS MADE SOME MINOR AJUSTMENTS ON HIS TRANSMITTER AND HOOKED UP THE VIDEO GAME CONTROLS TO TWO OF HIS ATV MONITORS.
THERE! THAT SHOULD DO IT.
HEY IT WORKS! WE GOT A PICTURE. I CAN SEE THE MOON.
MEANWHILE, THE VILVAUDIANS LURE THE PURSUING WARSHIP BETWEEN TWO LARGE ASTEROIDS.
ON ONE OF THE ASTEROIDS, GOUCHO HAS PLANTED A NUCLEAR DEVICE.
SHOOT THAT BUGGER OFF!
CAUGHT BETWEEN THE TWO ASTEROIDS, DUNG VENDOR'S IMPERIAL WARSHIP IS ENGULFED BY THE ATOMIC FIREBALL.
AMAZINGLY, THE WARSHIP SURVIVES THE BLAST, AND THOUGH IT'S DAMAGED, IT HEADS BACK TOWARD EARTH.
DESTROY THAT PLANET!
PUTT PUTT PUTT
I'D LOVE TO FIND OUT WHO MAKES HIS SPACE SHIPS.
LORD VENDOR! TWO VILVAUDIAN BATTLE CRUISERS DEAD AHEAD. SENSORS ARE REGISTERING NO LIFE FORMS.
IGNORE THEM.
PUFF
SNORT
THOSE SHIPS ARE DERELICTS.
I SEE THE WARSHIP.
WRONGO, DUNG! THOSE SHIPS ARE UNDER THE REMOTE CONTROL OF HARRY AND DONNA USING THEIR VIDEO GAME CONTROLS, HAM RIG AND ATV MONITORS.
THEY UNLEASH A BARRAGE OF PROTON BLASTS!
WITH ITS PROTECTIVE SHIELDS WEAKENED BY THE ATOMIC BLAST, THE WARSHIP IS VULNERABLE TO THE SURPRISE ATTACK.
I THINK I'M CATCHING ON TO THIS WAR THING.
I KNEW YOU'D LOVE IT, ONCE YOU GOT STARTED MR. GOUCHO.


LORD VENDOR! THE REACTORS ARE SUPERHEATING AND ARE REACHING CRITICAL MASS. SHOULD WE START PREPARING TO ABANDON SHIP? GAK!
COWARD! ANYONE LEAVING THEIR POST PUFF! WILL BE BURNED DOWN. SNORT! THIS SHIP WILL GO ON FIGHTING TO THE PANT! VERY END GURGLE! FOR THE GLORY OF THE EMPIRE.
PSST! HAVE MY SHUTTLE CRAFT MADE READY. OINK!
RELENTLESSLY, THE THREE CRUISERS PRESS THE ATTACK AND FINALLY, MOVE IN FOR THE KILL.
LATER, BACK ON EARTH.
WE'RE ETERNALLY GRATEFUL FOR WHAT YOU AND YOUR PEOPLE DID FOR OUR PLANET – BUT, WHY DIDN'T YOU STOP DUNG VENDOR FROM GETTING AWAY?
SO I WOULDN'T LOSE OUT ON THE ROYALTIES FROM ANY SEQUELS.
WELL, CAN WE KEEP THOSE UNMANNED SPACE SHIPS.
SORRY, SWEETIE! BUT IF 'BARNEY MILLER' - 'WELCOME BACK KOTTER' OR 'SOAP' EVER GO OFF THE AIR, THE CREW WILL PROBABLY WANT THEIR SHIPS BACK.
BY THE WAY, I'D LIKE TO GET A COUPLE OF HUNDRED CASES OF THESE DARK CANDIES. THEY'RE DELICIOUS. WHAT DO YOU CALL THEM?
CIGARS!
YOU DON'T EAT 'EM YOU IGNITE ONE END, THEN INHALE THE BURNING GASES THROUGH THE OTHER END.
THAT'S THE MOST RIDICULOUS THING I EVER HOIRD!
THE END

Voyager: messenger

In our imaginations, we have communicated with the stars. In reality, we have left crude messages carved in plastic stone along the pathways of our Solar System. Now, men have taken the next step: electronic reproductions of life as we know it on Earth are on their way across the reaches of the Universe. Who will read them?

by Norm Chalfin

As you read this, two unmanned *Voyager* space probes are speeding toward the planets Jupiter and Saturn. On April 10, 1978, the two spacecraft were moving in excess of 100,000 miles per hour with respect to Earth. Thus far these spacecraft have traveled about half-a-billion miles since leaving the Earth—one somewhat more, the other somewhat less. The first planetary encounter is still almost a year away.

Each voyager is carrying a gold-plated copper disc record on which is recorded a number of messages from the planet Earth to any intelligent beings who may intercept the spacecraft after they leave our solar system. The messages are in both sound and pictures.

Last to leave, first to arrive

The Voyager spacecraft were launched 16 days apart on August 20 and September 5, 1978 for a rendezvous with Jupiter respectively in March and July 1979. The Voyager I was launched later than Voyager II and was so designated because its trajectory will bring it to Jupiter first.

Voyagers I and II will pass Saturn in November 1980 and August 1981 respectively. One of the options still remaining open is a plan to permit the spacecraft to go on to the planet Uranus after the Saturn flyby, before exiting our solar system. If sufficient control gas remains this will most likely be attempted.

The scientific, photographic, electronic and computer systems aboard the spacecraft are designed to radio back to Earth photographs, atmospheric data, and radiation data from the planets and their environs.

The science instruments will observe the satellites of Jupiter, Saturn, and Uranus more closely than ever before possible. Discussions are still going on among the scientists involved as to whether to observe and photograph the rings of Saturn from the outside or from the space between the rings and the planet.

One can only marvel at the daring navigation involved in attempting to fly at least one of the Voyagers into the space between Saturn and its rings. Recent radar studies have suggested that the rings are composed of one-meter-large chunks of ice. All of this is to be accomplished by transmitting commands by radio over hundreds of millions of miles. A close encounter of a different kind.

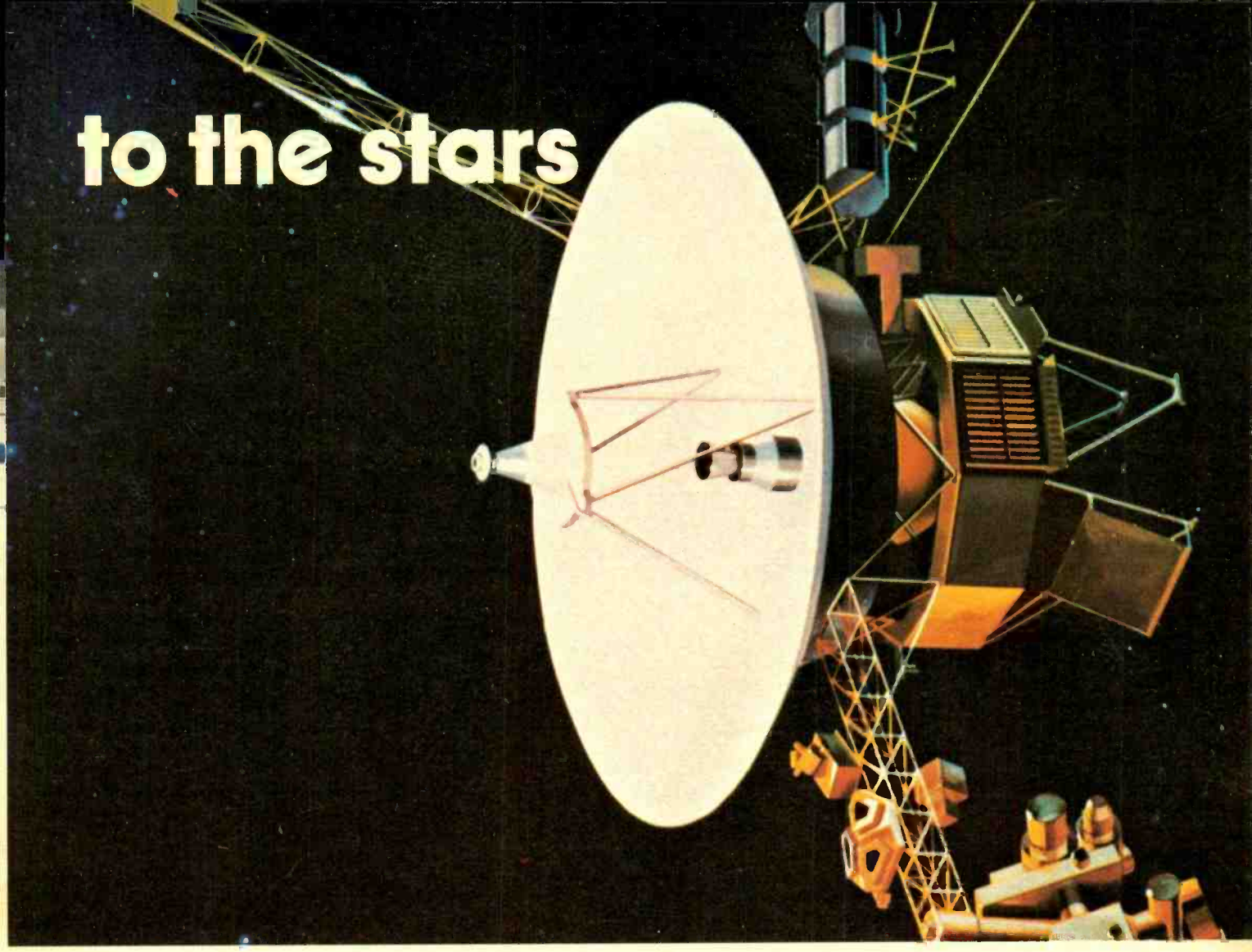
The golden record

A great many years in the future, when the Voyagers are in outer space far beyond our solar system, perhaps, in some distant galaxy, extraterrestrial space travelers, it is hoped, will encounter one of our Voyagers and find the gold record in its case attached to the side of the spacecraft. Hopefully, these beings will be able to decipher the binary instructions and illustrations for the use of the record, and the information about the source of the Voyagers and the recordings.

The Voyager phonograph record was designed by Dr. Carl Sagan and his associates at Cornell University and from other institutions. Recorded on it are messages from the President of the United States, the Secretary-General of the United Nations and from the leaders of many of the nations of the World.

There are messages in about 60

to the stars



languages, sounds of music of different countries, children singing, classical music, jazz, rock, and so on. There are industrial sounds; sounds of the cities and the farms; sounds of animals, and of ocean waves.

The designers of the record have included video phonogram photographs of the human and animal beings on Earth, their physiology, their life styles, their structures, social organization, some of their activities, and some history. All of this information has been engraved on a double-faced 12-inch diameter, 16-⅔ RPM gold-plated copper phonograph disc which plays one hour on each side.

Audio and video phonograms

How the information is recorded is one story. How the intelligent beings in outer space who encounter the record will decipher the intelligence on it, is a conjecture that more than likely will not be confirmed in the lifetime of any of us, or of our great, great, great grand-children.

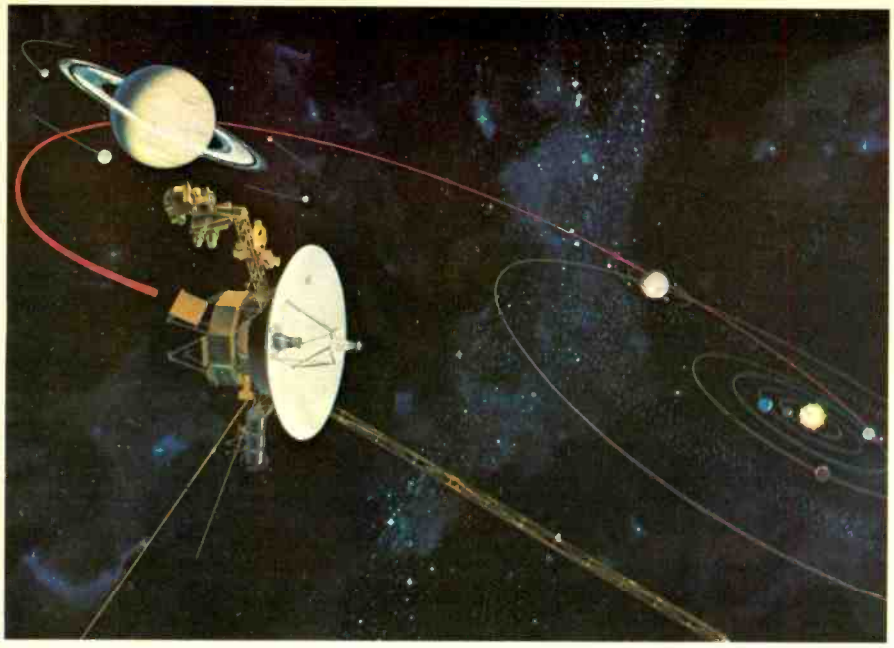
The information on the outer cover of the case containing the Voyager disc attempts to provide in binary form data as to the location of our Earth and Solar System with respect to pulsar sources in the Universe as we know them. The instructions for using the disc are also presented in binary form with an explicit diagram of the manner in which the sound is to be derived from the stereo recording. Scientists believe that any advanced civilization technologically capable of space flight should be able to decipher the binary instructions.

A playback head (Astatic Model 13Tx was found to be the only one which stood up under the hot/cold and space vacuum tests) is included with the disc. For translating the "video" information the diagram on the disc cover illustrates a vertical scan pattern of 512 lines, interlaced. The period between lines in 8 milliseconds so that a complete image is generated in 8.192 seconds.

The technique is very much like the slow scan technique used by amateur radio operators and the facsimile techniques used in facsimile photo transmissions by wire and news or weather satellite picture transmissions by radio. The video data signal waveform is illustrated on the cover of the disc with the other instructional information.

The sound component of the

John Casani, Voyager Project Manager at JPL, makes presentation of the golden record that will be carried into deep space. The presentation was made at the Cape Kennedy Space Center just prior to the launching of Voyager I.



The Voyagers will study the two giants of our Solar System, Jupiter and Saturn, before entering deep space, where it is hoped intelligent beings will discover it, and the messages contained in its recording.

Voyager disc recording was generated and recorded conventionally as on a very long playing disc.

Dr. Valentin Boriakoff of the office of space sciences at Cornell University in Ithaca, N.Y., was responsible for the technical aspects of the design of the disc, particularly, the image data processing portion.

The slow-scan video portion of the recording was produced at Colorado Video, Inc., in Boulder, Colorado on a magnetic tape.

Glen Southworth, president of Colorado Video, commented on the video recording:

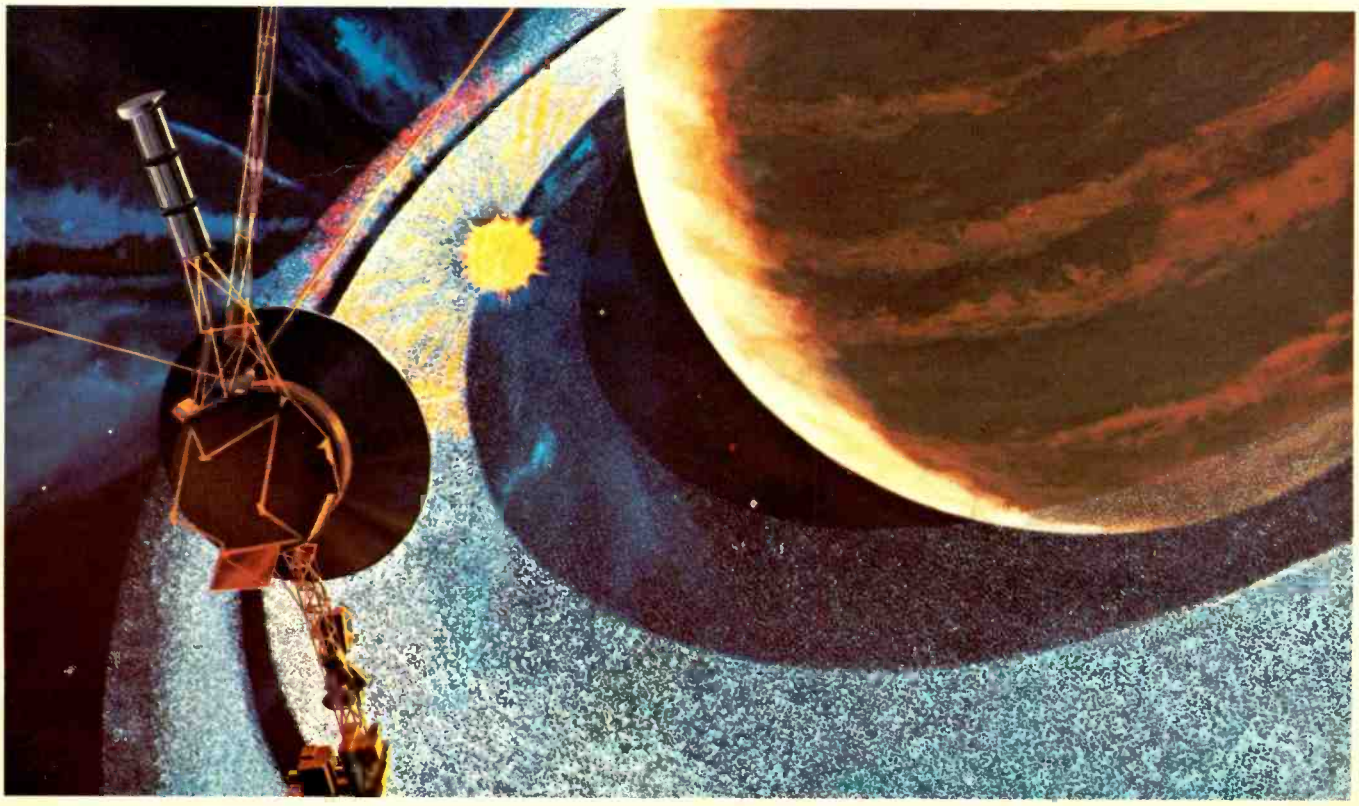
"First, to conserve space the pictures were recorded in "stereo," meaning that channel one of the stereo playback contains one series of pictures, while channel two contains the rest of the images.

"To the best of my knowledge a direct recording process was used (by CBS Records). The raw video from the (original video) tape was played back directly into the cutting head amplifier along with the audio, with the result that the original DC reference was lost. We did record two sets of square waves at the beginning of the tape so that phase correction requirements might be deduced (by any intelligent technologically advanced extraterrestrials who may find the record) and, following equalization, sync tip clamping could be used for DC restoration.

"We ended up with a good compromise, particularly in the use of dot interlace format, to achieve maximum subjective image quality with a limited number of pixels (240 x 512). My final rationalization as Dr. Boriakoff carried the tapes out the door at midnight was that a smart graduate student with a reasonably good computer would be able to reconstruct pictures as good as the sample. If he had the capabilities of Billingsley (Fred Billingsley of the J.P.L. Image Processing Laboratory is one of the pioneer experts on image enhancement) and the JPL crew he could do a lot better!"

I talked with Rick Smith, vice president in charge of business development at CBS Records about the Voyager golden record project. He told me that there is a possibility the recording may be released at a two-LP phonograph record set in the fall of 1978 coincident with a book by Dr. Sagan and his associates about the Voyager record project. CBS Records

please turn to page 59



ME photos: NASA/JPL

9 easy to build projects under $9

'By golly, Mildred. I like those little quick-n-easy projects in Modern Electronics. Think I'll just breadboard these up tonight. See how they work.' He loves them, and you will too. They're inexpensive, use readily available parts and are explained so you can understand them. Try your hand at one or all of our nine projects for a midsummer night's fun.

by Jeffrey A. Sandler
Contributing Editor

1 Lantern extender

Here's a circuit that will give you almost three times the normal life of a lantern battery, and still provide all the light you'll need. The amount of light a bulb emits is dependent on the power it consumes. More voltage applied to the bulb causes more current to flow, increasing the power, and increasing the light emitted. This circuit doubles the voltage while limiting the current. The effective power remains the same, but battery life is extended due to the decreased current drain.

This reduction in current is achieved by using a technique called chopping, which is nothing more than turning the light on and off very rapidly. The period the lamp is on compared to the period between turn-ons is called the duty factor. A 50% duty factor means the lamp is on half the time, and off half the time. If twice the current flows for half the time, the average current flow is equal to the current that would normally flow.

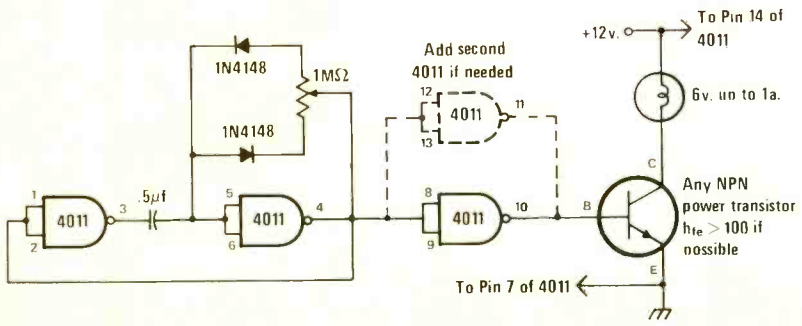
Connecting a six-volt bulb to a 12-volt battery would normally result in the bulb immediately burning out. This is because doubling the voltage would double the current, which means the power would increase four times. But, if the duty factor were set to 50%, you'd have double the voltage and double the current, but only half the time. The average voltage and current would what you'd have with a six volt battery. So, connecting a six-volt bulb across the chopped 12-volt supply will give you the same light as connecting it across a six-volt battery, but with half the current drain.

The circuit is built around a 4011 CMOS quad NAND gate. Two of the gates form the chopping oscillator, and a third is used to interface the chopper with any NPN power transistor with relatively high gain. If the bulb you're using requires relatively high current, you may need to add a fourth gate, as shown in dashed line. If you don't use the gate, be sure to tie its input leads to pin 14 of the IC. This will prevent self-oscillation in the unused gate.

Because CMOS uses little current, it can be powered directly from the 12-volt lantern battery. Parts layout is not critical.

The duty factor, and therefore the effective voltage and current applied to the bulb, depends on the setting of the control. Make sure the control is set at mid-range when first applying power. If the bulb is too bright, adjust the control to get normal brilliance. If the duty factor is set too high, the bulb will burn out in minutes, or even seconds.

You can, if you need a lot of light for a short period, set the control to give you a more intense than normal light. The bulb life will be shortened, but they're inexpensive enough to be considered a throwaway item.



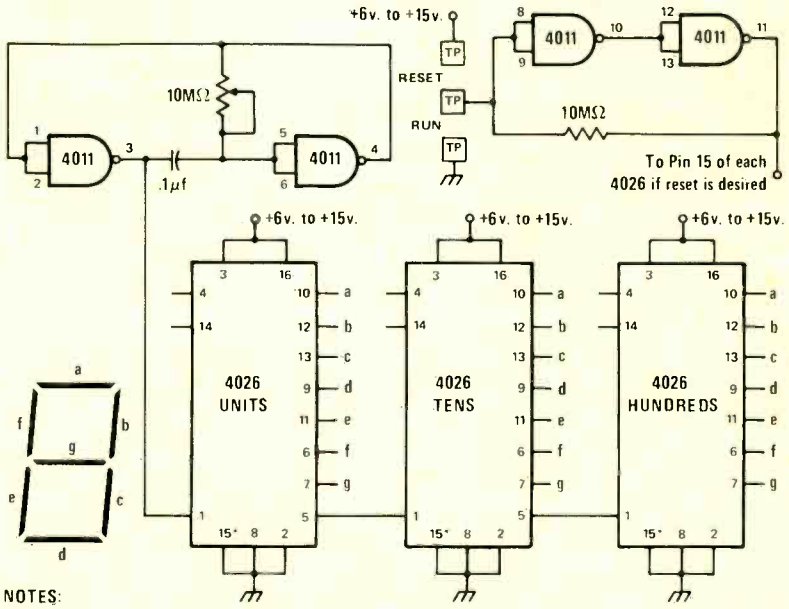
2 Free-running counter

This do-nothing circuit is sure to be the topic of conversation at your next party. It just sits there and counts at some predetermined rate with the count displayed on seven-segment LEDs.

This do-nothing uses half a 4011 CMOS quad NAND gate to generate an endless series of pulses. The rate at which the pulses occur is controlled by the setting of a variable resistor, and the value of the associated capacitor.

The pulses generated by the 4011 are used to trigger a 4026 counter. You can add as many 4026s as you wish, connecting pin 1 of the next IC to pin 5 of the preceding 4026. The seven outputs of each 4026 are used to drive the seven-segment LED display. You'll need one display for every 4026 you use. When all of the displays show the number 9, the next count will reset them to zero and the count will begin again.

You can further enhance the conversational value of your do-nothing by adding a reset/run function. It uses the other half of the 4011 as a flip-flop controlled by touchplate switches. The output of the flip-flop is connected to pin 15 of each of the 4026 ICs. If you don't add the reset, tie all four unused 4011 input leads to pin 14. This will prevent self-oscillation.



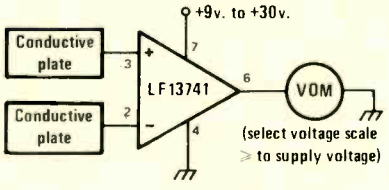
The touchplate is made of three strips of metal, the center being about a half-inch wide, separated from each other by about 1/16th inch. When you bridge the gap between the center and the grounded strip, you set the flip-flop to its *run* state, and the counter counts. But, bridging the other gap will set the flip-flop to its *reset and hold* state, which resets and holds the count at zero.

Although the circuit uses several ICs, the layout isn't critical. If you're using perf board, be careful not to short any of the IC pins together. You can power the unit from any six to 15-volt source.

3 Air meter

Here's an interesting do-nothing project that's sure to be a good conversation piece at your outdoor get togethers. Built around an FET-input op-amp, the circuit measures the conductivity of air. You can use it to record changes in conductivity throughout the day as humidity and barometric pressure changes, or you use it for demonstrations by changing the position of the electrodes.

FET-input op-amps have extremely high input impedances—some approaching 10^{12} ohms. This very high input impedance makes it possible to measure air resistance, which is in the millions of ohms per inch. By connecting two metal plates to the input of the op-amp, a minute, but measureable, current



will flow between them. This current will be reflected in the output voltage of the op-amp. All you have to do is hang a voltmeter across the output and you've got your air meter.

Because the impedances of air and the op-amp are so high, the metal plates can't be mounted on any material. Instead, they're hung in the air by the wires that connect them to the op-amp, which is itself hanging in air. The meter and battery leads can be used to suspend the op-amp and plates from a tree branch, clothes line, or other convenient support.

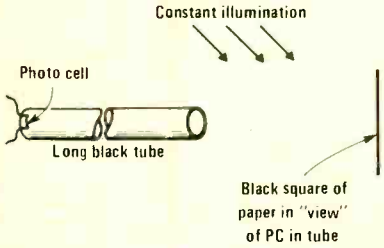
The LF13741 op-amp works best. But you can substitute a CA3140, or if you limit the supply voltage to no more than 15 volts, a CA3130 if you're unable to get a 13741.

One note of caution—Because the impedances are so high, make sure not to handle the op-amp with your bare fingers. The salts in your perspiration can form electrolytes on the package that will form leakage paths that can interfer with, or short circuit the air meter.

4 Intruder alarm

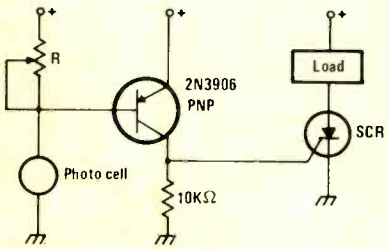
Here's a totally passive intruder detector you can use wherever there's constant illumination. The secret to its operation is reflected light.

The detector consists of just three parts—a photocell, a long tube painted black on its inside, and a large sheet of black, non-reflective material such as construction paper. The photocell is mounted at one end of the tube looking down its length.



The photocell and black material are located so the photocell sees only black as it looks out the far end of the tube. The light source, which should be relatively strong, is positioned over or behind the tube. Then, when any object passes between the tube and the black material, some of the light will be reflected off it into the tube where the photocell will pick it up.

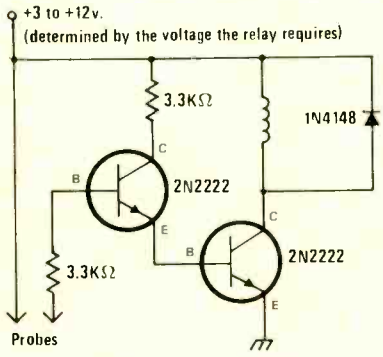
The presence of the reflected light will cause the internal resistance of the photocell to drop, and actuate an alarm. You can use the simple SCR alarm circuit shown here, or your own. The variable resistor is provided to let you adjust the sensitivity of the alarm. Set it so the alarm is almost, but not quite, tripped with the light source in its usual position and nothing between the tube and black material.



The photocell and transistor can be powered with a nine-volt transistor battery. The SCR/load circuit can be powered from any source providing the voltage and current required by your load, which can be a siren, bell, buzzer or other signal. Use an SCR that can handle the voltage and current involved.

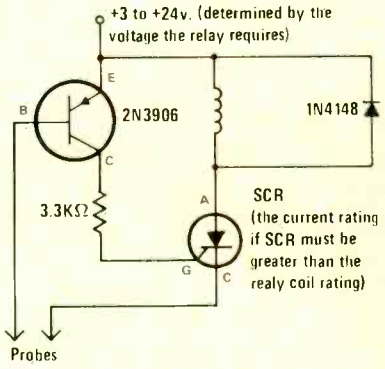
5 Liquid level detector

This nifty alarm lets you know when a liquid rises above the level of two probes you fixed in place. You can build the circuit in two versions. One is actuated only when the liquid is at or above the level of the probes. The other is triggered by the liquid, but remains actuated even if the level drops below the probes. This latching action lets you know that the pre-set level has been reached or exceeded sometime in the past.



NON-LATCHING VERSION

Both versions close relay contacts when actuated by the rising liquid. The contacts aren't shown in the diagrams because their connections



LATCHING VERSION

will depend on how you want to use the alarm. You can, for example, connect a buzzer or bell to give you an alarm signal that can be heard throughout your home or office. Or, you can use it to trigger a flashing lamp circuit. The possibilities are endless.

Parts layout is not critical. You can use a printed circuit board if you'd like, or hand wire on perf board. The circuit will operate from any voltage between three and 12 volts in its non-latching version, and three to 24 volts in the latching version. The choice of voltage will depend on the relay you use.

6 Tone relay

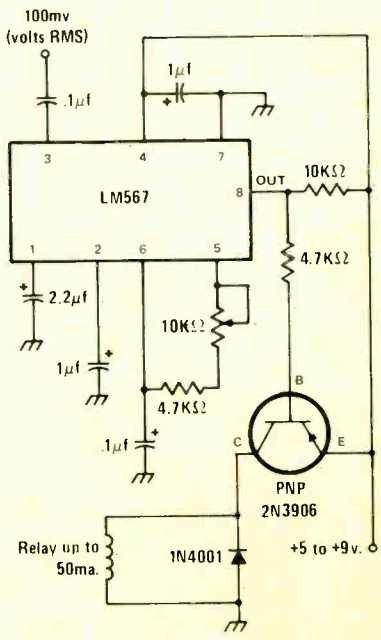
This tone-actuated relay circuit can be used to turn on, or off, a wide variety of devices. It's ideal for use with an intercom system where you occasionally want to leave a message or indicate you called. You can also use it for remotely unsquelching a radio receiver.

The circuit is built around the LM567 tone decoder IC. The 567 requires about 100 millivolts of audio at its set frequency to function. The frequency the 567 responds to is set by a 10K variable resistor, and can be any frequency between 700 and 1500 Hz.

When a tone at the set frequency is present, the 567's output goes low. This change in output state is used to energize a relay through a 2N3906 PNP transistor. The relay contacts are not shown because their connection will depend on what you want the circuit to do.

Parts layout isn't critical. The alarm can be powered by a six or nine volt battery.

You can use a standard telephone



touchtone pad to generate the tone or you can build your own audio oscillator.

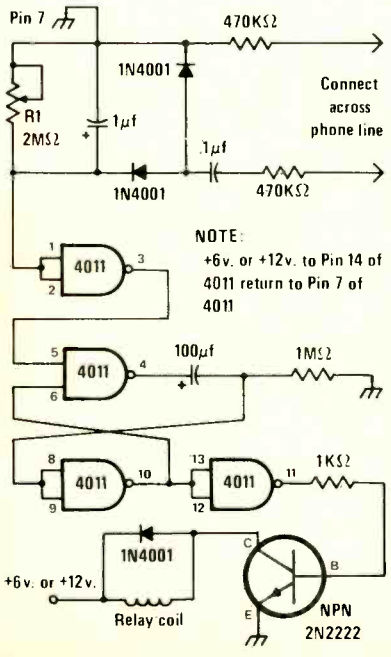
7 Telephone relay

Have you ever noticed the bells and horns used in garages, warehouses and other large or noisey operations to signal a phone call? Well, if you'd like a telephone alarm to let you know the phone is ringing, here's a circuit you'll like. Connected across the bell circuit of your phone, it closes a relay when the phone is ringing. You can use the relay contacts to actuate any bell, siren, buzzer or lamp you have handy.

The input circuit converts the pulsating signal used to ring the bell in the telephone into a dc voltage that charges a capacitor across the input of a 4011 NAND gate. When the voltage across the capacitor gets high enough, the gate changes state and trips a flip-flop. During the period the flip-flop is tripped, the relay contacts will be closed.

You can vary the period the contacts remain closed by changing the value of the resistor or capacitor connected to pin four of the 4011 IC. You can also adjust the sensitivity of the circuit with the variable resistor, R1. Lowering the resistance decreases the sensitivity of the circuit, but also makes it less susceptible to noise and dialing signals.

The circuit is straightforward, and parts layout isn't critical. You should exercise care in connecting the circuit to your phone, though. An accidental short won't endear you to the local phone company. They don't approve of your using circuits like this on their equipment.

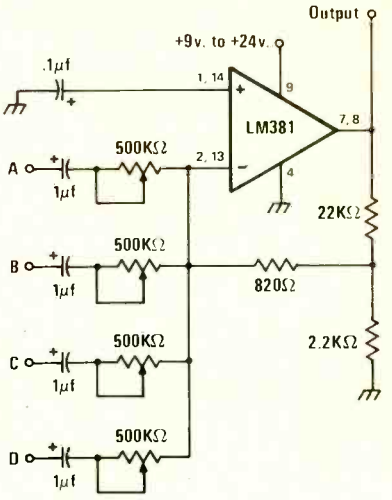


8 Four-channel mixer

If you're into audio or CB, you've probably wished you had a mixer circuit that would combine the sound from several sources into a single audio signal. Here's an inexpensive, easy-to-build mixer that should fill the bill. It uses a readily available LM381 op-amp and a handful of small parts, much of which you probably have in your junk box.

Because of the very high gain of the op-amp, it's important that the mixer circuit be well shielded from the 60 Hz fields present in your home. You can do this enclosing the circuit inside an aluminum box or cabinet, and using shielded cable for all the input leads. RCA phone connectors are the standard audio connector, and should be used for your input and output connections.

The circuit can be powered from any source of well-filtered nine to 24-volt dc. A nine volt transistor battery is ideal. If you need more signal output, connect two nine-volt batteries in series. The batteries can be mounted inside the cabinet to reduce the possibility of hum pick-up.



9 Auto burglar alarm

By David M. Mundy

Here's an interesting approach to auto burglar alarms that sounds the horn in your car when an intruder forces entry. It even has a special detector that'll sound the horn if someone runs into it, or tries to tow it away.

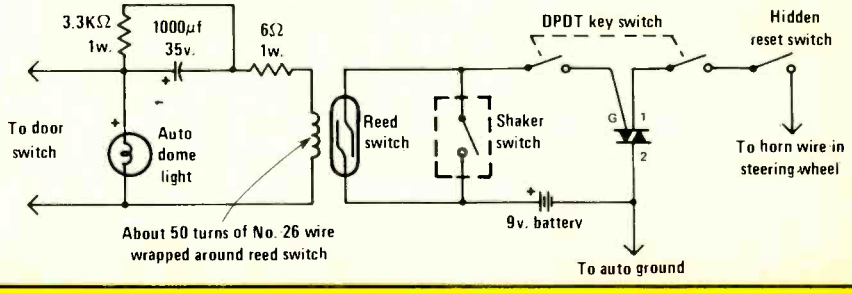
Although the alarm is triggered by the auto's ignition system, it has its own nine-volt battery to power the triac switch. When a door is opened, the dome light turns on. The voltage applied across the dome lamp actuates a reed switch which in turn triggers the triac. When the triac conducts, the auto's horn sounds.

A shaker switch is connected across the reed switch contacts. If the auto is shaken or tilted, as it would be if hit by another car or lifted for towing, the shaker switch will trigger the triac, and the horn will sound.

The alarm is turned on and off by means of a double pole, single throw key switch mounted on the auto body. However, there's a hidden reset switch you can use to kill the alarm if you loose your key.

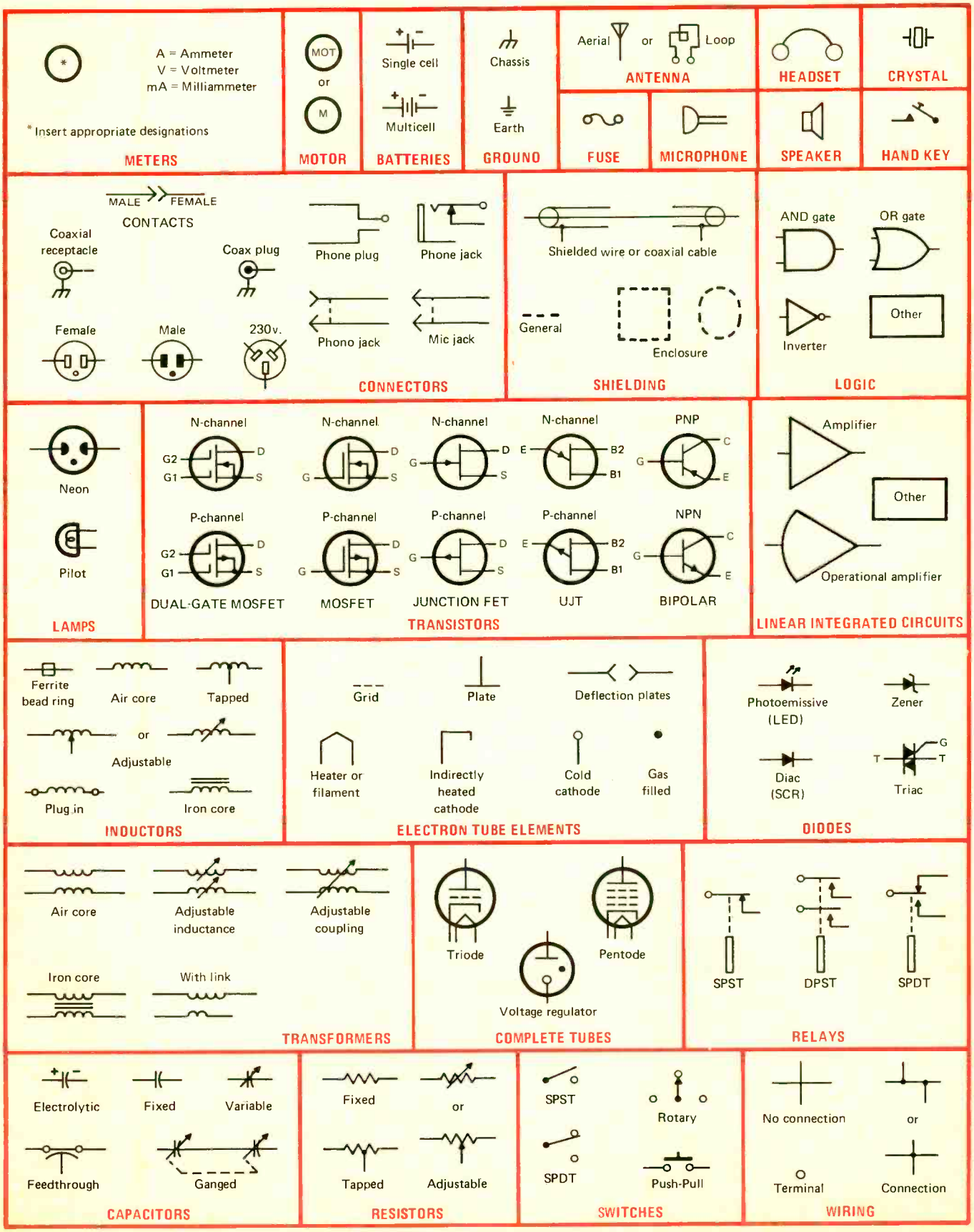
The parts layout is not critical. You can, if you want, split the circuit so that the reed switch wiring, shaker switch, and triac are widely separated. Being physically small, splitting the circuit will make it much more difficult for an intruder to locate—he'll be looking for a black box stuck under the dash or on the firewall.

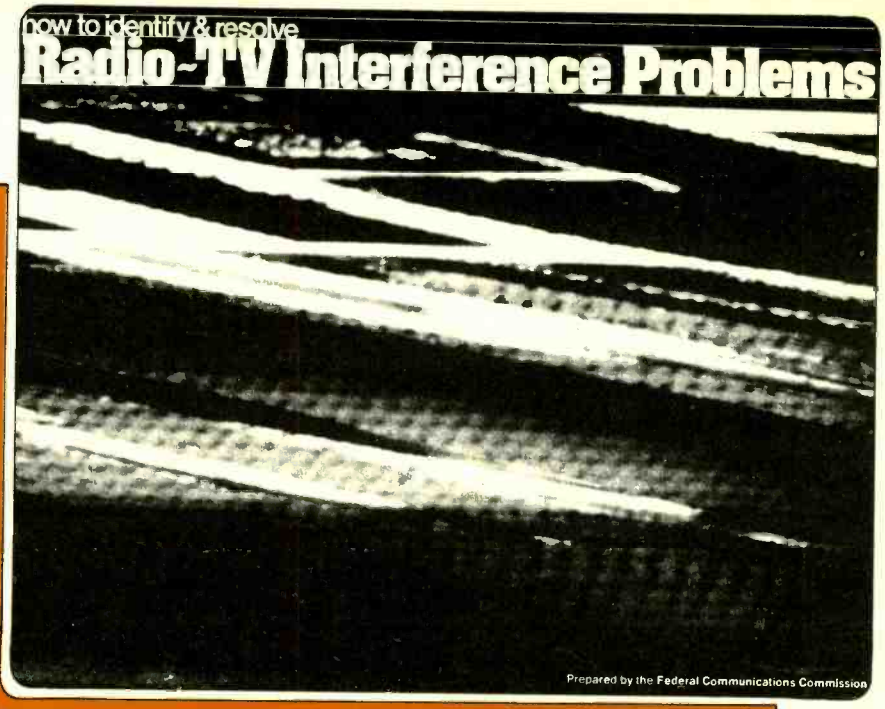
Using the horn is simple, but easy to defeat. The intruder need only cut a single wire and the horn will stop sounding. But, you can add a second horn or electric siren in a hard to get at location, using hidden wiring.



Electronic symbols

as used in Modern Electronics magazine





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

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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.

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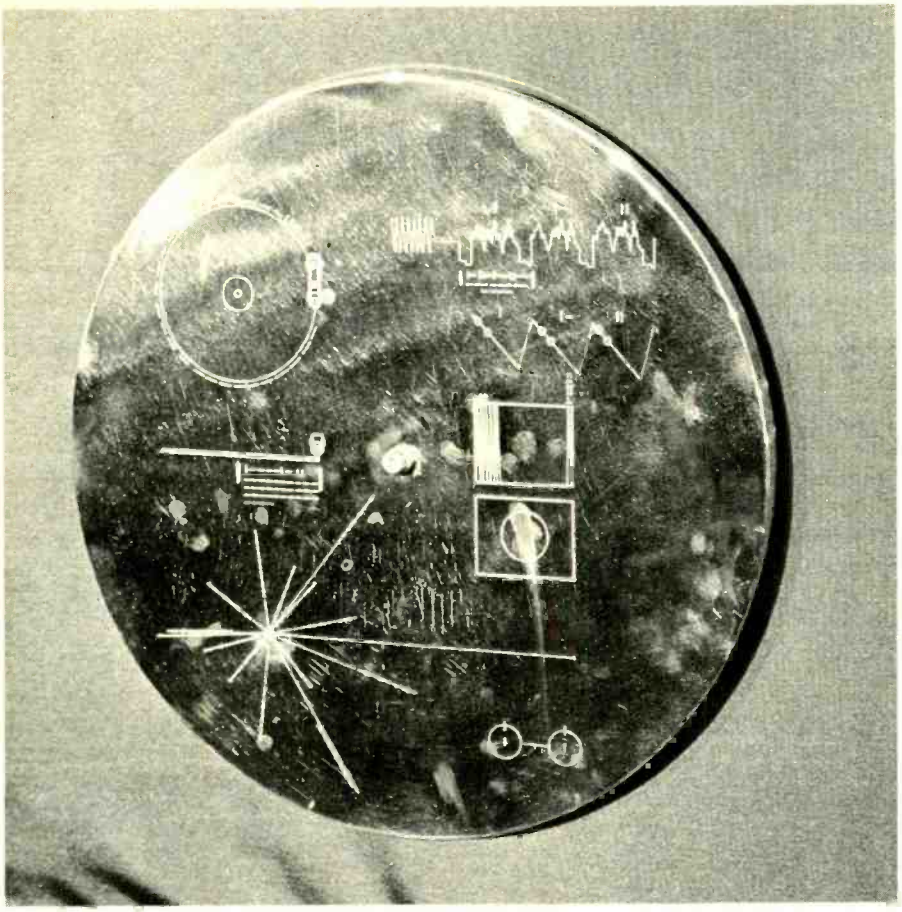


Voyager carries this golden recording that contains video pictures showing the variety of life on Earth. Markings on the cover tell how to play the record. A detailed explanation appears at the bottom of this page.

Voyager:

continued from page 52

produced the Voyager audio-visual disc.

Perhaps an amateur recordist or technician reading this article may find a way to produce the images from the LP records when they are released. That is, if CBS Records is astute enough in its marketing to realize that there are thousands of electronic hobbyists who would enjoy trying to decipher the images onto their tv sets. Certainly amateur radio SSTV enthusiasts will take a crack at it if the data is present on the disc.

If you are interested in the technique used in recording the Voyager golden record, the following data will provide an insight.

■ The original visual material was supplied by Cornell to Colorado Video, Inc. (CVI) in the form of twenty 35mm color slides, and 102 black and white slides.

■ The slides were video-processed at CVI in the following manner:

The slides were projected onto the vidicon faceplate of a monochrome CCTV camera (gama of .65).

Red, green and blue filters were inserted sequentially in the optical path between the projector and vidicon. Wratten filters #29, 61, 46 were used.

The video output of the CCTV camera was connected to the input of a CVI model 201A Video Compressor which sampled the "real time" input signal and generated a slow scan television signal with the following characteristics:

Line rate:	**60 per second**
Field rate:	**8½ seconds per R-G-B color component**
Frame rate:	**Approximately 30 seconds for R-G-B color**
Resolution:	**240 x 512 elements (pixels) per field, dot interlaced**
Synchronization:	**Field start—400 Hertz burst Line pulse—2 widths to identify dot interlace**

The Slow Scan tv signal from the model 201A was recorded on a Honeywell Model 5600 C instrumentation tape recorder for later playback at CBS's disc recording facilities. The video was superimposed on the audio recording.

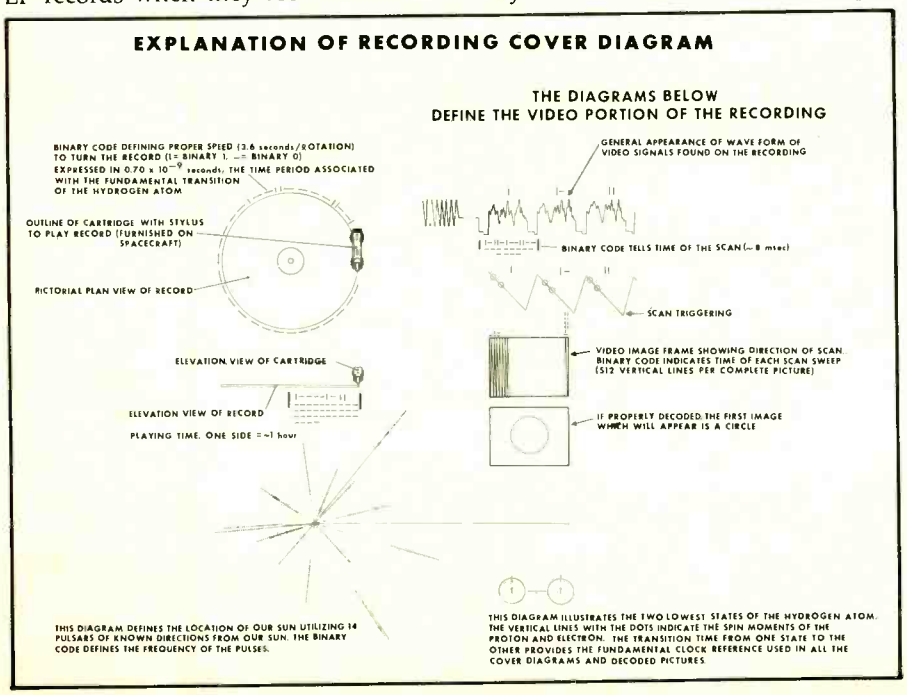
■ Miscellaneous considerations

The quality of the tape recording made at CVI was monitored by playback of the tape through the CVI Model 275B-8 Video Expander.

Monitoring was done on a field-by-field basis in *monochrome only*. An attempt was made to verify color characteristics by means of sequential photographic time exposures.

Useful visual data was transferred to tape and then to disc, but small errors in colorimetry and other technical characteristics exist. These are correctable by appropriate computer processing in the hands of the ultimate viewer. To some degree this may also be true of the limited resolution imagery necessitated by time/bandwidth restrictions of the record.

You know, if those extraterrestrials are able to decipher the disc I am sure that any terrestrial electroniker can, too.



Smart charger: lively

Batteries can be different-Some charge fast, others slowly. What you want is a smart charger that gives you what you need.

by Jeff Sandler
Contributing Editor

In this age of rising prices and seemingly lower quality, you're probably looking for ways to save some money, and the aggravation of having to buy and endless string of replacements. Especially batteries, which always seem to be goind dead when you need them the most. This smart battery charger can save you a bundle if you use lots of batteries, and is at the same time fun to build.

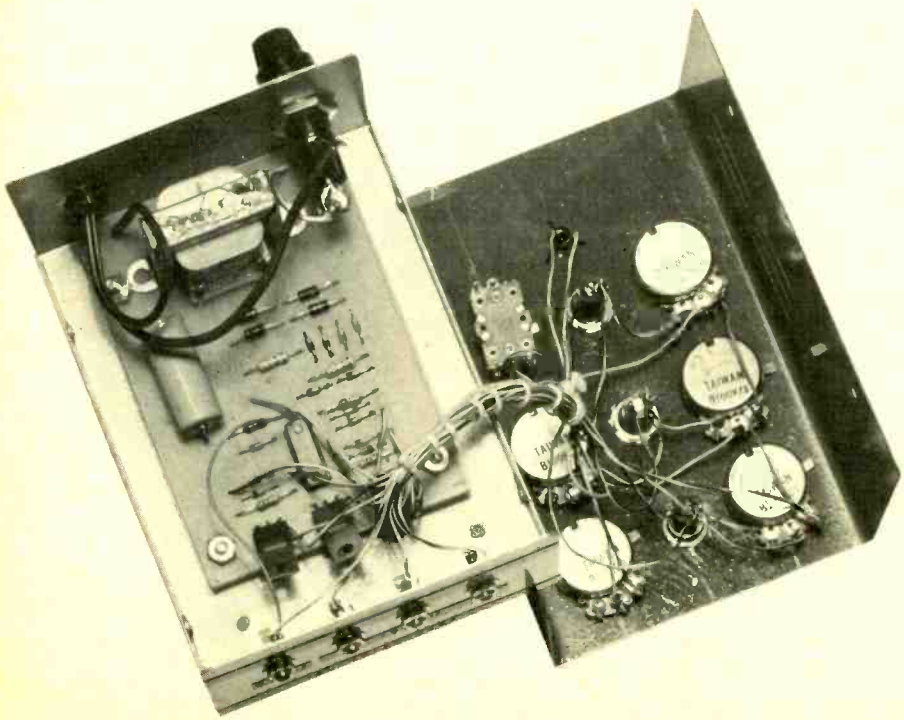
This nifty charger is called a smart charger because it knows how to charge all kinds of batteries. And you can charge up to four different batteries, at four different charging rates, simultaneously. That's something the commercial models can't do. Best of all, your smart charger will cost you about $5 to build, if you have a dc power supply handy. If you have to build the supply, too, the price will go up two or three dollars.

The smart charger is easy to build. The parts layout isn't critical and the parts are readily available.

Op-amp makes it go

The heart of the smart charger is a 324 quad op-amp integrated circuit. Each of the op-amps in a 324 can handle about 20 ma of load current, which is enough to charge most small batteries. Because of this, one section is set aside for charging penlight cells.

Larger batteries, C cells and up, require more charging current than the 324 op-amps can handle. A PNP transistor added to the output of each of the remaining 324 op-amps boosts the available charging current to as much as 100 ma or so.



The smart charger has three 100 ma charge outputs, each identical in circuitry. The current boost PNP is connected to the output of the 324 op-amp through a resistor-diode network. In the network is a variable resistor which lets you set the charging rate. A second variable resistor in the feedback loop lets you set the voltage at which the charging process stops.

When you build the smart charger, select a lamp bulb with a 100 ma rating. Radio Shack's six-volt number 272-1142 bulbs were used in the prototype. The value of R* should be selected so the bulb glows at normal brilliance when the variable resistor is set to its minimum value. This sets the maximum current that can flow into the battery being charged.

You can use any PNP transistor capable of handling 100 ma. Radio Shack's 79¢ RS-2034 is a good choice.

Regulated supply

The op-amps require a reasonably well regulated power supply. The circuit shown here provides the required 1.2-volt regulated output at tap *VR*. Regulation is provided by the relatively constant forward junction voltage of silicon diodes, which is 0.6 volts.

The basic supply uses a conventional fullwave bridge rectifier with a single capacitor filter. The voltage across the filter is about 18 volts, which is applied to the emitter of the PNP transistor from tap VS.

The smart charger is easy to build. Parts layout isn't critical. You can use just about any enclosure you have handy. The prototype was built in a Radio Shack 270-253 metal cabinet.

Batteries differ

Although some people say you can recharge alkaline batteries, there are others who say you shouldn't; that it can be dangerous. So, as far as alkaline bat-

old battery booster

teries are concerned, proceed *at your own risk*.

Carbon-zinc batteries, the common flashlight battery, and nickel-cadmium batteries, better known as NiCads, can be recharged safely. In fact, NiCads are designed to be recharged.

Least expensive among batteries, the carbon-zinc is also the most difficult to recharge. The battery consists of an electrolyte inside a zinc case, into which a carbon rod is placed. As the batter provides power, some of the zinc from the case dissolves into the electrolyte. In order to recharge the battery, you must re-deposit the zinc back into the case.

Although this sounds easy, the chemistry involved in the carbon-zinc battery is for the most part one-way. However, some of the zinc can be returned to the case. The process is, unfortunately, coarse and uneven. The result is a relatively short charge life. And, if the battery is really run down before recharging, the process will be even less satisfying.

Generally speaking, AA penlight cells should be charged at a 20 ma rate. C cells at a 40 ma rate, and D cells at a 60 ma rate. Because the charge is short-lived, use the batteries as soon after charging as possible. Don't be too disappointed in the limited service they'll provide. They weren't designed to give any beyond their first use.

If you'd like to try recharging alkaline batteries you reduce the risk of leakage or explosion by following some common sense rules of the road:

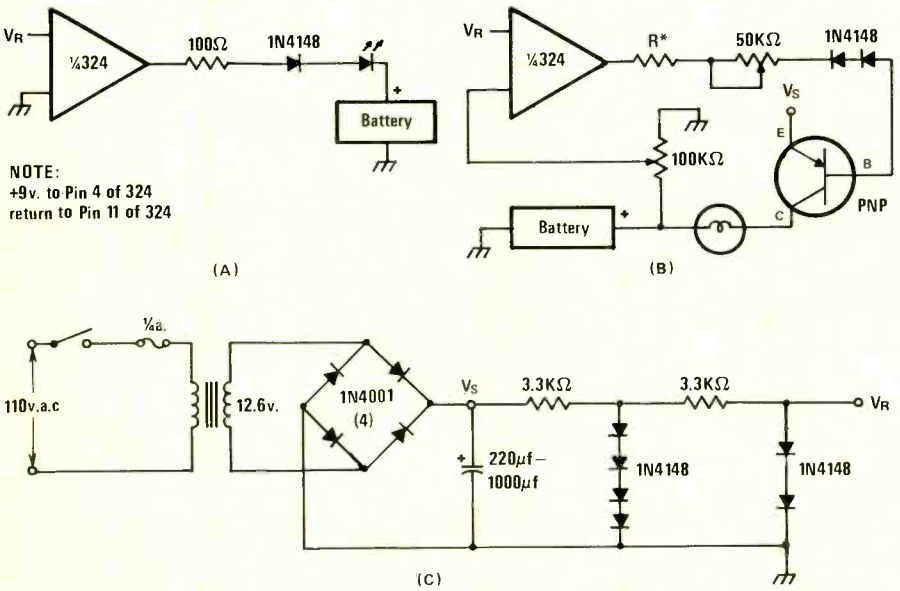
- *Do not* attempt to charge an alkaline battery until it is fully discharged.
- *Do not* use high charging rates. Under no circumstances exceed charging rates of 25 ma for AA cells, 50 ma for C cells, and 80 ma for D cells.
- *Do not* over-charge the battery. Use the voltage cut-off control in the smart charger to prevent over-charge.

A discharged alkaline cell will have a terminal voltage somewhere between 0.9 and 1.3 volts. As the battery recharges, the terminal voltage will climb to between 1.4 and 1.7 volts. The actual voltage will depend on the condition of the battery.

A new alkaline cell, being charged for the first time may reach the 1.7-volt level. An older cell, however, may only be able to produce 1.4 volts. On full discharge, the voltage can drop to 1.3 volts in a new battery, and 0.9 volts in the older cell. So, knowing the exact state of charge for any given battery isn't as easy as it seems.

NiCads are different

Nickel-cadmium batteries are made to be recharged. Most can be recharged over 500 times. Charging NiCads is a breeze compared to carbon-zinc and alkaline batterys. Most NiCads have an amp-hour and charging-current rating



Penlight and other small batteries are charged directly from one section of the 324 IC, as shown in (A). Larger batteries, requiring more charging current, are charged from any of the other three op-amps in the 324, each of which has a transistor follower that can deliver up to 100 ma of charging current, as shown in (B). The op-amps and transistor charging circuit are powered from tap VS of the power supply. Tap VR provides a regulated 1.2-volt reference voltage to the op-amps.

printed on their labels. Some may also indicate how many times they will take a charge.

The smart charger, as built, is designed to provide top performance at the lowest cost, leaving off as many frills as possible. If you'd like, you can replace the bulb in the charging circuit with a milliammeter. Since the maximum current the charger should produce is 100 ma, a 0-100 ma meter is ideal. But, make sure to put an instrument fuse in series with it, just in case you goof. You can get them from most of the large electronic distributors.

The voltage cutoff control lets you set the maximum voltage the battery being charged can attain across the terminals. To properly set it, you'll have to experiment a little.

First, get brand new batteries of the type and size you'll be recharging. Then using a known load, such as a resistor, discharge the batteries for one amp-hour. This can be a drain of 200 ma for five hours, or any other convenient combination of current and time.

Once you've discharged your batteries, connect them to the charger, one at a time, and recharge them for one-amp hour. This should replace what you've just drained out of them. After the proper time period, with the battery still connected to the charger, set the voltage cutoff control so the charging current *just* cuts-off. That's the proper setting of the control for the type and size battery you've just charged.

The smart charger can save you its cost to build many times over if you use lots of batteries. Even if you don't, it's an interesting project, and being able to charge a battery when you need to may make it a very inexpensive project at that.

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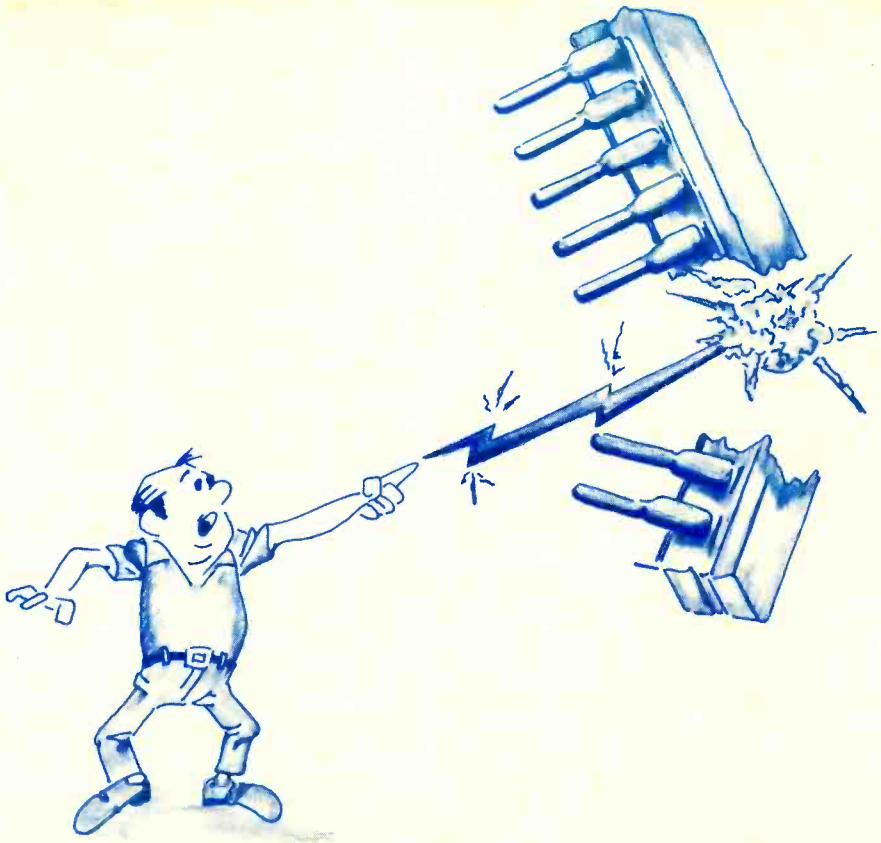


How to handle CMOS integrated circuits

Fumble resistors and capacitors and TTL integrated circuits around like footballs. But when it comes time to handle CMOS ICs, watch out! Precautions are in order. You can destroy the innards of these delicate devices faster than you can blink an eye. And you'll never know you did it until later, when you try to fire up what you've just built and find it won't work. Here's the proper way to go about playing with, touching, soldering these versatile power-saving chips.

by Judy Curtis
Contributing Editor

Zap! Damn. There goes another CMOS chip. You're patiently trying to wire together a microcomputer kit, but half the CMOS chips are going bad.

Handling CMOS is trickier than working with ordinary integrated circuit (IC) chips, and you should follow some simple safeguards to keep from ruining them.

CMOS is a solid IC made up of a delicate balance of transistors. The balance is so sensitive that static electricity that builds up in your hands and clothing can zap some of these transistors, ruining the chip.

Ground everything

When you're wiring a project with CMOS chips, you should ground together yourself, your tools and equipment, the printed circuit board and the chip.

Static electricity that builds up then will drain directly to ground and not go through the chip.

Use *clip leads* between all metal surfaces. For instance, use the leads from the metal above the tip of your soldering pencil, from the conductive foam package holding the chip, from the metal band on your wrist watch, all to the copper ground on the printed circuit board.

You can cut down on the amount of static charge that will build up by not wearing clothes that create large static build ups. For example, wear cotton instead of wool or synthetics.

Another place a large static charge builds up is where dry air is moving over plastic. Don't place CMOS chips near such an area.

When you're ready to pick up the chip, always touch the conductive foam container which stores the chip before touching the chip itself.

If you want to move the chip to another container, touch both containers first before touching and moving the chip.

Keep touching the board

Pick up a CMOS chip by its edges rather than the pins. Avoid touching the pins as much as possible.

Touch the printed circuit board before placing the chip on the board. Try to keep your hand on the board as much as possible while installing the chip.

Another important safeguard to remember is not to touch anything to the CMOS IC which you have not touched first (while touching both it and the chip itself).

CMOS chip manufacturers are trying to build protection into the ICs. But the best way to be safe is to follow these construction techniques.

LETTERS

continued from page 19

like this: a slight distance out from the antenna the free-space-behavior of the electromagnetic wave becomes significant in comparison to that of the fields much closer to and in the radiator elements themselves. It is sort of like the Rayleigh Criterion for light in reverse. This is something that leads to energetic limitations on the behavior of antennas and is just as real as Faraday-Maxwell Displacement Currents that have to be taken into account in an application like, say, a magnetron or a klystron. My point is that like the negative resistance unit, but in a much more sophisticated way, this phenomenon can be utilized in a device to increase energy storage and thus vastly increase gain. We must remember that the multiple characteristic possibility for a device is absolutely there; what is needed is to separate and inter-connect the pieces of characteristic curve in a way that will maintain itself indefinitely.

You may ask what is containing the electrons. My best answer is that the agent is not magnetic fields but electomagnetic form factors—complex electromagnetic condition that allows fragments of magnetic field existing very briefly to constrain entrapped particles more effectively than a static magnetic field. Remember that this is not the weak minor phenomenon of the antenna that is itself doing this: the energy is going almost completely to contain the electrons and very little is being used to amplify the antenna divergence factor itself.

I would now like to describe a physical situation which I believe pertains extremely to what we have been detailing. No doubt various aspects of the past argument have made you think of hydrodynamics, cooperative phenomena such as the laser and maser, and perhaps even of the connection between them. In a, say, vacuum tube the electrons often have energies of one hundred volts. In a, say, heavy metal atom the energies of electrons range from a few thousandths of an electron volt to the gamma ray range. The latter, though, is not usually reached too well; we could probably make a good approximation with ten thousand electron volts, so that the geometric average is in the vicinity of a few electron volts. In other words, in a vacuum tube there would be a small but appreciable chance of strong electron-nucleus interaction if the electrons could be gotten into a macroscopic quantum state.

Imagine a system that is moderately energetic, large, and susceptible to low—grade lasing. This means that once lasing occurred a significant amount of energy at that frequency would remain in the system, performing a stimulated-emission action on the other potential radiators. Given a little luck, what after-lasing occurred would feed energy to the afterwave and not to the group of ensembles leading to the next lasing. Eventually, though, near-lasing and collapse of the afterwave would occur and the lasing would be violent; the afterwave this time would be even weaker but at the same time more subtle. The end product of this would be utterly violent lasing of short duration and with a very large time interval—the space between would be very constant and so would the frequency content of the pulses.

What I am referring to is a pulsar. That pulsars should work by lasing is certainly not absurd since lasing and nucleodynamics are both cooperative systems. In a vacuum tube the electrons are removed from nuclei in a manner energetically very similar to that which it has been recently suggested that the mid-inner electrons of the heavier atoms could easily be superconducting. Also, as you may know, a neutron star is really a massive single nucleus, and nuclei, as in the fission of uranium, are very susceptible to superfluidity. There has been much good theorizing on superconductivity but one could still say just as well that it is simply just one of those things that happens without explanation. Might it be that, as with the supposed 'antenna oscillator' above, the crystalline microstructure of a material could become a circuit under the right conditions? Conversely, might the reason be that why electronic tubes work in the first place is because a reasonably right initial design is then helped by forms and energetics very like mid-innerelectron-superconductivity? After all, since the very beginning electron tubes have been helped by addition of quantities of heavier metals, such as barium. thorium, molybdenum, tantalum and the rare earth elements. In solid state physics it has also been recently discovered that band structure can be ejected from an electronic cystal—something which I would suppose is very like a pulsar.

The end purpose of all of this has been to describe fundamental physical reasons why an electronic unit device such as an electron tube or a semiconductor device could be made to perform many more functions at once than is currently done with single unit devices. The question then becomes one of the particulars of design. One would suppose that the actual design would use few tubes rather than many, would use few precision passive components rather than many, and also would require very little in the way of unusual waveguides, shielding screening, magnetrons, etc. Indeed, this is a good point at which to take a gook look at the limitations of the 'divergence antenna' application. From a knowledge of coaxial cable dimensions getting appreciable antenna behavior inside a vacuum tube should not be difficult. The same thing could probably be done in a semiconductor device because of the electrical materials' values of susceptibility. Remember that it is the antenna divergence PRINCIPLE that we are after and that the energy interface for the antenna itself does not have to be large at all. Afterwards, we need to realize that the antenna divergence is not the only parameter that needs to be considered in getting this piece of equipment to work. Please recall that the multiple characteristic possibility is in any device all the time, ever since they were invented. All that is needed is energy and resolution to get the characteristics strengthened and made more liable to interaction. This is why I suggested something like a small computer as our 'object of replacement' for, say, ten vacuum tubes. The amount of passive circuitry required for this will be extensive but remember that most of it would be there anyway. We would then need extensive digital systems knowledge to determine just how, for example, we would go about randomly distributing power supply connections to a microprocessor and then set about seeing what would happen when some of these were randomly deleted.

One can look at the prospective circuit configuration in those ten vacuum tubes as if it were a very large array of digital and analog elements with semi-random interconnections, in power supply, signal and even some nonsensical connections, each being controlled by a separate digital array at its midpoint. Of course, semi-randomly-selected portion of these 'controllers' would themselves be part of the general circuitry. This is one reason why to choose a very large system such as a computer for replacement so that it can be treated statistically--and since our method of replacement has a number of degenerate elements we can then take the statistical analogies a step further. By 'degenerate elements' I mean quantum degnerate aspects of the materials used, of the 'antenna divergence' principle itself, of the randomness of the connections, and of the physical processes that are being analogized, such as superfluidity, molecular susceptibility, and the pulsar model.

It must be realized that any closing of such a discussion ought to be capped with a more—than—hefty dose of historical investigation. One of the few major reasons why people like Armstrong, Edison, DeForrest and Marconi went ahead from preliminary youthful decisions is that they knew from liberal arts or being read or just the history of science that the principle of 'Occam's Razor' is almost true—most over-articulated would-be inventions don't get anywhere but a significant proportion of those that are 'simple but concise'

do. Any upper-level course in physics teaches what is 'the greater lesson of the correspondence principle'—that is, the meaning of 'physical intuition'. Modern widespread teaching of quantum mechanics has to some extent obscured a principle that itself has one of its best enunciations in quantum mechanics—under—yes, 'degenerate' conditions—when things are right a quantum system when taken to its limits of validity becomes extremely nearly identical to a classical system.

Modern engineering is a three-way interaction of approximations, basic physics and the unpredictabilities AND HIDDEN POSSIBILITIES of real-world materials. Part of this for them was knowing, even only unconsciously, that the fields and principles and materials they were working with themselves naturally contained the behavior they were seeking. Another factor was common sense; a hundred years before induction, telegraphy, magnetics fields from currents and not from permanent magnets, all these were unknown as were strong steels, internal combustion and atoms—but most of the knowledge that would eventuate in these things already existed. Similarly, a hundred years before that steam was a baby, and the gas laws and gravity were well-meshed in mathematics but as yet not well corroborated. In short, Marconi and DeForrest and the rest knew that the odds of natural and technological inevitability were on their side. Remember—with all our modern knowledge we have barely begun to describe electricity in terms of other forces. Most of our knowledge is just elaborated mechanics, fancy extensions of Maxwell's work, nuclei just as massive crystal centers and not something we can work with with our hands. If only by the myriad implications of what we now know, the day of the 'simple mechanism' is not going, it has barely begun. Remember—when DeForrest finished his work he had something that functioned—period; the transistor is just a sophisticated child of the galena crystal; the largest processor is just a near cousin to the works of something that was conceived in Vienna by the contemporaries of Helmholtz. Try to match your experience and learning with the concept of the 'antenna divergent' and of a network of components that separates new possible characteristics in the same way that applying voltage to a semiconductor makes its own quantum-mechanical characteristics come apart from each other and be more real.

John C. Bassette

We saw an article in a computer magazine some time ago, John, which took words and phrases and combined them at random to make up written reports. You've got that program beat by a mile!

See that garage door over there?

Here's how to open it from over here.

One of life's great little labor-saving devices: the electronic garage door opener. Here's how to install one and save lots of wear and tear on yourself.

by Ron Cogan
Contributing Editor

Pulling up to the garage in your sedan, you throw the gear-shift in park and prepare to open the garage door—just like hundreds of thousands of other homeowners across the nation. It's an everyday chore you do without thinking until, of course, inclement weather sets in and you're subjected to rain, snow, or freezing cold during those few moments it takes to open and close the door. Enough to ruin anyone's day!

Over the years, a viable solution to this problem has been the addition of a remote-control door opening system. These handy gadgets allow a motorist to open a garage door without ever leaving his car, and then close it in the same manner once inside the garage and parked. No more soaking rain or cold to deal with—just the comfort afforded by your car and the relative warmth and shelter provided by an enclosed garage.

These systems typically offer an enclosured drive motor, rails and bracketry, chain or cable, receiver, and a remote transmitter that is placed in your automobile. Additionally, all mounting hardware is supplied and only normal hand tools are required to complete the installation. Most systems offer additional transmitters for a nominal cost for households with more than one vehicle.

One of the largest and most important drawbacks to this type of system has been the possibility of an unauthorized person opening your garage door with

Your first step will be to assemble the system's railing, bracketry, chain, and assorted hardware per the detailed instructions included with the garage door opener packaging.

Next, determine the vertical center line of the garage door, then install the door arm bracket to the top edge of the door as shown. Carriage bolts, washers, and nuts are supplied for this task.

After installing the header bracket to the wall above the door, secure the end of the sprocket bracket to the header bracket. The height of the header bracket is important to the proper operation of the system, so be sure to refer to the instruction manual for measurements.

his own transmitter from the same manufacturer. This could subject your automobile and garage contents to theft, and even your home if it is connected to the garage with a common door. However, recent innovations in this field have included transmitters and receivers that allow a homeowner to set his own frequency for security reasons, such as the model #139.655 digital control opener shown in this article from Sears, Roebuck & Co. Because of this design feature, chances of an unauthorized person remotely opening your garage door are phenomenally small and virtually unheard of.

The installation of the Sears unit used in our sample is a simple one when approached on a step-by-step basis, an easy consideration since Sears supplies a completely detailed installation manual with all of their openers. Although this project is one which most-do-it-yourselfers can handle, independent electricians or field personnel from the store the opener was purchased from will generally do the job for fifty to seventy-five bucks, depending on the condition of your garage door and its components.

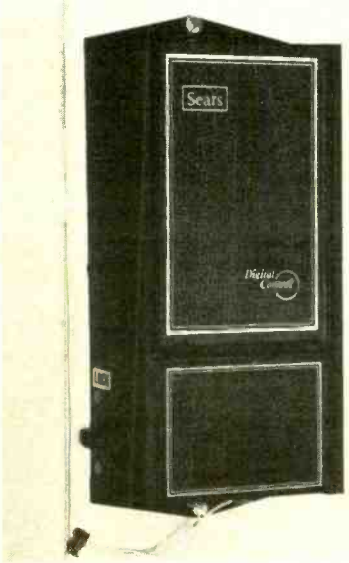
Once connected to the header bracket via the railing's sprocket bracket, the opener should be supported roughly in position on a stepladder. Align the opener carefully per directions, as this is extremely important to correct operation when in use.

Measure and cut the opener's mounting brackets to size, then secure to opener and joists which nuts and bolts supplied.

There is one preparatory step which you'll have to handle before beginning the installation of the opener itself. Garage door openers normally come with an electrical cord that is four feet or less in length due to housing electrical codes. If your garage is outfitted with a 3-wire, grounded receptacle within easy reach of the opener's cord, then you're in luck; if not, this will have to be handled before you proceed. This task can be performed by an electrician at a reasonable charge if you don't care to tackle it yourself.

Your first installation step will be to assemble the opener's railing, chain, and hardware per the directions outlined in the installation manual. After assembling this completely, you will have to install the opener's garage door bracket with carraige bolts, nuts, and washers. Locate this bracket by determining the vertical center line of the garage door, then positioning the bracket center-on-center with this line at the leading edge on the top of the door.

You will be installing the system's garage header bracket next. Open the



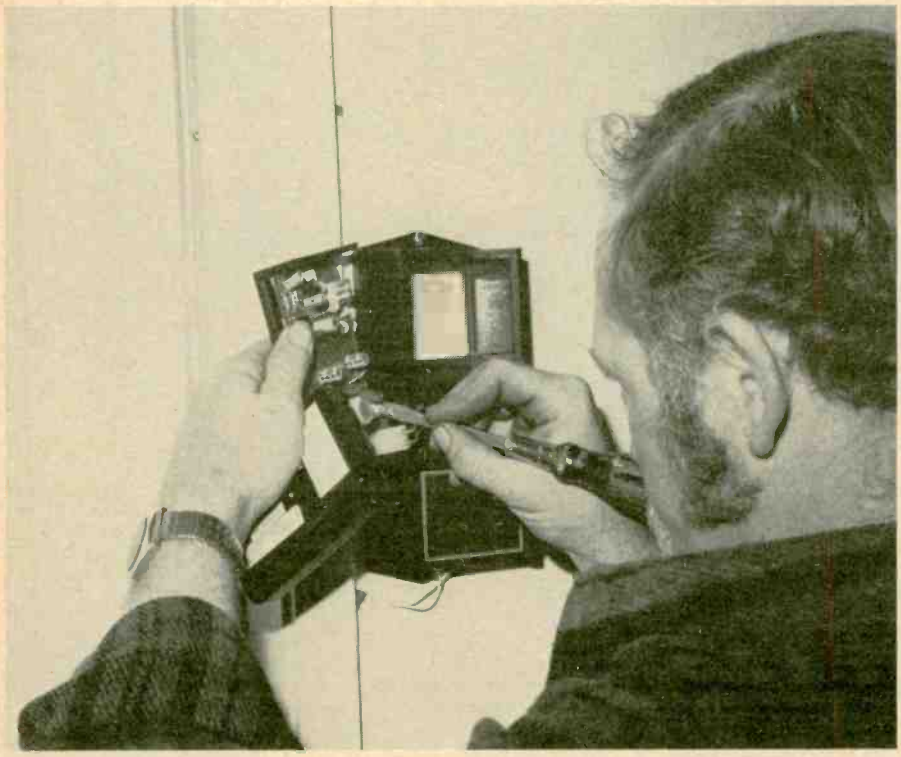
The receiver should be mounted at a convenient spot on one of the garage's inside walls, such as next to a service entrance.

Route the bell wiring provided along wall and ceiling to join receiver to operator. Strip the wire ends and join to the terminals found on both components.

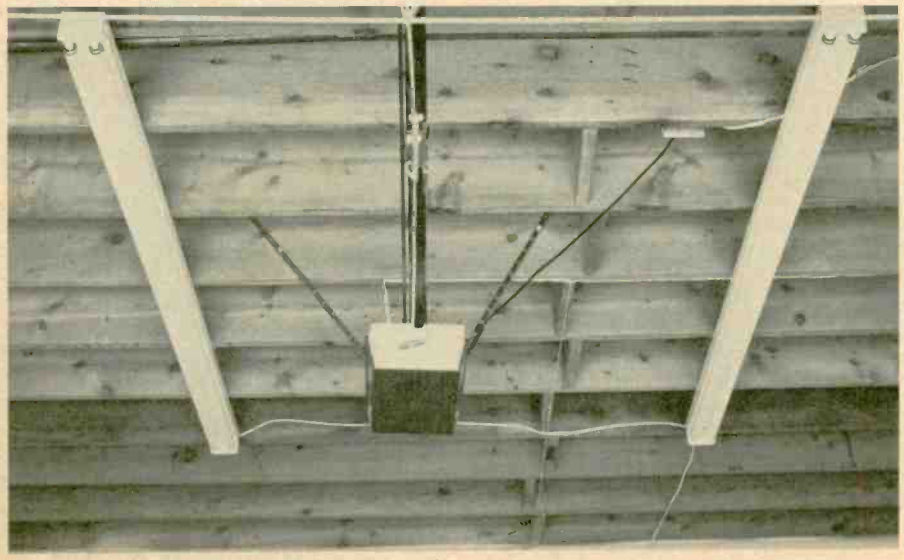
It is vitally important to adjust the mechanism inside of the opener itself per directions. Remove the four screws that hold the opener's cover in place, then slide the cover off for access.

Next, secure one end of the straight door arm to the door bracket, and the short end of the curved door arm to the trolley. These two arms are then bolted together into a singular unit.

The system's remote key switch should now be installed in one of the garage's outside walls. This will allow the door to be opened and closed without the use of a transmitter should the need arise.



The system's operating code is set by removing the faceplates on both transmitter and receiver and setting the code block with the aid of a screwdriver or pencil. Both the receiver and transmitter must be coded indentically to ensure operation.



This overview shows the finished installation—completely mounted, wired, ready to go.

door to its highest point of travel, and then measure the distance from the top of the door to the garage floor. After subtracting the actual height of the door from this figure, you will end up with the amount of "door rise"; this figure is correlated with the chart contained in the installation manual to determine just how far above the top of the garage door the header bracket should be positioned. Place this bracket at the referenced height and center-on-center with the extended vertical center line of the door, then secure with hardware provided.

Set the door operator (enclosured motor) on its packing box and raise the rail until the sprocket bracket joins the header bracket. Align the holes and secure the two together with the clevis pin and cotter pin supplied. Now raise the motor end of the opener to a height equal to that of the door bracket with the door open, and support the opener with a stepladder. (For maximum efficiency, the operator should not be secured more than two inches higher than this.)

With the enclosured motor now supported in its final position, measure the distance between the housing and the nearest joists or other roof supports. Cut both pieces of hanging bracket provided with the installation kit, notch the ends with a hacksaw, and then bend the ends to form desired angles. Fasten these brackets to the operator chassis with screws, drill 3/16-inch pilot holes in the roof supports at appropriate spots, and secure to supports with lag screws.

Now it's time to install the system's receiver. After determining a suitable location for the receiver (such as adjacent to the service door), it should be attached to the garage wall with screws at the top and bottom. Next, route the bell wiring provided along the garage wall and ceiling to join operator to receiver; this is secured with insulated staples as you proceed. Strip off a half-inch of insulation at each end of the wires and attach to the terminals on both the operator and receiver to complete this circuit.

After plugging the unit to the receptacle, use the radio control to run the trolley back to the "up" limit near the motor end of the unit. Disconnect the power and remove the four screws that hold the cover in place, then slide cover forward. This will allow access to the adjustment controls inside of the operator housing. Make adjustments as outlined in the manual to ensure proper operation of the door opening system.

Your next step is to secure the door arm. Using a ⅜-inch clevis pin, connect one end of the straight door arm to the door bracket, and the short end of the curved door arm to the trolley. Close the garage door tight, bring the two door arm sections together, and bolt them securely into a singular length.

Final steps in this project include

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Arecibo:

the quest for knowledge

Radio signals have been leaving Planet Earth for nearly a century. We've sent coded messages and television pictures and even one giant balloon of 10-4's over the years. But, what if someone were hearing all that and sending something back? Replying to our outbound transmissions? Now somebody here is listening, turning an ear toward the vast depths of Outer Space.

by Dava Sobel

Frank Drake drives a metallic blue Porsche 911 when he's at home in Ithaca, New York, identifying himself on his CB radio as "Bluebird." But when he makes his monthly trip to Arecibo, Puerto Rico to oversee operations at the world's largest telescope, he tolerates any old station wagon or economy car that he can rent in a hurry.

It usually takes him three hours to drive from the San Juan Airport to the hills on the northern coast of the island, where an international community of astronomers works to investigate the electrical properties of Earth's atmosphere, map the surfaces of distant planets, hunt for evidence of extraterrestrial life, and even broadcast messages into deep space in the hope

are not alone.

The Arecibo telescope is a white concrete, steel, and aluminum structure rising some 565 feet in the air out of a blue-green jungle. It is a multi-million dollar tool for exploring the universe through the radio portion of the spectrum. Most familiar telescopes rely on visible light, but the few wavelengths from red to violet are only a tiny portion of the electromagnetic spectrum.

Stars and galaxies emit radio waves, X-rays and gamma rays as well, and the heavens also shed informative ultraviolet and infrared radiation. Progress in modern astronomy comes when signals of all kinds are ferreted out and pooled together with many kinds of observing instruments.

In fact, asking today's astronomers to rely on visible light alone would be like asking a musician to play only one octave on a huge piano.

The radio telescope explores a whole new sky which our eyes would never recognize. On maps drawn from radio data, the moon and planets are almost invisible. Gone are the familiar stars and constellations seen in the night sky.

Out of this curious heaven, the Arecibo telescope picks up radio energy that may have taken as long as ten billion years to reach the Earth from strange objects at the edge of the universe. These celestial radio signals are so faint, that all the energy collected in the 45-year history of radio astronomy is about equal to the energy released when a few snowflakes fall on the gound.

"That's when they hit," Drake emphasizes. "The energy released as they melt is much greater."

ME photos: Cornell University

The Arecibo telescope does more than listen to the sounds from space. It has a radar capability powerful enough to hurl its own signal across enormous distances. Radar bounced to Venus and back, for example, enables Arecibo astronomers to map the planet's surface in spite of its obscuring cloud cover—50 miles thick.

Radio waves, unlike visible light, easily pierce through clouds and dust, and can be studied day or night. In fact, some radio astronomers get so accustomed to working the day shift that they'd be hard pressed to identify the Big Dipper on a starry night.

The telescope was originally designed under the direction of William E. Gordon, now at Rice University, who wanted to do radar studies of the far regions of earth's atmosphere. Most radio telescopes have a steerable dish, or reflector, that collects the radio waves. But the giant dish Gordon wanted for increased sensitivity would be too big to steer, so he turned standard telescope plans upside down.

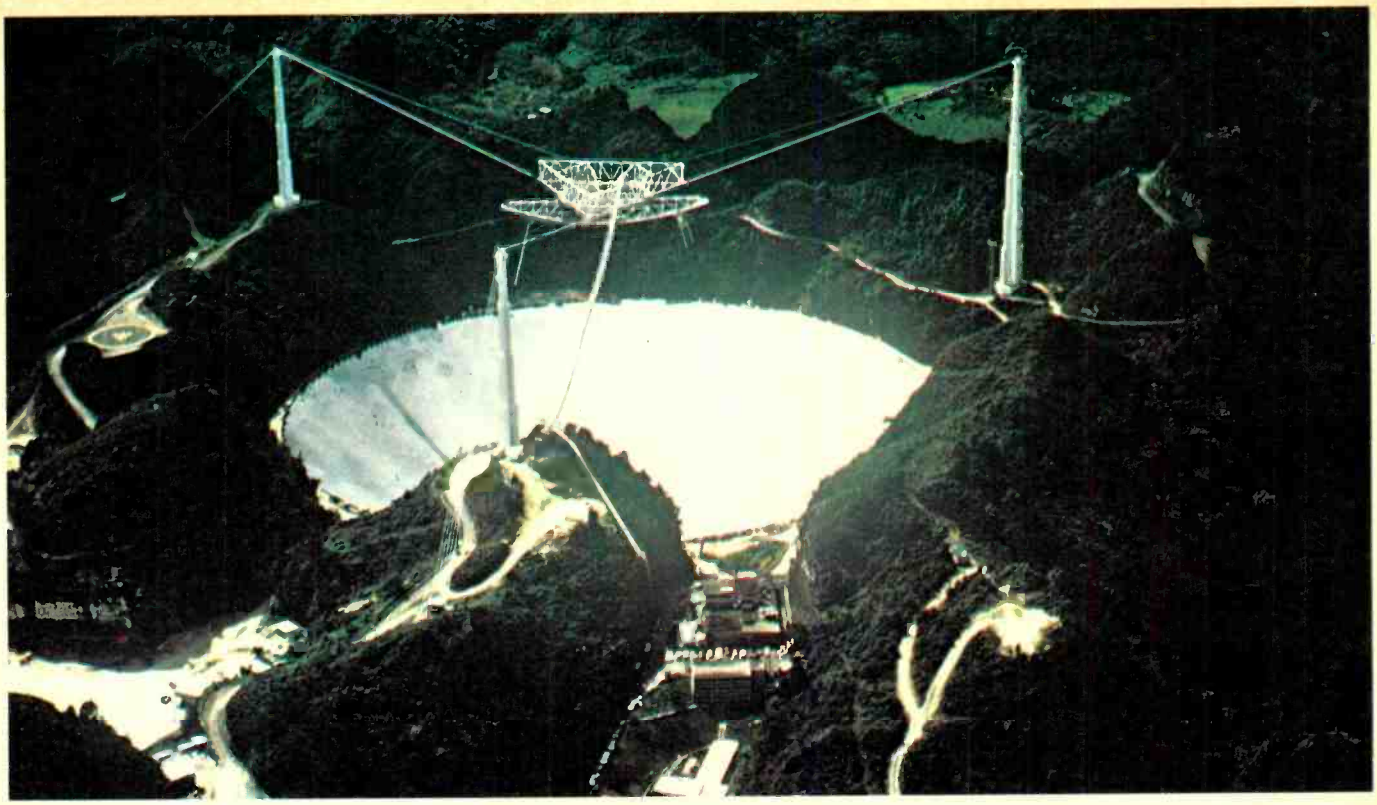
He envisioned a reflector bowl 1,000 feet wide, lying immobile in the earth. Above it, the receiving and transmitting equipment—all 600 tons of it—would hang by steel cables from three concrete support towers anchored in the surrounding countryside.

The required site had to be within 20 degrees of the equator, where the moon and planets pass nearly overhead. (Although they are invisible in the radio sky because they make no emissions of their own, these bodies can be studied in detail with the telescope's radar.)

The tropical location would also guarantee fairly constant temperatures, causing minimal thermal expansion and contraction of the structural materials. The builders had a certain kind of topography in mind, too, because they knew they couldn't afford to dig a hole as big as they needed. Once they settled on limestone cave country, they quickly narrowed the field to Puerto Rico for political reasons.

Good government relations notwithstanding, activist groups have allegedly attempted to blow up the support towers on several occasions. The Observatory is now heavily guarded and surrounded by high fences. Visitors are admitted during a two-hour open house on Sunday afternoons only. The children of the farmer who originally owned the land, however, have access to a special footpath through the site for their daily two-mile walk to school.

A careful aerial survey of the island produced scale maps on which a 1,000-foot hole was the size of an ordinary 25-cent piece. The designers located possible sites by moving a quarter on the maps until it fit in a hole, or so the story goes. By tiddlywinks, then, the planners settled on a hole in Barrio Esperanza



Carved out of the mountains near Arecibo Puerto Rico, 20 acres of aluminum antenna stare into the heavens. Above it, suspended by cable, is the giant platform from which S-band radar signals of almost a half-million watts power are generated. After being focused by the dish, the signals have more effective radiated power than is produced by all the world's generating stations combined and multiplied by 100.

("the township of hope") because it was the most isolated—farthest from any possible source of radio interference.

It was also very difficult to get to. The 11-mile distance from the northern coastal town of Arecibo to the Observatory site can easily take an hour to travel. The road changes altitude and direction every few feet.

The tortuous 1½-lane thoroughfare boasts 91 blind curves, often gets blocked by wandering cows, and is the scene of frequent collisons between cars and slow-moving sugar-cane trucks. Yet every piece of equipment, all the needed supplies and raw materials, including more than 15,000 cubic yards of concrete, were dragged to the site over that road.

Drake holds the Observatory speed record for driving the route. During the two years that he served as on-site director and commuted in a responsive vehicle, he could race down the Arecibo road in the dead of night, envious astronomers report, in an incredible 13 minutes.

"This is where the nun broke her foot," he announced as we wound through the hills the first time he drove me out to the telescope. "And this is where Little Joe smashed his pelvis." Every turn had its own horror story. Drivers are required by law to blow their horns at each bend in the road. Only one of the curves, however, is marked with a yellow diamond-shaped road sign that says simply, Curva Peligrosa.

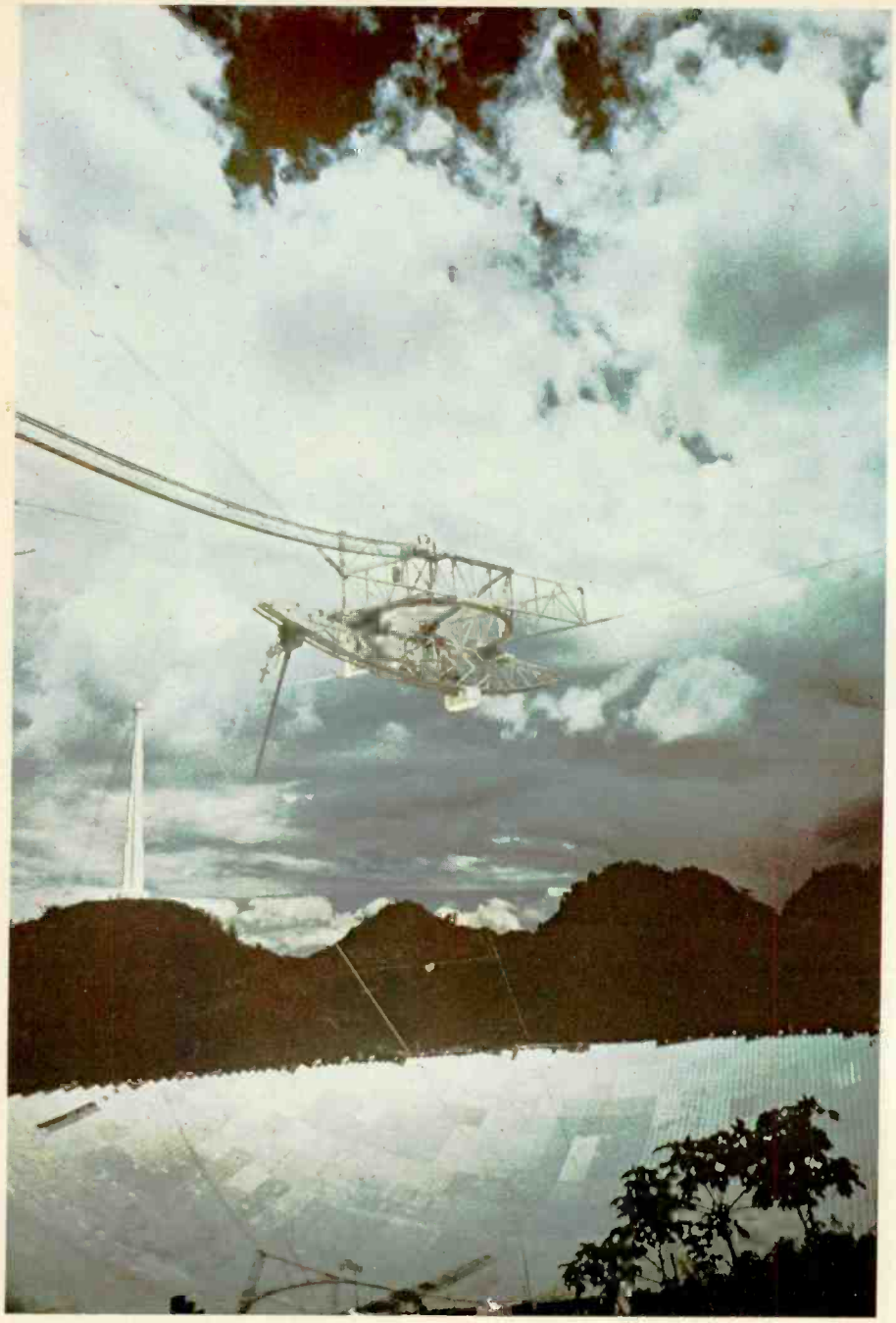
All along the road real bananas grew right on the trees. Pigs and chickens and children flew in and out of pastel-colored stucco houses. Dogs slept in the heat and dust. Every now and then, a car or truck passed us in the opposite direction, with appropriate horn-blowing, shouting and gesticulating. We went around one more turn and seemed to travel 200 years ahead in time. One of the support towers loomed into sight, stark white against the lush vegetation. The one tower and about a third of the suspended structure were all I could see.

Enormous beyond imagination, and bleakly geometrical. A giant's erector set. The scenery for an extravagant science fiction flick. I lost my breath just as it disappeared. The road had reversed again. For the next ten minutes the telescope grinned in and out of sight behind the hills as we approached it. Then the guard spotted Drake's white hair coasting toward the entrance, and the gates sprang open.

Long a popularizer of science, Drake talks about the Observatory to all sorts of after-dinner groups in non-scientific terms:

"The total collecting area of the Arecibo dish—20 acres—is equal to the combined collecting area of all earlier telescopes built since Galileo first used

The giant telescope's dish is made up of over 38,000 separate panels, each measuring about 40 by 80 inches. In all, more than 300 tons of aluminum were used to make the perforated sheets and frames that make each panel.



the instrument in 1610. The bowl is really big enough to hold 357 million boxes of cornflakes.

"The suspended triangular platform structure weighs three times more than the Statue of Liberty. From the bottom of the bowl, you can see that weight supported by cables leading to towers that reach higher than the Washington Monument.

"The telescope has to be this big to observe cosmic radio sources because they shed so little power on Earth—only a few watts."

Operating in the receiving mode, the telescope collects data with the 20 acres of aluminum that line the natural depression in the Earth. Because the shape of the surface is spherical, the collected signals are focused not to a point but a long line, about 500 feet above the bowl. Specially designed "line feeds," or antennas hang from the suspended platform to receive the radio signals collected by the reflector. The signals then travel through a wave guide to computers in a control room on the ground.

To transmit with the instrument, the radar beam is directed down one of the antennas to the dish, where the signal is magnified and beamed into space.

The Observatory is designed so that a single experimenter can operate the entire facility alone. Those who have done solo stints have wonderful stories to tell. Once, Yervant Terzian of Cornell University was working through the night by himself and had to leave the control room to make an adjustment to equipment up on the platform. He rode the cable car up there from the foot of Tower T-12. (The other two are T-4 and T-8, for clock positions.)

Terzian made the adjustment swiftly, rushing to get back to the control room before the Earth's orbital motion put the source out of reach, and was half-way through the 4½-minute ride down when the cable car came to a wobbly halt. He had turned on the power to the car in the control room, and jammed the switch into place with a box of cigarettes, but the packet had fallen out, shutting down the power and leaving him stranded.

By the time the night watchman noticed that the cable car was marooned in midair, Terzian was beside himself with frustration. The whole night had been a bust. The only positive outcome was the subsequent installation of a walkie-talkie in the cable car.

Later, when Terzian was back at Arecibo for another week's observations, he found himself in the open cable car during a sudden late-afternoon downpour. Hot and uncomfortable, he peeled off his wet clothes as he walked back uphill to the control room, where he found the assistant director giving a guided tour to a few distinguished male and female guests.

Observing time is fiercely coveted, and available on an equal competitive basis to all scientists. Eight to ten visiting investigators are usually working at the site at any given time. The resident scientists and supporting staff number approximately 150 men and women.

Originally finished in 1963 at a total cost of about $9 million, the telescope was upgraded ten years later to perform frontier research in radio astronomy. The National Science Foundation financed the $5.5 million facelift for the surface and NASA (National Aeronautics and Space Administration) provided an additional $3.3 million for a new high-power, short wavelength radar transmitter. (The cost of the transmitter and its auxiliary apparatus about equals the Observatory's operating budget for a full year—$3.5 million.)

Workers ripped off the old wire mesh surface of the reflector one section at a time, replacing it with 38,778 individually adjustable aluminum panels. The two-year project impeded some astronomical research, but stopped it completely for only two weeks. Drake says the 20 acres of old wire mesh went to the local farmers, who found it just the thing for making chicken fences.

The new panels, each about 40 by 80 inches, were assembled in a special factory built right on the Observatory grounds. (No one would risk transporting the fragile panels over that road.) The factory processed some 350 tons of aluminum—enough to make a guardrail all the way around the island of Puerto Rico.

White squares on the corners of each

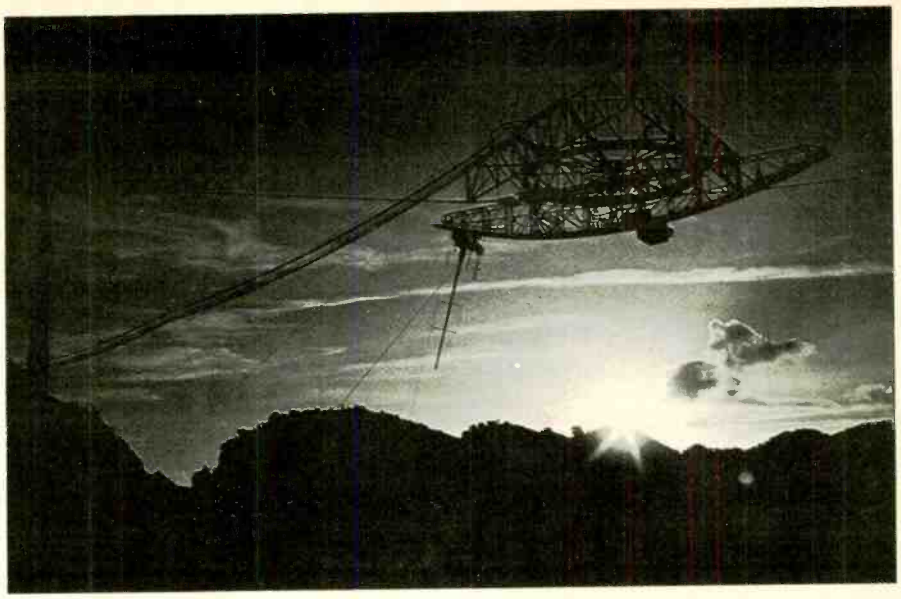
panel serve as targets for a special laser system used to check that the surface curvature of the dish is perfectly spherical. Lasers can survey the entire surface to an accuracy of better than one millimeter in a single night. Such a job could easily take three months with standard surveying techniques.

The shiny new skin is supported on a web of steel cables traversing the bowl in east-west and north-south lines. These cables are also the arteries of a trolley system that carries maintenance men in a pulley-rigged sled under the surface to any points where panels need adjustment. The cables are anchored by thinner "tie-down" cables to thousands of concrete blocks around and under the dish.

Every panel is dotted with tiny holes that let the sun and rain through to the rich vegetation underneath the reflector. Without these plants—mostly ferns with a few wild orchids—the ground might erode and the whole collecting surface lose its footing in the bowl.

The completion of the upgrading increased the telescope's sensitivity for certain studies by a factor of 2,000—making it a virtually new instrument. The staff of the National Astronomy and Ionosphere Center (NAIC), which runs the Observatory from headquarters at Cornell University, organized a two-day bash to celebrate. The party had everything from formal speeches to a cake in the shape of the telescope, and one unheralded surprise.

When the 250 scientists and government officials arrived at Arecibo on November 16, 1974 to attend the dedication, Drake initiated the new radar by transmitting a message to whatever beings might inhabit the globular cluster of 300,000 stars known as M-13, which happened to be overhead as the ceremony took place.



Drake is unshakably convinced that extraterrestrial life exists, and furthermore that radio signals from other worlds may surround us even now, arriving on some unknown frequency like a whisper we can't quite hear.

"Interstellar contact would undoubtedly enrich our civilization with scientific and technical information which we could obtain alone only at very much greater expense," Drake says. "More than that, it is extremely likely that any civilization we detect would be more advanced than ours. Thus it would provide us with a glimpse of what our own future could be.

From this we might learn the best course of action in planning the development of our own civilization without wasting time and resources through the trial-and-error approach, which has been until now our only available avenue to progress. We would learn ways to improve the quality of life on Earth at an unprecedented rate. We would learn what ultimate social systems are arrived at through evolution in other civilizations.

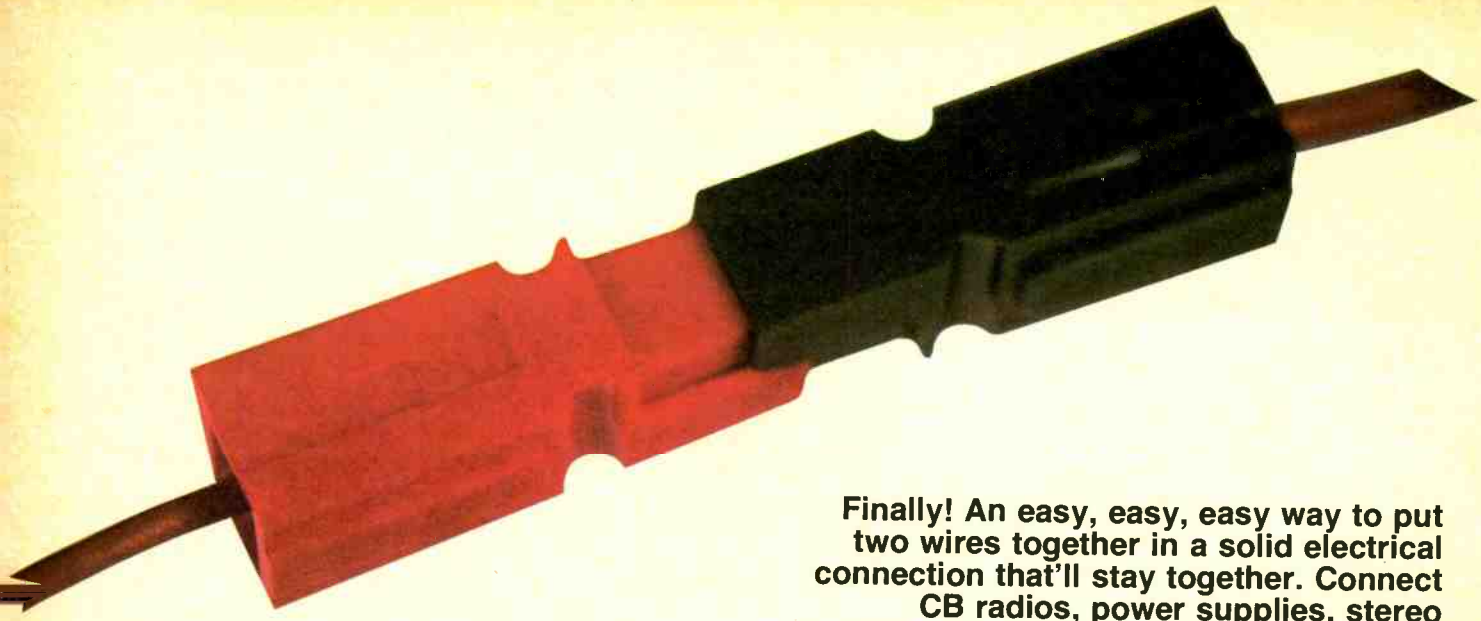
"We need not be afraid of interstellar contact," Drake is certain, "for unlike the primitive civilizations on earth which came in contact with more advanced technological societies, we would not be forced to obey—we would only receive information." (Extraterrestrials are too far away to pose any threat to us. To wit, the message sent to M-13, though it is tearing across space at the fastest possible pace—the speed of light, or 186,000 miles per second—will not reach its destination for another 25,000 years.)

"We would learn art forms and amusements in this universe," Drake continues, "thus extending our own possibilities. And very likely we would learn profound aspects of intelligent life that we as yet have not begun to imagine. As with all explorations and scientific discoveries, these would be the most important of all."

Even before the upgrading, the Arecibo telescope listened for signs of life from elsewhere in the galaxy. With 200 billion stars in the Milky Way alone, and some 2 billion of those thought to have habitable planets, it has long seemed unlikely that Earth could be the only hunk of rock in all the vastness of

please turn to page 88

To prevent the surface of the dish from being distorted, workmen must wear special, oversized shoes when walking on the reflector. Puerto Rico's tropical sun and the silvery surface of the aluminum dish mean instant sunburn, so protective clothing, including the Foreign Legion like neck protectors, is a must at Arecibo.



Finally! An easy, easy, easy way to put two wires together in a solid electrical connection that'll stay together. Connect CB radios, power supplies, stereo speakers, auto fog lights and anything else needing a fast, simple hook-up.

It's a snap!

Whew! It's a real pain in the neck. Twisting those loose wires together, wrapping them in black electrical tape, hoping they stay in connection. Now you don't have to go to the trouble anymore. Just pop a set of *It's a snap!* connectors on the ends of your wires and your installation is neat and tidy in seconds, ready to stand up to thousands of rugged miles of abuse.

In fact, *It's a snap* connectors not only are top-notch mobile power and speaker connectors but they work fine around the house.

These handy new plugs let you hook up stereo receivers and tape decks and speakers and even printed circuit boards for your one-night projects like those *9 Projects Under $9* on page 53 of this issue of *Modern Electronics*.

Got a boat? Use the new-style connectors to hook up your deck compass light or a bilge pump or even mast lighting. In your van, they'll connect power to your CB or ham rig, tie speakers to a tape deck or fix fog lights to the wiring.

The *It's a snap!* connectors are, well, um, what the heck, we're not afraid to say it: they're a snap to use. Here's a step-by-step guide to using these easy plug togethers. (See the numbered photos on page 75.)

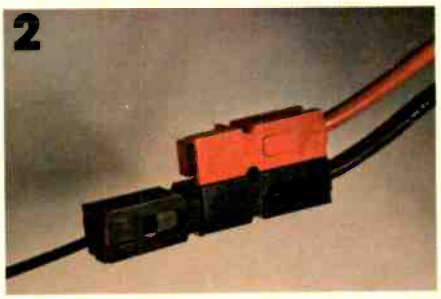
■ Determine the amount of current you expect the *It's a snap!* connector to carry. Smaller contacts are rated good up to 15 amps. Larger are good to 30 amps, according to the manufacturer.

■ Select a wire size to match the current-carrying capacity of the metal *It's a snap!* contacts.

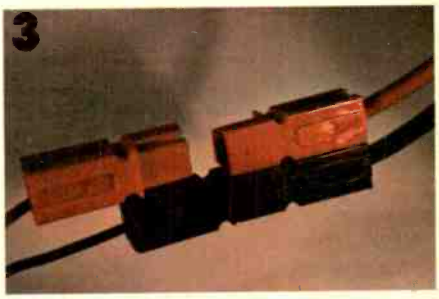
■ Use the *It's a snap!* crimp tool to strip away insulation from the end of

Connector kit contains everything you need in a high-impact-resistant plastic case. The convenient storage compartments house an all-purpose crimping tool, the special insertion tool for use with the connectors and a total of 64 assorted connector housings and contacts. Contacts come in both 15 and 30 amp capabilities to fit most popular wire sizes. There's even a complete instruction manual for those who formerly were all thumbs when it came to connecting wires.

It's easy to use the special tool to insert a contact into a connector housing.



Align the contacts and the housings and they just snap right together. Easy as one, two, three!



Housings stack up for complex connections. They have snap-in dovetails which allow modular stacking.

the wire to which you will attach the new-style connector.

■ Pick the housing color suited to your work. For instance, color code wires which will carry positive or plus voltages with a red connector cover. Negative or minus voltages should be black. Housings of other colors can be used for codings where voltage polarities are not important.

■ The custom-made insertion tool, designed specifically for the *It's a snap!* line, will allow you to place the contacts inside the colored housing with ease.

■ Choose the proper metal contact to place inside the housing. Smaller contacts are good for up to 15 amps current-carrying capacity, according to the manufacturer. Larger contacts are useful up to 30 amperes. Now that you've selected the wire size, proper contact and proper color-coded housing, you're ready to put them together into a finished connector.

■ Finish the ends of as many wires as you need with *It's a snap* connectors. Then snap all your connectors together into one solid bundle.

Suppose you want to wire up a 12 volt dc power supply in your house to power the CB radio from your car.

Determine how many volts your CB requires to operate and how much current it will drain from the power source. Most need 12 volts dc and draw up to three amps or less. Let's figure your CB needs a power supply providing three amps at 12 volts dc.

The power supply will have two output wires. One delivering 12 volts positive or plus and the other giving 12 volts negative or minus. Be sure to unplug the power supply from your ac house power. Strip the insulation from near the tips of the wires and install a red *It's a snap!* connector on the plus wire. Put a black connector on the minus wire.

Similarly, your radio will have two power input wires. One will be for plus 12 volts dc in and the other for minus 12 volts dc. Place a red *It's a snap* on the plus 12v lead and a black connector on the minus 12v wire. Now you have color coded the power supply and the radio wires so they always can be hooked, unhooked, rehooked in the proper connection.

The same sort of polarized connecting can be done with other types of electrical connections for CB, ham, stereo, home computers, burglar alarms, marine electronics and so on.

The *It's a snap!* connectors are easy to use and hard to beat. And they're handy to keep around the workshop, car or boat for quick fixes when somebody else's wiring gives out. Try 'em. You'll like the way they go together.

It's a snap! connectors are available from Concepts Unlimited, 36C Carlough Road, Bohemia, NY 11716. Or, for more information, circle 100 on our reader-service card.

Crimping tool

The voice of Egyptian leader Anwar Sadat could be heard clearly on 15545 kHz, accompanied by an English translation. The same speech could also be heard in Arabic on 17920 kHz. Hearing a world leader speak on shortwave radio is not unusual, but this was something special. For this day was November 20, 1977, and President Sadat was in *Israel* addressing the Knesset.

The 15545 kHz station was the Israel Broadcasting Authority, carrying a speech by an Egyptian president, and the 17920 kHz station was Radio Cairo, originating a broadcast from within Israel. Both events would have been unthinkable only a few months before—and a dramatic demonstration of how shortwave radio can put you "on the spot" as history is written!

Yet harmony was hardly the topic dominating shortwave that day. Later on November 20, the shortwave stations of other Arabic nations roundly denounced the Sadat visit. The most memorable objection was not even in

English. The Peoples Revolution Broadcasting Corp., transmitting from Libya, was heard on 6100 kHz at 2115 GMT with a nearly-hysterical announcer whose voice dripped venom. One could tell the topic due to the mentions of "Sadat," and the announcer's voice left no doubt as to his feelings about the visit!

The Middle East dominates the international news, combining an explosive mixture of bitter antagonisms and oil. For the SWL who wants listening excitement of the first order—or simply an exposure to a rich, varied culture—it's hard to beat listening to the shortwave stations of the Middle East. Fortunately, most of the stations are high-powered and easily heard throughout North America even on simple equipment.

The Big Two

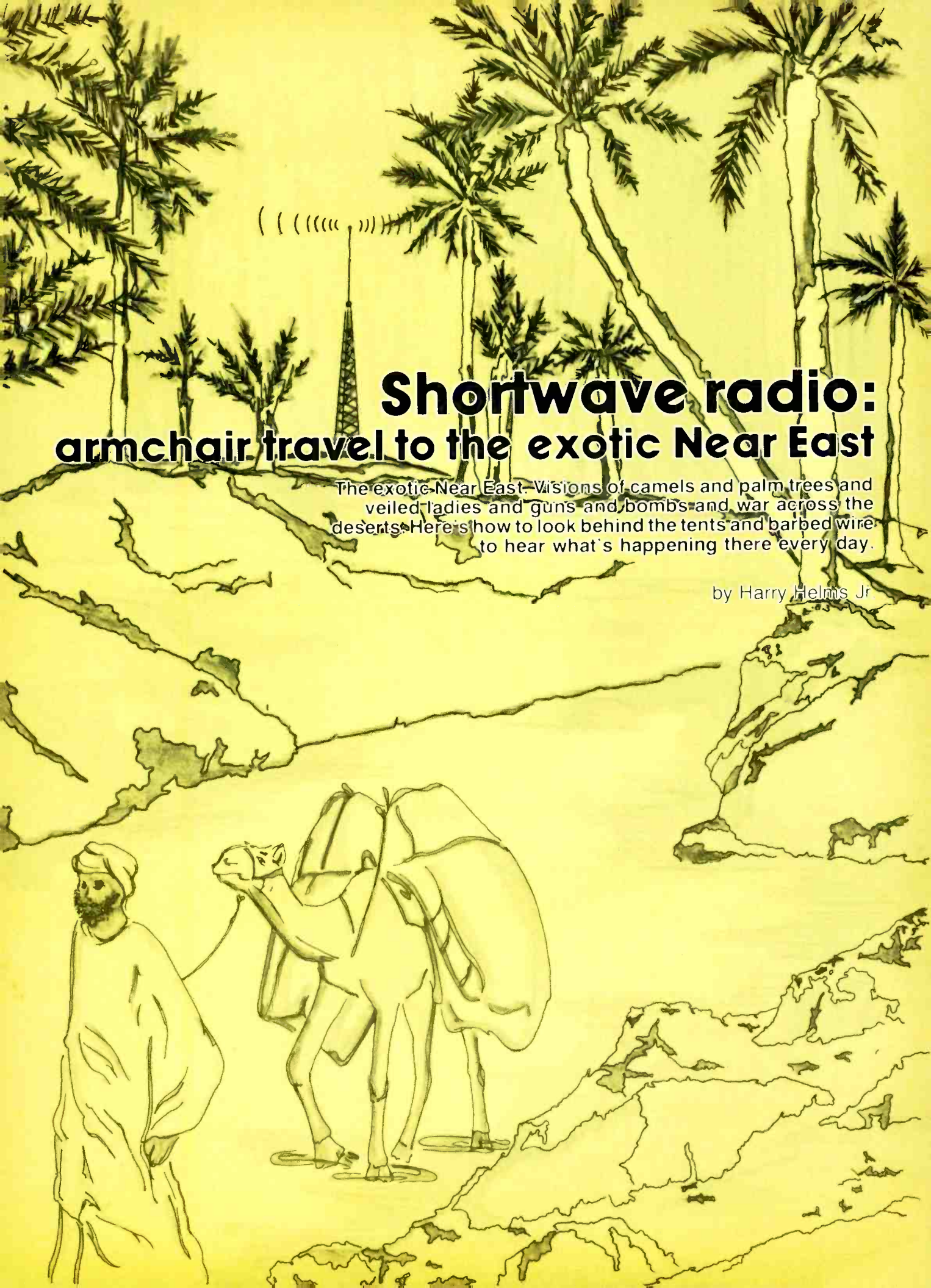
Some of the most consistently fascinating listening from the Middle East is provided by Israel's Israel Broadcasting Authority (IBA) and Egypt's Radio Cairo. The IBA beams English programs to North America on 7412 and 9815 kHz at 2230-2300 GMT, and 11655 kHz at 0500-0515. IBA also has English on 9009 kHz at 2000-2030 that is often heard well along the East Coast.

Empires of Oil

Radio Cairo has only one English transmission to North America, best heard on 9475 kHz at 0200-0330 GMT. In addition to news and commentaries, Radio Cairo features much Arabic music and even some *Egyptian* rock and roll—a most unusual treat for Wester ears!

Both IBA and Radio Cairo welcome listener reception reports and answer correct ones with colorful QSL cards. You can address your reports to Israel Broadcasting Authority, Overseas Service, P. O. Box 1082, Jerusalem, Israel and Radio Cairo, Propagation Department, P. O. Box 1186, Cairo, Egypt.

One can hardly think of the Middle



Shortwave radio: armchair travel to the exotic Near East

The exotic Near East. Visions of camels and palm trees and veiled ladies and guns and bombs and war across the deserts. Here's how to look behind the tents and barbed wire to hear what's happening there every day.

by Harry Helms Jr.

East without also thinking of oil. The world's largest producers of petroleum are located there. Many "petrodollars" have gone into the building of modern broadcasting facilities.

Ancient Persia

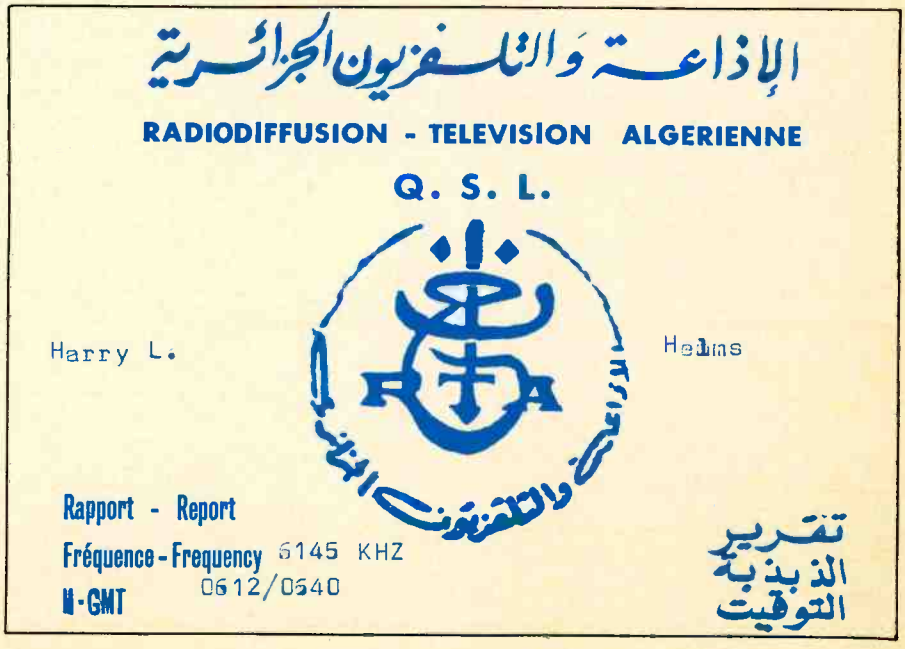
Saudi Arabia can be heard in English on 11855 kHz at 1900-2200 GMT. Listen for the station identification as "the Broadcasting Service of the Kingdom of Saudi Arabia." In addition to news and commentaries, this station programs much Arabic music and has numerous features on the Islamic religion, which is one of the dominant forces in the Arab world. This stations also issues QSLs for listener reports; address them to Broadcasting Service of the Kingdom of Saudi Arabia, Ministry of Information, Riyadh, Saudi Arabia.

Iran is another nation whose name is almost synonymous with oil. Its shortwave outlet for foreign listeners is known as the Voice of Iran, and can be heard in English on 9022 kHz at 1930-2000 GMT. After 2000, the station carries a home service program in Farsi, the national language of Iran, until sign off at 0200 GMT. The Farsi program features much local music and is exotic listening. Iran welcomes listener reports addressed to National Iranian Radio-Television, External Broadcasting, P. O. Box 33-200, Tehran, Iran.

Kuwait is a small nation on the Arabian Gulf that is home to one of the largest oil reservoirs in the world. Its shortwave service is Radio Kuwait, one of the most fascinating stations you're likely to run across on shortwave. It transmits on 12085 kHz in English at 1700-2000 GMT. Unlike other Arab broadcasters, Radio Kuwait's programming is filled with rock, pop, and disco music, along with fascinating bits of trivia such as which drug stores in the nation will be staying open all night! Radio Kuwait welcomes reception reports addressed to Radio Kuwait, P. O. Box 397, Kuwait, Kuwait.

Turmoil and Trouble

Lebanon has been one of the world's trouble spots recently, racked by a civil war and skirmishes with neighboring Israel. During their civil war the outside world could follow the tense developments over their shortwave outlet, known as Radio Beirut. Broadcasting activity was largely curtailed in the aftermath of the war but has recently resumed under the name of Radio Lebanon. This station can be heard on 9680 kHz from 0230 to 0300 GMT in English, beamed to North America. This program provided dramatic and exciting listening during Lebanon's recent border coflict with Israel. Getting an answer to a reception report in view of Lebanon's internal situation is difficult, but you can try a



Clubs and Publications for Shortwave Listeners

Shortwave stations change frequencies and schedules with bewildering swiftness. To keep with what's on the air, active listeners should investigate joining a club that covers the shortwave scene. The following groups are all non-profit and isue monthly bulletins to members. When writing to these clubs, enclose a self-addressed, stamped envelope for a reply and enclose one dollar for a sample bulletin.

North American Shortwave Association, P.O. Box 13, Liberty, Indiana, 47353. Publishes *FRENDX* with stations heard by members listed by frequency, QSL report a feature section entitled "Shortwave Center," and "Listener's Notebook," a compilation of station schedules and miscellaneous data. $13 per year.

SPEEDX, P.O. Box E, Lake Elsinore, California, 92330. Publishes bulletin with shortwave stations heard listed by country, also includes QSL section, technical column, features. Also covers utility DX (military, aircraft, marine, etc. stations). $12 per year.

American Shortwave Listeners Club, 16182 Ballad Lane, Huntington Beach, California, 92649. Publishes *SWL* which covers shortwave stations heard by members listed by country, utility stations, and standard am broadcast band DX. Also includes QSL section and features. $13 per year.

The SINPO System

When reporting to stations for QSL cards, you should give an indication of how well the station's signal was heard. Many stations prefer to receive reports using the SINPO system. The meaning of the system is as follows:

S (Signal Strength)	*I (Interference)*	*N (Atmospheric Noise)*
5—Excellent	5—None	5—None
4—Good	4—Very little	4—Slight
3—Fair	3—Moderate	3—Moderate
2—Poor	2—Severe	2—Severe
1—Barely Audible	1—Extreme	1—Extreme

P (Propagation)	*O (Overall Rating)*
5—No fading	5—Excellent
4—Slight fading	4—Good
3—Moderate fading	3—Fair
2—Heavy fading	2—Poor
1—Extreme fading	1—Unusuable

For example, a signal of good strength, very little interference, no noise, and moderate fading could be rated SINPO 44534.

How to Convert GMT

All times in this article are in Greenwich Mean Time (GMT). To convert GMT to your local time, subtract hours as follows:

Eastern Standard	5 hours
Central Standard	6 hours
Mountain Standard	7 hours
Pacific Standard	8 hours

For example, 0300 GMT is 10:00 p.m. Eastern standard time.

report sent to Radio Lebanon, Ministry of Information, Beirut, Lebanon.

Libya has long been surrounded by controversy since Colonel Qaddafi came to power in the late 1960's. Colonel Qaddafi holds the distinction of being one of the few world leaders who is able to simultaneously offend both the Israelis and moderate Arabs. Oil-rich, Libya has installed several powerful new transmitters operated by a government agency know as the Peoples Revolution Broadcasting Corporation. Program is entirely in Arabic and can be heard with good signals on 11700 kHz at 1600-2200 GMT and on 9500 kHz at 2200-0100. The transmission on 9500 kHz is beamed to North America although totally in Arabic. Don't be too surprised if they add in the near future, though. The QSL reports with a letter, and they can be sent to Peoples Revolution Broadcasting, P. O. Box 333, Tripoli, Libyan Arab Republic.

New Voices and Old Reliables

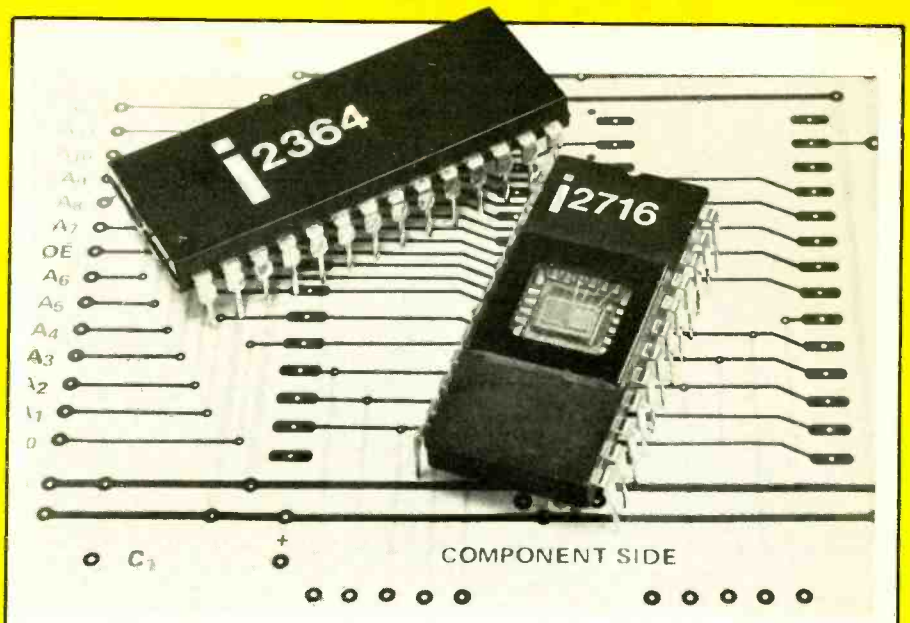
New shortwave stations and services keep popping up all the time. A recent addition from the Middle East is an English language service form Iraq's Radio Baghdad. Tune for it on 9745 kHz at 1930-2030 and 0300-0400 GMT. Reception has been very good in North America, especially during the 0300-0400 segment. Reports go to Radio Baghdad International, Salihiya, Baghdad, Iraq.

Some shortwave stations remain the same over the years, even clinging to the same traditions followed during the days when the nation was the colony of a foreign power. One case in point is Algeria, a former French territory. French is still the dominant language of the country, although Arabic is a close second. Its radio voice is Radiodiffusion-Television Algerienne, and it can be easily heard in Arabic from 0500-0900 GMT on 6145 and 9685 kHz. These programs, relays of the home service, can give a keen insight into Arabic culture. Western listeners will particularly enjoy the recitations from the Koran, the holy book of Islam, which are presented in a rhythmnic, singing style that sounds like chanting. One doesn't have to understand the language to marvel at the incredible vocal range displayed by the reciters. The music is likewise an "ear-opener," totally unlike anything you're likely to have heard before. Reports can be mailed to Radiodiffusion-Television Algerienne, 21 Blvd. des Martyrs, Alger, Algeria.

It's little wonder, then, that tuning in the Middle East is the favorite listening activity of many SWLs. It offers a combination of world headlines as they happen along with exotic music and culture—a potent duo unmatched elsewhere!

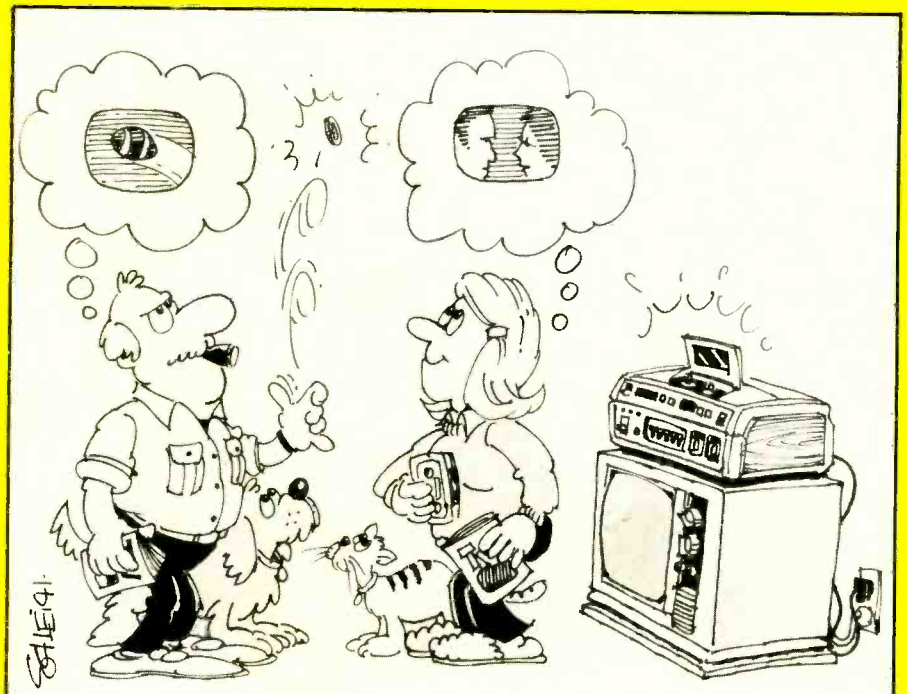
gear parts tests books

The editors roundup exciting new products you should know about.



Monster memory

Got the world's largest computer club? Need gigantic memory space to hold the roster information in your home computer? Burn it into Intel Coporation's new 2364 *read-only memory* chip which will hold 64K bits of data! Yep, 64K on a single chip. Organized as eight bits wide and 8192 long. It's latest ROM state of the art and simple to use, requiring only a five-volt supply. In and out of the chip is TTL all the way. The 2716 we show here for size comparison, by the way, is a 16K EPROM or erasable programmable read-only memory. Intel is due out soon with a 32K EPROM called the 2732. For details, circle number 110 on our card.

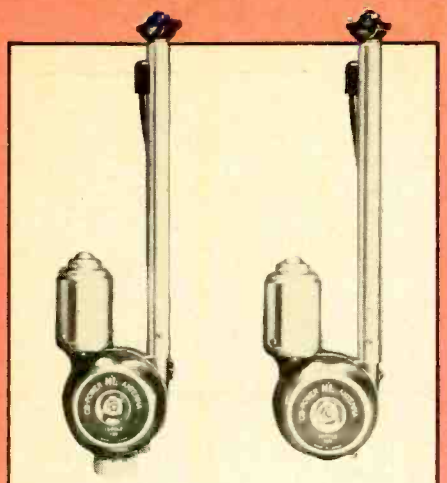


Flip your coin

Can't agree on which program to watch on tv? No need to flip a coin any more when you have the Sears BetaVision *home video recorder*. It lets you record one show while you watch another on a different channel. You get to watch both shows: one now, one later. The BetaVision system at $995 records and plays back two-hour tapes. For more information, please circle number 125 on our reader-service card.

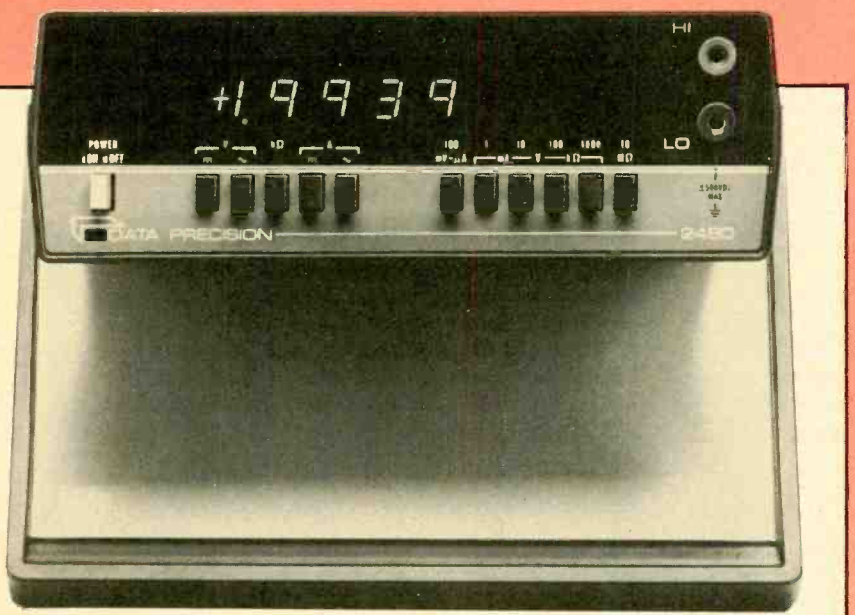
Field scope

Need to escape from the workbench for a test of gear in the field? Dynascan Corporation's model 1432 portable *oscilloscope* is a compact dual-trace device with more features than many in-lab-only instruments. Bandwidth of this triggered sweep scope is at least 15 MHz with a top-notch vertical sensitivity rating of 2 mV per division. You can use response beyond 30 MHz. Mount the battery pack inside the box and off you go for work in the field. For more information, please circle number 120 on our reader-service card.



Pick a pair
Fully automatic. Semi automatic. Take your pick. The Harada Industry of America *Triway Power* antennas let you hear CB, am and fm in your car. Model TW-85, left, $79, is fully automatic. TW-65, $66, is semi. Both mount flush into front or rear fenders and keep your CB secret from the world. Only your body man will know! By the way, both have silent 10-pole motors for twice the power of some motorized antennas. Shields prevent static from getting into your CB. For more information, circle number 123 on your reader-service card.

Big quality, small package
A bit larger than two square inches and only one-quarter inch thick, these Sony *microcassettes* are as small as any cassettes available today. Yet they have the quality of larger, old-fashioned audio tape cassettes. And that includes a recording or playback length of 60 minutes at 15/16 inches per second (ips). Like larger standard tapes, the microcassette transport system has capstans and pinch rollers to maintain constant tape speed and low wow and flutter. Compare that with most small-format tapes which rely on less-stable spindles producing an annoying level of distortion. These tapes are held together by screws rather than glue or cheap snaps. And there's a special lubricant on the tape too. They're $3.49 list. For more information, please circle number 121 on our reader-service card.



Sexy meter
The argument goes on about analog and digital-readout *test meters*. Some say analog meters are easier to read. Others like the precision accuracy of a digital readout. For our money, the sexiest look on the market is in the digital lines, especially the new model 2480 ($279) from Data Precision. It's a 4½ digit multimeter for bench or portable work. It has 0.03 percent basic dc accuracy, wide frequency response, automatic zero and a one-year calibration cycle. For more info, please circle number 122.

The editors roundup exciting new products you should know about.

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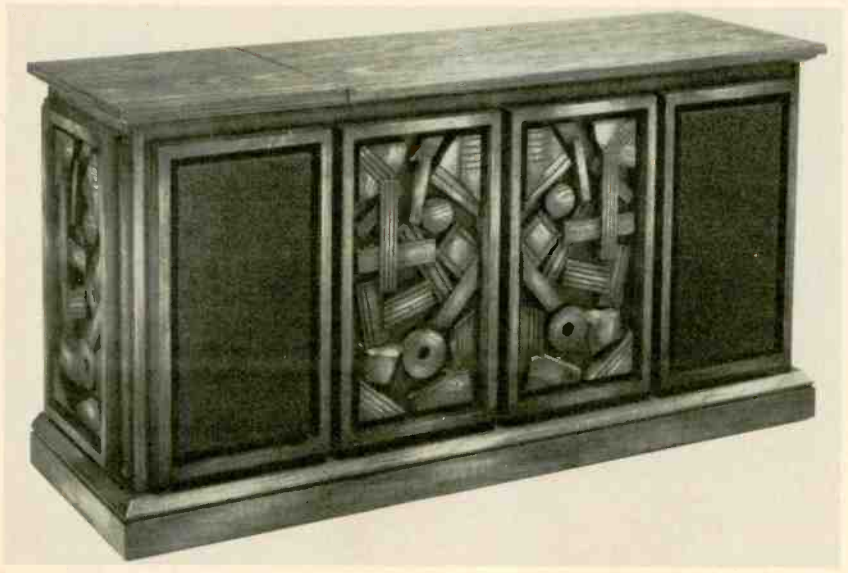
gear parts tests books

The editors roundup exciting new products you should know about.

Spy chips

You too can be replaced by a pushbutton! Remember how hard it used to be to break secret codes and penetrate mystery spy messages? Well, it had to happen sooner or later. The black many-legged bug surrounded by Scrabble chips is Intel's new *data encryption unit* or electronic spy device as we've come to know it around the ME offices. Hook up the 8294 to your home computer and it'll encrypt, decrypt and do other good things to secret information. Would you believe it does it so well it meets the National Bureau of Standards specs for solving the algorithm in the federal information-processing data-encryption standard (whatever that is!)? Remember, we didn't say it would be easy. Pssst! Hey, buddy. Want more on this secret device? Circle number 115 on our reader-service card.

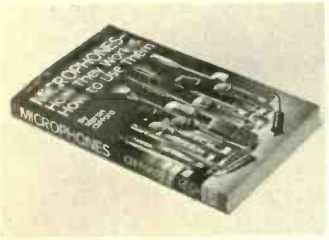


Contemporary console

Not all stereo rigs today come as components. Some folks like a package deal. This 55-inch model D-804R has 8-inch woofers, 2½-inch tweeters and electrical crossover networks built in. And an 8-track tape player too. It's from the *Imperial* division of Superscope Inc. For more info, please circle number 119 on our reader-service card.

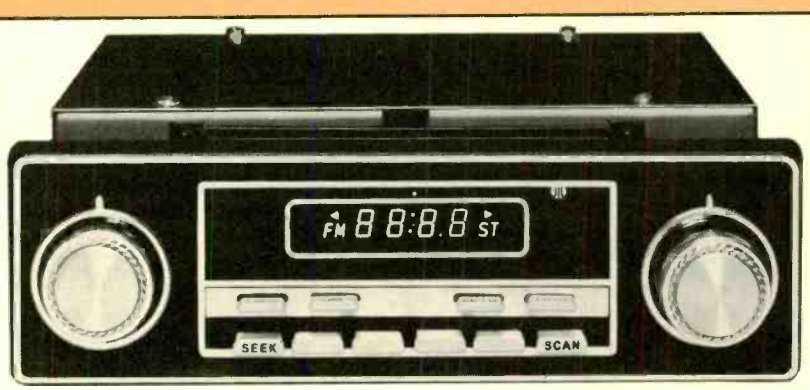
Unlock your ears

Wow! We love those black boxes and lots of LEDs. These gorgeous gadgets are, top to bottom, the model 118 dynamic range enhancer, model 128 combo dynamic range enhancer with noise reducer, and model 3BX three-band dynamic range expander. They're from a company called *dbx* and they make your tape recordings sound a whale of a lot better. For more info, please circle number 113 on our reader-service card.



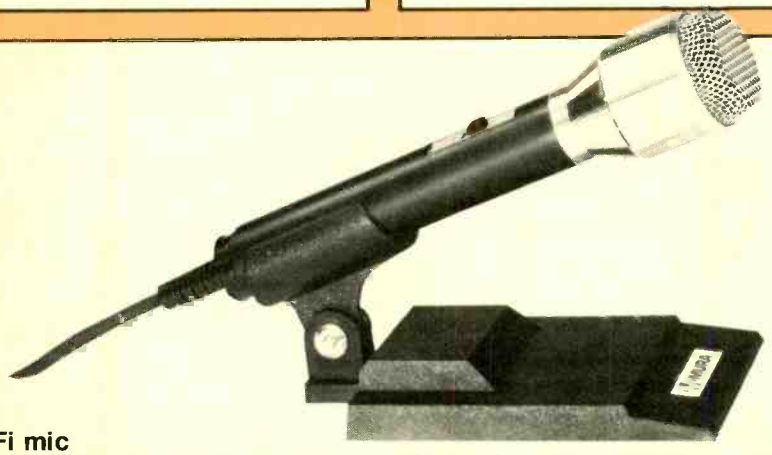
All about mics

A lot of words have gone over the dam on microphones. Physical construction of good mics. Operation. Applications for microphones. Most texts have been heavy and understood only by those already in the know. Now there's a book which lays all that bare, getting down to brass tacks. Audio writer Martin Clifford is out with a 224-page *Microphones–How They Work and How To Use Them* published by Tab Books. It's in lay language and takes the mystery out of how these sound pickeruppers work. For more info, circle number 109 on our reader-service card.



Computer in your dash

Microcomputers are everywhere today. Including inside this J.I.L. *Power Pumper* model 874E am/fm/multiplex stereo radio and 8-track tape player for your car dash. It delivers a whopping 20 watts of RMS power per channel when you turn on its booster switch. The miniature computer circuit scans the am/fm dial, pausing for seven seconds at each station before moving on. Or it locks onto the station you want. Or it moves the tuner to the next station down the dial and locks on there. The dial scanning speed is adjustable. And there's none of that old-fashioned analog readout tuning dial. The Power Pumper reads out frequency in an ultramodern fluorescent vacuum display. And it tells the correct time of day, too. You can program in four of your favorite am and four fm channels for instant tuning as you wish. For more, circle number 111.



Hi-Fi mic

What the world needs now is a solid inexpensive *microphone.* Mura Corporation's DX-235 at $20 might fill the bill if you're looking for an omnidirectional mic that's not a cheap replacement mic for a tape recorder but not as expensive as many professional radio station units are. It has a stand and adapts to either quarter-inch or mini plug, circle number 114.

gear parts tests books

gear parts tests books

The editors roundup exciting new products you should know about.

World's most powerful

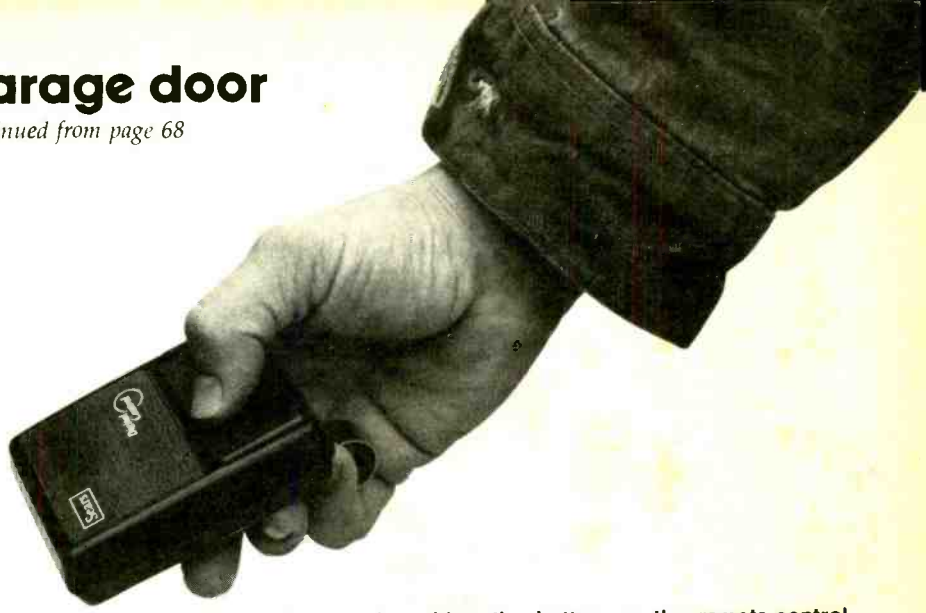
This 320-pound RCA *vacuum tube* is the world's most powerful. It'll be used to see if electricity can be made from nuclear fusion. The tube generates 25 million watts. That's enough power to turn on 300,000 tv sets at the same time. Twelve of the biggies will be used in a $239 million reactor at Princeton University. For more information, please circle number 124 on our reader-service card.

Ringo Starr car

When somebody goes to all this trouble for a little publicity, we can't resist the fun. Remember how we all loved those '57 Chevy coupes? Well, it seems Craig Corporation signed on George Barris, king of the California car customizers, to deck out a '57 as a showpiece for Craig's newest car-stereo sound system plus an in-dash digital radio with electronic clock, a 72 watt equalizer and amplifier package and the Trans-Rib speakers front and rear. By the way, they didn't sock it to just any old Chevy. This heavy dude belongs to Ringo Starr (member of a rock group with Paul before McCartney was in Wings!). Barris took Ringo's car, slicked on some shiny black paint, dabbed orange and yellow flames on the nozzle and lit up an interior to match. To make the package complete, Craig sponsored a tv special featuring Ringo and including Carrie Fisher and Art Carney (pictured with Ringo here in front of the Chevy). To top it all, Craig decided to give away Ringo's machine complete with the Powerplay stereo system built in. Tim Hendrick, Ringo and John Romain, all Craigpeople, compare heights alongside a telephone pole, in front of the '57 in our natural, unrehearsed photo. Oh, well. For more info on Ringo, read *Crawdaddy* For more on the Craig auto goodies, put your mark around number 112 on our reader-service card.

garage door

continued from page 68

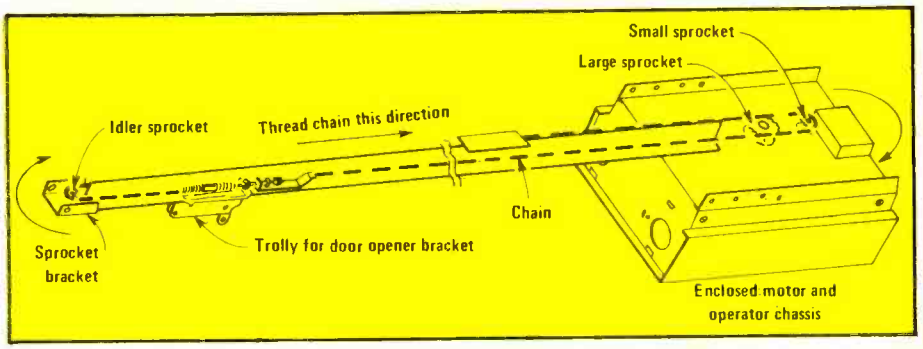


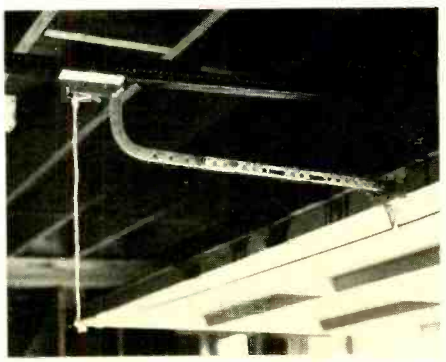
The door opener is activated by pressing either the button on the remote-control transmitter, or the button on the wall-mounted receiver. This operates both opening and closing.

mounting and wiring the opener's key switch, installing light bulbs and lens at the front of the operator housing, and testing the system for correct operation. The key switch is a handy item that should be installed on the outside wall of the garage and wired to the receiver mounted inside. This will allow access to the garage by way of a key (without a transmitter) in the event a transmitter is lost or if a neighbor is taking care of the place while you're on vacation.

Once the installation is complete you will have to set the code you wish the transmitter and receiver to operate on. This is accomplished by removing the faceplate on both receiver and transmitter to gain access to their code switch blocks. To set the code, you simply press one or more switches either on or off as you choose. This code setting must be exactly the same in both the receiver and transmitter to operate the opener.

With this system now installed and operating in your garage, there is no longer a need to leave the comfort of your car to open the garage door. Simply press the button on your transmitter as you approach the house and the door will be opened by the time you hit the end of the driveway. Also, as an extra convenience, the door operator's light comes on whenever the opener is activated to provide a convenience and safety feature. This light turns itself off after a pre-set delay has expired.





In the event an unlikely power outage occurs, the system is equipped with a rope and handle at the door arm to allow manual opening and closing of the door.

The system also works in reverse once you're inside the garage—simply press the transmitter button mounted on the inside garage wall and the door will close. And, in the event of an unlikely power outage, a special rope and handle is secured to the door arm to allow manual opening and closing. All bases are covered!

This entire installation project shown took a total of two hours. Since the installer was experienced with this type of project, it would be safe to assume that a first-time could get the job done in a day or less. The detailed instructions included with most openers really make this task a cinch, so why wait?

TEMPO

VHF/ONE PLUS

MORE POWER / 25 OR 5 WATTS OUTPUT SELECTABLE

REMOTE TUNING / ON MICROPHONE

NEW LOWER PRICE / NOW ONLY $399.00

SIDEBAND OPERATION WITH SSB/ONE ADAPTER / MARS OPERATION CAPABILITY / 5 KHz NUMERICAL LED

The Tempo VHF / One Plus is a VHF / FM transceiver for dependable communication on the 2 meter amateur band • Full 2 meter coverage, 144 to 148 MHz for both transmit and receive • Full phase lock synthesized (PLL) • Automatic repeater split—selectable up or down • Two built-in programmable channels • All solid state • 800 selectable receive frequencies with simplex and +600 KHz transmit frequencies for each receive channel.

TEMPO FMH-2, FMH-5 & FMH-42 (UHF)

6 channel capability • selectable 1 or 2 - 1 or 5 Watts output • Solid-state • Battery level meter • Earphone jack • Built-in charging terminals and separate charging jack for Ni-cad batteries • Flex antenna • Carrying case standard • Excellent frequency stability allows use with booster amplifier for high power output over 100 Watts • 8 AA batteries or 10 AA Ni-cads.*

*Not furnished.

FCC Type accepted models available.

TEMPO VHF & UHF AMPLIFIERS

VHF (135 to 175 MHz)

Drive Power	Output	Model No.	Price
2W	130W	130A02	$199
10W	130W	130A10	$179
30W	130W	130A30	$189
2W	80W	80A02	$169
10W	80W	80A10	$149
30W	80W	80A30	$159

UHF (400 to 512 MHz)

Drive Power	Output	Model No.	Price
2W	70W	70D02	$270
10W	70W	70D10	$250
30W	70W	70D30	$210
2W	40W	40D02	$180
10W	40W	40D10	$145
2W	10W	10D02	$125

FCC Type accepted models available.

TEMPO POCKET RECEIVERS

MS-2, 4 channel scanning receiver for VHF high band, smallest unit on the market. MR-2 same size as MS-2 but has manual selection of 12 channels. VHF high band. MR-3, miniature 2-channel VHF high band monitor or paging receiver. MR-3U, single channel on the 400 to 512 UHF band. All are low priced and dependable.

WE also carry the complete line of BIRD products.

Sold at Tempo dealers throughout the U.S. and abroad. Please call or write for further information.

Prices subject to change without notice

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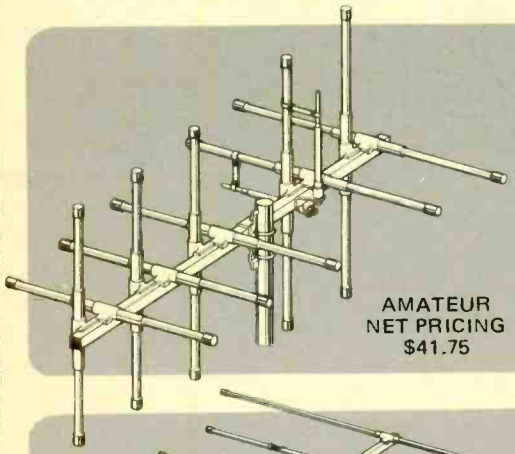
Butler, Missouri 64730 816/679-3127

Henry Radio

CIRCLE 60 ON READER SERVICE CARD

LOOK OUT The FINCO Stingers are here!

FINCO Is introducing its new Stinger Series Amateur Antennas.



AMATEUR
NET PRICING
$41.75

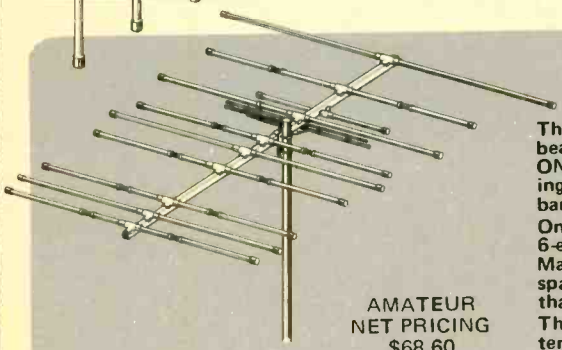
FINCO STINGER A 2+2

2 Meter

The model Stinger A 2+2 is a ten-element, dual polarization 2-meter antenna designed for OSCAR communications or where switching from horizontal to vertical polarization is required. The A 2+2 can even be phased to operate on both horizontal and vertical polarization at the same time (circular polarization). This is not only ideal for OSCAR work but gives your station versatility for ground communications.

Wide, non-linear element spacing gives the A 2+2 superior gain. However, since it is a five element beam in one given plane, the half power beam width does not make satellite tracking difficult because of sharp directivity. The dual gamma match assemblies provide for a very low V.S.W.R. and will withstand 2,000 watts P.E.P.

The Stinger construction features make the A 2+2 extremely heavy duty. Provisions are made for mounting the antenna at the end of the boom – for azimuth control – or at the middle of the boom for normal applications.



AMATEUR
NET PRICING
$68.60

FINCO STINGER A62

6 & 2 Meter

The model Stinger A 62 is a truly remarkable combination 6 and 2-meter beam designed for optimum performance on both bands yet only requiring ONE transmission line. This is accomplished through the use of exclusive phasing elements to accomplish dual band operation with no sacrifice to either band – NO SWITCHING REQUIRED!

On 2-meters, the A 62 has 6 colinear elements – equivalent to three 1/2 λ 6-element yagis stacked side by side – thus giving outstanding performance. Maximum forward gain is assured on 6-meters through the use of four wide spaced elements. The heavy duty Stinger construction is used throughout so that the antenna will withstand 100 mph plus wind loads.

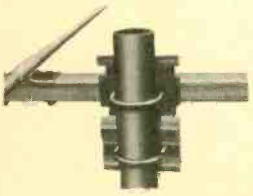
The A 62 is ideal for mounting on the same mast as your tri-bander or other antenna thus easily opening up the world of 6 and 2-meter VHF communication.

OTHER FINCO STINGER AMATEUR BEAMS AVAILABLE:

MODEL	AMATUER BAND	ELEMENTS	BOOM LENGTH	AMATUER NET PRICING	MODEL	AMATUER BAND	ELEMENTS	BOOM LENGTH	AMATUER NET PRICING
A10-4	10 Meter	4	16′	57.15	A2-5	2 Meter	5	5½′	25.60
A6-3	6 Meter	3	6′	27.30	A2-10	2 Meter	10	10′	41.15
A6-5	6 Meter	5	13′	41.95	A1¼-10	1¼ Meter	10	8′	29.65

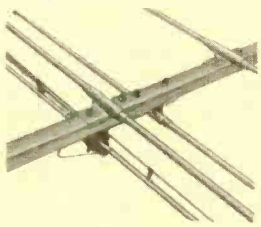
ENGINEERING FEATURES:

All Stinger Series Amateur Antennas incorporate heavy duty fully adjustable gamma matching systems to allow for maximum power transfer. The design provides for minimum V.S.W.R. and a wide bandwidth. A built in SO-239 type connector assembly is utilized plus the matching systems are power rated at 2,000 watts P.E.P.



A 4"x 6" x full 1/8" thick heavy duty plated steel mast to boom mounting assembly is used on all Stinger Series of Amateur antennas. The bracket assembly locks permanently on the square boom and thus withstands high wind loads and torque without twisting or becoming misaligned. The assembly accepts mast diameters of up to 2" O.D. Provisions for mounting either in a vertical or horizontal plane is incorporated in several models.

Exclusive Stinger square boom construction is used on all amateur antennas. The 1¼" square booms are of .064 wall high tensile strength aluminum which is many times stronger than its round counterpart. Also, special bracket assemblies have been developed to allow instant element to boom alignment – plus they stay aligned in the highest wind and ice loads. All elements are of thick wall high tensile strength aircraft quality aluminum.



Antenna design engineering is a specialty at FINCO. Top quality lab standard test equipment is used throughout the development and design of all antennas. The FINCO antenna test range has been carefully checked for erroneous reflection characteristics that could cause errors in antenna designs. Shown is the sophisticated stub and matching system that has been developed for the Stinger A62, 6 and 2-meter dual band beam. No traps or coils to burn out or detune, thus assuring you of the highest possible performance on both 6 and 2-meters.

Write for Catalog No. 20-827, Department 36

PRICES AND SPECIFICATION SUBJECT TO CHANGE WITHOUT NOTICE.

AMATEUR CB TV ANTENNAS FINCO® ACCESSORIES MATV/CATV

THE FINNEY COMPANY

FINCO, the Champion of all Electronic Independent Service!

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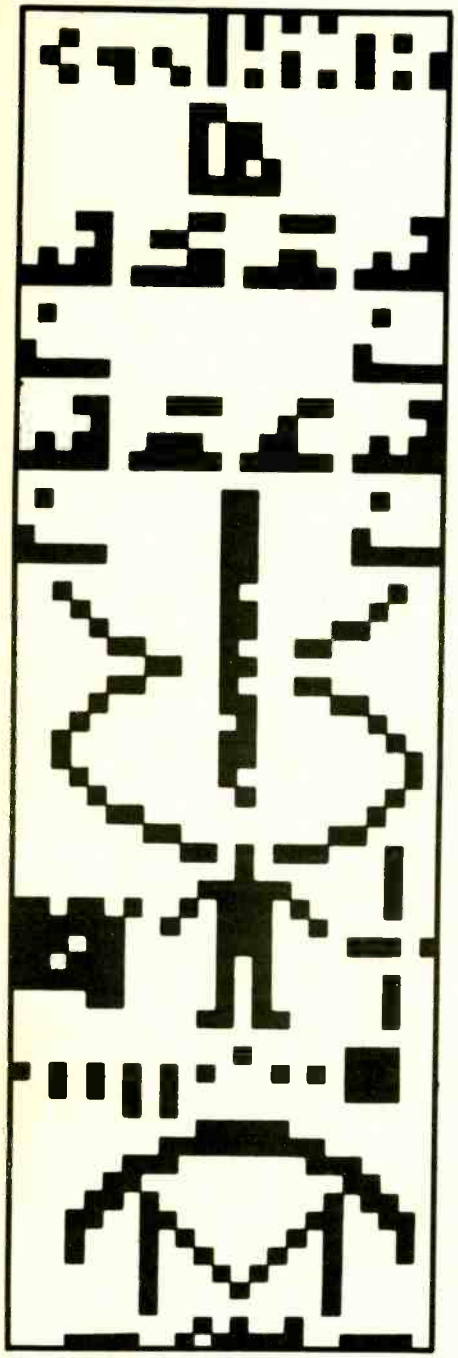
Arecibo

continued from page 73



Scientists on a planet in galaxy M-13 will someday be receiving this message from Arecibo on planet Earth. Decoding the message will give the scientists an insight into life on Earth by identifying the key elements—hydrogen, carbon, nitrogen, oxygen and phosphorous, and by describing the DNA molecule.

space that teemed with life.

In fact, scattered through interstellar space, between the stars and dust clouds, are isolated molecules of materials like hydrogen, formaldehyde and methyl alcohol—some of the same organic materials found on Earth.

The Arecibo telescope can be used to gather data for analyzing and quantifying these molecules, as well as to search for other freely floating chemicals. So the chemistry of Earth and the chemistry of outer space appear to be far more alike than scientists had anticipated.

The same researchers who once contended that extraterrestrial life would bear no resemblance at all to life as we know it, are now saying that other creatures may be quite similar to us indeed. If the seeds of life float in the spaces between the stars, they may have rained down on other planets, been jolted by ultraviolet light and congealed into the same kind of primordial soup that gave rise to life on Earth. Life, it seems, must be the rule and not the exception.

A veteran of numerous efforts to reach across space with messages of various kinds, Drake spent months with other NAIC staff members to compose the transmission to M-13. It consists of 1,679 characters beeped into space in just under three minutes.

The noise of the transmission filled up the air over the site, like the two alternating pitches of a simple musical theme played on a giant electronic synthesizer. One minute after completion, the message passed the orbit of Mars. After 35 minutes it had gone the distance to Jupiter, and after 71 minutes, Saturn.

By the time the ceremony and the luncheon were over, when the guests had piled on buses to leave the site, the message was nearing the outer limit of the solar system in the vicinity of Pluto's orbit.

Some 250 centuries hence, the residents of a planet belonging to one of the many suns in M-13 will receive a signal that will differ greatly from any recordings they will have made of other interstellar phenomena.

It will come from the direction of a known star, but with millions of times more power than they associate with that star. It will be received as a repeating pattern of 1,679 consecutive characters of a two-character code, each of the two represented by a specific radio frequency.

The astronomers of the planet may decide to keep the message secret until it has been decoded—to avoid panic in the general public. They will call in other scientists to help them decipher the signal, putting their best minds to work on the problem. They will take its repetition and regularity as evidence of its intelligent origin.

By factoring the number of characters received, they will be able to break the message into 73 consecutive groups of 23 characters each. Since these are prime numbers (divisible only by themselves and the number one) the recipients should be able to hit on the proper arrangement of the message through some simple juggling on their computers. If they interpret the two frequencies as dark and light squares, crossword-puzzle-like, they can draw a picture with the information.

The first group of characters is a lesson in the number system used to send the message: the binary system, where numbers are written in powers of two rather than of ten as in the decimal system.

The numbers one through ten are written in binary notation across the top from right to left. The second part of the message could now be recognized as five numbers; reading from the right, they are one, six, seven, eight, and fifteen. The chemists in the group will recognize here the atomic numbers of the elements hydrogen, carbon, nitrogen, oxygen, and phosphorous—the key materials in Earth life.

The next section is quite complex, containing 12 groups of numbers, each group representing the chemical formula of a molecule. The amount of room in the message devoted to this section is an indication of its importance.

When decoded, it is a graphic description of the DNA molecule (deoxyribonucleic acid), which contains the genetic information controlling the form, living processes, and behavior (to some extent) of every living creature on Earth.

Stretching below the chemical formulae is a rough sketch of the DNA double helix. In the center of the pattern is a very large number—approximately 4 billion, indicating the number of constituent parts in human DNA. The size of the number, placed where it is, should indicate that the intelligent life sending the message is complex and highly developed.

A crude sketch of this being appears under the helix. The human is flanked on either side by numbers. To the creature's left is another representation of the number 4 billion. This time, it stands for the number of such creatures on the planet where the message originated. The human's size is indicated to its right: lines extend from head to toe, with a number in the center—14, showing that the creature is 14 units long.

The only unit of length common to both the M-13 scientists and the Arecibo astronomers is the wavelength of the transmission: 12.6 centimeters. This makes the human 5'9½" tall (Drake's height).

A schematic diagram of the solar system appears in the next block of the message. The third planet out from the sun is set above the others and centered below the creature to mark it as the home of the intelligent beings.

The object drawn below the planets is an attempt at a telescope. It doesn't depict the Arecibo instrument exactly, but shows how rays hitting a curved reflector are being focused to a point, which is, essentially, the way any telescope operates. Beneath the sketch are numbers describing the size of the actual instrument; 2,430 wavelengths in diame-

ter, or about 1,000 feet.

Ironically, the first few sounds of the signal were four short beeps followed by two short beeps—Morse Code for "Hi."

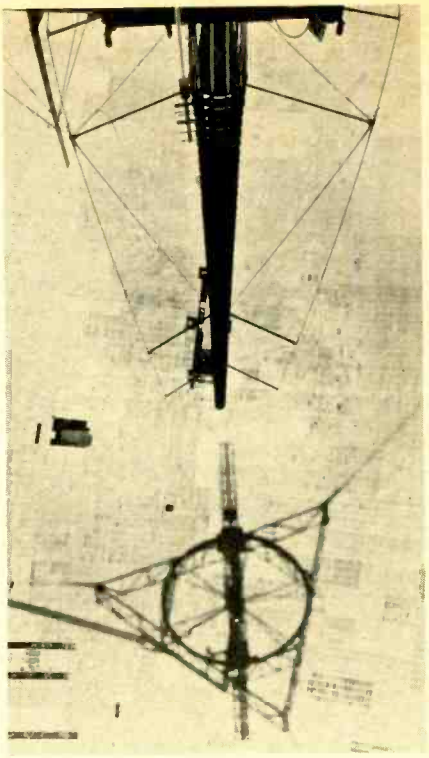
Even without the transmission of this message, radio telescopes elsewhere in the Milky Way might be able to detect us. All kinds of radio signals leak through the atmosphere—not just the intentional ones. Ordinary radio and television transmissions have been spreading through space for 50 years. Pieces of early episodes of "The Shadow" or "Howdy Doody" will probably be the first announcement of our presence in the universe.

Recently completed computer models of the Earth's radio appearance imply that this planet turns on big and bright whenever North America rises, Drake reports, particularly in the UHF tv region. So astronomers at Arecibo are searching for extraterrestrial tv transmissions. Right now, a Harvard astronomer visiting the site is engaged in an active SETI (Search for Extraterrestrial Intelligence) program—monitoring 64,000 channels at once. He's already checked 100 nearby stars, but found no messages yet.

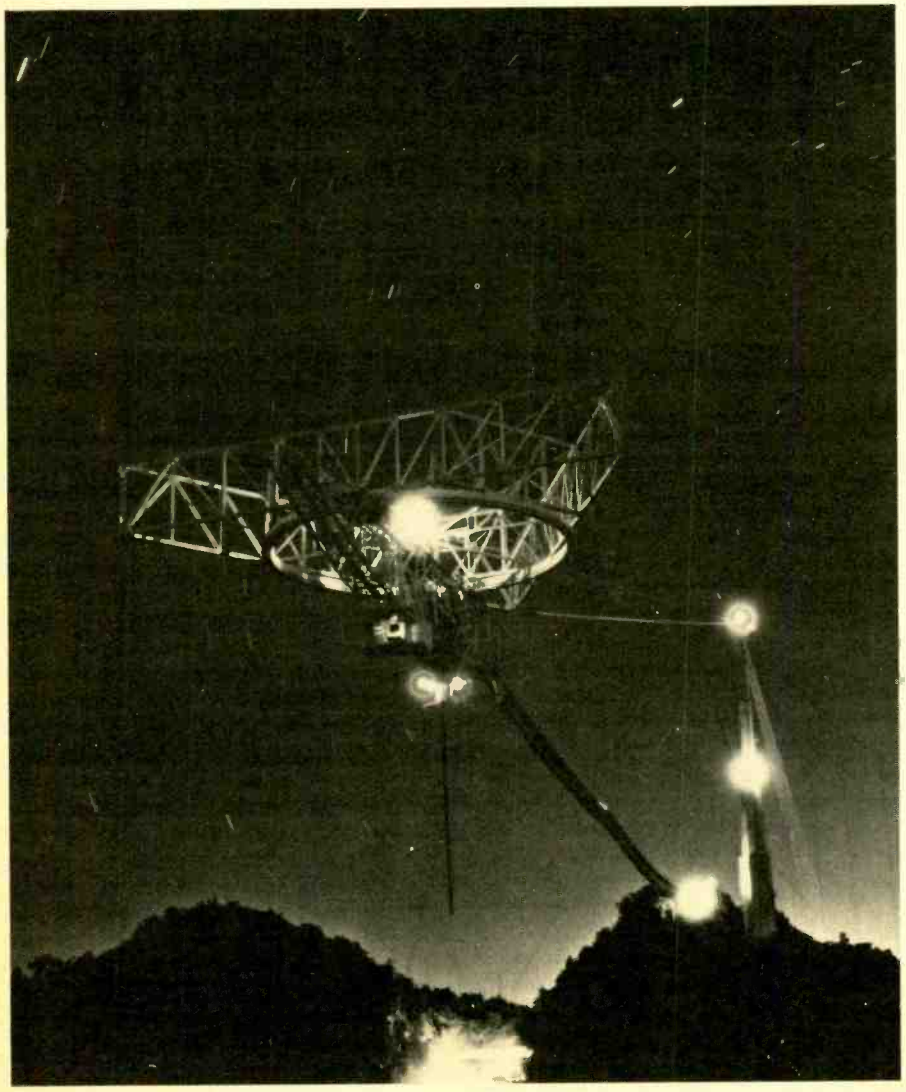
Closer to home, another construction program is now under way at Arecibo to build a new facility for studying the ionosphere. Scheduled for completion in June 1979, the HF Ionospheric Modification Facility will be an array of antennas occupying about 21 acres located 15 miles from the telescope.

Power from four 200,000-watt transmitters (multiplied to an output of 160 million watts by focusing the antennas) will heat up certain sections of the electrically charged region at the outer fringes of the atmosphere. Then the telescope's radar will be used to study the effects of these man-made alterations. Such studies, Drake says, can determine how solar flares and sunspots influence radio communication on Earth, as well as provide basic information on the behavior of this part of the atmosphere.

"Now that solar power satellites are being considered as future energy sources," Drake adds, "scientists and concerned citizens would like to know what will happen in the atmosphere when these space stations beam their collected power to Earth in microwave transmissions. One of our goals is to simulate the anticipated heating in a controlled way and monitor the result."



The largest antenna at Arecibo for receiving signals from space stretches some 96 feet from tip to base, and weighs almost five tons. Hanging from the giant platform, the antenna looks down at the aluminum surface of the dish hundreds of feet below.



Outlined against the evening sky, the giant antenna platform bounces radar signals off the dish beneath it into the far reaches of our Galaxy.

The National Science Foundation is providing $1.2 million to build the HF facility. Until the construction is complete, atmospheric scientists will keep using the old ionospheric heating apparatus at the telescope. This device, which operates at lower power, has to be mounted on the telescope whenever needed, and makes it impossible to use the telescope for any other experiments as long as it is in place.

Proud and excited when speaking of Arecibo's past achievements, Drake can only guess what new discoveries will be made. The one success he craves the most, though, may take many more lifetimes to achieve. How does he feel to think he won't be the one to intercept an intelligent message?

"In a way, I'm glad, The priceless benefits of knowledge and experience that will come from interstellar contact shouldn't come too easily. To appreciate them, we should have to devote a substantial portion of our resources, our assets, our intellectual vigor, and our patience. Other civilizations may well generate signals intended to benefit others—signals that are strong enough only for the deserving to receive. I hope it's a cosmic rule: Among civilizations there shall be no spoiled children. They must earn their inheritance."

Semiconductors revolutionize electronics

Semiconductors are solid-state devices which replaced **vacuum tubes**.

Vacuum tubes

Tubes pass electricity in one direction.

Basic tube has two elements.

1. **plate** - a piece of metal which acts as a conductor and passes current
2. **cathode** - when heated, releases electrons

Filament is heating element in tube but not counted as active element.

Tube with **two** elements is called a **Diode**.
TRIode is tube with **three** elements.
TETrode has **four** elements.

Disadvantages of vacuum tubes

1. fragile
2. large
3. give off heat

Advantages of Semiconductors

1. tiny
2. cheap
3. cool

Rectifier tube has two elements and is a diode.

Diode rectifiers were made solid.

Rectifiers

Rectifiers convert ac to dc. They make possible dc power supplies being built into ac-powered devices like radios and televisions.

Ac flows back and forth; dc flows in one direction. A **rectifier** must be able to pass current in one direction but not in the other.

Solid-state diodes act the same as tubes. They permit current to flow in one direction but not in the opposite one. They **rectify**.

Semiconductors made possible tinier and tinier circuits, shrinking the overall size of the finished product.

Individual parts of circuits can be close together without burning up.

Examples of semiconductors

1. diodes
2. transistors
3. integrated circuits (ICs)

Individual diodes and transistors are packaged together in solid lumps. These are **integrated circuits**.

Solid construction makes these tiny circuits nearly unbreakable.

puzzle

OUR ELECTRONIC BRAINTEASER OF THE MONTH

by John Shepler

F	L	I	P	F	L	O	P	R	A	S	F
D	R	E	T	S	I	G	E	R	E	L	A
R	N	L	N	A	N	D	L	V	I	B	N
O	T	G	G	N	I	K	I	P	S	E	D
T	E	A	O	C	A	R	D	P	O	T	M
A	R	T	N	C	I	E	I	S	L	A	E
R	C	E	E	I	C	F	R	T	O	T	M
B	R	D	D	G	K	F	E	U	M	S	O
I	E	I	A	O	J	U	V	O	C	I	R
V	T	N	C	L	C	B	I	N	A	R	Y
I	N	V	E	R	T	E	R	A	I	T	R
T	U	E	D	L	B	C	D	F	S	M	N
L	O	R	O	T	A	R	A	P	M	O	C
U	C	S	S	E	L	E	C	N	U	O	B
M	O	N	O	S	T	A	B	L	E	R	V

TTL PUZZLE WORD LIST

1. MULTIVIBRATOR
2. MONOSTABLE
3. COUNTER
4. BOUNCELESS
5. COMPARATOR
6. BINARY
7. MSI
8. FANOUT
9. BUFFER
10. DRIVER
11. FLIPFLOP
12. REGISTER
13. NAND
14. TRISTATE
15. MEMORY
16. JK
17. LOGIC
18. DECADE
19. BCD
20. INVERTER
21. GATE
22. DESPIKING
23. DIP
24. LSI
25. DECODER
26. AND
27. OR

RULES

1. Find all of the listed words hidden in the Integrated Circuit.
2. All of the words are terms used in TTL logic circuitry.
3. Words are arranged in straight lines in all directions. There are no blank spaces or skipped letters.
4. Good Luck!

Six steps for successful PC soldering

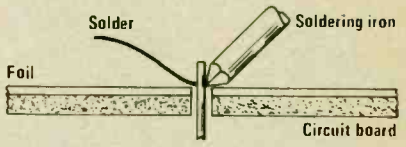
There's no question about it, using a printed circuit board makes circuit construction much, much easier than old-fashioned point to point wiring. But, if you're not careful, you'll find printed circuits also make it a lot easier to create *short* circuits. That's because it's so easy accidentally to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

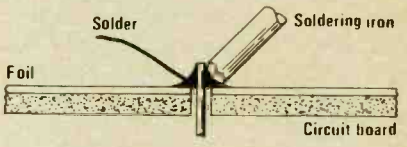
The trick to using printed circuit boards is to do a good job of soldering the component leads to the copper foil. It's really easy to do, if you'll follow these tips and take your time.

■ 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.

A frequency counter is one of the most useful tools around your workshop. The new Heathkit low-cost line of counters works wonders. Here's the inside story of the build-it-yourself testers.

ME tries a new frequency counter

by Carmine W. Prestia
Contributing Editor

It is often said that the most versatile tool you can have on your electronics workbench is an oscilloscope. If the oscilloscope is most versatile, then the most *useful* is a frequency counter. For the professional repairman or the serious hobby builder it is a necessity.

In the not too distant past frequency counters were analog meters with sometimes questionable accuracy. The first digital meters were big "boat anchors" that took two men to lift, not to mention costs into the thousands of dollars. Now though, modern digital electronics has reduced both the size and cost of counters and has given us direct digital readout and extreme accuracy. With these advances the setup of a transmitter frequency to tight tolerances is a breeze.

There are almost more counters on the market than you can count, and prices run all the way from under one hundred dollars to well over five hundred dollars. The price goes up along with the maximum frequency of the counter since frequencies into the vhf range require more critical circuit layout and devices. The less expensive models cut off at 30 or 50 Mhz. Models that handle frequencies up to 500 Mhz begin to cost around three hundred dollars.

One of the newest counters is from Heath of Benton Harbor, Michigan. The IM-4130 is top of the line in a new series of frequency counters. This particular model's range is from 5hz to 1 Ghz (1 gigahertz = 1000 megahertz; 1 megahertz = 1 million hertz). In addition to frequency measurement this counter can total events and periods. With a photocell circuit attached to the input you could count the number of people who walk through a doorway or the rpms of a fan. The period function can keep track of the time it takes an event to happen, say a bullet travelling between two foil pads to measure its velocity.

To make all these measurements and keep its accuracy the IM-4130 uses an internal temperature compensated crystal oscillator. The 1 Mhz signal from this standard is brought out on the rear panel of the counter should you need an accurate marker signal. This output connector can be switched to an input for an external time base, if needed. At extra cost both a 12 volt power supply and NiCad batteries are available if you want the counter to be portable.

The entire counter is solid state, made up of over 40 integrated circuits and hundreds of other parts. Even the displays are light emitting diodes (LED), rather than the nixie tubes that were used in older Heath counters.

As you would imagine from the number of parts, this kit may not be for a novice builder. It took me just over twenty hours to build the counter, and that was too fast. I paid for my speed later with a couple of knotty problems.

First I couldn't get it to count a frequency. A lot of probing and circuit tracing with an oscilloscope (remember that versatile tool) turned up a bad solder joint in the input circuits.

After curing the solder joint problem I still could not get the counter to read in the two upper frequency inputs. More circuit tracing and searching, and the sharp eye of a friend, revealed a transistor that *I* had forgotten to install in the input switching circuits. I had wondered why there was an extra! I installed the forgotten transistor and now everything worked except the 1 Ghz input.

More trouble shooting led to the only bad component in the *entire* kit, an IC on the input circuit board. A call to Heath's parts department brought the IC within days and I was back in business.

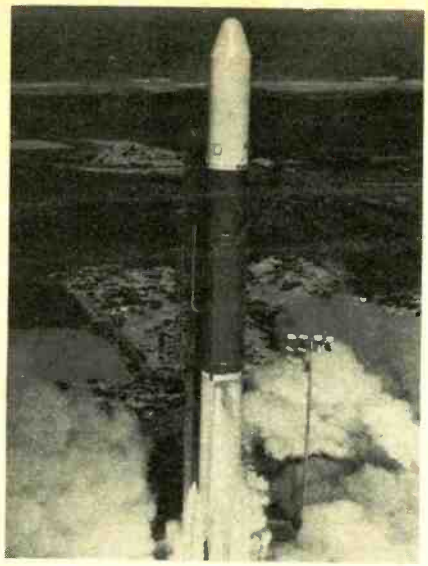
One other problem occurred earlier in the assembly. Initial testing of the power supply caused the fuse to blow. I had interchanged two of the three voltage regulator ICs in the supply. Here, however, I think that Heath should share a little of the blame. Although the assembly manual is Heath's usual high quality, the regulators all look the same and I didn't look closely enough at the instruction and part numbers to pick the correct one. Perhaps a cautionary statement in the manual at this point would prevent the problem for other builders.

Calibration of an instrument like this is important since final accuracy is directly related to the calibration process. Heath provides two methods, one without any other instruments that uses the internal 1 Mhz oscillator, and one using laboratory standards.

Since I don't have a lab quality signal generator, I was able to get into a local tv station through the help of a friend. Here we used the 3.58 Mhz color burst signal of the station and the super accurate output of the station's *Rubidium atomic clock* at 5 Mhz. While Heath claims "setability" of the time base to plus or minus 0.1 part per million we were able to set the counter to within .5 hz of 5 Mhz. With a little more time we undoubtedly could have done better. In any case that is more than suitable accuracy for the most finicky technician.

The IM-4130 frequency counter is definitely a high quality instrument. It costs $529 and is well worth the price for anyone with a serious need for a good counter.

OSCAR 8:



ME photos: Norm Chalfin and NASA

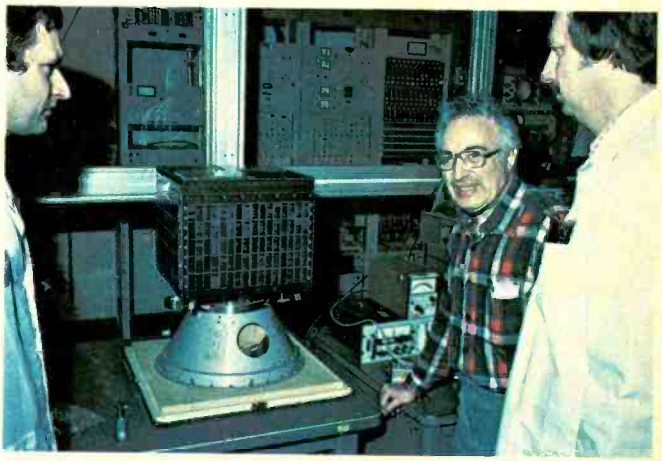
The Delta rocket lifted off at 9:54 am Pacific Standard Time, March 5, 1978, from NASA's Western Test Range, carrying the LANDSAT-C earth-resources technology satellite and AMSAT's OSCAR 8 into polar orbits.

Been following our coverage of how ham radio operators have built their own space-orbiting communications satellites? Here's the last in our series of exclusive *Modern Electronics* reports on the birds: OSCAR 8 is up and working like a charm!

by Norm Chalfin

Whatever form any electronic hobbyists interests take they are bound to be more esoteric than similar hobby activities in other fields. You have read in the March issue of this publication about Jan King, K6GEY who has built amateur radio communications satellites in his basement. Another one of these satellites has now been lofted into orbit around the earth and is being used by amateurs around the world to communicate with one another. It is also being used by science teachers to give their pupils hands-on experience in space science and communications.

The new Orbital Satellite Carrying Amateur Radio is designated OSCAR-8. It was launched March 5th at 9:54 AM PST from the NASA Western Test Range Pad at Lompoc, California. It is in a polar orbit encircling the earth every 103.23 minutes. Each morning and each evening there are three passes which will be "in view" for any part of the globe. The view periods will be about 10-12 minutes. If you plan to listen for OSCAR signals it would be wise to obtain the orbital predictions so that you can pin point when to listen.



OSCAR stands for final portrait before launch after being unpacked from shipment to California from Washington, DC. Skip Reymann, W6PAJ, Perry Klein, W3PK, and Norm Chalfin, K6PGX, center, stand by.

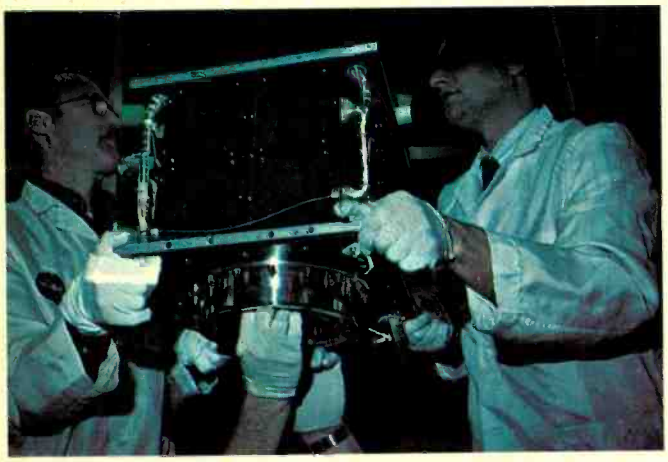
Like all good passengers, OSCAR stays strapped in its seat aboard a United Airlines jumbo jet enroute from Washington, DC, to Los Angeles, CA.

OSCAR-8 will be operating in two modes. One of these is called Mode "A" and receives input signals from 145.85 to 145.95 MHz (the 2-meter band) and converts them to an output in the 10 meter band between 29.40 and 29.50 MHz. There is a beacon sending groups of 3 digit numerals in Morse code preceded by the letters "HI" the traditional "ham" greeting. The beacon frequency is 29.405 MHz. Any shortwave receiver with a 10 meter (30 MHz) capability and a beat frequency oscillator (BFO) will make listening to OSCAR possible. Morse Code and Single Sideband (SSB) signals are the only signals you will hear in the 29.4 to 29.5 MHz pass band.

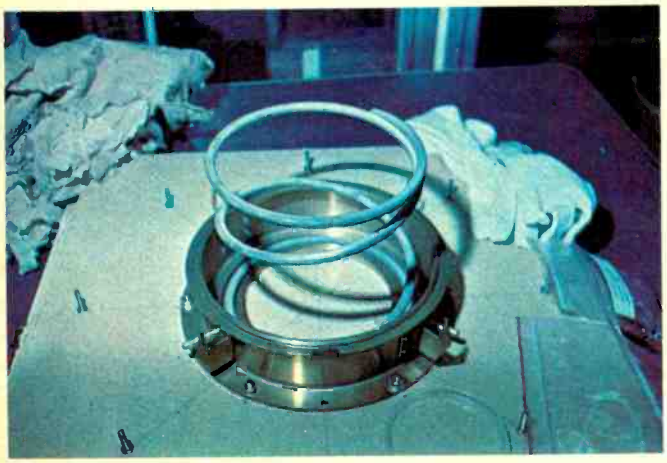
The other mode is identified as Mode "J" and will accept inputs between 145.9 and 146.0 MHz which are converted to 70cm band signals between 435.1 MHz and 435.2 MHz. The beacon frequency is 435.095 MHz.

The Mode A transponder was designed and built by U.S. amateurs. The Mode J transponder was the

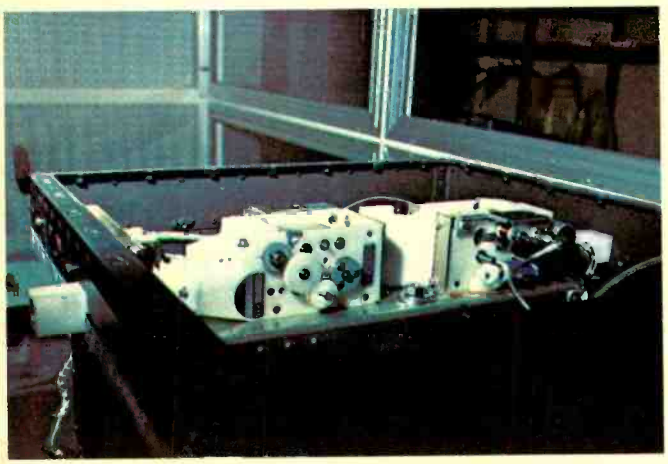
New ham satellite is A-OK



Dick Daniels, WA4DGU, left, who built one of the radio communications repeaters aboard OSCAR, and Perry Klein, W3PK, president of the Radio Amateur Satellite Corp. (AMSAT, the international club of hams and others who build amateur-radio satellites) hold OSCAR while Jan King, W3GEY, hands at bottom, adjusts the spring which ejected OSCAR 8 from the Delta rocket.



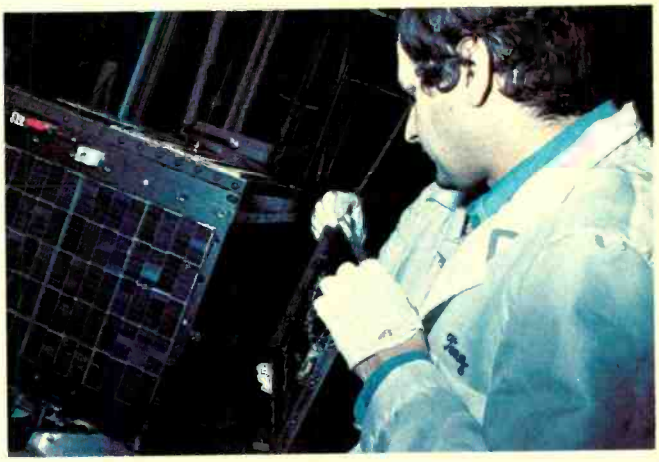
The ejection spring, an energy-saving device if ever there were one, was the "motor" which separated the spacecraft from the rocket which carried it into space.



Radio communications transmitters and receivers are behind the solar panels covering the faces of OSCAR. Other equipment includes magnets which stabilize the satellite in its orbit. And a long 10-meter-band radio antenna stretches out from the satellite upon command from hams on Earth. The antenna extender motor had to, and did, work right the first time.

product of members of the Japan AMSAT organization (JAMSAT). Members Amateurs from West Germany, members of AMSAT Deutschland contributed control circuitry. Members of the AMSAT Canada organization contributed telemetry systems to the OSCAR-8. There are AMSAT affiliates in most countries of the world including one in the Eastern European zone.

The preparation for launch of the AMSAT/OSCAR-8 amateur radio communications space satellite took



Perry Klein, W3PK, removes solar panel for final tests of OSCAR's electronics. NiCad rechargeable batteries aboard the spacecraft power radio receivers and transmitters. Batteries are recharged by electricity generated when sun strikes the panels of solar cells.

Jan King, operator of amateur radio station W3GEY, and others attach OSCAR to the rocket while Norm Chalfin, K6PGX, makes a photojournalism record for satellite history books.

place in the last two weeks of February. The steps of putting the spacecraft together and mating it with the Delta 139 Rocket are illustrated in the accompanying photographs. The Primary mission of the Delta was to orbit the LANDSAT-C Earth Resources Technology Satellite. OSCAR was given a piggy-back ride on this mission as a secondary payload. Another experiment aboard the Delta 139 is identified as PIX. It is a plasma interaction experiment designed to study the corona breakdown characteristics of solar cells when used in high voltage configurations expected to be involved in future space power systems.

news check

STOP THE PRESSES: LAST MINUTE NEWS JUST IN TO MODERN ELECTRONICS

BY ANTHONY R. CURTIS

WHAT'S THE BOTTOM LINE? Just how thin can a wire be made? Using photolithography, printed circuits now are made with "wire" lines as narrow as two microns. Ultraviolet, X-ray and electron-beam methods of printing circuit boards promise even narrower stripes. For instance, electron-beam lithography, under development now at IBM, puts down a strip eight picometers (eight-millionths of a millimeter) wide. The thin strips of wiring have been dubbed "nanostrips." The question now: how thin can it get before it stops acting like a wire and starts behaving like a chain of atoms?

A WHOPPING 21 PERCENT tariff on imported CB radios is in effect, up from the old six percent figure. President Carter said he upped the tariff to protect U.S. radio manufacturers. The tax will fall back to 18 percent next year, 15 percent in 1980 and finally back to six.

THE LAST INTELSAT COMMUNICATIONS satellite is in orbit over the Indian Ocean, handling more than 6000 telephone calls and two television programs simultaneously for 40 countries. Last of an historic series, the sixth INTELSAT, a model IV-A, joined Early Bird which went up in 1965, four INTELSAT II's, eight INTELSAT III's, eight INTELSAT IV's, and five INTELSAT IV-A's. The fifth IV-A was launched Jan. 6 and is standing by near the sixth, launched Mar. 31, for backup. The birds are owned by International Telecommunications Satellite Organization. U.S. Communications Satellite Corporation manages the satellites under contract to Intelsat.

HOME COMPUTERS WILL BE EVERYWHERE in the Dallas Convention Center on Sept. 29-Oct. 1 as 250 dealers and thousands of dedicated hobbyists cram the International Microcomputer Exposition. Competitions and seminars will be held and door prizes will be given away.

WALL STREET LOVES RADIO SHACK again, according to reports in the financial press recently. Tandy Corporation, parent of Radio Shack, is being widely recommended to stock buyers. The consumer electronics business adds up to more than $10-billion a year and growing rapidly. Radio Shack is getting a healthy chunk of the action, despite problems in 1977 (like all CB dealers) with citizens-band radio sales. The new TRS-80 microcomputer system for home hobbyists and small businesses is pushing the 6000-store chain in the right direction.

FCC BAN ON 10-METER LINEAR amplifiers ticked off many amateur radio operators. Commission took away 10 meters from add-on linear amps to get at illegal use in and around CB radio channels. Manufacturers must not make amplifiers capable of covering 23-35 MHz. That knocks out 10 meters which is 28-29.7 MHz. CB channels fall in the 26.9-27.4 range and illegal high-power operators have been there as well as in the 27.4-28 MHz range between CB channels and the 10-meter amateur band. Opposing hams want the FCC to limit the ban to CB frequencies, permitting linears operable from 28-29.7 MHz. Meantime, amateurs are permitted to operate on 10 meters and may construct homebrew linear amplifiers for 10 meters.

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Selectivity: SSB/CW ±1.5 KHz (−6dB), ±4 KHz (−50dB) AM ±3 KHz (−6dB), ±7 KHz (−50dB)
Power Requirements: 100/110/117/200/220/234 VAC, 50/60 Hz
Power Consumption: 25 VA
Size: 360 mm (W) × 125 mm (H) × 295 mm (D)
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