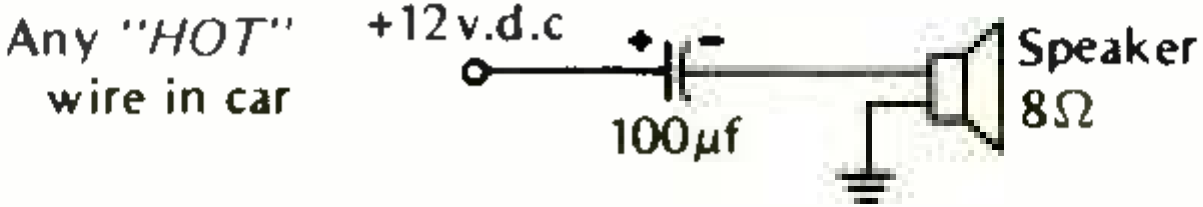
Whine tester

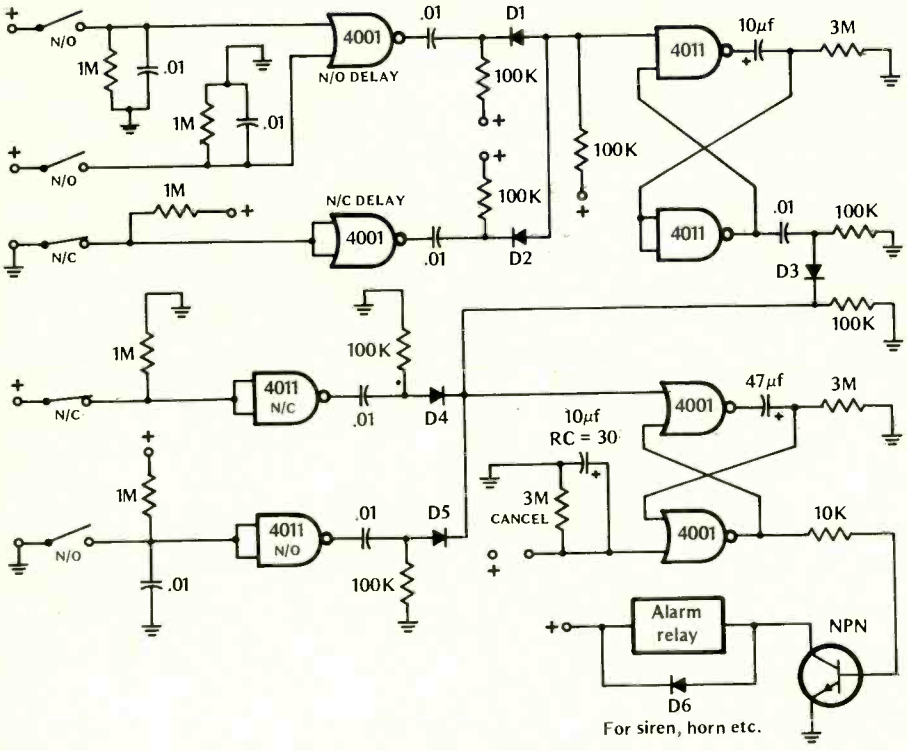
11



This simple under-$1 circuit tells you if there's anything wrong with your car alternator by analyzing the whine. A clean-sounding whine means the alternator's OK. Whine with a buzz means one or more diodes burnt out. If whine frequency doesn't keep pace with engine speed, the fan belt is loose.

Home-security brain

12



Get a loud blast of sound for your home security monitoring system for protection against forced entry by burglars. Battery powered, the unit is on duty even during power failures. Standby current drain is so low the batteries will perform for their shelf life. The circuit shown provides both normally open contacts (NO), such as fail-safe magnetic door switches, and normally closed contacts (NC), such as window tape. The two lower switches provide instantaneous operation. The three upper switches turn on the alarm after a 30-second delay, giving you time to turn off the system by closing the "cancel" switch.

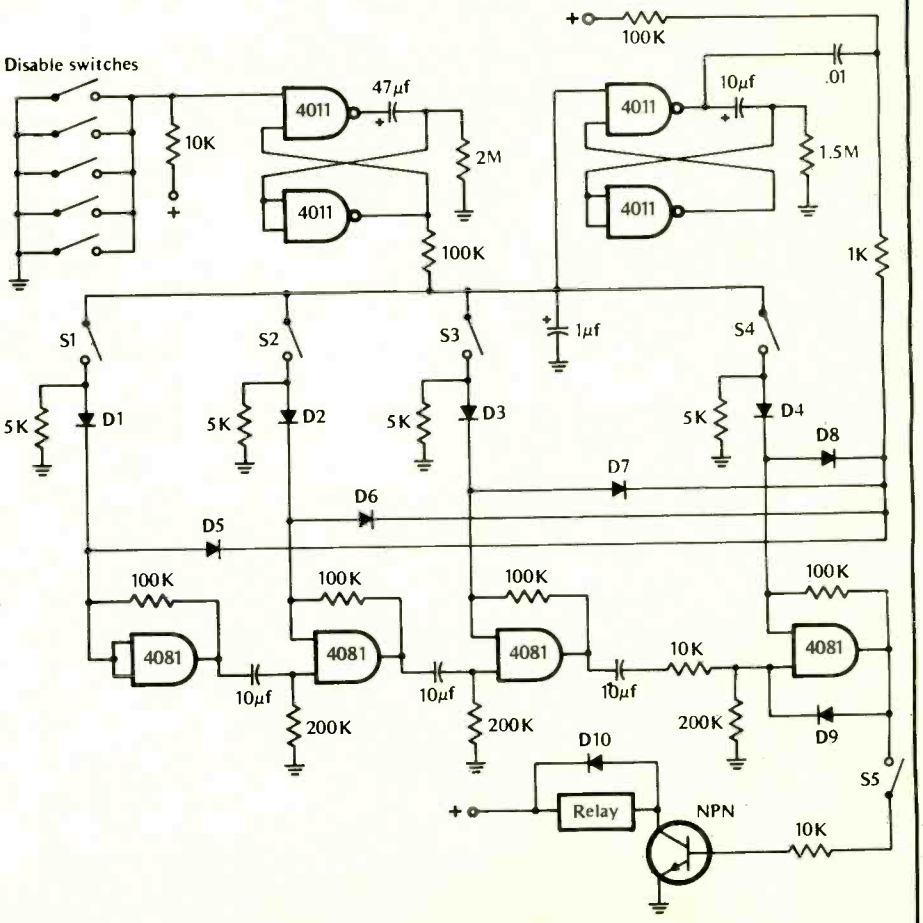
If you use a reed relay to activate your alarm, a 2N2222 or 2N3904 transistor can be used. Otherwise, any NPN transistor with a current rating high enough to power the relay you use will work.

Electronic combination lock

13

A thief has only seven seconds to crack this 10,000 combination pushbutton lock. If an incorrect button is pushed, an alarm sounds and all pushbuttons stop working for two minutes. The relay built into our circuit lets you control anything from your front door lock to car ignition. A nine-volt transistor radio battery runs the circuit one year.

To operate the lock, you must close S1, S2, S3, S4, and S5 in rapid sequence. By connecting these five switch leads in a random fashion to a 10 button switch pad, you can make any sequence you want—9, 2, 5, 4, 10 for example. To further complicate things, you connect the "disable" switch leads to the remaining switches on the pad. So, if the intruder pushes 9, 2, 5, 4, 8, the lock disables so that even if he then pushes 10, it still won't open. You can use any NPN transistor with ratings high enough to power the relay you use to activate a circuit or electrically operated lock.



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CIRCLE 51 ON READER SERVICE CARD

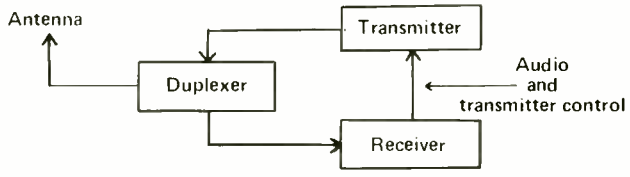
Repeaters are the best thing that's happened in ham radio since sideband

ME art: Harold Perry

A repeater is a receiver feeding its audio into a transmitter. Signals received at the repeater site are retransmitted over the air. The advantage is to weak portable or mobile stations which need only to transmit enough power for their signals to be heard at a repeater site atop a tall building, hill or mountain. The weak signal is boosted and retransmitted over a wider area.

by Judy Curtis, WB3AIQ
Contributing Editor

The most exciting news in ham radio in 25 years is the boom in VHF and UHF repeaters. With well over 2,000 "machines" on the air, old-timers are flocking



Repeaters are easy to understand. In block form: the antenna intercepts signals in the air. A duplexer allows signals to pass into the receiver without interference from the repeater's transmitter which is on the air even as the repeater is receiving signals. The repeater's receiver changes incoming radio signals into audio sounds which are fed into the repeater's transmitter. The transmitter boosts the signals and sends them out through the duplexer to the antenna and into the air.

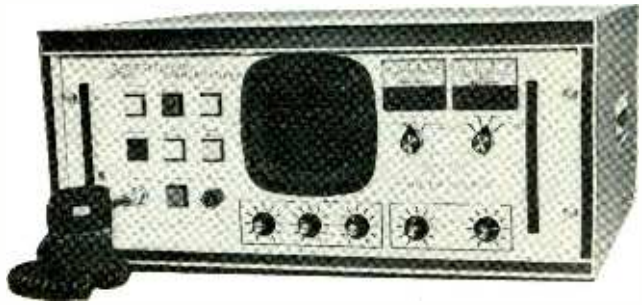
back onto the air and newcomers are about to double our numbers.

Hams always have wanted to chat while driving cars. Some have done it, even decades ago when gear filled trunks and sapped car batteries. In the last 10 years relatively small shortwave transceivers from Yaesu, Kenwood, Atlas, Swan and others have let us cart the high-frequency station away from home.

But these radios are bulky and frequencies in the 3-30 MHz portion of the spectrum require monster antennas and cumbersome loading coils, like tree trunks sprouting from rear bumpers.

So what are hams doing differently in 1978? Using small mobile and tiny portable VHF/UHF fm radios with antennas only a fraction the size of 3-30 MHz whips.

Transmissions in fm give hi-fi voice reproduction.



Spectrum Communications SCR-1000 is a complete under-$1000 amateur radio VHF fm repeater in a single package. It has operating controls and metering up front in a contemporary-styled cabinet. An antenna system, with or without duplexer, is all that is needed to put this machine on the air.

ME photo: Mary Patton

Bob and Tom Gutshall, operators of amateur radio stations W3BTX and W3BZN at Altoona, Pennsylvania, work high up a tower on the antenna of ham repeater WR3ACM on a mountain in central Pennsylvania.

Transmitter powers range from less than one watt to 30 watts of typical output power rather than the 100-1000 used on lower frequencies. Uncut quarter-wave antennas are as short as six inches. Typical antennas in use are about three feet long and boost the signal. Compare that with nine-foot no-gain antennas for lower frequencies.

There is a drawback to VHF/UHF radio. Tall buildings and mountains, like transparent window glass to shortwave signals, block or reflect VHF and UHF signals. How do we get around such roadblocks? Repeaters.

Repeaters are super-sensitive receivers and high-power transmitters placed atop hills, mountains, tall buildings and towers in flatlands. They hear weak signals from mobile and portable stations and re-transmit them out over very wide areas for others to hear.

Mini radios

I have used a tiny Wilson 1402 handheld battery-powered portable two-watt radio in my living room to chat with friends up to 100 miles away. The secret: the ½-watt effective-radiated power (ERP) from my Wilson traveled a short distance—less than 10 miles—across town to a repeater atop a high hill. My friend, miles away, was using a 30-watt base station with beam antenna pointed at the same repeater. Our conversation was pleasant and free of interference.

Hams everywhere use hand-size portables by Wilson, Motorola, Standard, Heathkit, Tempo, and others for walk-around communications: chatting, helping out with parades and walk-athons, handling emergency communications and even giving tourist directions.

Names like Kenwood, Yaesu, Midland, Clegg, Lafayette, Icom and others are on miniature mobile radios slung under the dashboards of hams' cars. These sets usually put out 10 or 25 watts power.

Repeaters can be used for ragchewing (the amateur version of what CBers call ratchetjawing), emergency communications, public service work and even telephone calls.

Telephone calls

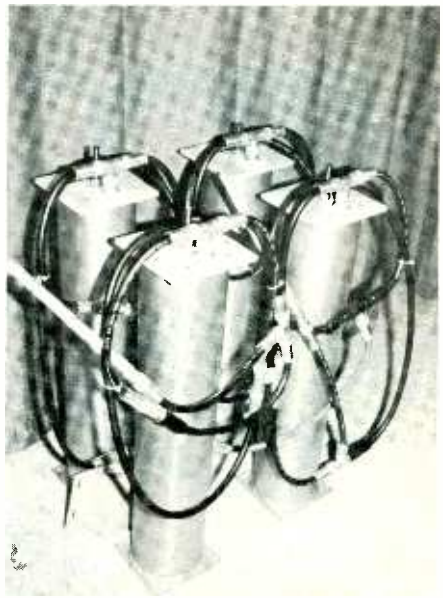
Hams in the Central Pennsylvania Repeater Association at Harrisburg, PA, installed an "autopatch" unit in a repeater they built for that area. Hams there equipped their portable and mobile radios with Touch-Tone (a Western Electric trademark for the key switches and tone generating circuitry in a Touch-Tone telephone)"pads."

A ham dials a special number through his radio, causing the repeater to hook itself into a local Bell Telephone Co. line. The amateur then transmits the seven-digit number he wishes to dial. The system is similar to "phone patch" which hams have used for years on shortwave, except that it is done automatically, at the remote repeater site, with no hams in attendance on the scene.

Joe deCourcelle, K3OBU, operates this repeater near Philadelphia. Bottom half of the cabinet is filled with duplexer.

An autopatch conversation is carried on as if the ham were at a regular telephone except that he must release his own push-to-talk button to hear the party on the other end. The ham retains full control at all times and can blank out unwanted comments from the other party.

Hams in Chicago, IL, Staten Island, NY, and other major cities have added automatic dialing of the telephone company's 911 emergency police number.



Duplexers are machined metal tubes, or "cavities," which allow use of a single antenna for transmitter and receiver. Received signal from antenna passes through to the repeater receiver but the outgoing signal from the repeater's transmitter is blocked by the duplexer from entering the receiver. Receiver receives and transmitter transmits, both at same time.

At Columbus, OH, hams added an extra receiver capable of hearing National Weather Service continuous forecast broadcasts. When a correct set of audio tones is transmitted to the repeater by a ham, weather forecasts are switched on the air for use in emergencies.

The Horseshoe Radio Club of Altoona, PA, lifted a repeater to the top of Blue Knob Mountain, nearly the highest peak in the state. Before, the Pennsylvania Turnpike had poor repeater coverage through central and western Pennsylvania. Now hams can stay in touch for more than 100 miles of that superhighway with just one repeater. Altoona hams monitor the machine around the clock to relay emergencies to police.

Hams traditionally have been experimenters, and there's plenty of experimenting going on with repeaters. The friendly group running the Wheeling, WV, machine has gone as far as to build

please turn to page 85

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CIRCLE 54 ON READER SERVICE CARD

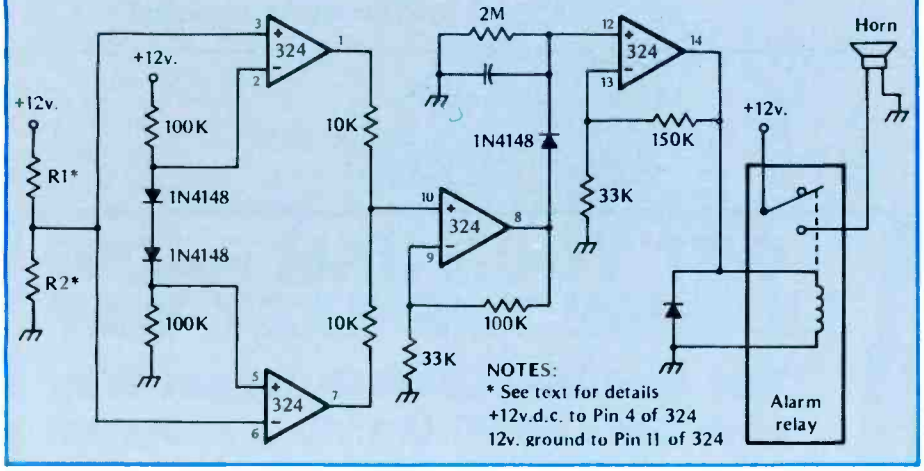
4 op-amp one-nighters

Hook-up and solder readily-available parts for one night's project fun. Make an inexpensive boat alarm, auto analyzer, temperature indicator and signal squarer.

by Jeffrey A. Sandler

boat-rustler alarm

Here's a simple alarm circuit that looks easy to defeat, but in reality isn't. The key ingredient is a resistor hidden under the dock and connected to the boat by a loop of insulated wire—ordinary lamp cord will work quite well. A potential thief, seeing the wire, will either cut it or try to short circuit it on the boat. Either action will trigger the alarm. The hidden resistor and another with identical resistance form a voltage divider connected to the alarm input. If the wire is cut or shorted, the voltage at the alarm input will change, and the alarm will sound for about 5 minutes. The value of these resistors is not critical—anything from 20 to 100,000 ohms will work.

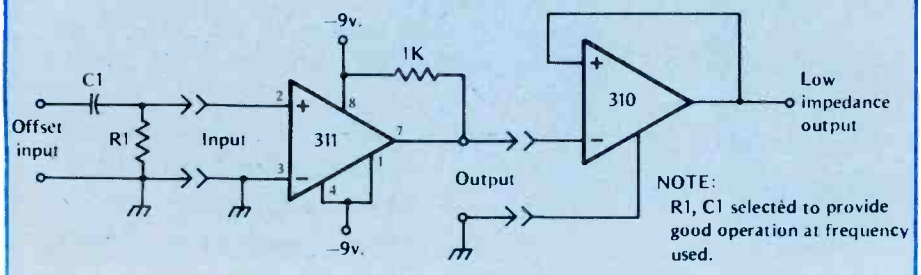


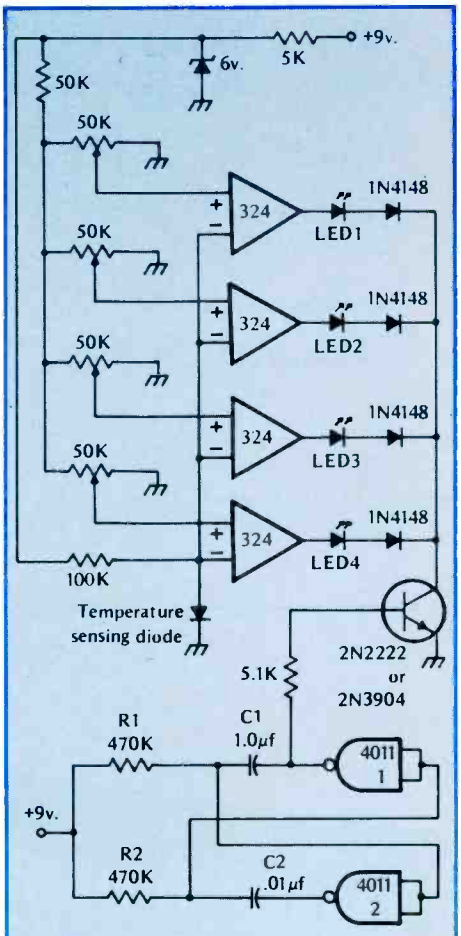
wave squarer

If you have a circuit that requires a square wave or squared pulse input, but have available only a sine wave or rounded pulse, this handy squarer circuit is just what you need. It's an updated version of the classic Schmidt Trigger, or zero crossing detector.

The output is normally zero volts. However, when the input signal crosses zero in a positive going direction, the output jumps to near the supply voltage in about 200 nanoseconds. It remains at this voltage until the input crosses zero in the negative going direction.

By offsetting the input, an asymmetrical output can be obtained. However, if you have a sine wave with a dc offset, and want a symmetrical square wave, you can use the optional input filter. Also shown is an optional amplifier that provides a low impedance output.





power-failure alarm

Ever come home and find all your digital clocks reading "eights" leaving you wondering how long the juice was off? Well this inexpensive circuit can give you a good idea. All you have to do is connect it to any outlet.

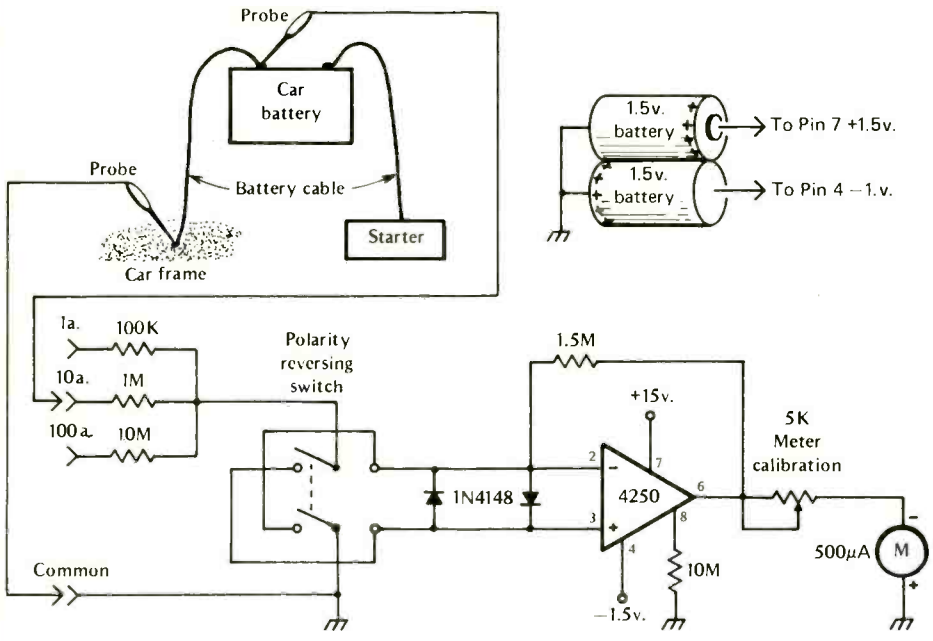
When the power fails, an alarm will sound and from one to four LEDs will light, depending on how long the outage lasts.

You can select the time required for each LED to light by carefully choosing the values of each R*C* pair. The values given here are for 1 second, 10 seconds, 100 seconds, and 500 seconds. The tone of the alarm is determined by R_1C_1.

Current drain is quite low when the alarm is off. A single 9-volt battery should last a year.

After a power failure has occured, you can reset the alarm by momentarily depressing the pushbutton "reset" switch.

auto analyzer



Measuring the current drain on your car's battery can be quite a problem. For one thing, it's hard to find some place in the circuit where you can break the line to connect an ammeter.

Using this handy op-amp analyzer, you can measure the current drawn by any device in your car, whether you can find the wires going to it or not. The analyzer works by measuring the very small voltage that develops across the battery cables when current flows.

The analyzer can be built as a small portable test instrument, or permanently mounted on the dashboard. However, you must insulate the instrument so that only the probes make connection to the car.

Once you've connected the probe tips to the battery cable ends (either cable will do), you'll have to calibrate the unit. To do this you must measure the current flow somewhere in your car with an accurate ammeter, then adjust the analyzer for that current reading.

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CIRCLE 57 ON READER SERVICE CARD

SSB/CB

Donald Duck talks farther than Ancient Modulation

Talk farther, get through worse interference with one of these pro quality single sideband rigs.

by Gerald R. Patton
Contributing Editor

Imagine a CB radio that lets you talk over longer distances, with less interference, than conventional rigs, and also comes equipped with three times as many channels. These features can be yours right now with any of the fine single sideband (SSB) CB radios currently on the market!

Sideband transmissions are more efficient than regular AM signals because all the power of the transmitter is concentrated on the intelligence portion (voice) of the signal rather than being wasted on a "carrier wave" of radio frequency (RF) energy. An AM signal is made up of this carrier wave in between two equal but opposite intelligence-carrying signals known as sidebands. Only one of these side-bands is necessary to transmit your message through the airwaves, because each of them contains the complete voice information of the transmission. When using SSB, one sideband is eliminated completely, and the RF carrier wave is highly suppressed.

More channels, less interference

The fact that sideband signals require much less bandwidth than AM signals makes it possible to more efficiently utilize the frequencies available for CB because more channels can "fit" into the same amount of spectrum space. For example, 80 SSB channels exist within the 40 regular AM channels. Unfortunately, these sideband channels can be effectively "wiped out" by strong AM stations located on the same channels.

SSB receivers are, however, relatively immune from some other forms of interference that cause real noise problems in conventional AM receivers. One way that interference can enter a receiver is by "riding" in on another station's RF carrier wave. With single sideband, though, the carrier wave is almost totally suppressed, thereby eliminating this possibility. Furthermore, at this time there are not nearly as many sideband stations on the air as AM stations, so that those channels reserved by gentlemen's agreement for SSB use don't exhibit the crowded conditions of many CB channels.

One negative aspect of sideband communication is the "Donald Duck" voice quality apparent on signals when the transmit and receive frequencies don't exactly match. This is the reason for having fine tuning or clarifier controls on sideband sets. The proper use of this control homes in the tuning of your receiver to the other operator's transmitter to make voices sound natural.

Sophisticated sideband

All sideband CB radios on the market offer the unique advantages of single sideband communications, but one

Cobra 132XLR rig gives 120 channels with the standard 40 available for am plus the same 40 subdivided into 40 upper and 40 lower sideband channels.

super-sophisticated unit by Texas Instruments (TI), the first to utilize microcomputer control, has even eliminated the Donald Duck syndrome. A brief tone burst code is transmitted preceding voice modulation. When using two of these radios, the tone burst is received by the other unit and causes it to immediately adjust for any frequency disparity between the sets.

TI has advanced the state of the art even further with this unit, which is available in both base and mobile configurations. All operating controls, along with a light emitting diode (LED) display, are located on a small handset. You can control squelch and volume, change channels, and select AM or upper or lower sideband modes of operation, all with this handset. The radio will advise you of the standing wave ratio (SWR), via the LED display, of the antenna you're using and will even search out a clear (or busy) channel for you.

Silence can be golden

The TI units contain a unique digital selective calling system that, when activated, allows your receiver to remain absolutely quiet regardless of other activity on the channel, until another TI radio sends a signal to you with the correct code. Millions of different possible code/channel choices are available for programming into your transceiver. Better yet, the five codes you use most often can be memorized by the microcomputer so that just one key stroke is needed to select the particular code desired.

Typical of the new breed of performance-oriented SSB transceivers is CB-5470 by Sharp Electronics.

This rig, which carries a suggested price of $249, has an LED channel indicator which flashes when Channel 9 (the nation-wide emergency frequency) is selected.

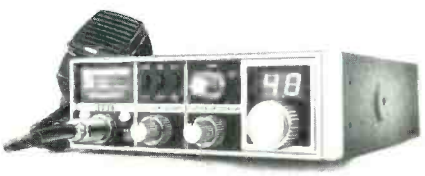
The unit also has a noise blanker, RF gain control, and lighted mode (AM-USB-LSB) indicator.

If you haven't yet had a chance to use, or at least listen to, single sideband CB, there's a thrill in store for you. The increased range of communications possible with less interference, plus the knowledge that you are getting in on the ground floor of the future of CB, provide a welcome entry into single sideband communications for today's active, involved CB'er!

Randy Patton is an assistant director of the American Radio Relay League and an elected official in Pennsylvania.

Washington model SSB CB rig is from President Electronics.

SSB CB mobile radio, above, and base station, right, by Texas Instruments, have microcomputers built in. All controls are in the handset/microphone.

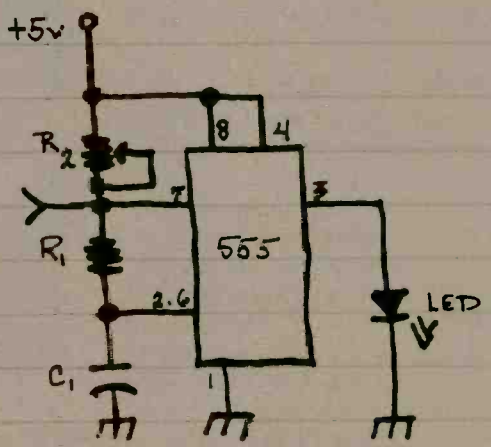


Among available SSB radios are SBE, top right; Communications Power Inc., middle right; Panasonic, lower right; Teaberry, lower left; and Sharp, upper left.

A Resistor Is An Electricity Sponge

The more water pressure in a pipe, the more water that flows. Similarly, the more volts in a circuit, the more electricity that flows. Volts are the pressure making electrons, or current, flow. The more volts of pressure, the more electrons that flow.

Electron flow, then, is current. Sometimes it's good to have a part of the circuit resist current flow. Thus, we have **resistors**. Resistors are like sponges pushed into water pipes. A sponge would soak up some water before passing it on. To get more water through, you would have to increase the pressure. Similarly, raise the voltage to pressure more current through a resistor in an electrical circuit.



Schematic symbols

We have labels used to name the measures of electricity:

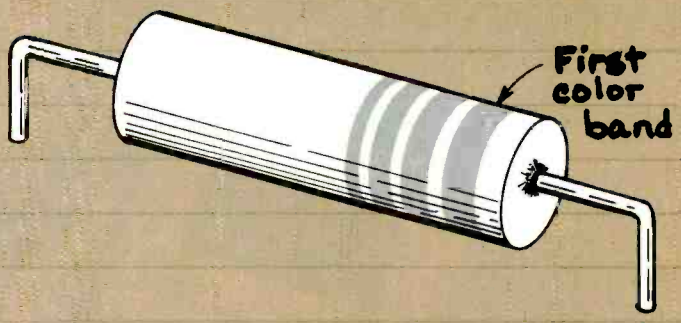
a. The electromotive force or pressure in a circuit is measured in **volts**.

b. Current flow is measured in amperes or **amps**, for short.

c. Resistance provided in a circuit by a resistor is measured in **ohms**. We use the symbol Ω to indicate ohms.

A zig-zag line, in a circuit diagram, indicates a resistor. This schematic represents a timer which will light the LED periodically. Resistor R_1 has a fixed value. R_2 is variable, like a radio volume control. C_1 is a capacitor and 555 is an integrated circuit "chip."

A resistor is a tube with stripes and a wire coming out of each end.



Here are the numbers matching the first two color bands on a resistor. The third band shows the number of zeros following. For example, a 4700 ohm resistor is yellow, violet and red in that order.

BROWN	1	ORANGE	3	GREEN	5	VIOLET	7	WHITE	9
RED	2	YELLOW	4	BLUE	6	GRAY	8	BLACK	0

What if none of your resistors is the right value?

Resistors are manufactured in standard values. Experimenters often stock several values. But, what if you need a 200 ohm resistor and have only two at 100 ohms?

Easy! Put the two end to end in "**series**" in the circuit and add their values.

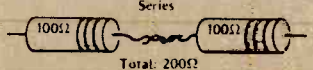
$$R_1 + R_2 + R_3 + R_N = R_{total}$$

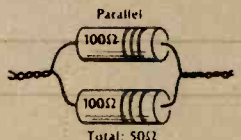
SERIES
100Ω 100Ω
total: 200Ω

If you had placed the two 100 Ω resistors side by side in "**parallel**" in the circuit, the formula would be:

$$R_{total} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_N}}$$

PARALLEL
100Ω
100Ω
total: 50Ω





Measuring devices

I. **Ammeter** measures current.
II. **Voltmeter** measures emf or voltage.
III. **Ohmmeter** measures resistance.

This instrument is a **volt-ohmmeter** (VOM) to measure volts, amps and ohms. It is model 3300 by Triplett. Meters and test gear make it possible to build or repair electronic equipment.

There is a nice thing about volts, amps and ohms. They relate in a very predictable fashion. Rule of thumb for this relationship is **Ohm's law.**

Ohm's law

Here's the formula : $E = IR$

E = volts
I = amps
R = ohms

To find volts in a circuit multiply amps times ohms. For example, 100 volts equals 2 amps times 50 ohms.

Turn the formula around to calculate amps. For instance, divide 100 volts by 50 ohms to compute 2 amps.

$$I = \frac{E}{R}$$

Or divide 100 volts by 2 amps to get 50 ohms.

$$R = \frac{E}{I}$$

Power: how many watts in that circuit?

The strength of an electrical circuit is its power, measured in **watts**. Power can be calculated with the formula: **P = EI**

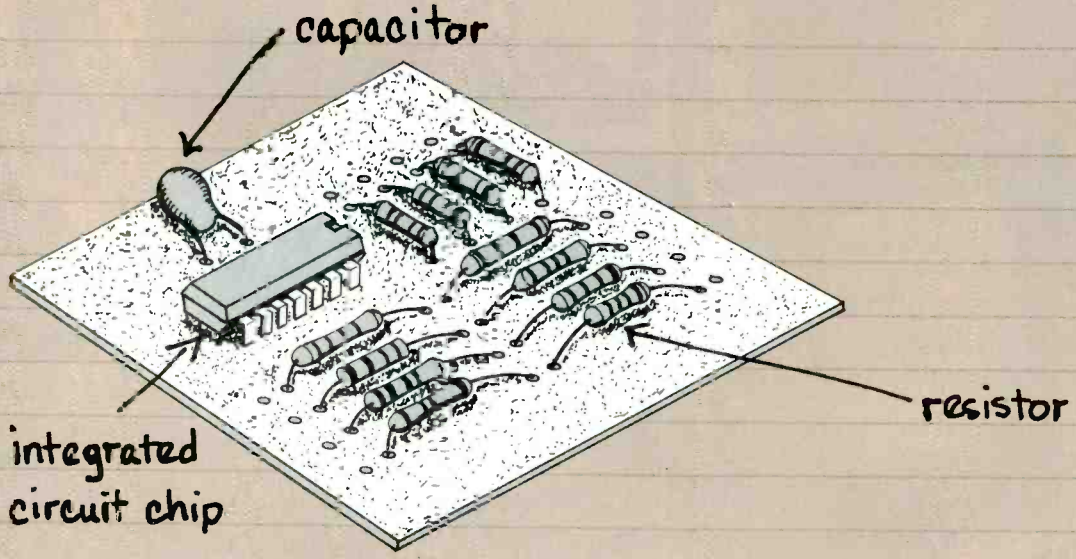
P = watts
E = volts
I = amps

For example, 12 volts pushing 5 amps equals 60 watts.

$12 \times 5 = 60$

Resistors have to be physically big enough to withstand the power of the circuit they are in. For instance, a 10 watt resistor is needed in a circuit where 5 volts and 2 amps are present.

$P = EI. \quad 10 = 5 \times 2$



1978-style hardware usually is built of individual parts soldered to a **printed circuit board.** Above, a PC board holds resistors, a capacitor and an IC.

Piggybanks for time

Time is money and a penny saved is a penny earned. With a videotape recorder you can amass a fortune.

by Bob Margolin

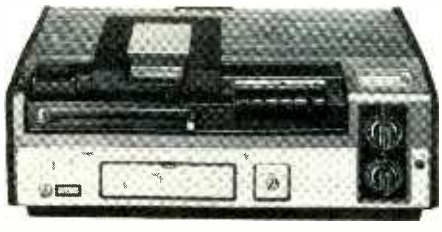
You're all set to enjoy the sporting event of the week on tv when your boss calls and asks you to have a lengthy report on his desk the next morning. It's 9 p.m. and time for the movie of the week, a film you've been waiting months to see, but the family insists on watching a special on another channel. Tomorrow is your child's birthday and you'd like to record on film those once in a lifetime happenings, but there's never enough time to set up your movie camera. What do you do?

The solution to these dilemmas is the latest, most exciting home electronics product — the home videotape recorder. Known as the HVTR, or just VTR, it is occasionally referred to as the VCR, or video cassette recorder. By any name, it is truly a marvel. With a VTR, you can record for later viewing a program being aired while you're at work or visiting a sick friend. Or, you can record the program on one channel while watching another channel. And, with an optional camera, you can make instant color and sound home movies.

Videotape recorders have been around since mid 1960s. Until recently, however, the cost and physical size of VTRs put them beyond the reach of most people. But thanks to design and production technologies spun off the space program, VTRs are becoming more affordable. Today, you can purchase a home VTR for less than $1000 complete.

Sony, a major world producer of home tv, was the first to market a VTR specifically designed for home use — the Betamax. Introduced in Japan in the spring of 1975, the $1300 Betamax reached the U.S. market in November, 1975. To produce a VTR at this relatively low price, Sony reduced the size of the videotape to one-half inch and created a new method of recording the program information, called the Beta format.

Encouraged by the success of the Betamax, other companies began work on home VTRs. About a year after the introduction of the Betamax, JVC (Japan Victor Company) introduced its Video Home System, or VHS format. Developed in conjunction with Matsushita, manufacturers of Panasonic products and the parent of JVC, the VHS used technology different from, and incompatible with, the Sony Beta format.



Quasar's Great Time Machine uses a simplified design that is easier and less expensive to build.

Though producing about the same picture quality as the Betamax, the VHS was physically lighter and smaller.

The great time race

The original Betamax provided one hour of playing time per cassette. This seemed adequate since most TV shows run either one-half or one full hour. JVC, however, with sporting events and full-length feature films in mind, designed the VHS to provide two full hours of playing time per cassette.

Sony countered JVC's two-hour VHS with the design of a changer that automatically would feed a second one-hour cassette into a Betamax, increasing its playing time to two hours. More recently, Sony introduced a two-hour version of the Betamax, the Beta-2 format. About this time, RCA decided to enter the home VTR market. After considering the pros and cons of both the Beta and VHS formats, it chose the VHS approach. However, RCA believed that what you really wanted was four hours of playing time per cassette. Working with RCA, the engineers at Matsushita

Sanyo's V Cord II uses higher tape writing speed for a sharper picture.

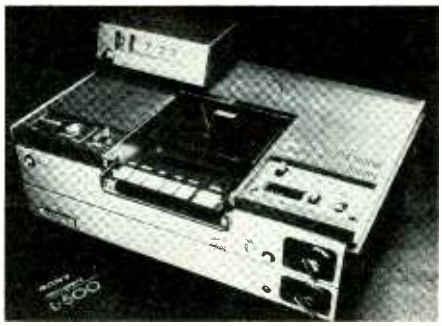
succeeded in modifying the VHS format to produce four-hour capability.

To differentiate between the two-hour and four-hour versions of the VHS format, VTRs are identified as being either VHS-2 or VHS-4 machines. The major difference between the two formats is the width of the recorded track on the tape. The VHS-4 track is about half the width of a VHS-2 track. Although the circuit has been modified in the VHS-4 to minimize the effect, picture quality is slightly poorer in the four-hour version than in the two.

In order to provide you with the best possible picture, all VHS-4 machines are equipped with a switch that let's you convert to the VHS-2 format when the four-hour playing time isn't required. When set for VHS-2 operation, the four-hour machines produce a videotape identical to that produced by a standard VHS-2 recorder.

Who's on first?

In selecting your VTR, you'll have to choose which format and what time capacity you want. There's the one-hour or two-hour Betamax, and two-hour or four-hour VHS format. And if these recorders don't fill the bill, there's also



Sony was the first to market a VTR specifically designed for home use—the Betamax.

the Quasar Great Time Machine and the Sanyo V Cord II.

The Great Time Machine is based on an early VTR design of Matsushita that utilizes a single record and playback head. Because the recorder uses less complex mechanics and supporting electronics, it is less costly to build. It sports a list price of $995.

The Sanyo V Cord II is based on Sanyo's industrial and educational VTR designs. The major advantage of the V Cord is a higher tape speed which gives you a crisper picture than the other three formats. It sells for about $1200.

Both the Great Time Machine and the Sanyo V Cord II offer you two-hour playing time per cassette. While both have some advantages over the Beta and VHS format recorders, their biggest disadvantage is their limited distribution and potential. As "oddballs" in the VTR market, blank tapes and accessories may be hard to obtain. Servicing, however, should be readily available through the nation-wide network of Quasar and Sanyo service centers.

Your VTR becomes an instant sound home movie production center with the addition of a mic and tv camera.

ME graphics: Color Directions

The VHS-4 format, developed by Matsushita for RCA and now offered by Magnavox and other brands as well, gives you a choice of two or four hour playing time. In the long playing mode, this machine can record an entire evening's network tv programming on a single cassette.

Because of electrical and mechanical differences, a cassette designed to fit one of the VTR formats will *not* work in any of the other three. If you plan to swap tapes with a friend, you'll have to have the same format recorders. While it is too early to tell, it seems the market will be divided roughly in half between the Beta and the VHS format, with the Great Time Machine and the Sanyo V Cord running far behind.

Since you'll want to save some programs for later viewing, you'll need to buy more than one blank cassette. The prices for cassettes run about the same for all four formats — one-half hour cassettes about $12 each, one-hour cassettes about $15, and two-hour cassettes about $20.

The quality of the picture you get on your tv set depends on how well aligned it is. If it is in tip-top condition, the picture you get from your VTR will seem slightly out of focus when compared to an off-the-air picture. Even the Sanyo V Cord's picture will seem a little soft. However, if your tv is in average condition, you'll never notice the difference between taped and off-the-air programming.

What about picture quality?

If you're a perfectionist who insists on the very best, you can get razor sharp pictures from another kind of home VTR — the three-quarter-inch recorder. The three-quarter inch format has been in use for about 15 years in commercial applications. With the success of the home VTR, several manufacturers such as NEC (Nippon Electric Company), JVC, Matsushita, and Sony, have added the features you need to their professional three-quarter-inch recorders. The result is a somewhat larger, heavier VTR that looks like a standard home recorder, but gives you professional performance.

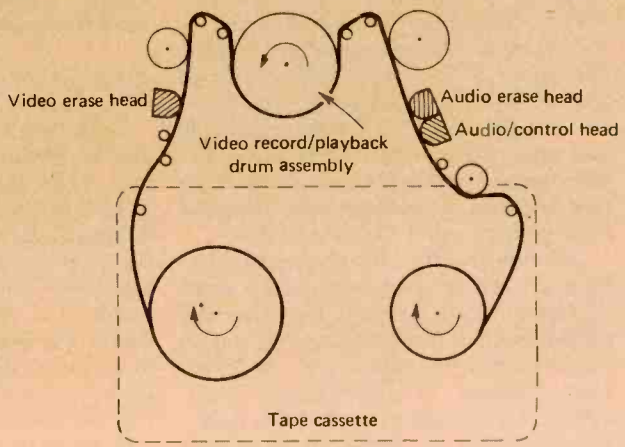
As you might expect, this added performance is going to cost you. The home type three-quarter-inch recorder prices start at about $2000. And the blank cassettes will cost more, too — about 60 percent more. But if you want the best, the three-quarter-inch VTR is worth the price.

Lights, camera, action!

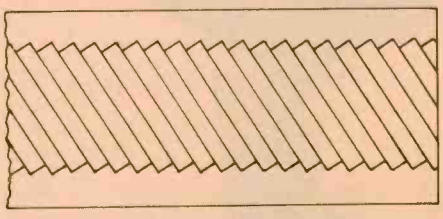
All VTRs are sold ready to record and playback tv programs. But, with the

Speed counts

Take a peek inside a typical videotape recorder and see how the tape transport, playback and record heads work.



If you've ever dabbled with audio recording, you know that most reel-to-reel tape recorders can provide a smooth response up to 15,000 Hz, and many to 20,000 Hz. But have you ever wondered why even the best cassette recorders can only get up to 12,000 Hz or so?



An overlapping track pattern and rotating record/playback head provide tape writing speeds of more than 20 inches per second.

The answer is speed. All other things being equal, the faster the tape travels across the recording head, the higher the frequency that can be recorded. How, then, can several megahertz of video signal be recorded on a tape moving at about the same apparent speed as it does in a standard portable cassette recorder?

This feat is accomplished by passing the tape across a recording head that is moving at a very high speed. The speed at which the signal is recorded, the tape *writing* speed, is the net speed of the rotating head and tape motion. You're probably asking yourself how the recording head can move in any direction. It can because it's mounted in a rotating drum assembly.

Overlapping pattern

The head assembly is designed to record at an angle across the surface of the tape in an overlapping pattern. By over-

The tape controls on some VTRs such as the Sony Betamax (top) are exactly the same as those on your portable cassette recorder. Others such as the JVC (bottom) have added pause and audio dubbing pushbutton keys.

addition of a $300 tv camera, you're ready to make instant black and white home movies. Add an inexpensive microphone and you have sound on film.

Color is an expensive proposition. Until recently, color cameras ran well over $2000. Today, you can get a good color camera from JVC for only $1500. While this may seem high, you can pay for it with the savings in film and processing costs.

The real advantage of using your VTR to make home movies is that you can see what you've shot in the time it takes to rewind the tape. If you're not happy with it, shoot it again. And when something you've shot is no longer of interest, you can reuse the tape.

If you buy a VTR, it's most likely because you want to record tv programs off the air. But, soon you'll be able to buy, rent, or even borrow from your local library, pre-recorded tapes. As this "software" becomes available, you'll have access to a much wider variety of program material than you can get off the air, including uncut feature films and sporting events.

VHS videotape

Curtis Mathes*
4-hour, tv-VTR console

GTE Sylvania*

Hitachi*

JVC Vidstar
2-hour deck, $1280. B&w camera, $395. Color camera, $1500.

Magnavox
4-hour deck, $1075. B&w camera*

MGA*

Panasonic
4-hour deck, $1095. B&w and color cameras available from $395 to $4000.

RCA Selectavision
4-hour deck, $995.

Sharp*

Beta format videotape

Sanyo Betacord*

Sears Betavision*

Sony Betamax
2-hour deck, $1300. Cassette changer and b&w camera*

Toshiba
2-hour deck; $1300.
IK-12 color camera, $1700.

Zenith
2-hour deck, $1300. 25 inch tv-VTR console, $2500. B&w camera*

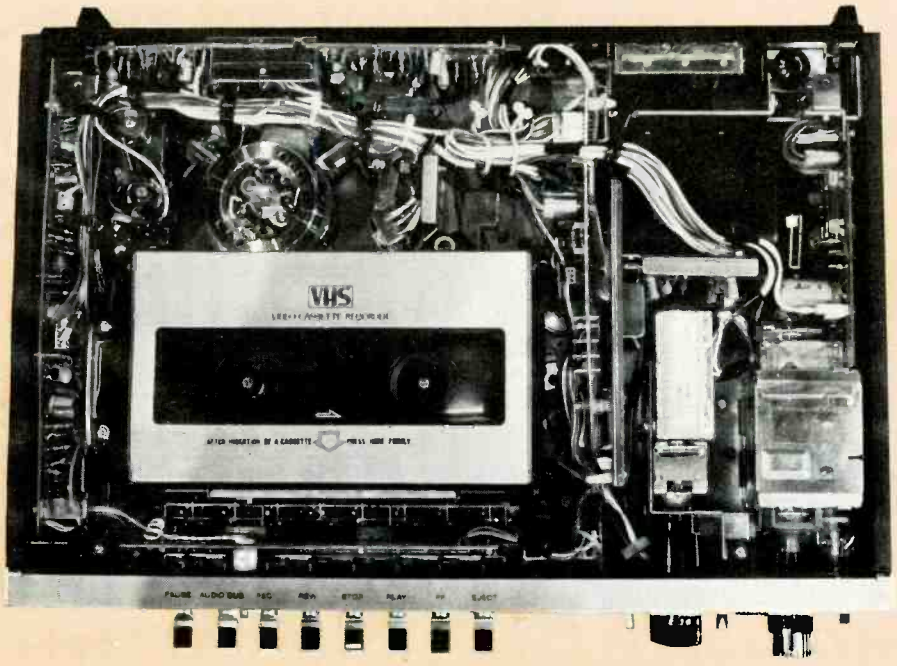
The others

Sanyo V Cord II
2-hour deck, $1050.

Quasar Great Time Machine
2-hour deck, $995. B&w camera with built-in mic*

*Price and product information not available.

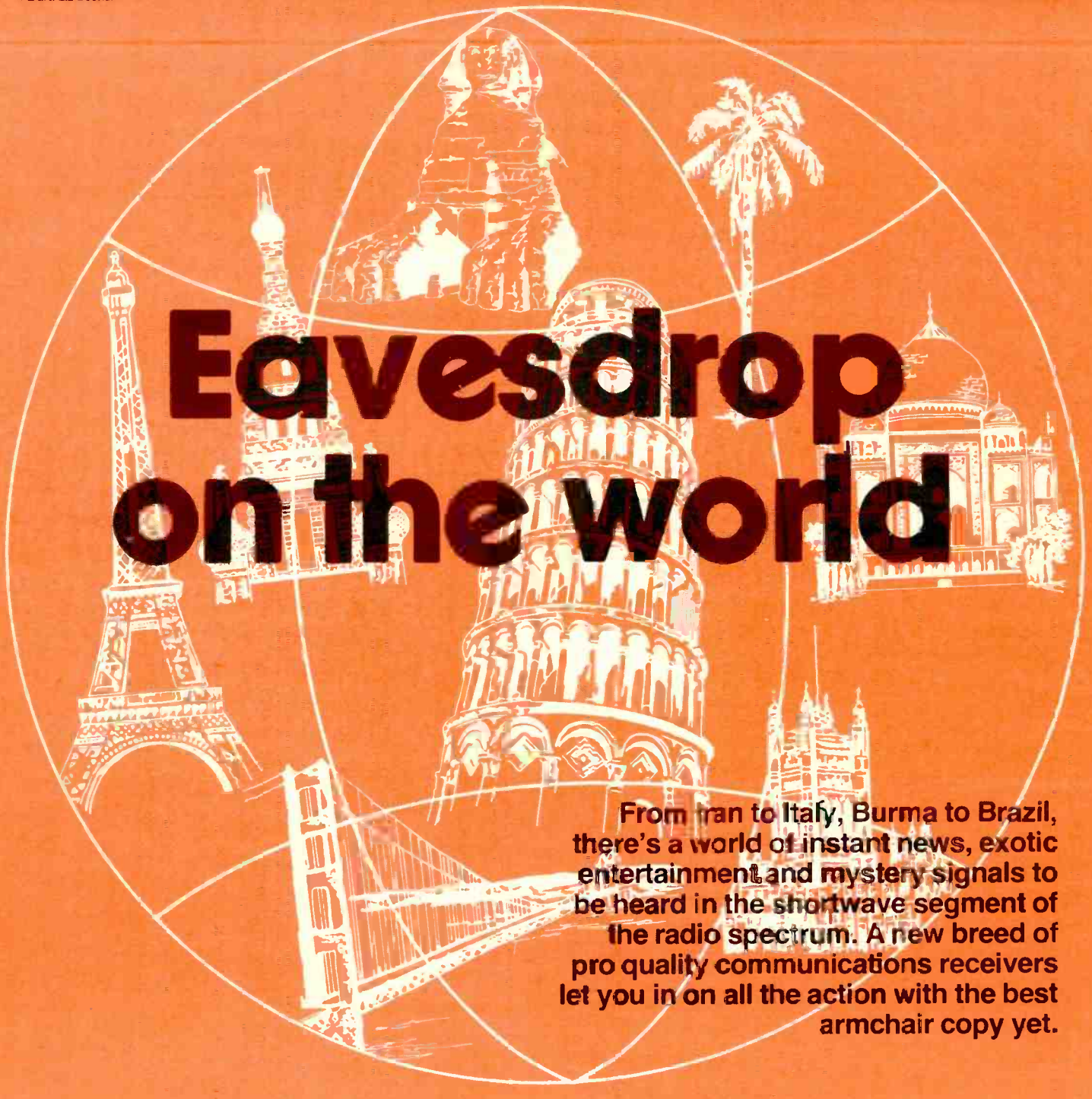
lapping, much more information can be recorded per inch of tape than otherwise possible. In the JVC VHS-2 format, for example, more than six times as much! Because of the overlap and the rotating head, the effective writing speed in the VHS-2 format is 23.2 inches per second.



Another operating characteristic of VTRs that you won't find on your portable cassette recorder is the tape path. In your portable, the tape remains within the cassette case, traveling from one internal reel to the other across one exposed side. The tape in a VTR cassette, however, is pulled out of the case to travel through the interior of the VTR itself. In some respects, it's similar to a cassette-loaded movie projector, with the tape following a complicated path through a series of rollers.

Although the path is much more complex, the operation is similar to your portable recorder. First, the tape is passed over an erase head that removes the previously recorded video program. The tape then passes over the rotating record/playback head assembly where the video is recorded, and stationary erase and record/playback heads where the sound and control signals are recorded. Because the frequency response required for recording these signals is so low, a conventional technique is used, identical to that used in your portable cassette recorder.—*Bob Margolin*

ME art: Liz Beener



Eavesdrop on the world

From Iran to Italy, Burma to Brazil, there's a world of instant news, exotic entertainment and mystery signals to be heard in the shortwave segment of the radio spectrum. A new breed of pro quality communications receivers let you in on all the action with the best armchair copy yet.

by Anthony R. Curtis
Modern Electronics' Editor

The glare from a gooseneck lamp pushes a shadow from your pencil as you stare at the dimly-lit dial on your shortwave receiver, headphones cocked as you work to hear through a pile up of megawatt international broadcasters. Underneath booming signals from the likes of Moscow, London and The Netherlands, is the pirate voice of Arab Syria attacking the national regime. It's in there, you can almost hear it. And you need it for your log of stations heard on shortwave!

Around the world, thousands of listeners everyday twist radio dials in search of the rare and elusive *DX* radio broadcaster's signal. Shortwave listeners man monitoring posts in attics, basements, garages, dens as radio signals from four corners of the Earth descend their antenna wires.

Exotic music from the Orient, precise news from London, ham radio operators helping out in an earthquake, even CBers talking across your hometown.

Now you can eavesdrop on radio signals, secret as well as public, more easily than ever before.

There's a new breed of general-coverage radio receiver being used by SWLs (shortwave listeners) around the world. The new sets, costing $150-$350, are as well-built and sensitive as the $2500 professional rigs of the '60s.

Names like Yaesu, Kenwood, Drake, Heathkit and

Yaesu FRG-7

McKay Dymek have a familiar ring in today's SWL listening post where sets by these manufacturers pick up weaker signals, separate interfering stations, and have more features than many of yesterday's most expensive receivers.

Wet noodle

The new radios go beyond the $25 multiband portables which hear only the giants of international shortwave broadcasting. In fact, it takes little more than a wet noodle to pick up the millions of watts transmitted by Radio Moscow, Voice of America, or the British Broadcasting Corp. (BBC).

The new batch of professional communications receivers offered to hobby listeners are far more sensitive, selective and convenient to use:

■ More sensitive means they can hear Afghanistan, Peking or the 50 African nations now transmitting music, news, comment, sports and other forms of shortwave listening excitement.

■ More selective means you can tune in weak signals buried on the dial between Radio Cairo, All India Radio, Radio Japan or the Voice of Vietnam.

■ The new sets are convenient with more controls up front, finer tuning knobs and well-marked front panels.

Radio Shack, Drake, Yaesu, Kenwood and Dymek all tune continuously from the bottom end of the U.S. am broadcast band at 550 kilohertz (kHz) up to the top end of the shortwaves at 30 megahertz (MHz).

In addition, the Radio Shack covers 150-400 kHz. Kenwood's R-300 covers 170-410 kHz and the Dymek hears signals from 50 kHz on up.

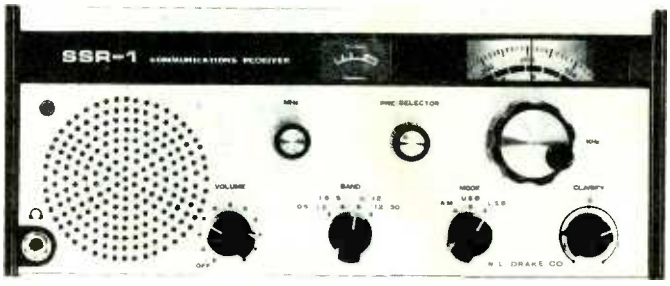
Needs only a skyhook

All you need to make these new sets work is an antenna, and many come with a simple beginner's whip or wire. One simple antenna you can make yourself is the dipole described with this article. Hang a wire out the window to the nearest tree. Or even stretch a small-diameter hidden wire under your living room rug.

In evaluating four of the best of the new breed, I listened to hams chatting around the world, to propaganda from Albania, and to radioteletype (RTTY) carrying news stories to tickers in far corners of the globe.

I tested the FRG-7 from Yaesu Electronics, which lists at $299 and is sold in some stores at $269; the SSR-1 from R.L. Drake Co., which lists at $350 and sells in one store at $245; the DX-160 available at 6000 Radio Shack stores in North America at $159; and the Heathkit HR-1680 from Heath Co. at $199.

The excellent Yaesu FRG-7 also is available from Sears, Roebuck and Co. (catalog number 61A3638C) as well as in super-fine SWL tune from Gilfer Associates.



Drake SSR-1

Where to search for exotic signals

Tune across these frequencies in the shortwave portion of the radio spectrum. International broadcasters, amateur radio operators, CBers, all sorts of unique transmissions can be heard.

International broadcasting to SWLs

120-meter band	2.300-2.500 MHz
90-meter band	3.200-3.400 MHz
75-meter band	3.900-4.000 MHz
60-meter band	4.750-5.060 MHz
49-meter band	5.950-6.200 MHz
41-meter band	7.100-7.300 MHz
31-meter band	9.500-9.725 MHz
25-meter band	11.700-11.975 MHz
19-meter band	15.100-15.450 MHz
16-meter band	17.700-17.900MHz
13-meter band	21.450-21.750 MHz
11-meter band	25.600-26.100 MHz

The *World Radio TV Handbook* by Jens Frost of Denmark, distributed by Billboard Books ($10.95), 1515 Broadway, New York, NY 10036, is a popular guide to the international broadcasting stations and their frequencies.

U.S. amateur radio ham bands

160-meter band	1.800-2.000 MHz
80-meter band	3.500-4.000 MHz
40-meter band	7.000-7.300 MHz
20-meter band	14.000-14.350 MHz
15-meter band	21.000-21.450 MHz
10-meter band	28.000-29.700 MHz

U.S. amateurs have additional frequencies in the VHF, UHF and microwave portions of the radio spectrum.

U.S. CB Citizens Band

Channels 1-40	26.965-27.405 MHz

Time signals

WWV, Colorado	2.500 MHz
WWVH, Hawaii	5.000 MHz
	10.000MHz
	15.000 MHz
CHU, Canada	3.330 MHz
	7.335 MHz
RAT, Moscow, USSR	5.000 MHz
BVP, Shanghai, China	9.368 MHz
JJY, Japan	10.000 MHz

Radio Shack Realistic DX-160

The Kenwood R-300 is being sold by one store at $239. The Dymek is $900.

Tuning capacitors

The Drake and Yaesu rigs use an ultramodern *synthesizer* circuit to determine what frequency the receivers are tuned to. Radio Shack uses conventional tuning capacitors but adds dial markings so you can tune very quickly to an international broacasting portion of the radio spectrum or to a ham band. That may make the DX-160 a bit easier for an SWL newcomer to find signals of interest.

Radio Shack, Yaesu and Kenwood have noise limiters to dampen static and car-ignition interference. And the Radio Shack has an automatic volume control (AVC) switch so you can select the steadiest signal.

Yaesu and Drake provide attenuator switches to cut

Kenwood R-300

down signal strength from overpowering local stations. These are useful when local am broadcasters overdrive your receiver or when your CB neighbor transmits on a channel next to one you happen to be monitoring.

Radio Shack and Kenwood use an RF gain control, rather than an attenuator, giving you a larger range of control.

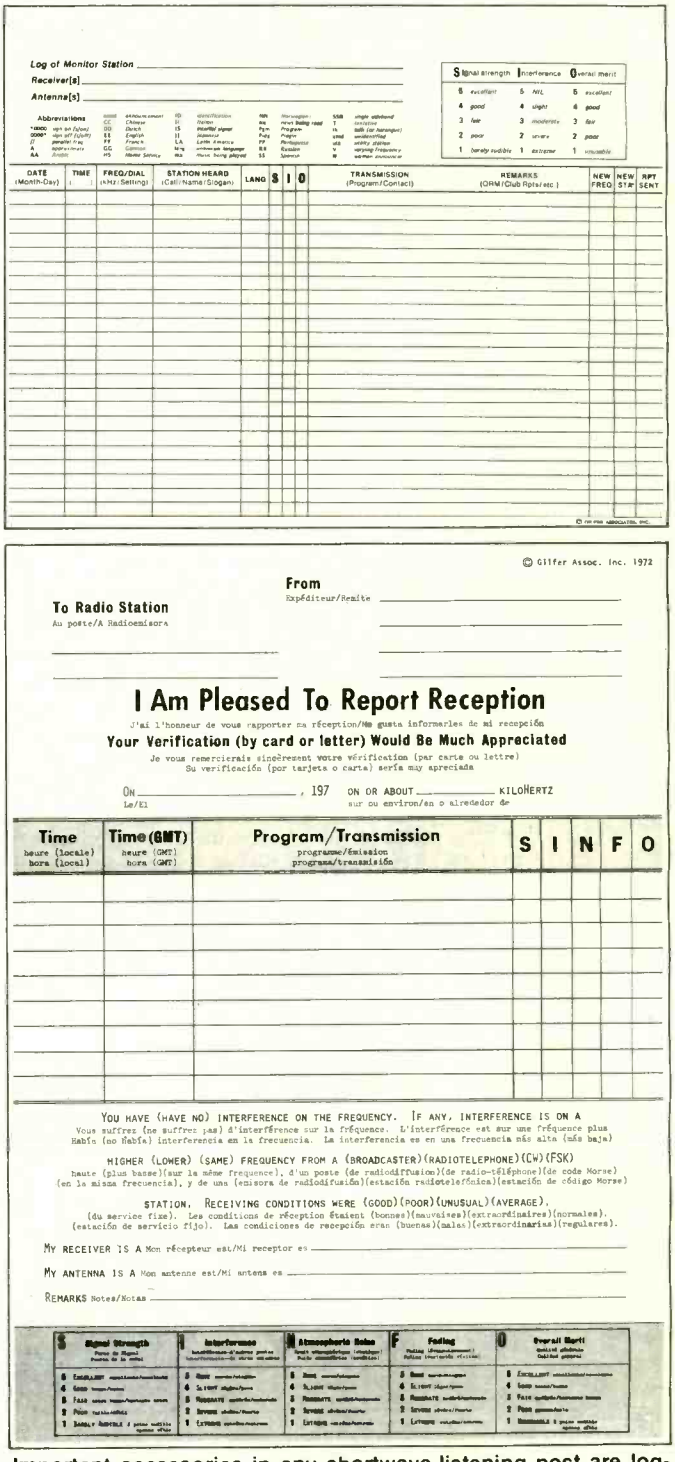
Channel 9

You can tune smoothly and continuously from 26.960 to 27.405 MHz (CB channels 1-40) with these receivers, even hearing signals between channels. You might operate your CB transceiver on your favorite local channel, for instance, while using a shortwave receiver to monitor emergency channel 9.

The Yaesu, Drake, Radio Shack and Kenwood all operate from either 110-volt ac house power or the 12-volt dc battery in your car or boat. Yaesu, Drake and Kenwood have space inside for packs of D batteries. Batteries left inside, if house electricity fails, automatically keep the sets functioning.

Ham-band only

What of the Heathkit HR-1680? It's a special receiver covering only the shortwave ham bands. The advantage is better sensitivity, selectivity and convenience on those particular frequencies.



Important accessories in any shortwave-listening post are logbook, top, and reception report form, bottom above. Log has spaces where you record date, time, frequency, station heard, signal report and other key data. You fill in the blanks on the reception report and send it to the station you heard. If you are in luck, the station will send you back a QSL card confirming your reception. Pads of both forms are available at $2.50 each from Gilfer Associates, Box 239, Park Ridge, NJ 07656.

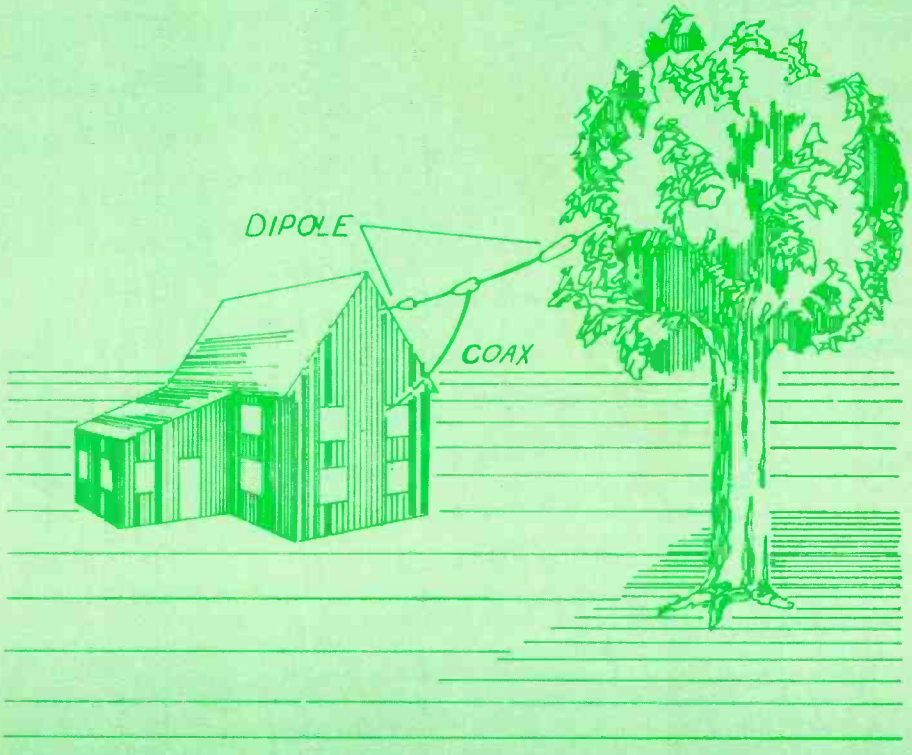
A disadvantage is no tuning outside of five 500 kHz-wide bands.

No tuning outside those bands doesn't prevent you from serious SWL DXing. I hooked the audio coming out of the HR-1680's earphone jack into a Hal Communications Corp. ST-6000 RTTY converter and received excellent copy of radioteletype from around the world on my old surplus Teletype model 19.

How do the new sets look? They have a blend of classic communications receiver design and modern high-style appearance. They would look great in your attic, basement, garage or bedroom listening post. But they'll also tuck away nicely in the family room. Boat anchors they're not!

How to build your own dipole antenna

Here's how to make a top-notch *dipole* antenna for any international broadcaster, ham, CB or other frequency:



ME art: Tom Batcher

Frequency

Determine the frequency you wish to hear. For example, if you would like to listen to the international broadcasting stations in the 31-meter band, note their frequencies range from 9.500-9.725 MHz in the radio spectrum. You'll want to tune across the entire 31-meter band so cut the antenna for the middle of the band: about 9.615 MHz.

Wavelength

Translate the frequency into wavelength. That is, change 9.615 MHz into an exact wavelength in meters. To do that, divide 300 by the frequency in MHz. Dividing 300 by 9.615 gives 31.2 meters, the exact wavelength for the specific frequency.

Half-wave dipoles

The dipole antenna is a *half-wave* antenna. Its overall length is five percent less than one-half of the wavelength of the specific frequency for which you are cutting the antenna. In this example, the wavelength for 9.615 MHz is 31.2 meters. Half of 31.2 meters is 15.6 meters. The total length of the dipole will be 15.6 meters less five percent end-to-end. That's 14.82 meters.

Non metric

If you're not into metric numbers yet, you'll want to convert 14.82 meters to inches and feet. One way is to recall that there are 39.37 inches in one meter. Multiplying 14.82 meters by 39.37 shows there are 583.46 inches in overall length to our dipole. With 12 inches in a foot, 583.46 inches equals 48.62 feet. That's 48 feet 7 inches approximately. So, the total length, end to end, of our dipole antenna will be 48 feet 7 inches.

Cutting antennas

A dipole antenna is a length of wire, any wire of any size strong enough to hold itself between a tree and your house, between two poles, or between two supports of one sort or another. The length of wire is cut exactly in the middle and a lead-in wire is attached at that center point. If our wire is 48 feet 7 inches long, where is the center point? Half of 48 feet 7 inches is 24 feet 4 inches. The dipole wire is cut exactly 24 feet 4 inches from either end.

Insulators

The ends of the dipole antenna and the two halves of the wire must be insulated so no electrical connection is made between them and any other object. An insulator of porcelain, plastic or rubber (Radio Shack catalog number 270-1518 is a package of two insulators for 59¢) is inserted between the two halves and at the ends. Wire can be used to support the antenna wire (Radio Shack catalog number 278-1329 or similar) but it must be insulated from the antenna.

Lead-in wire

Coaxial cable of either 50-ohm or 75-ohm (Radio Shack catalog number 278-1326 or 278-1327 or similar) can be used. They are sizes RG-58/U and RG-59/U. Larger, more expensive RG-8/U is more efficient but not necessary at shortwave frequencies. Coax has a center conductor surrounded by an outer braid of wire. Connect one side of the antenna to the braid and the other side to the coax center conductor. Make sure the connection is firm mechanically and sure electrically. Solder the joints.

At the receiver

Hang the dipole as high as possible off the ground. It will work inside an apartment under a rug or taped to the walls. But, outside will be better. Stringing the wire between two trees at a height above 50 feet would be ideal. Run the coax away from the dipole at a right angle and into your shortwave-listening shack. Attach the center conductor of the coax there to the antenna terminal on your receiver. Connect the coax braid to the ground post on your set.

Wide band

The dipole will work most efficiently when your receiver is tuned to 9.615 MHz. It will, however, work well across the entire 31-meter band. Technically, it will be less efficient when your receiver is tuned to 9.500 or 9.725 MHz, but you won't be able to tell the difference.

Other bands

Here are some wire lengths for other international broadcasting shortwave bands:

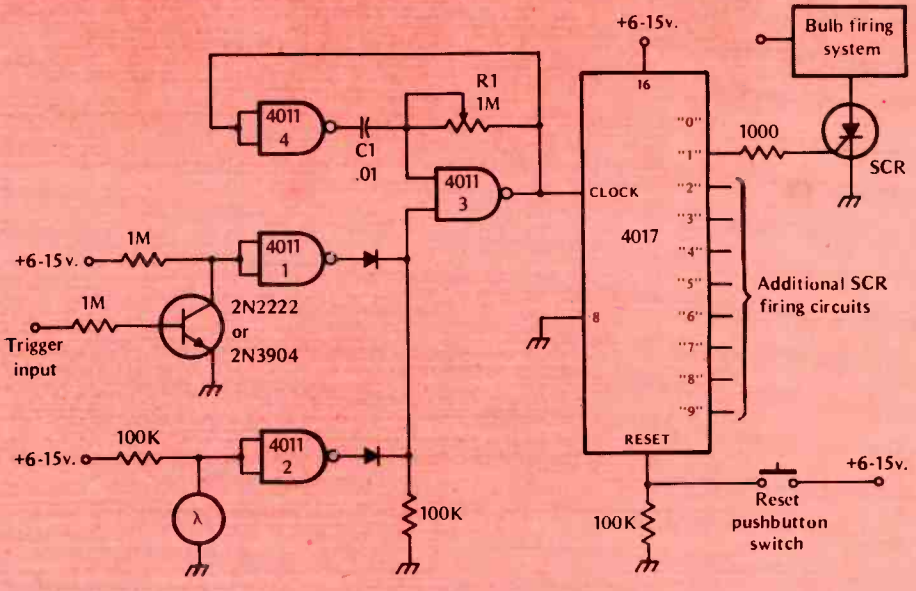
11-meter band	17'
13-meter band	21'9"
16-meter band	26'3"
19-meter band	30'6"
25-meter band	40'
31-meter band	48'7"
41-meter band	65'
49-meter band	77'
60-meter band	107'6"

7 winter weekend warmers

Looking for a fun way to warm a cold February weekend? One answer could be curling up with a hot soldering iron and a handful of parts from your local electronics store. Build one or all of our quick-seven projects this weekend and have a ball!

by Jeffrey A. Sandler

photo stop action



This handy circuit lets you create multiple "stop-action" photographic effects, like showing a bouncing ball in up to nine locations in a single photograph.

All you do is connect this circuit to your strobe or flash units, set the camera to *bulb*, and shoot. The circuit will automatically fire the bulbs sequentially with the time between each firing variable.

Though the circuit is functionally complete, you will have to provide the actual firing system. In many cases, a simple SCR will work, as shown in the diagram. In others, the SCRs can be used to provide a triggering pulse through a bulb trigger coil.

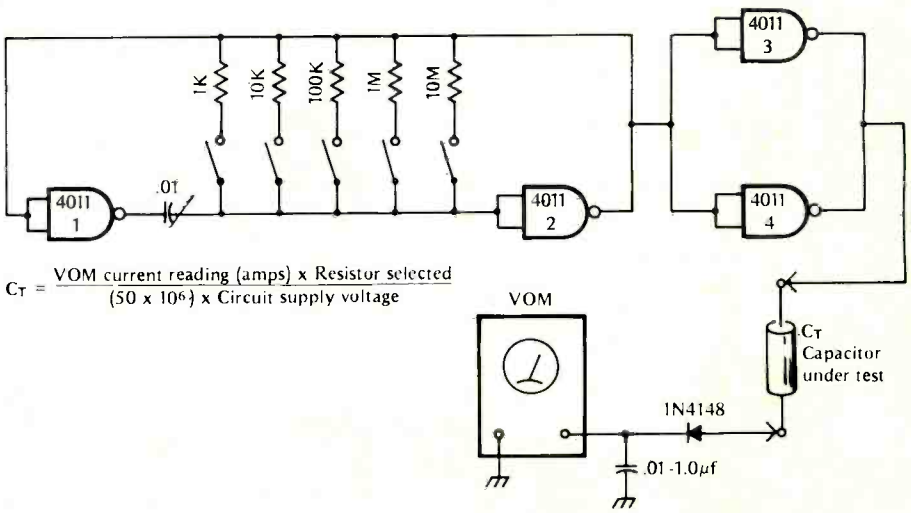
The firing can be initiated in one of two ways. A trigger pulse can be applied to the Trigger Input terminal through a capacitor, or you can operate the unit as a slave. Light from your camera-mounted flash will activate the circuit through its built-in photocell pickup. The time period between each successive flash is determined by C_1 and R_1, which is variable. After firing the circuit, it must be reset by momentarily depressing the reset button.

capacitance meter

If you have a VOM, this nifty circuit will let you measure the capacitance of any capacitor. Your VOM measures the current flowing through the capacitor under test, and using the equation given, you can convert that to capacitance.

Operation is based on the fact that the current flowing through a capacitor is directly proportional to the frequency of voltage applied. Knowing the voltage, current and frequency, you calculate the capacitance.

By selecting the proper resistance, you can obtain a frequency that produces a current flow compatible with your VOM scale. To avoid pinning the meter, always start with the highest resistance. This produces the lowest frequency, and the lowest current flow.

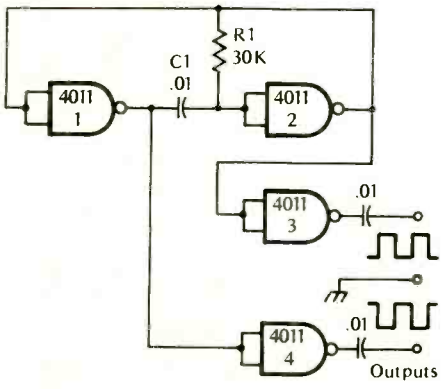


$$C_T = \frac{\text{VOM current reading (amps)} \times \text{Resistor selected}}{(50 \times 10^6) \times \text{Circuit supply voltage}}$$

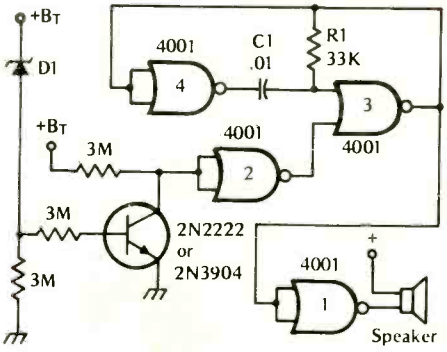
signal injector

If you ever get into the repair of radios, one thing you'll need is a good signal injector. This handy gadget lets you put an i-f or rf signal into the circuit at any point you choose. With an injector, you can work from the output end of the circuit back towards the input. When the output signal disappears, you've found the bad stage in the circuit.

The injector shown here uses a single 4011 CMOS chip powered by a 9-volt transistor battery to produce a square wave. The frequency is determined by the RC time constant of R_1C_1. Though the upper limit for this circuit is about 1 MHz, the harmonic content of the square wave should provide signals well into the rf range.



low-volts alarm



Here's an inexpensive dc supply voltage monitor that sounds a warning when the voltage falls below a preset value. It's ideal for keeping track of your rechargeable batteries since it draws only a few microamperes when not sounding.

The voltage at which the alarm sounds is determined by the zener diode, D_1. When the voltage falls below the zener voltage, the alarm sounds. The alarm tone is determined by the RC time constant of R_1C_1.

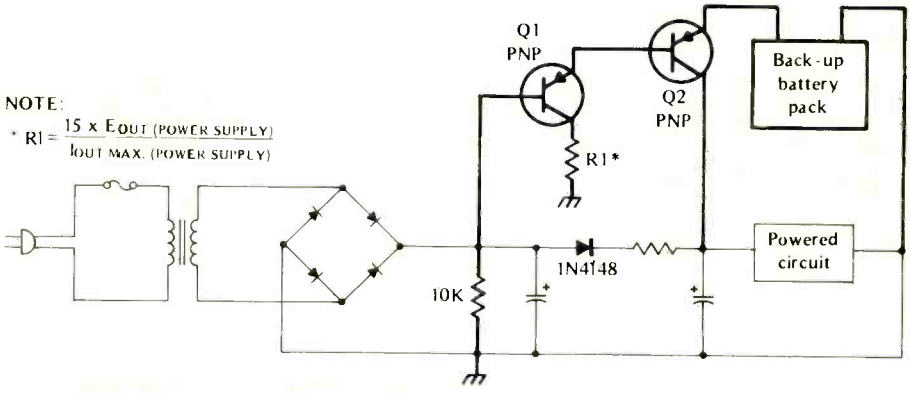
ME art: K&S Graphics

battery backup

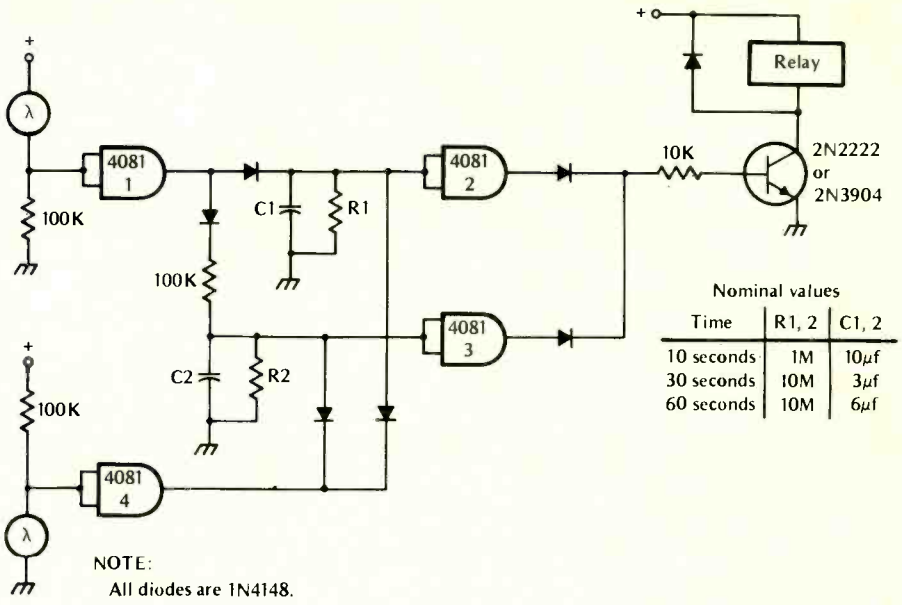
If you have a circuit powered by a small dc supply you'd like to protect against power failure, here's an automatic battery backup system that's just the thing.

While the power supply is working, the battery is isolated from the circuit. However, when power fails, the battery is instantaneously connected into the circuit. There's hardly a flicker in the voltage during the change-over.

The power supply circuit shown here in light line is meant only to represent the typical supply. Yours may be different. The back-up circuit is shown in heavy line. The back-up battery must provide the same voltage and current as your supply. Q_1 can be any small-signal PNP transistor, such as a 2N3906. Q_2 should be a PNP power transistor rated to handle at least the power used in the circuit being protected.



tv killer



If you'd like an easy and inexpensive way to kill tv sound during commercials, try this handy flashlight-actuated remote control.

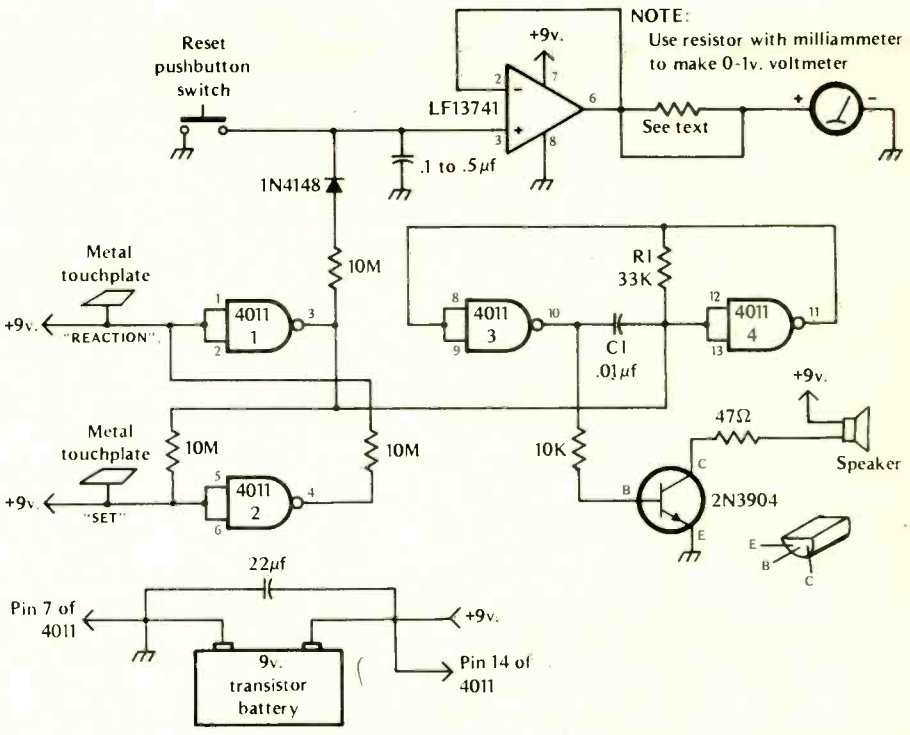
Shining your flashlight on the "cut sound" photocell for an instant kills the sound for a time period equal to the RC time constant of resistor R_1 and capacitor C_1. After expiration of this time period, the sound is automatically restored.

If you hold your flashlight beam on the cut-sound photocell for several seconds, the sound will be killed for a longer time period, determined by R_2 and C_2. You can restore the sound before the built-in time period has elapsed by shining your flashlight on the "cancel" photocell.

Because the background light varies from one home to another you'll have to tailor the photocell sensitivity to your specific environment. You can do this by covering part of the photocell with black tape so that the unit does not respond to room light, but does actuate when struck with your flashlight beam. Power for the unit can be supplied by a standard 9-volt battery.

The circuit functions by opening a relay contact in the speaker line. To connect the circuit, you'll have to open your tv set and connect one of the speaker leads through the relay. Remember there are lethal voltages inside your set. Be careful. A safer way would be to use an external speaker plugged into the earphone jack, with one lead connected through the relay contacts.

reaction timer



Think you're pretty fast, eh? Well here's a reaction timer that lets you prove the point—if you can.

When a friend touches a remote "set" touch plate, a tone is sounded and the meter needle starts a rapid increase in reading. As soon as you touch your touchplate, the tone and needle travel stop.

If you're competing with friends, the fastest contestant is the one with the lowest meter reading.

You can use your VOM or a spare panel meter for the indicator. If you use an ammeter, you'll need a series resistor to convert it to read voltage. If you use a voltmeter, omit the resistor. You can change the tone by changing R_1 and C_1. The touchplates can be any metallic object connected to the battery supply line as shown.

Videodisc: a colorful alternative

Whether laser beams or tiny capacitors, the pits and slots in videodiscs may bring low-cost color movies, sports, entertainment specials for your home library.

by Bob Margolin

If you're not ready to spend $1000 or so for a VTR, a $400 video player may be more appealing. With a player and rented or borrowed recordings, you can use your tv to view a wide variety of programs, even though you won't be able to record your own.

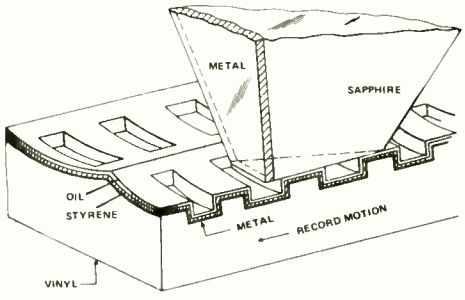
Two giants in the home entertainment industry — RCA and North American Philips Corporation — are just about ready to introduce another kind of video player. It's the videodisc, and it's very much like the phonograph you already have in your den. All you do is hook it to your tv set, put a disc on the turntable, move the pickup into position, and presto, you're watching your favorite feature.

Both RCA and Philips are heavily involved in the VTR market. But both believe that there is a viable disc market as well. The major advantage of the disc is price. RCA, for example, expects to provide a two-hour program for between $10 and $15.

At the moment, both RCA and Philips are moving ahead with different disc systems. While the VTR market is vital enough to support four different formats, the videodisc market is not. Eventually, one of the two systems will prevail, the other being relegated to the status of fond memory. Which system wins out depends on which reaches the market first, which is more reliable, and which can provide the best selection of pre-recorded discs.

Different discs

The RCA system is closest to the phonograph record you're used to handling. About the same size, its surface



contains the same kind of groove. The pickup uses a stylus very similar to that used in your stereo pickup.

One significant difference is the way in which the signal is impressed on the disc. In a stereo phonograph record, the walls of the groove undulate in step with the program material. In RCA's video-disc, the groove walls are smooth-sided with transverse slots etched into the surface. A thin layer of metal is deposited on the disc surface after slotting, which is in turn covered by an insulating material.

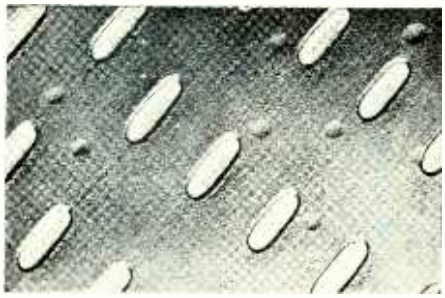
The stylus consists of polished sapphire to which a strip of metal is attached. As the stylus rides in the groove, a capacitor is formed with the metal in the disc and on the stylus acting as the plates.

The actual capacitance is unimportant. What matters is the change in capacitance as the stylus travels over the slotted surface. It is this change that is processed to produce the picture you see on your tv set.

Play it again, Sam

Although there is wear to both the disc and the stylus, RCA claims each videodisc should be able to provide over 200 plays, with the stylus good for over 200 hours of use. Present plans call for the player to cost about $400.

The Philips system uses radically different technology. Instead of grooves, tiny "pits" are etched into the surface of



the disc. Instead of a stylus, the pickup uses a laser beam to scan the disc.

The laser beam is reflected off the disc surface and onto a photosensitive pickup. As the videodisc rotates, the laser beam alternately reflects off the smooth surface and the pits. As a pit passes through the laser beam, the angle at which it is reflected changes, which causes the reflected light beam to alternately fall on and off the photosensitive pickup. It is this change of light intensity at the pickup that is processed to produce the tv picture you see.

Although the Philips/MCA discs only provide about half as much playing

The Philips videodisc player, to be sold under the Magnavox label, is similar in operation to a child's record player. Just open the lid, drop the disc on the turntable, and close the lid. The player does the rest automatically.

time, the "optical" system employed is said to offer other advantages over the RCA system. For one thing, the pickup is not locked into a spiraling groove. You can stop its across-the-surface travel and re-scan the same picture over again to "freeze" the action. By slowing the turntable speed, you can create "slow motion" effects. You can even reverse the action by reversing the direction the turntable rotates.

Two very large questions that have yet to be answered are how easy will it be for you to get the videodiscs themselves, and how large a selection of material will be available? Both RCA and MCA have excellent distribution networks for their phonograph records. MCA does seem to have a slight advantage in the programming department because it owns Universal, which distributes such movie smash hits as Jaws, American Graffiti, and Airport.

Please turn to pages 64-67 for a complete report on videotape recorders and an explanation of how they work, by Bob Margolin, Modern Electronics' assistant editor.

Mobile antennas: fact and fiction

Your CB radio isn't worth a plugged nickel without a good antenna to squirt the signal into the air. It can be a real head scratcher, sorting through confusing claims for antenna performance. Here's a complete easy-to-understand explanation of CB antennas for cars, trucks and RVs.

by Bill Orr, W6SAI

OK SPORT FANS, let's talk about mobile antennas for two-wheelers, RVs and eighteen-wheelers. (For the uninitiated, that means automobiles, campers/trailers and tractor-trailer rigs.)

Radio transmission and reception from moving vehicles is nothing new, radio hams were doing it in the early "twenties" and Detroit, Michigan had radio equipped Bears (patrol cars) in the early "thirties". But it is only in the past few years that mobile CB radio has really caught the attention of the American public. Some observers of society say that the big growth and interest in CB radio came about as a result of the trucker's strike in the fall of 1975. Who knows?

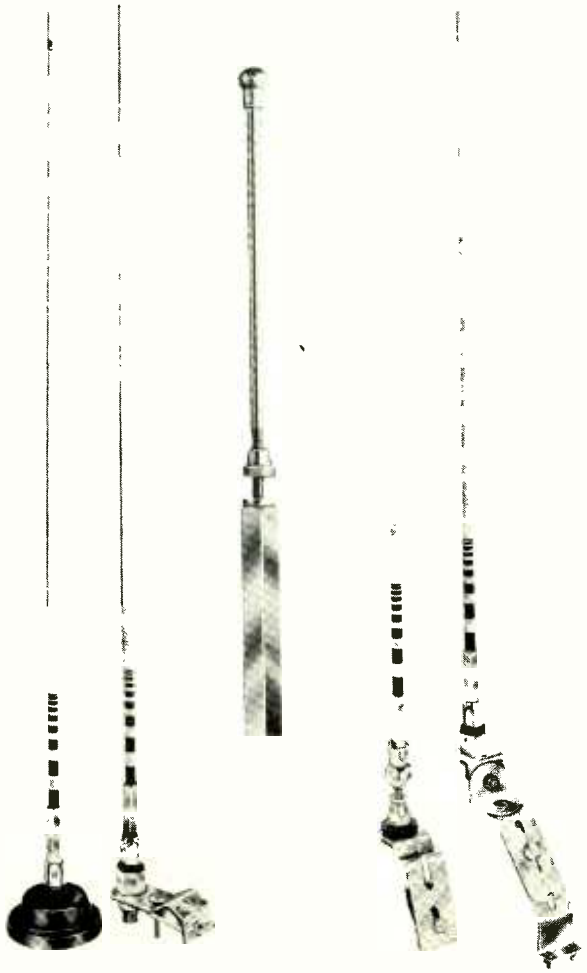


Fig. 1—Whips, whips, whips! They come in a variety of sizes with a variety of mounts. Which is best for you depends on what you want your antenna to do.

But the end result is that today there is more interest than ever in CB radio and a big proportion of the interest is in mobile operation.

In magazines and on TV "commercials" you'll see the advantages of mobile CB radio extolled—just the thing for highway emergencies, or to inform the little woman that you'll be late for dinner, or for the better half to tell you to stop and pick up some extra canned beans for dinner! This is great stuff, and very thrilling, if it works.

However, many CB service centers report that a vast number of CBers experience trouble with their mobile rig, and that the trouble usually centers around the antenna installation! It would seem, then, that the mobile antenna is the weak link in the communication chain which can drastically impair your enjoyment of CB two-way communication. God knows there are enough mobile antennas on the market! A quick glance through S-9 will convince you that whatever type of mobile antenna you desire, it is available, and in quantity. What, then, is the big hang-up? Why do so many CBers experience difficulties getting the CB rig from the shipping carton, and into action in their vehicle?

Well, before we examine the action, a word of advice from this Old Timer—advice that applies to CB equipment of all types, antennas included: too many CBers think the instruction manual, or sheet, is something to be thrown away with the shipping carton. As a last resort, before you panic, *read the instructions!* The manual, or instruction sheet, is included with the equipment for a very good reason. *Read it and save it!* Now, having gotten that bit of folk wisdom off my chest, let's get the show on the road.

What is the mobile antenna—and why?

The usual CB mobile antenna is a vertical metal whip of some sort mounted on the body of the vehicle. The whip is made stainless steel, or other conducting material, and is insulated from the body of the vehicle by a support structure made of nonconducting mate-

rial. Thus, there's no electrical connection between the antenna, as such, and the body of the vehicle.

By tradition, and because of ease of mounting, the mobile antenna is placed in a vertical position and for best results the antenna length bears a definite relationship to the length of the CB radio wave. The "work horse" antenna for CB mobile service is the *vertical whip,* shown in various versions by figure 1. The most popular whip is flexible, quarter-wavelength long tapered stainless steel rod having a threaded base fitting. (Better antennas use stainless steel for the whip assembly to reduce corrosion and rust). The top end of the whip should have a steel or plastic ball on it to prevent you from putting your eye out when installing it on your car. In addition, the ball insulates the tip and prevents the build-up of static electricity on the antenna, as often happens in a fast-moving vehicle in dry weather. Static electricity can cause a crackling, frying noise in the receiver that makes reception extremely difficult and has even been known to burn out the sensitive transistors in the input circuits of a receiver!

Whip antennas come in all sizes, price ranges and performance values, so let's discuss some of the more popular models.

The 102 whip

The so-called "102 whip" is 102 to 106 inches long, or nearly one-quarter electrical wavelength (Figure 2). Actually, a quarter-wavelength is closer to 106 inches, but part of the antenna length may be included in the mounting fixture and, as a result, manufactured whips take this into account and usually run only about 102 inches from top to bottom. Many 102 whips have a base section having a special ⅜" x 24 threaded post to fit most mounting devices.

Some whips are demountable, that is, the whip is held in position in the threaded post by a threaded coupling or by an *allen* set-screw (Figure 3). The user can quickly loosen the whip with an *allen* wrench and remove it for storage in the car, so that it won't be ripped off!

Generally speaking, whip length is not critical within two or three inches, and most whips are "fine tuned" by cutting one end, a half-inch at a time, until the antenna is tuned to the channel desired.

Fig. 2—The quarter-wavelength whip antenna. This so-called "102 whip" is made by a variety of manufacturers. The whip may be stainless steel, or steel coated with fiberglass. A small ball is placed at the tip of the whip to prevent you from putting your eye out when installing it on your car. The tip ball also helps to reduce build-up of static electricity on the whip. The base of the whip is threaded to fit into a spring mount and swivel ball. The split ball permits mounting the whip on a surface which is at an odd-angle to the ground.

Fig. 3—This base loaded whip is quickly removable from the mount. A threaded fitting permits the whip to be taken off with a few turns. Some whips can be locked into position with an *allen* set screw to prevent them from being stolen. It is a good idea to remove the whip when the vehicle is parked in a public place so that it won't attract attention to the radio equipment in the car!

Everything else being equal, the 102 whip is just about the best mobile antenna from the point of view of overall efficiency. All of the antenna is radiating as part of it is not wound up into a coil which does no radiating. However, the 102 whip is not without its problems. First of all, it is an unwieldy device, capable of striking your garage entrance, and long enough to bang into overhead tree limbs when you drive down the street. In addition, under high speeds the 102 whip tends to bend backwards in the wind, and flop about, which often adds a very objectionable "flutter" to the signal.

Some CBers try to remedy these faults. The whip is mounted very low on the vehicle (usually on the rear bumper) so that it will not strike overhead objects, and the whip is braced to the car body with nylon cord to keep it from moving about when the vehicle is in motion.

These are not bad ideas, but when the whip is mounted low on the vehicle, the body of the vehicle tends to "shield" the antenna in certain directions and

please turn to page 82

Get a piece of the

For a new hobby or a better job, it's easier than ever to study electronics at home.

by Gerald R. Patton
Contributing Editor

You're interested in electronics and want to learn more about this fascinating realm. The electronic equipment market is expected to total $48 *billion* this year and you feel this just may be the industry for your future. Or, you want to enjoy electronics as a thrilling hobby, such as amateur radio or experimenting with your very own microcomputer.

Whatever your goal, if you are out of school with job and family responsibilities, you probably find it impossible to fit your lifestyle into a classroom, even if a continuing education or vocational training course is available in your area. You also may find it difficult to just select a book or two on a subject as technical as electronics and get a really good

ME art: Chuck McVicker

Learn to repair radios, TV sets or stereos. Improve your communications skills. Gear yourself up for an exciting new hobby or train for a better job. Home study provides learning at your own pace in familiar surroundings.

$48-billion action

grasp on it without expert guidance on materials to choose. It can be an extremely frustrating experience, to say the least.

Fortunately, another option is available in home study, popularly known as *correspondence courses*. There are several types of courses from which to choose.

Hobby courses

A new and exciting entry into the short course arena is Heath Co., the electronics kit manufacturer at Benton Harbor, Michigan. Heath is offering several "kit courses" for under $100, including training hardware, on such subjects as DC and AC electronics, semiconductors, circuits, and digital techniques. A ham novice license course is available for $25, and new courses will deal with microcomputers.

If you're interested in more serious career training, including preparation for passing the all-important FCC commercial license examinations, then more formal, in-depth programs offered by companies such as the National Radio Institute (NRI) of Washington, D.C., and Cleveland Institute of Electronics (CIE) in Ohio probably are for you. These courses consist of forty or more lessons, usually in small individual manuals plus reference manuals. Kit hardware, such as test equipment or a color television to provide "hands-on" training, is provided with many such programs.

A series of open-book exams are self-administered throughout the course. These tests are then mailed in to the school, where they are reviewed and graded for you. The instructor at the school will comment on your answers and provide additional explanations and assistance either upon request or as he feels necessary. Depending upon the course, a final exam, either self-administered or proctored, signals your understanding of the lessons and qualifies you for a diploma from the school.

Did you study today?

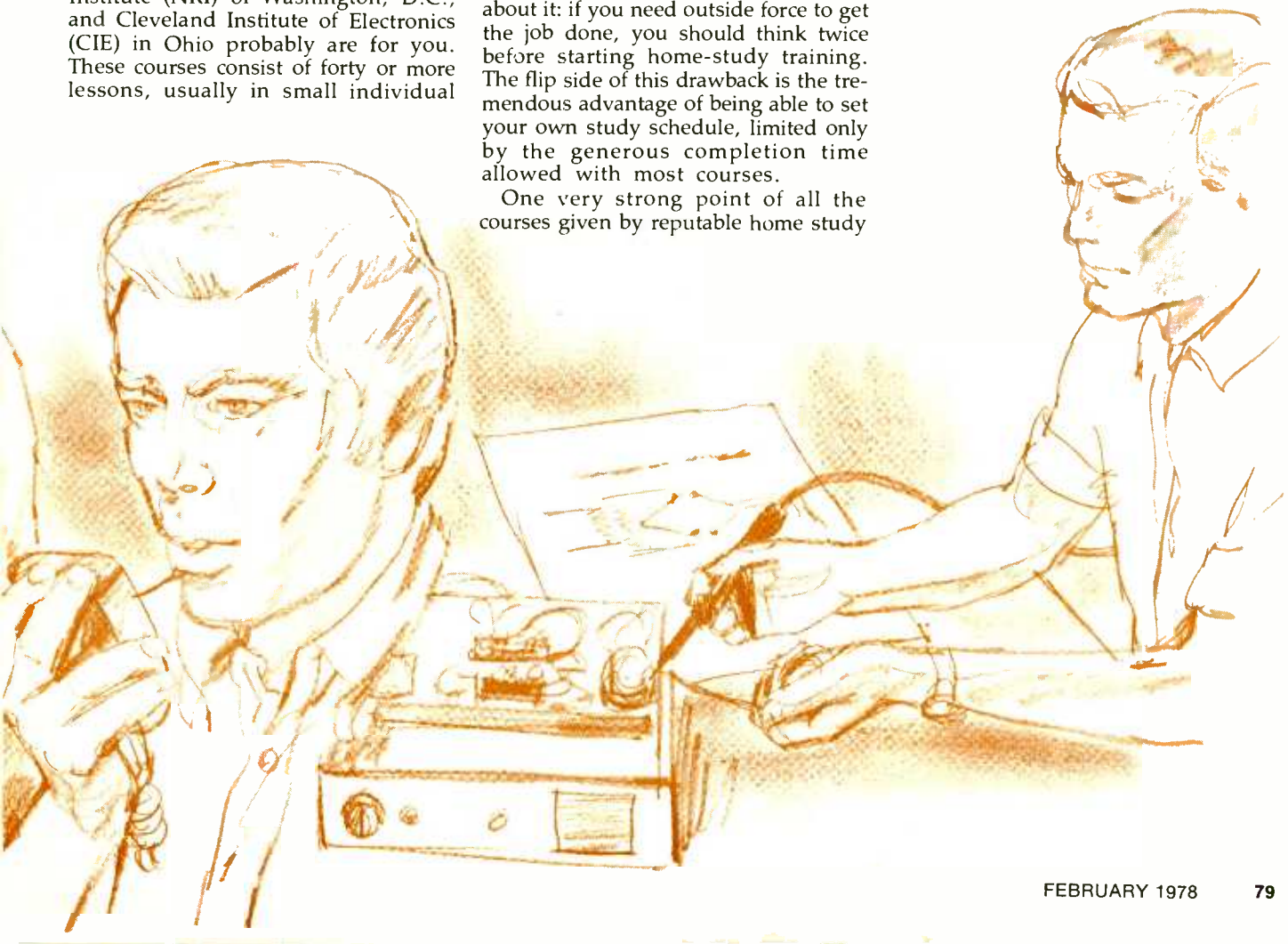
One disadvantage of home study over a structured classroom environment is the amount of drive and self-discipline necessary to complete the program. There is no steely-eyed instructor to require excuses if you get too tired or for some other reason fail to complete a lesson the night before. There's no doubt about it: if you need outside force to get the job done, you should think twice before starting home-study training. The flip side of this drawback is the tremendous advantage of being able to set your own study schedule, limited only by the generous completion time allowed with most courses.

One very strong point of all the courses given by reputable home study schools is the overall quality of the text material they provide. This is the heart of a correspondence course. Their texts have to be easy to read and understand in order for you to be successful with their courses. Without this, they have nothing to attract you as a student, and the big schools in the industry have been around for many, many years.

College, too

One step beyond even these complete technical programs is a series of four "semesters" of courses offered by the Center for Degree Studies of International Correspondence Schools in Scranton, Pennsylvania, which can lead to an Associate in Specialized Technology (AST) degree in electrical engineering technology or electronics technology.

This institution has accreditation by the Commission on Higher Education of the Middle States Association of Colleges and Schools, making it the first



$48-billion action

proprietary, non-traditional postsecondary institution to achieve this status.

A two-week residence requirement at Lafayette College in Easton, Pennsylvania, is an integral part of this program. ICS also offers the traditional type of correspondence course leading to a diploma.

License guarantees

If one of your primary reasons for enrolling in a correspondence school is to obtain an FCC commercial license, which is a government requirement for engineers and technicians who service and maintain all broadcast transmitters and, indeed, nearly *all* transmitters except those licensed in the amateur radio service, then be sure to find out whether the school in which you're interested offers an "FCC license or money-back" guarantee.

Many established institutions have this provision, which means that, within a certain period of time following your successful completion of their course, if you are unable to pass the FCC exam of the appropriate class, all or a large part of your tuition will be refunded to you. The period of time covered by this type of warranty usually varies from three to six months.

What's it cost?

Here's a rundown on prices of 15 courses offered by National Radio Institute, Washington, D.C.:

CB radio specialist	$595
TV/Audio servicing I	$475
TV/Audio servicing II	$585
Color TV servicing	$880
Master color TV service	$1195
Advance color TV service	$665
Digital computer electronics	$980
Electronics technology master	$660
Communications electronics	$875
FCC license	$320
Marine electronics with FCC	$335
Aircraft electronics with FCC	$335
Mobile communications with FCC	$335
Applied math in electronics	$90
Basic Electronics	$195

Tips and extras

Here are a few things to check out:

■ Schools offering formal correspondence courses should be approved by the Accrediting Commission of the National Home Study Council in Washington, D.C. This assures you, for example, of fair cancellation and refund policies if you are unable to complete your course.

Typically, a registration fee of $50 or 10 percent of the tuition, whichever is less, is charged in addition to an amount corresponding to the percentage of completion of the program. For example, if you have completed less than 25 percent of the lessons, you would owe the registration fee plus 25 percent of the tuition. If you terminate your enrollment after having completed 25 percent of the lessons, but less than 50 percent, the charge would be the registration fee plus half the tuition. After 50 percent of the lessons have been completed, full tuition is required.

■ If you're a member of the armed forces or are a veteran, you'll want to be sure that the school is a participant under the G.I. bill for educational benefits. In this way, provided you're eligible, you can receive up to 90 percent of your tuition back from the Veterans Administration as you complete the course.

■ Some institutions offer optional lessons in some courses to meet specific interests.

■ Another feature sometimes available is a toll-free telephone number which you can call with specific questions and problems.

■ Many schools will prepare professional style resumes for you and will also write letters of recommendation to help you find employment in the industry. However, no reputable school can or will promise you employment following your graduation from their program.

Course sources

Here's a list of major schools and other sources of home study materials in electronics:

CLEVELAND INSTITUTE OF ELECTRONICS, INC. (CIE)
1776 East 17th Street
Cleveland, OH 44114

CAPITOL RADIO ENGINEERING INSTITUTE (CREI)
3939 Wisconsin Avenue
Washington, DC 20016

GRANTHAM COLLEGE OF ENGINEERING
2000 Stoner Avenue
Los Angeles, CA 90025

HEATH COMPANY
Benton Harbor
Michigan 49022

NATIONAL RADIO INSTITUTE (NRI)
3939 Wisconsin Avenue
Washington, DC 20016

NATIONAL TECHNICAL SCHOOLS
4000 South Figueroa Street
Los Angeles, CA 90037

INTERNATIONAL CORRESPONDENCE SCHOOLS (ICS)
Scranton
Pennsylvania 18515

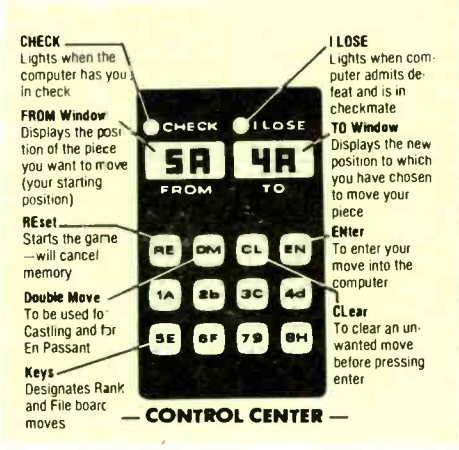
Play chess against the computer

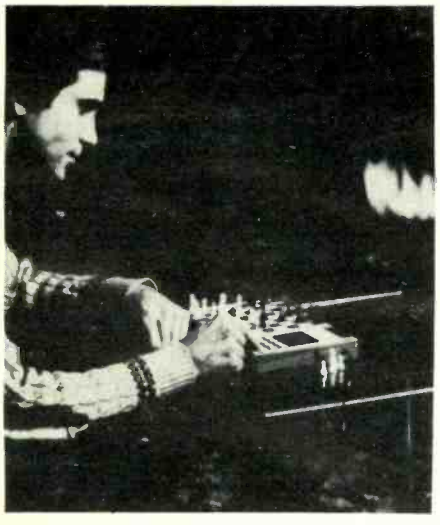
Playing the chess computer is easy. Beating it is not.

A computer able to play chess used to fill an entire laboratory. Not any more! Now the computer is built into the very board itself, making it only imperceptibly thicker than a non-electronic game.

Chess Challenger is an ordinary-board-sized $199 game with a real computer inside. It's programmed at a level to teach beginners but challenge experts. It's said that average players beat the board 25-70 percent of the time.

Input to this computer is through a keyboard. Output is in red light-emitting diodes (LEDs) above the keys. The board is marked with special lettering for your use in keying in your moves. And those moves can include castling and en passant!





Chess Challenger is not a kit. It is ready to go, powered from 110-volt ac house power. Pieces are wooden.

The computer is available from Heath Co., Benton Harbor, MI 49022; Chafitz, 1055 First St., Rockville, MD 20850; and other stores.

Great for learning and practicing, Chess Challenger can tune and sharpen the game of an expert. And a backgammon version is on the way!

Your own chess partner is Chess Challenger, a computerized playing board by Fidelity Electronics.

continued from page 77

radiation from the antenna is not the same in all directions from the vehicle.

Short, loaded miniature whip antennas are becoming increasingly popular among mobile CBers. These whips are from 18 inches to 80 inches long, with the missing portion of the whip that is required for a full quarter wavelength system being wound up in a *loading coil* placed in series with the whip. The coil may be either at the base of the whip (Figure 4), or in the middle of it. Since a portion of the normal, full-size antenna is missing (wound up in the coil to conserve height), the efficiency of the whip suffers to a degree.

Fig. 4—The base loaded whip. This compact whip antenna is about 42 inches high and is designed for roof or rear deck mount. The missing portion of the whip is wound up into a loading coil, which may be seen at the base of the whip, just below the flexible spring. Whips of this general type may be obtained having an overall length of 18 to 80 inches. The longer whips have greater efficiency than the shorter ones. Some models of the mini-whip can be adjusted to frequency by trimming the whip length an inch at a time.

Fig. 5—The center loaded whip. The efficiency of a short whip can often be improved by moving the loading coil from the base to the center of the antenna. This 28 inch high mini-whip is designed to mount on the rain gutter. A special clamp permits quick and easy attachment to the rain gutter of a vehicle. Make sure that thes base clamp penetrates the paint of the vehicle to make a good metal-to-metal contact for grounding purposes.

Very short mini-whips (18" to 36") that have the loading coil at the base seem to average about ten to twenty percent as efficient as a full size whip, with the greater portion of the transmitter power wasted in the form of heat in the coil. Longer mini-whips, of course, have higher efficiency.

The mini-whip antenna

Many CBers are willing to accept the trade-off of antenna efficiency for convenience, and whip lengths of 48" to 80" are becoming very popular. Because the mini-whip is shorter, it can be mounted higher on the vehicle, atop the roof and atop the rear turnk area being two convenient mounting places. Some antenna manufacturers state that the loss in efficiency brought about by the use of a mini-whip antenna is more than compensated for by the ability to mount the whip antenna at a higher point on the car—and they may very well be right. Since not everyone drives the same kind of car, RV or truck, it is difficult to make specific comments, and observers such as myself are reduced to generalities which are based upon common sense. Here are a few such generalities:

1—Longer antennas are more efficient than shorter ones. Use the longest whip antenna (up to a quarter-wavelength) that you can.

2—Mount the whip as high on the vehicle as you can.

3—Don't let the body of the vehicle cast a "shadow" on the whip. (One of the worst installations is to mount a whip on the rear bumper of a station wagon, as the body of the wagon is very close to the whip and creates a radio "shadow" around the whip).

Mini-whips make use of an inductor called a *loading coil* to establish the *electrical* length near resonance, or about 102 inches. As I said before, the portion of the antenna wound up in the coil doesn't do anything as far as radiating the signal goes. Theoretically, it is possible to place the loading coil at any point in the antenna. Placing the coil at the base of the mini-whip makes a physically strong assembly that has very little wind resistance. Antenna efficiency, however, can be raised an appreciable amount by placing the loading coil near the center of the whip (Figure 5), rather than at the base. Raising the coil beyond the center of the antenna does not "buy" much, and tends to make the antenna top heavy and makes adjustment more critical.

Once again, the user is confronted with a trade-off in values. Which is more important, antenna efficiency or wind resistance? Is it more aesthetic to use an antenna with a base loading coil, or to use one with a (relatively) unattractive loading coil in the center of the antenna?

Some manufacturers place the loading coil near the mid-point of the mini-whip in order to boost antenna efficiency, and then cut down the length and diameter of the coil to decrease wind resistance. The improvement in efficiency in such circumstances is doubtful.

The problem confronting the manufacturer, seller and end user of any mobile antenna is that it is extremely difficult to determine the overall efficiency of the antenna, especially when it is to be mounted on a vehicle of the user's choice. Measurements of antenna efficiency and performance are costly and difficult to perform. Some of the larger manufacturers have an "antenna range" where measurements may be made under controlled conditions. On a typical range, the antenna under test is placed in the middle of a large sheet of metal and readings of the signal strength from the antenna are taken at various points around the compass, several hundred feet away from the antenna. In some instances, the antenna may be actually mounted on a vehicle, or truck.

Sad to say, performance of a given antenna varies greatly from vehicle to vehicle and from truck to truck.

please turn to page 86

program

TRY THIS ON YOUR HOME COMPUTER

BY THOMAS ROHR

This month's Basic program saves time and effort in transistor amplifier calculations

Here's the first in a series of computer programs which will be simple to understand, easy to run on popular home computers and, usually, in beginner's Basic language. Our *Program of the Month* will show what a program looks like, how its steps are logical and, with study, how to write other programs for your personal computer. Our first package helps you calculate voltages, current, input resistances and the gain of transistor circuits.

The transistor amplifier circuit of figure 1 is perhaps the most common circuit configuration. It is an NPN transistor used in the common-emitter circuit to provide gain in audio and other low-frequency applications. Depending on the values of the resistors and capacitors used, it can provide gain in the range of five or less up to a hundred or more. It can operate at supply voltages from a few volts up to a hundred volts (with suitable transistors), at currents ranging from a fraction of a milliampere up to several tens of ma.

Our computer program, written in the Basic programming language used in home as well as professional computers, calculates the voltages and currents in the circuit, as well as the input resistance and the gain of the circuit. The voltages and currents are useful in troubleshooting, since they are easily measured with almost any inexpensive multimeter.

If you have a circuit to check, you can use this program to calculate the voltages and currents that it should have, and then compare these with the values actually measured. The gain, which describes how much larger the ac output voltage is than the input, can also be measured with fairly inexpensive equipment. The input resistance, while not especially useful for troubleshooting, is useful in deciding what can be connected to the amplifier's input.

Even if you do not have access to a computer, the program can still be interesting. By studying it, you can see that the Basic programming language is

BASIC PROGRAM FOR TRANSISTOR AMPLIFIER CALCULATIONS

```
1 PRINT "ENTER VALUES OF VCC, R1, R2, R3, R4, R5 (IN OHMS)"
2 INPUT S, R1, R2, R3, R4, R5
3 PRINT "ENTER YOUR VALUE OF BETA"
4 INPUT B
5 V = S * R2 / (R1+R2)
6 R = (R1*R2) / (R1+R2)
7 I1 = (V-0.7) / (R + B*(R4+R5))
8 V1 = V - I1*R
9 I2 = I1*B
10 V2 = S - I2*R3
11 V3 = I2 * (R4+R5)
12 D = 0.025/I2 + 2
13 G = R3 / (R4+D)
14 T = B * (R4+D)
15 N = (R*T) / (R+T)
16 PRINT "BASE CURRENT IS "; I1*1000; " MILLIAMPERES"
17 PRINT "COLLECTOR CURRENT IS "; I2*1000; " MILLIAMPERES"
18 PRINT "EMITTER CURRENT IS "; I2*1000; " MILLIAMPERES"
19 PRINT "BASE VOLTAGE IS "; V1; " VOLTS"
20 PRINT "COLLECTOR VOLTAGE IS "; V2; " VOLTS"
21 PRINT "EMITTER VOLTAGE IS "; V3; " VOLTS"
22 PRINT "INPUT RESISTANCE IS "; N; "OHMS"
23 PRINT "THE GAIN OF THE AMPLIFIER IS "; G
24 PRINT
25 GO TO 3
26 END
```

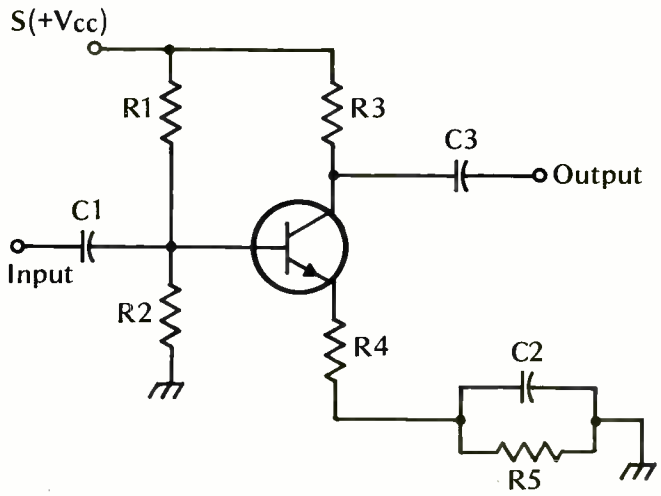


Figure 1: schematic diagram of amplifier

quite easy and straightforward to use and understand.

As most programs, this one has a short section at the beginning which asks for the user to enter the values of the supply voltage, the five resistors, and the beta of the transistor (also called h_{fe} in the transistor spec sheets.) The center section of the program calculates the results, while the last section of the program prints them out in an orderly format.

As it turns out, the circuit's operation does not depend very much on the beta of the transistor at all. This is one of the reasons why it is so popular. To illustrate this point, the program has an instruction at the end which says *GO TO 3*. This returns the computer back to line 3, and allows the same set of calculations to be repeated, but with a different value of beta. A sample set of calculations is shown beneath the program listing.

If you want to use the formulas without having a computer, the following calculations are done. Start with these given values:

S = value of dc supply voltage (also called V_{cc})
R_1 = top base bias resistor (see figure 1)
R_2 = bottom base bias resistor
R_3 = collector resistor
R_4 = emitter resistor which is unbypassed by capacitor
R_5 = emitter resistor which is bypassed
B = transistor beta.

If the Beta is not known, a good trial value is 100 for small transistors. If no emitter resistor is present at all, use 0 ohms for R_4 and R_5. If the entire emitter resistance is bypassed by a capacitor use 0 ohms for R_4. If no emitter bypass capacitor is used, then use 0 ohms for R_5.

Each line of the Basic program has a line number, which identifies the line to the computer. Lines 5, 6, and 7 are performed, in that order, to find I_1, the base current. Arithmetic formulas in Basic are written in the same way as they might be written in algebra, except that they must be written all on one line. Thus line 5 could also be written as

$$V = \frac{S\,R_2}{R_1 + R_2},$$

but the one-line form used in the program is equally easy to understand. The only strange symbol is *, which means 'times'.

To solve the problem without a computer, the equations are done in order as listed in the program. After the base current is found in line 7, base voltage V_1 is found in line 8, followed by collector current in line 9.

The collector and emitter voltages are found next in lines 10 and 11. Following this, lines 12 and 13 are done to find the gain G, followed by lines 14 and 15 to find the input resistance N.

The calculated values then are printed by the computer using lines 16 through 23. In each case, a *PRINT* instruction tells the computer to start a new line, print the words enclosed in parentheses exactly as shown, followed by the value of the calculated result. Since the currents were found in amperes, each current value is multiplied by 1000 in the *PRINT* instruction to convert it to milliamperes.

After the last printout in line 23, line 24 says *PRINT* one more time, but without specifying anything to be printed. This is used to skip a line in the printout. Then the program says *GO TO 3*, which instructs the computer to return to line 3 and start again from there. This allows you to keep the same resistor and voltage values specified at the beginning, but enter a different value of beta. The computer will repeat the program as long as you wish, allowing you to try different values of beta each time.

The printout of the results shows the values calculated by the program for the typical circuit of Figure 2. As you can see, doubling the value of beta, from 50 to 100, has very little effect on the results. Only the input resistance changes markedly.

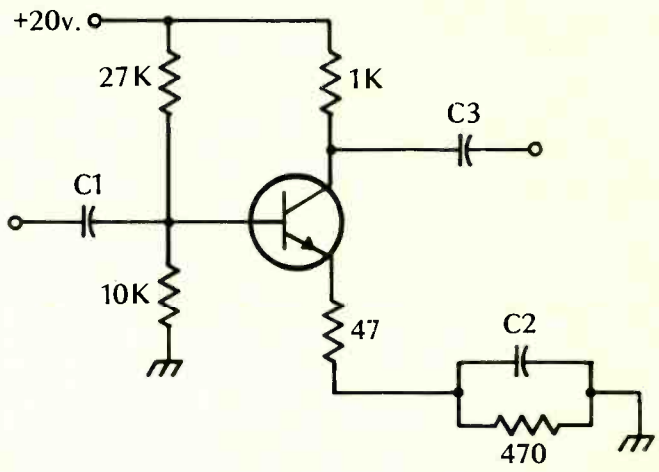


Figure 2: sample circuit

SAMPLE RESULTS FOR CIRCUIT OF FIGURE 2

```
ENTER VALUES OF VCC, R1, R2, R3, R4, R5 (IN OHMS)
?20, 27000, 10000, 1000, 47, 470
ENTER YOUR VALUE OF BETA
?50
BASE CURRENT IS  .141954     MILLIAMPERES
COLLECTOR CURRENT IS  7.09772     MILLIAMPERES
EMITTER CURRENT IS  7.09772     MILLIAMPERES
BASE VOLTAGE IS  4.36952     VOLTS
COLLECTOR VOLTAGE IS  12.9023     VOLTS
EMITTER VOLTAGE IS  3.66952     VOLTS
INPUT RESISTANCE IS  1931.14     OHMS
THE GAIN OF THE AMPLIFIER IS  19.0396

ENTER YOUR VALUE OF BETA
?100
BASE CURRENT IS  7.97563E-02     MILLIAMPERES
COLLECTOR CURRENT IS  7.97563     MILLIAMPERES
EMITTER CURRENT IS  7.97563     MILLIAMPERES
BASE VOLTAGE IS  4.8234    VOLTS
COLLECTOR VOLTAGE IS  12.0244     VOLTS
EMITTER VOLTAGE IS  4.1234    VOLTS
INPUT RESISTANCE IS  3040.91     OHMS
THE GAIN OF THE AMPLIFIER IS  19.1811
```

Repeaters

continued from page 53

microprocessor control circuitry for their repeater. It almost thinks for itself.

Amateurs in Vermont use a Burlington machine with so many bells and whistles hooked up that it even tells when the tones you send to it are wrong.

In Southern California, Nevada and Arizona, hams can instantly link up several local repeaters to cover thousands of square miles of countryside when needed.

These examples are reproduced everyday across America. There's hardly a square mile of turf where you are out of reach of one repeater or another. And there are a great many more repeaters in Canada, Europe and other parts of the world.

In the air everywhere

You don't have to be a licensed amateur to listen to the fun if you have a receiver to tune in. Chances are you do have one: a public-service-band police scanner.

The two-meter ham band, with the largest number of repeaters of the six bands where they are legal, is adjacent to the VHF-High Police band in the spectrum. High-band scanners often cover 144-174 MHz. Hams are at 144-148 MHz. Thousands of two-meter repeaters are on the air.

The second most popular band is 442-450 MHz, adjacent to the 450-512 MHz UHF public service band.

Other ham repeater bands are 10 meters (29.5-29.7 MHz); 6 meters (52-54 MHz); 1¼ meters (222-225 MHz); and 1215 MHz. Hams operate tv repeaters, capable of retransmitting video as well as audio, in the 442-450 MHz UHF band.

800 channels in one radio

Small ham radios, like small CB sets, make the hobby fun. As transceiver technology advances, radios get more features and better specs while growing smaller.

Yaesu, Kenwood, Wilson, ICOM, Midland and other manufacturers have been able to cram *800 channels* into under-dash mobile transceivers about the same size as modern 40-channel CB radios.

Most of the current crop of amateur radio fun gear operates in the two-meter 144-148 MHz ham band. Some radios, which look and feel the same, operate in the 220-225 and 420-450 MHz bands. The radios are used for friendly chatting and public-service work through some 3000 repeaters on the air in North America (see: *Repeaters are the best thing that's happened in ham radio since sideband*, page 52).

Wilson Electronics' 1405 handheld has a five-watt transmitter and a receiver as sensitive as many larger mobile radios. Such a low-powered handheld can be used for contacts from 20-100 miles through repeaters.

With so many repeaters on the air, an individual amateur can have a seemingly-endless string of friends for rag-chewing on the way to work or on a transcontinental journey. There are dozens of different repeater frequencies, called *channels*, in use. At $10 a pair,

A powerful 800-channel radio is the Midland 13-510 with 25 watts.

amateurs tire of buying crystals for new channels. So, the advent of *synthesized* radios was inevitable.

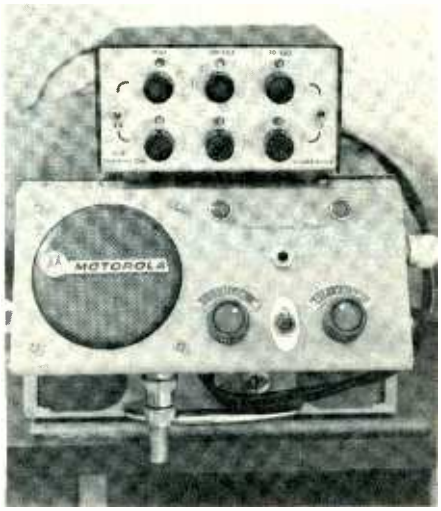
Repeaters listen on one frequency and retransmit what they hear onto another frequency. For example, a popular

Heath HW-2036, under-$300 radio with 400 channels, is a popular kit used by amateur radio operators for conversations through repeaters. The telephone-style dialing pad in the microphone permits "autopatch" telephone calls through repeaters.

repeater *pair* is 146.34 MHz and 146.94 MHz. The individual amateur transmits his signal to the repeater on 146.34 The repeater retransmits that out on 146.94 MHz for other hams to hear. There are many such repeater pairs in the 146-148 MHz portion of the two-meter band alone, with other frequencies in use too.

If a radio is capable of transmitting and receiving on frequencies every 10 kilohertz (kHz) from 144-148 MHz between 144-148 MHz, it has 800 channels capacity. If it can do the same steps up from 146-148 MHz, it is a 400-channel radio.

Heathkit and others manufacture 400-channel radios. Most 400 and 800-channel transceivers run either 10 or 25 watts



Many amateurs use older, surplus police and fire department radios. A GLB synthesizer converts a one-channel Motorola to 400 channels.

transmitter power. Range through repeaters is 20-100 miles.

Synthesized two-meter radios are $250-$500.

Smallest two-meter radios today are battery-portable handhelds. These crystal-controlled transceivers are used by amateurs for a wide variety of fun, games and public-service work. Wilson, Standard, Regency, Genave, Motorola, Hy-Gain and others have sets in use by amateurs.

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The irregular body of the vehicle distorts the antenna pattern so that reception and transmission varies greatly, depending upon the direction from the vehicle the measurement is being taken.

This is little comfort for the CB buyer. He would have to have a whole room full of expensive instruments, and a large "antenna range" in order to make comparisons between mobile antennas, and the results he would get from these measurements would vary from vehicle to vehicle. And it is asking too much for Yours Truly to state that one antenna, or type of antenna, is better for your vehicle than another. In the last analysis, the one that works *best for you* is the best one for you!

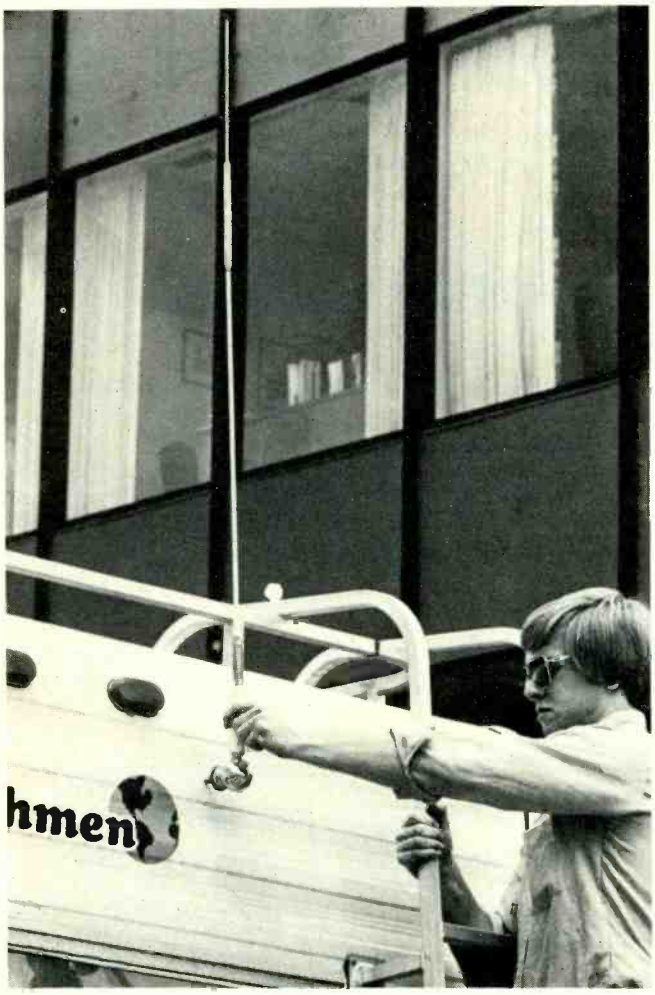


Fig. 6—A few mobile antennas such as this Breaker Corp. Model 10-500 are specially designed for use on fiberglass-bodied RV's, campers and sports cars.

When all the smoke dies away, is there a real difference between an unloaded, full-length whip, a bottom-loaded mini-whip and a center loaded mini-whip? I asked a friend of mine that question. He's an antenna engineer for a very large antenna company that makes mobile antennas for CBers, radio hams and the military. Here's his reply:

"Well, the full length, 102 inch whip is a great antenna. If you use a super-stiff spring in the mount you can keep it upright at normal highway speeds. But it tends to bend over at high speeds. And if you hit a tree with it—that's all, brother!

"Center-loaded mini-whips tend to be a bit better as far as efficiency goes than base-loaded whips, but they sway about in the wind and the motion detunes the whip, imparting a flutter to the signal unless the whip is very rigidly made. The bottom loaded mini-whip is very stable under all road speeds and has very little bending action at high speeds. It's more durable because it is quite short and can't be battered about by trees. But the base-loaded whip has less overall efficiency than the other two types. Also, it can be detuned easily by nearby objects. Even walking close to the body of a vehicle with a base-loaded mini-whip can detune the whip.

"My advice to the CBer is to keep his eyes and ears open. See what the other CBers are using in the way of antennas. See who has the best and most consistent mobile signal. Examine the whip antennas at your local CB outlet. Look at the antenna of your choice. Is it well made? Corrosion resistant? You can tell a lot by merely eyeballing the antenna.

"Don't forget that the automobile forms the ground system for the whip antenna. Some vehicles with a fiberglass body—such as the Corvette—don't provide a very good ground system. In this case, the best thing to do is to cover the inside of the rear of the vehicle with self-adhesive, aluminized tape. The tape is put everywhere you can reach on the inside and then connected to the ground connection at the base of the antenna by a very short piece of wire. Some antenna manufacturers sell a ground kit for this problem (*the Antenna Specialists Co.*, 12435 Euclid Ave., Cleveland, Ohio 44106. Ask for Ground Kit M-262)."

The final wrap-up

Look through the pages of S-9 and read all the advertisements for CB antennas. You can get catalogs of many of these outfits at your local CB store, or you can write directly to the manufacturer for his catalog. I'll bet you would make him happy if you enclosed 50¢ postage, too, as a lot of the catalogs are quite weighty and costly to produce and mail. Spend an evening reading the literature, and when you finish, you'll have a good working knowledge of mobile antennas. Don't let the exotic antenna names "snow" you; antenna manufacturers have the same weakness prevalent in the automotive field—that of giving exotic names to rather mundane products!

Next, examine your vehicle, catalogs in hand. Where can you mount the antenna? How much overhead can you afford? Once you answer these two questions, you'll have come a long way in deciding what type of mobile antenna is best suited for your particular installation.

Next month's column will discuss antenna mounts and how to mount the mobile antenna on a number of vehicles. Until then, may all your signals be wall-to-wall and tree-top-tall!

how it works

ONE PIECE OF GEAR EXPLAINED

BY ANTHONY R. CURTIS

Now there's even a computer buried inside a stereo cassette deck with a command post fit for a king.

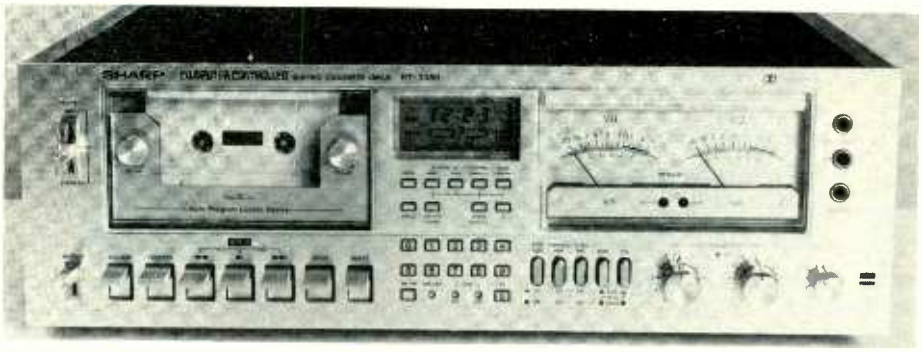
Want to play the fifth cut on your favorite cassette music tape at 11:13 every morning? Skip the sixth cut, which sounds like last year's hog-calling contest? And save the seventh for wake-up tomorrow morning? You can do all that, and more, by hooking a computer to your tape deck.

Sharp Electronics Corp., 10 Keystone Place, Paramus, NJ 07652, is first in the audio industry to do just that.

Officially called, "Computer Controlled Stereo Cassette Deck RT-3388," it has five forms of memory. It can be directed to find the start and automatically play any song on a cassette by going either forward or in reverse. It can be programmed to turn itself on and off, and has both rewind and tape counter memory. It can even be programmed to repeatedly play a certain segment of a tape.

According to Charles Daigneault, vice president of Sharp's Consumer Electronics Division, the under-$300 RT-3388 is a significant technological breakthrough in tape equipment.

Tweezers show size of the large-scale-integration circuit "chip" which is the computer heart of Sharp's RT-3388 stereo cassette deck.



Sharp's new cassette deck is the first in the audio industry with a microcomputer built in. With five memories, it can find the start and automatically play any song on a cassette by going either forward or reverse. Programmable to turn itself on or off, it has both rewind and tape-counter memory. It even will repeat plays of one song.

"Operation of a tape deck generally involves a lot of guesswork and annoying delays," Daigneault says.

"Incorporation of a microprocessor eliminates these problems and insures that deck operation, including finding the start of a song, replaying a specific section of tape, and setting up timed recording and playback operations, can be accomplished easily and accurately."

Sharp eye

According to Daigneault, Sharp Corporation in Japan could develop the RT-3388 because it was able to combine the technology of its exclusive "Sharp Eye" Automatic Program Search System (APSS), with its ability to design and manufacture the tiny integrated-circuit chip that is the microcomputer.

APSS, which has been on Sharp tape products for several years, enables a listener to skip ahead to the next selection on a tape, or back to the start of the selection being played.

Among the capabilities of the new computer-controlled stereo tape deck:

■ It can be directed to find the start of any song on a cassette. Through an automatic *program locate device*, it searches out the non-signal segments of a tape and can skip—either forward or in reverse—up to 19 songs and stop, or start playback of the desired song automatically. Thus, the listener can play only the songs he wants to hear and in the order he wants to hear them. He can switch from song one to song five, then back to song four, on to song nine, and then back to song two.

■ It has *tape counter memory*, enabling a listener to locate a specific number on the tape counter. And, the counter memory button can be directed to remember that number and recall it when so directed. For example, if a listener has a favorite aria in an opera, he can automatically switch to that section without listening to earlier parts of the opera.

■ It has a *memory rewind* function which can be used to reset the tape counter to "0" at any point on the tape. When put into the rewind mode, the tape will stop at that reset "0" point, or start playback automatically depending upon which button is depressed. The same opera listener might want to hear the last three arias a second time after the opera is completed. He can go back to that point on the tape by programming this memory rewind function.

■ By using a *combination* of memory rewind and counter memory, it is possi-

ble to mark off a specific section of the tape to be replayed. Then, by entering this section into the microprocessor memory bank, and through the use of direct memory, the listener can direct the tape deck to replay this section as often as desired. The listener, for example, can have a special section of a symphony replayed by depressing the proper buttons. It will play and stop when the section ends. To replay it again, the listener just has to push the direct memory button and rewind. And, he can continue to repeat this section as long as the cassette remains in the machine.

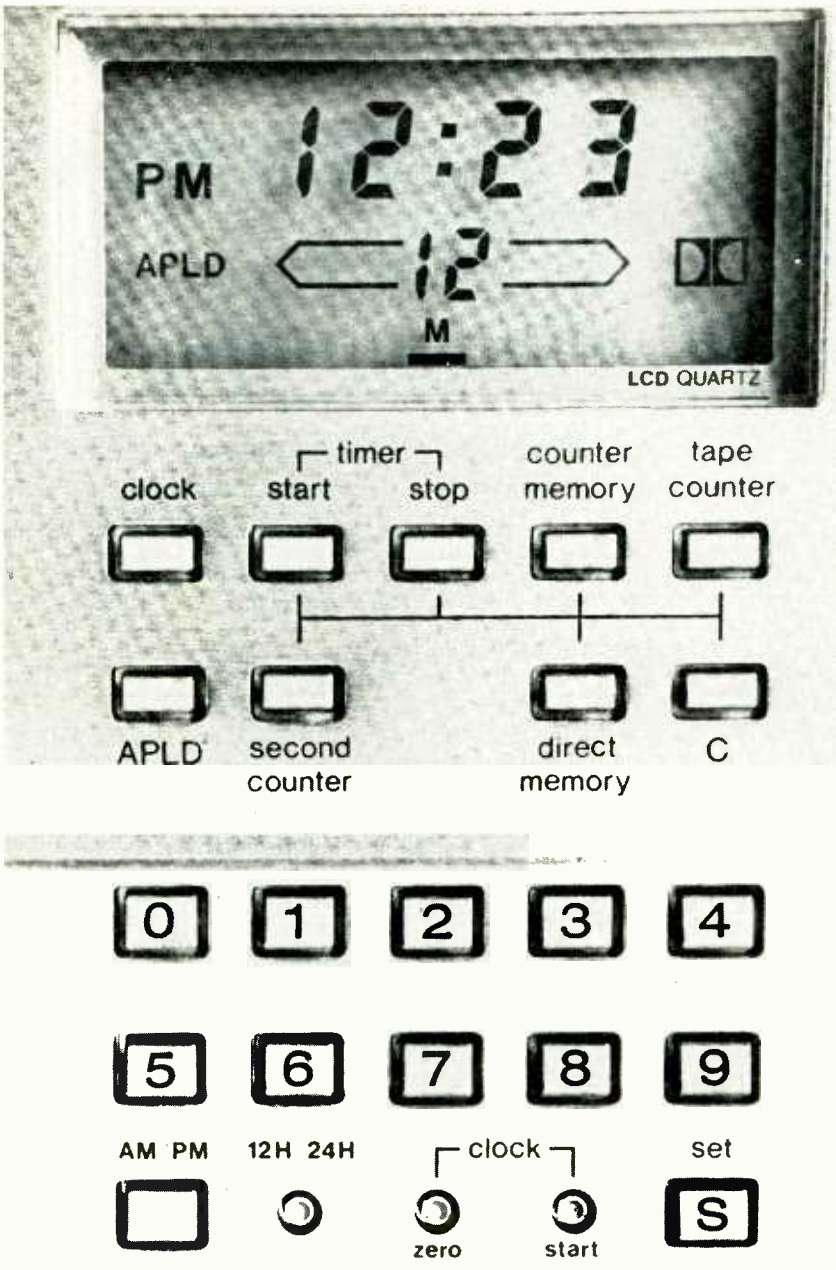
■ It can be programmed to turn itself on at a certain time of day, or off, or both *on and off*. Thus, a listener can arrange to record a program from any source when not at home. This programmed time on/time off can be stored in the machine and recalled each day. For example, a person can arrange, each day, to have the deck come on, record the 6-6:30 news, and shut itself off when it goes off the air. The receiver or amplifier plugs into an ac outlet in the rear of the cassette deck.

■ It has a *direct memory* function which instantly memorizes any point on the tape for a single playback. Thus, a listener can mark off any spot on the tape for replay by pushing the direct memory button at the point of desired future replay. The listener can then recall that point later on.

■ It has an electronic *tape counter* assuring accuracy in all microprocessor-controlled functions. A seconds counter is also included. This can be set to count the number of seconds a tape has been running during recording or playback. It can also be used to determine approximately how much time is left on the tape when recording.

Heart of the microprocessor unit is an LCD (Liquid Crystal Display) digital quartz clock and *command post* that serves as the headquarters of the operation. Time is displayed in either twelve hour day, with am/pm displayed, or twenty-four hour day. And the command post also tells the listener what else is taking place.

Arrows indicate when the deck is in fast forward, reverse, or play mode. Footage can be digitally displayed. A symbol comes on when the *Dolby* noise reduction system is on. When the automatic program locate device is on, the listener can watch the countdown to the song he selected as numbers flash on the display.



Heart of the Sharp computer-controlled stereo cassette deck is an LCD (liquid-crystal display) digital quartz clock and this "command post." Time is displayed in either 12-hour am/pm days or 24-hour days. The command post also tells what the computer is doing at any one time. Arrows point when the deck is in fast forward, reverse, play. Footage is shown. A symbol flashes when Dolby is on. You can watch the countdown to a specific song you have selected on a tape as the automatic "program locate" works; numbers flash by. Pushbuttons below the LCD control microprocessor actions in the under-$300 deck.

Fail safe

In order to assure accuracy of the clock and to preserve its memory function, the microprocessor automatically switches the clock to built-in battery operation during a power failure.

In designing the RT-3388, Sharp did not just concentrate on the microprocessor.

"We were just as concerned with providing high performance standards," Daigneault says. "That's why we have included such features as a Dolby noise reduction system, a bias and equalizer tape selector and an ultrahard permalloy record/playback head."

Other features include:

■ An *editor button* for recording puts a non-signal segment between songs to facilitate the APLD search.

■ A full *automatic stop* mechanism with a Hall Effect IC.

■ A friction damped cassette holder for gentle cassette release and less wear and tear on the compartment door. The cassette compartment is lighted. The compartment door can be removed easily in order to facilitate cleansing of the deck heads.

■ Independent mic/line circuits make *microphone mixing* possible, permitting added versatility and allowing creative combinations during recording and playback.

■ Separate VU meters and peak level indicator.

■ LED recording indicator.

■ Output level control.

■ The pause key doubles as the standby key for timed recording and playback programs.

How to kill ignition noise

Radio hash, thrown out by your automobile engine, can wreck CB, ham and other two-way mobile reception. Now something can be done. Here's how to cut the noise and suppress interference easily and efficiently.

by R. W. Woodbury

Manufacturers of CB and other 2-way radios strive to produce communications equipment providing clear, clean reception. Most radios are designed with sophisticated circuitry incorporating safeguards against generating noise from within. But even the best of equipment cannot assure interference-free reception when the source of vehicular noise happens to be from devices such as generators, alternators, voltage regulators, ignition coils, etc. Vehicular electrical systems produce one of the worst possible environments for radio reception.

In order to reduce this type of interference, you must take up where the radio manufacturer left off . . . he did all he could to keep his equipment from emitting interference, now it's up to *you* to suppress vehicle originated noise at its source.

SAFETY PRECAUTION

Before carrying out any of the procedures outlined in this article which pertain to mobile radio interference, REMOVE BOTH RED (+) and BLACK (–) CABLES FROM BATTERY TERMINALS. ***Failure to remove both cables may result in personal injury.*** **Follow all installation instructions completely and in the correct sequence. Automotive wiring can be hazardous since the battery can deliver hundreds of amperes instantaneously. Such high currents can heat up finger rings, pliers, and screwdrivers, with resultant burns and other possible physical injuries.**

Take time to do it right

Satisfactory interference suppression can only be achieved if all components are properly connected where necessary and grounded where necessary. Be sure that paint, oil, grease, dirt, or rust is removed from those areas where good electrical contact is required. This means those areas where filter capacitors will be mounted by their mounting straps and/or brackets. Scrape or wire-brush these areas down to bare metal. When you mount components, use clean hardware and sharp-toothed lock-washers to further ensure positive ground connections. Where wires connect to filter capacitors, be sure that connections are electrically and mechanically *good*. Every soldered joint must be sound. Tape all

(continued)

exposed connections where there is the slightest possibility of accidental contact with other wires, the grounded engine, or nearby accessories. Whenever it becomes necessary to cut the wiring leading to an alternator or generator in order to put a filter into the circuit, use cable connectors, such as Sprague QH2-5 or QH2-10, on the cut ends to ensure positive and permanent connections.

Careful attention to every aspect of installation of filter components will result in improved radio reception and tape playback.

Pre-filtering suggestions

When installing or replacing radio or audio equipment in your car, truck, boat, or tractor, these simple suggestions will minimize any additional steps for reducing interference:

1. Check all suppression components installed as original equipment by the vehicle manufacturer. These include resistor plug wiring, bonding straps, and bypass capacitors. Replace anything that doesn't look right.
2. Have the engine tuned by a good mechanic. This will not only eliminate some of the interference, but will give you better engine performance.
3. Connect the radio or tape deck directly to the battery through the proper in-line fuse.
4. Route all new wiring away from other wires, especially high-voltage ignition wires. THIS IS IMPORTANT!
5. Make certain the antenna lead-in wire shield is properly grounded at each end. All connections must be clean, tight, and properly soldered.

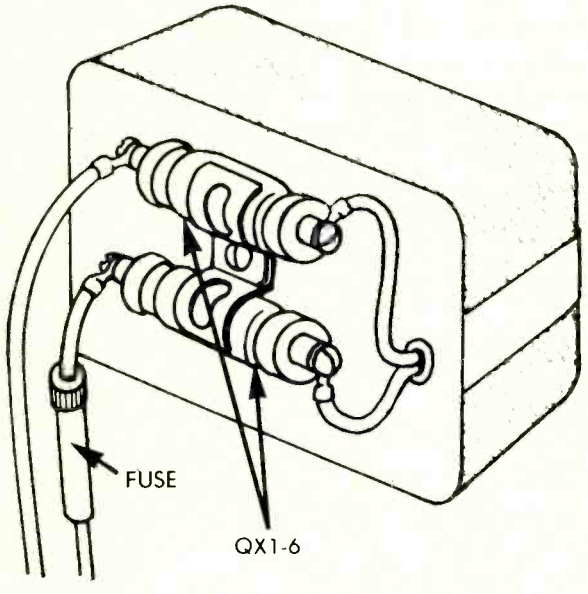


Figure 1A

Filtering the power line

To suppress radio-frequency noise, which is usually the most troublesome for CB and other AM radio installations, mount a general-purpose .1μF @ 400 VDC, 20-amp feed-thru filter capacitor (Sprague Type QX1-6) on the back of the radio chassis, as shown in Figure 1A. Cut it into the power line as close as possible to the radio. If there is more than one power lead, install the filter in the lighter-gauge lead first. If noise persists, install a second filter in the remaining lead.

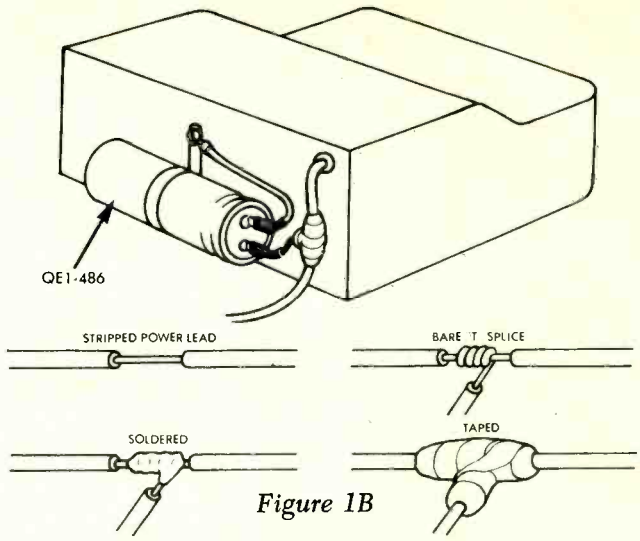


Figure 1B

Audio-frequency noise, especially in tape decks and AM/FM receivers, can be just as annoying and troublesome. In these situations, connect a 200μF @ 200 VDC electrolytic filter capacitor (Sprague Type QE1-486) to the power line as closely as possible to the cabinet, as shown in Figure 1B.

With negative-ground electrical systems, connect the black lead to the tape deck cabinet, and the red lead to the power line. With positive-ground electrical systems, ground the red lead and connect the black lead to the power line.

Filtering the ignition coil

Mount a general-purpose .1μF @ 400 VDC, 20-amp feed-thru filter capacitor (Sprague Type QX1-6) as closely as possible to the ignition coil, as shown in Figure 2. Don't mount the filter on the engine block. Disconnect from the coil the wire which leads to the ignition switch. Connect this wire to one end of the

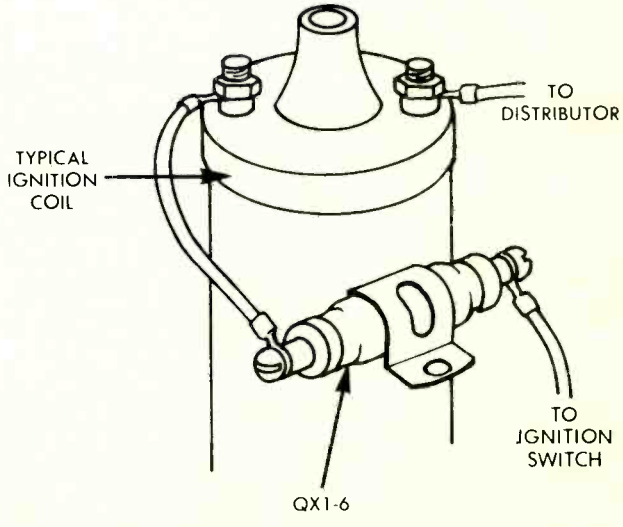


Figure 2

filter capacitor. Install a jumper wire using the same size and type of wire, from the remaining end of the filter to the coil terminal from which the wire was removed.

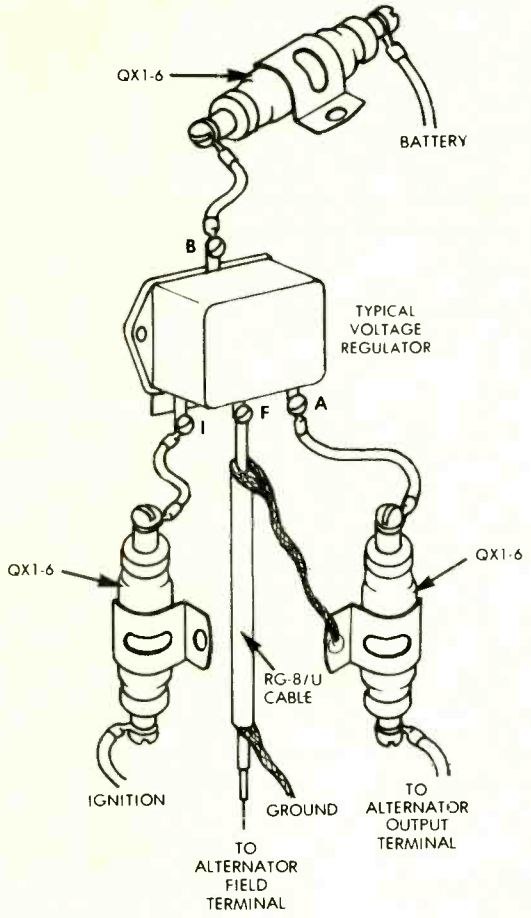


Figure 3

Filtering the voltage regulator

For vehicles with plug-in type electrical connectors, check with your auto mechanic for proper wire identification.

Mount a general-purpose .1μF @ 400 VDC, 20-amp feed-thru filter capacitor (Sprague Type QX1-6) as closely as possible to the voltage regulator, as shown in Figure 3. Disconnect the wire from the terminal marked "I" or "ignition", and connect it to one end of the filter capacitor. Install a jumper wire, using the same size and type of wire, from the opposite end of the capacitor to the "I" terminal.

If noise persists, disconnect the wire from terminal "A" (armature) and connect it to one end of a second filter capacitor. Install a jumper wire from the opposite end of the capacitor to the "A" terminal.

If noise persists, disconnect the wire from terminal "B" (battery) and connect it to one end of a third filter capacitor. Install a jumper wire using the same size and type of wire, from the opposite end of the capacitor to the "B" terminal.

If regulator noise still persists, replace the wire from Terminal "F" with Type RG-8/U coaxial cable, grounding both ends of the braided "shield" portion of the cable to the chassis or nearest grounding point other than the engine block. Be certain that the cable does not touch the engine block or any other accessory which may become hot during operation.

WARNING: Do not install any filter device on the terminal marked "F" or field. Permanent damage will result if this terminal is filtered or by-passed.

Filtering the alternator or generator

For standard alternators and generators, use a .5μF @ 50 VDC 40-amp feed-thru filter capacitor (Sprague Type QX1-18). For heavier-duty alternators, use a .5μF @ 50 VDC 40-amp feed-thru filter capacitor (Sprague Type QXI-100). For heavy-duty truck alternators, use a .5μF @ 600 VDC 100-amp feed-thru filter capacitor (Sprague Type QX1-500), or a .5μF @ 600 VDC 200-amp feed-thru filter capacitor (Sprague Type QX1-600).

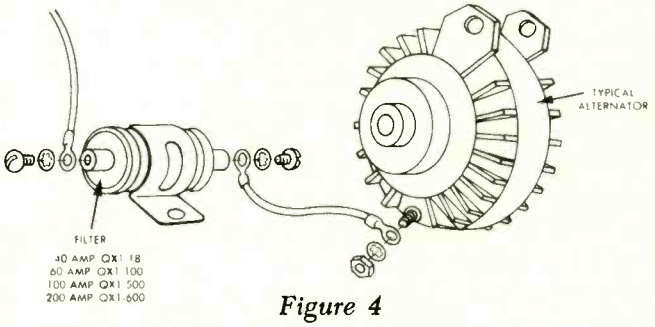


Figure 4

Mount the filter capacitor as close as possible to the alternator or generator, as shown in Figure 4. However, do not mount it on the engine block. Disconnect the wire from the output terminal on the alternator or generator and connect it to one end of the filter capacitor. Install a heavy jumper wire from the other end of the capacitor to the alternator output terminal.

Additional auto noise suppression measures.

Additional suppression steps can be taken at the terminals of such devices as the ammeter, oil pressure gauge, engine temperature gauge, and fuel gauge. It may even be necessary to suppress noise caused by the wiring at the dome light, trunk light, and instrument panel lights. In such cases, a general-purpose .1μF @ 400 VDC, 20-amp feed-thru filter capacitor (Sprague Type QX1-6) should be located as close as possible to the offending accessory, or where its lead wire passes through the engine compartment firewall.

Grounding the exhaust end of the tail-pipe can reduce re-radiated interference. Such grounding can be accomplished by using a length of braided grounding strap.

For severe cases of ignition noise, before you resort to complete ignition system shielding, try the following less-expensive alternatives first:

1. Use resistor-type spark plugs, *after* you have checked with your auto mechanic. These plugs are

not to be used with capacitor discharge ignition systems.

2. Investigate the use of bonding or jumper straps, especially between the engine hood, fenders, engine block, alternator frame, and tail-pipe.

3. General-purpose .1μF @ 400 VDC, 20-amp feed-thru filter capacitors (Sprague Type QX1-6) will often eliminate intermittent noise from turn signal flashers or windshield wipers by installing them at the terminals of the offending devices. NOTE: Feed-thru filter capacitors will have *no effect* on wiper motor noise, or signal fading, where the auto radio antenna is embedded in the windshield.

Automotive noise suppression requirements will vary with different vehicles, engines, and accessories. It is not possible to prescribe pat cure-alls for all noise problems. Each must be considered a custom case, with solutions for that particular car only. However, the information in this article should give you a good step forward in the suppression of noise for most of your specific problems. It remains for you to put the finishing touches to the job.

Boats and aircraft

Since electrical systems, power sources, and accessories in boats and airplanes are substantially more varied than those found in automotive vehicles, it would be extremely difficult to even generalize on procedures for noise suppression. It is suggested that you consult with your marine or aviation serviceman to determine the best approach and solution to your particular noise problems. Note that in the case of aircraft, a certified, licensed mechanic must be employed. It is always best to check with your dealer.

Filtering at Power Cord of A-C Radios

CAUTION: Before doing any work on A-C line operated equipment, *Pull the Plug!*

If your fixed-station radio rig is used in a properly-grounded electrical system (a 3-wire 110 volt a-c system, a system using BX cable in good condition, or a permanent chassis-to-ground system), an a-c power line filter with a dual 3-amp rating @ 250 VAC/60Hz (Sprague Type QX1-03) may be installed in your radio to suppress line interference, as shown in Figure 5. Remove the line cord from the a-c receptacle and discharge any filters or bypass capacitors connected across the line cord.

Disconnect the line cord from the terminal strip, fuse holder, transformer, etc. Remove any bypass capacitors (usually disc ceramic capacitors) connected across the line cord or connected between the line cord and the chassis ground. Install the filter so that its lead wires reach the points where the line cord was originally connected. Connect the original line cord to the lug terminals of the filter.

CAUTION: When servicing equipment in which a line filter has been installed, always remove the line cord from the receptacle *before* removing the ground connection. Conversely, always connect the ground line *before* plugging the cord back into the receptacle.

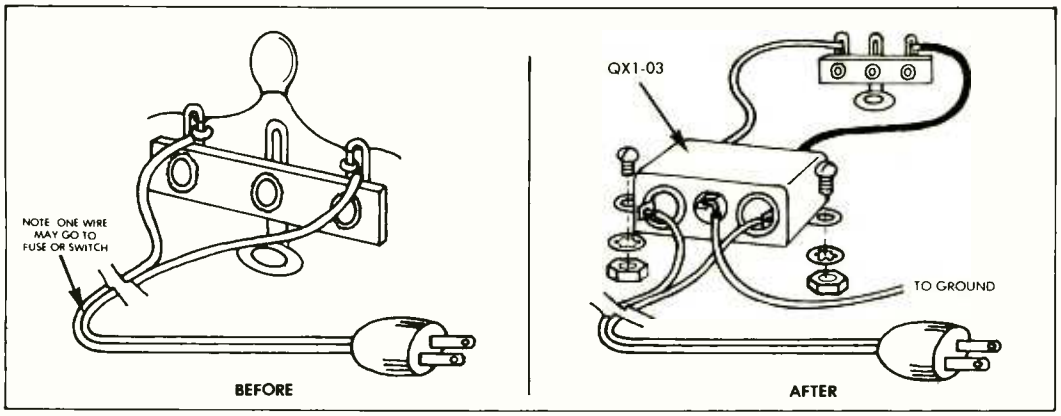
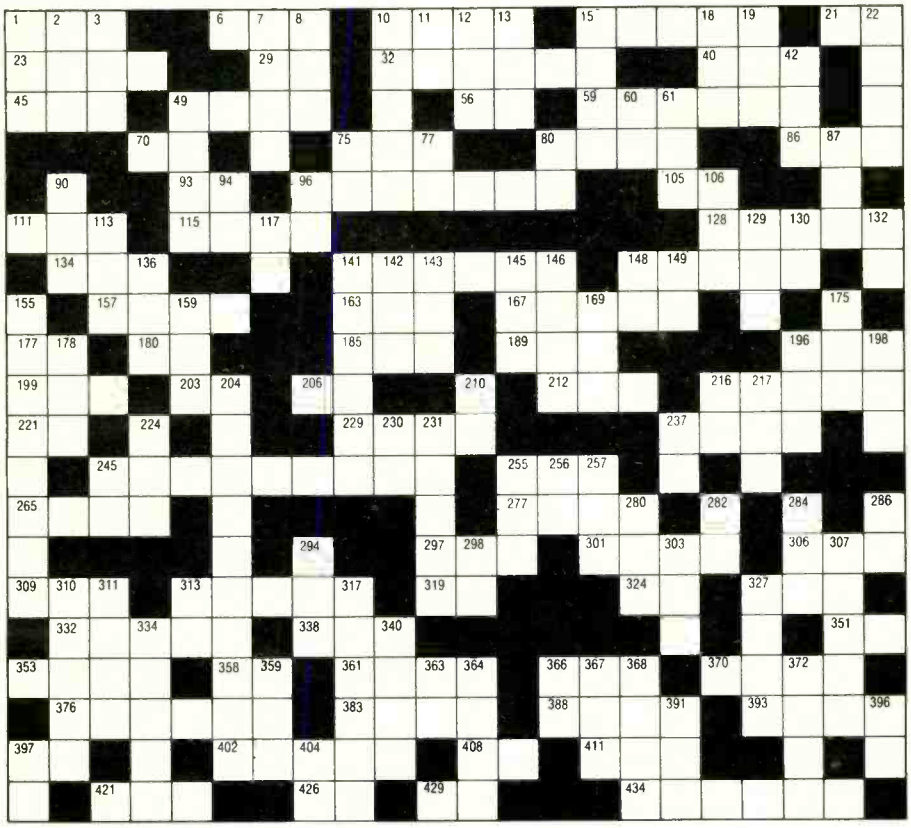


Figure 5

puzzle #1

OUR ELECTRONIC BRAINTEASER OF THE MONTH



Across

1. Turntable speed
6. Card acknowledging receipt of transmission
10. Opposite of space in RTTY
15. Measure of power
21. Measurement of sound level change
23. A bit of news
29. 1000 Hz (obs.)
32. Unit of current
40. 30-300MHz
45. 5-volt logic
49. Tube element
56. Belonging to me
59. Resistors can be hooked in parallel or in_____
70. Final amplifier in a transmitter
75. Motorola transistor numbering system
80. A unit
86. A thousand cycles per second
93. Integrated circuit
96. Another name for antennas
105. Silicon rectifier
111. If 110 is high voltage, 12 is_____voltage
115. Kind of modulation popular with VHF hams
128. Operational amplifier
134. One who monitors foreign transmissions
141. Type of switch
148. NE555
157. Unit of electromotive force
163. Unit of resistance
167. Popular computer language
177. Any amateur radio operator (abbrev.)
180. Manufacturer of CBs, TVs and light bulbs (abbrev.)
185. Universal time (obs. abbrev.)
189. Reduced-carrier supressed-carrier mode of transmission
196. Type of transistor
199. Part of radio you speak into
203. Flows in one direction
206. Prefix in coax numbering system
212. Meaning of radioman's "affirmative"
216. _____ modulation is psuedo-fm
221. _____ _____-259
229. Phase-locked _____
237. To monitor several frequencies with same piece of gear
245. Electronic part
255. Fast-scan is_____.
265. Vacuum _____
277. Only metal which magnetizes
297. Personal receiver of mechanical soundwaves
301. Portion of electromagnetic spectrum
306. Film speed
309. "Say again please" (CW abbrev.)
313. Video tapes and video_____
319. Transmitters put out _____ energy
324. According to Ohm's Law, E= _____ _____
327. Heath_____
332. Mel
338. Test instrument, measures current, resistance, voltage
351. Watts = _____ _____
353. Radio-tv manufacturer
358. One logic device is an _____ gate
361. Pilot _____
366. Chases mice from ham shack
370. Manner of transmission
376. Panel _____ tell what's happening in your set
383. Tune in by turning the radio _____
388. Antennas often are made of _____
393. Light _____
397. _____ you were, men!
402. Hard iron
408. Light at a non-visible wavelength
411. Science fiction: _____ gun
421. One side of SSB
426. Other non-visible wavelength of light
429. _____58U coax
434. Contributing Editor Randy Patton's birthday comes _____

Down

1. Clarifier
2. _____ button on microphone
3. Our robot
7. Long distance radio propagation on shortwaves
8. Battery-saving readout
10. Another name for manufacturer
11. Mode of radio transmission
12. Measure of how fast your LP spins
13. Used to send Morse code signals
15. In ham lingo, W6 is on the _____ Coast
18. Unwanted disruption of home entertainment by a transmitter
19. Female pronoun
22. Alarm clocks _____
42. Radioteletype mode of operation
49. Transistor's beta is a measure of its _____
60. College major in electronics (abbrev.)
61. Term used in ac
75. Floats your balloon
77. _____ network
80. Sixth and seventh letters of name of simple emitter-base-collector semiconductors
87. Male pronoun
90. Well-known distress signal
94. World's largest two-way radio network
96. Ancient modulation
106. Semiconductor device which gives out stored information on command but won't take new data
113. Station which transmits time
117. Kind of broadcasts between 88-108 MHZ
129. Twice the average dc power output
130. End of transmission (CW abbrev.)
132. Keystone State
136. SWL, ham or CB operations record
141. _____switch
142. 19th Century German physicist
143. World time standard
145. Measure of weight (abbrev.)
146. This puzzle is _____
148. Invented the integrated circuit
149. Hundreds or thousands of transistors in one small package
155. Now you can own one of these
159. Bright red readout
169. Two-way radio manufacturer
175. Large industry convention
178. Some electronic gear is manufactured to _____ specs
196. Used to cool tubes
198. _____ little Indians
204. Devices for storing an electrical charge
210. Record
216. Board used to mount components (abbrev.)
217. Amateur radio operator
224. Five per foot
230. Turn the power _____
231. Different; additional
237. End of contact (CW abbrev.)
245. Channel 19 is in a _____ radio
255. Put your transmitter on the _____
256. Antenna and power switching relay in a two-way radio
257. Voice-controlled tape recorder or transmitter
280. Famous electronics home-study school
282. Please stand _____
284. Italian radio
286. One-thousandth of an Ampere
294. Kind of voltage from car battery
298. Receivers deliver this to loudspeakers
303. High-voltage _____
307. Stainless _____
310. You load information into these only once
311. Bass or treble
313. Make with
317. Lead and tin
327. Your stereo has a main-tuning _____
334. Groups of multiple bits in computer lingo
340. Reading the _____
359. Signal report (CW abbrev.)
363. Fractional measure of current
364. _____ in the tv
366. Transmission of International Morse code
367. _____ waves
368. Flat receptacle with raised edges for carrying things
372. Stereo requires _____ speakers
391. I would like an _____ ball contact with you
396. _____ line
397. opposite of dc
404. Power equals _____ _____

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ME

news check

STOP THE PRESSES: LAST MINUTE NEWS JUST IN TO MODERN ELECTRONICS

BY BOB MARGOLIN

COMPUTERS ARE TRENDING toward ready-to-run-when-you-take-it-home gear. Several plug-in-and-go types are on the market, along with many kits. Radio Shack has a ready-to-go computer, complete with video display under $600. Sears hints at a test market for a $600 set up during 1978. Atari, the video game people, Bally, the giant of pinball manufacture, PET and others are tooling up to ship micros to beginning-computer fans.

THE FCC CLAIMS to be stepping up enforcement activities. A recent sweep through high-problem areas resulted in hundreds of pink tickets. The best new tool in the Commission's arsenal is a highly-sophisticated transmitting-locating van. The direction finding gear in the truck displays the bearing, accurate to within one degree, of an illegal transmitter in less than one second! The FCC can easily pinpoint the location of a bootlegger within the time it takes the illegal operator to key his mic button.

STEREO BUFFS with fm receiver reception problems caused by signal ghosts have a new answer. BIC has a new Beam Box as a stereo accessory. It has an fm antenna inside which can be pointed electronically in any one of four directions selected from the front panel. A second front panel control lets you adjust antenna sensitivity to reduce the likelihood of your receiver being captured by strong stations on adjacent frequencies.

HAM RADIO operators around the world are excited about Russian and American amateur radio satellites. The two-way communications satellites provide world-wide talk power and are used by thousands of amateurs. The Russian bird is due any time and the U.S. OSCAR 8 will fly this spring. OSCAR 8 will replace the dormant OSCAR 6 which lost battery power last summer after years of valiant service.

HOME SECURITY with a complete tv system for $425 is available in a new Sharp Electronics package. The three-piece outfit includes a two-pound camera, a 9-inch monitor and a two-way intercom with talk button. Power is in the 33 feet of cable and no ac installation is required. Sharp had been out of the home security business for years.

THE SHADOW KNOWS you have a radar detector in your car, but the cops don't. Shown at a recent auto accessory show, The Shadow allows you to tuck your present radar detector behind the front bumper/grill area. Shadow relays alarms to the driving compartment. Also seen at the show: Screw Ball, a rachet screwdriver with two built in slotted bits and two phillips; Mr. Charge BC-1 battery charger which plugs into the 110-volt house power in your garage; and Fox, a high-performance two-band radar detector, also hides under the hood in grill.

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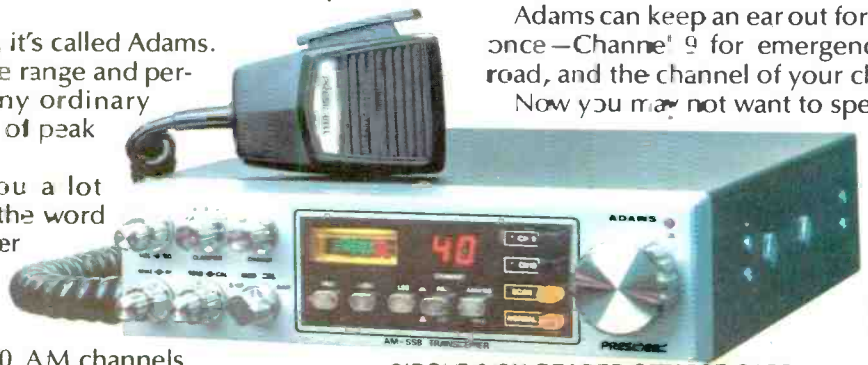

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