DIGITAL AUDIO

- Digital Audio
- Servicing Mr. Coffee
- The Home Computer
- Television Casebook

nri journal

May/June 1978

from CONAR...a special

CLOSEOUT SALE

On this page and on other pages throughout this issue of the Journal, you'll find pictures and descriptions of many items at special low prices.

All are new and in their original factory cartons, but because of new models or slow movement, they are not listed in the current CONAR catalog.

Prices are lower than previously advertised—in some cases lower than our cost. We'll lose money on these items but we must clear our inventory. Cash or time payment—refunds or adjustments will be made if we can't ship. Remember, quantities are limited.

Below you'll find described the first of these outstanding bargains.

LIMITED QUANTITIES

First Come, First Served!

B&K Model 1460

Triggered-Sweep Oscilloscope

The solid-state Model 1460 oscilloscope combines all the advantages of triggered sweep with fully automatic sync. Also features 1, 2, and 5 steps on the calibrated vertical attenuator. Very fast writing speeds and very bright patterns.

Vertical amplifier: Sensitivity 10 mv/cm to 20 v/cm. Response to 10 MHz dc, 2 Hz to 10 MHz ac. **Sweep:** Automatic, triggered. **Sweep time:** 0.5 microsecond/cm to 0.5 second/cm. **Horizontal amplifier:** 300 mv/cm, 800 kHz dc. **Size:** 9" by 10" by 17". **Power requirements:** For 105-125 volts ac, 50-60 Hz, three-wire cord. Less probe.

- TV-H and TV-V positions
- Automatic sync
- 10 MHz bandwidth

now just $300

Only ~~$399.95~~

Stock No.WT1460
Weight 28 pounds

nri journal

May/June 1978
Volume 36, No.3

In this issue, we show you how to clean up your Caruso records, keep Mr. Coffee turned on, and water your lawn by computer. And don't miss Television Casebook, a new series of fascinating and practical true-life TV servicing case histories by NRI's own Wayne Brandenburg.

The NRI Journal is published bimonthly by the National Radio Institute, a division of the McGraw-Hill Center for Continuing Education, 3939 Wisconsin Avenue, Washington, D.C. 20016. The subscription price is two dollars yearly or 35 cents per single copy. Second-class postage is paid at Washington, D.C.

from CONAR...a special

CLOSEOUT SALE

FIVE-INCH SOLID-STATE TRIGGERED OSCILLOSCOPE/VECTORSCOPE

The triggered scope is an improved type of cathode-ray oscilloscope with a one-shot sweep circuit. The electron beam remains in a stationary position and does not deflect until "triggered on" by an input waveform or transient. When turned on, the beam sweeps across the CRT displaying the incoming waveshape, and then returns to rest. Each succeeding pulse will cause the beam to deflect again, giving the effect of a repetitive waveform. The triggered-sweep feature makes it possible to observe nonrecurring transients and to synchronize on either the high-frequency or low-frequency components of complex waveforms. The horizontal deflection is calibrated in time, making it possible to measure the frequency or duration of waveforms and pulses. The vertical is calibrated in volts per centimeter, making precise amplitude measurements possible. It is also possible to operate the sweep in an automatic or conventional free-running state.

VERTICAL AMPLIFIER: Sensitivity: 20 mv p-p/cm, 9 steps in 2-5-10 sequence and uncalibrated continuous adjuster. **Bandwidth:** DC or 2 Hz to 10 MHz. **Rise time:** 35 nsec. **Input impedance:** 1 megohm, shunted by 33 pf. **CALIBRATION: Square-wave voltage:** 0.05, 0.5, and 5 volts p-p; 1 kHz approx. **HORIZONTAL AMPLIFIER: Sensitivity:** 200 mv p-p/cm or better. **Bandwidth:** 2 Hz to 200 kHz. **Input impedance:** 1 megohm shunted by 40 pf. **TIME BASE: Sweep speeds:** 1 μsec/cm to 0.2 sec/cm, 17 steps in 1-2-5 sequence and uncalibrated continuous adjuster. **TV:** V (for 30 Hz) and H (for 15.75 kHz/2). **Magnification:** x5 (maximum speed 0.2 μsec/cm). **Sweep mode:** triggered and automatic (slope + and –). **Synchronization:** internal and external: + and –. **POWER SUPPLY:** 115/230 v; 50/60 Hz; 50 va approx. **SIZE:** 10½" high by 8" wide by 16½" deep. **WEIGHT:** 30 pounds.

Just $275

~~$389.95~~

Stock No.501WT

B&K Model 281 Digital Multimeter

The Model 281 gives you a non-blinking razor-sharp display, with automatically positioned decimal point and a large, easy-to-read numerical readout. It has 100 percent overrange capability, plus positive out-of-range indication: the first digit remains off and the second and third digits flash on and off together. Wrong polarity is indicated as follows: the first digit remains on, while the second and third digits remain off.

Input impedance: 10 megohms, all ranges. **DC volts:** ±100 mv to 1 kv. Accuracy ±1 percent of reading ± 1 digit. Maximum dc input: 1500 volts dc or dc plus ac peak. Function switch has polarity reversal position. **AC volts:** 100 mv to 1 kv rms. Accuracy 1.5 percent of reading ± 1 digit. Frequency response 20-1000 Hz. **DC current:** 100 μa to 1 ampere. Accuracy ±1.5 percent of reading ± 1 digit. **AC current:** 100 μa to 1 ampere. Accuracy ±1.5 percent of reading ± 1 digit. Response 20-1000 Hz. **Resistance:** 10 ohms to 10 megohms. Accuracy 2 percent of range from 10 ohms to 1 megohm, 3 percent of range in the 10-megohm range. **Overrange:** 100 percent on all ranges. **Overload protection:** DC/AC volts: diode and series current-limiting resistance. Ohms ranges: fuse. **Size:** 3½" by 7" by 9". **Power requirements:** 105-125 volts ac, 50-60 Hz; three-wire grounded ac line cord. With test leads and PR-21 probe.

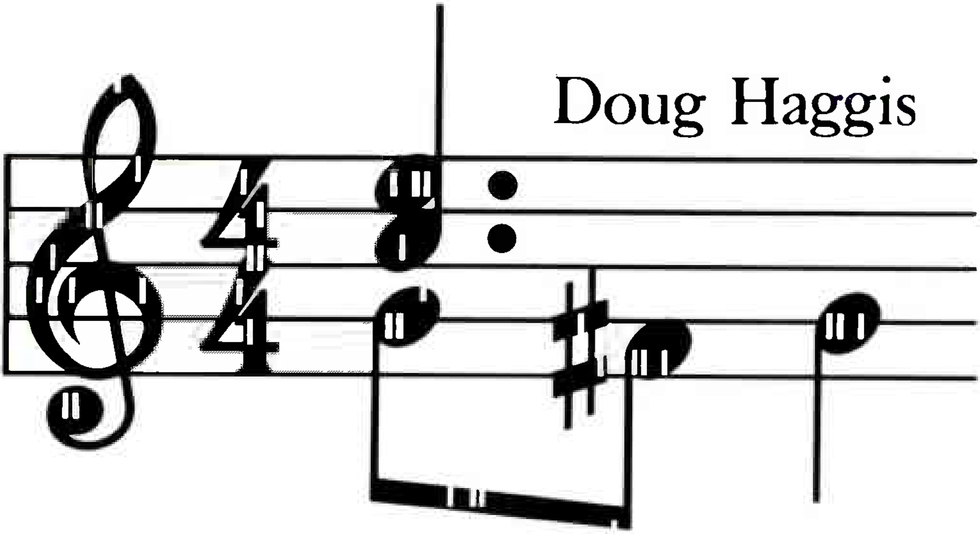
Stock No.WT281
Weight 5 pounds
Parcel Post Insured

Just $50

ONLY ~~$170.00~~

Digital Audio

Doug Haggis



Today, the expression "digital audio" is appearing more and more frequently in magazines and trade journals. Yet, there are many people who do not know what this expression really means, even after reading some of the things written on the subject.

There are actually two uses of the expression "digital audio." It is the second of these which has been used most predominately in recent months, and which we will discuss at some length in this article. The first use of the expression concerns audio power amplification, and we will briefly discuss this aspect in the next few paragraphs. This will serve as an introduction to the entire subject of digital audio.

Digital Audio Amplifiers

With the advent of the transistor, there came a new world of audio amplifiers. Gone were the power-hungry vacuum tubes with their hot filaments and noisy electrodes. The transistor made an admirable substitute for the low-level linear amplifiers formerly used in audio equipment. However, the power amplifiers were another story.

Almost all power amplifiers used push-pull stages to produce the greatest amount of power output while maintaining a fairly high efficiency (to reduce power dissipation in the output stages). Even so, high-power amplifiers tended to run "quite warm" when delivering high power, and heat is the one enemy of the transistor!

As a result, even those amplifiers with modest output power required multiple transistors mounted on quite large heat sinks to keep the power dissipation (and heat) down to a reasonable level. If the heat became too great, you ended up with a zapped transistor and no amplifier.

The one place in which the transistor works quite well is as an electronic

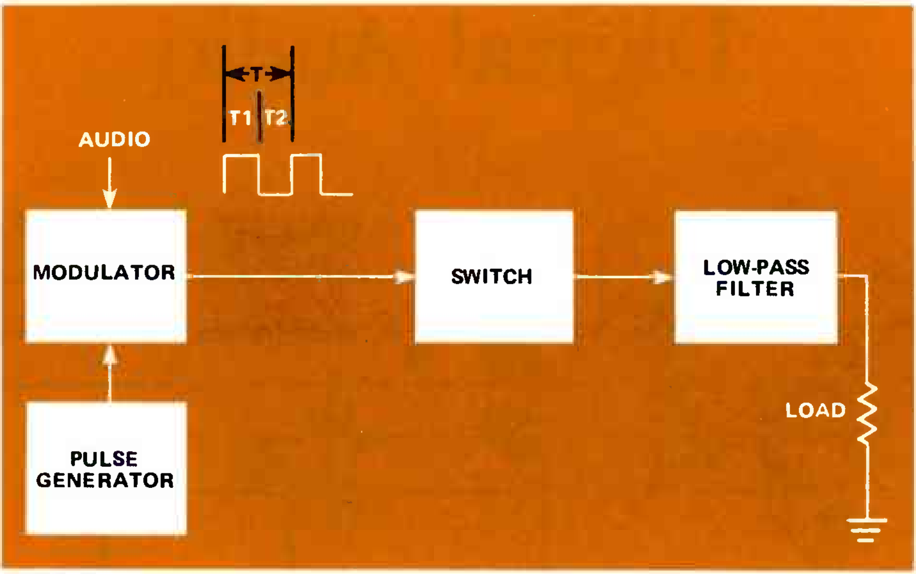


FIGURE 1. DIGITAL AUDIO AMPLIFIER.

switch. That is, it is either conducting very heavily (saturated) or it is cut off. In either of these two extreme conditions the dissipation in the transistor is very, very small, and yet a tremendous amount of power can be delivered to a load.

Consider a saturated transistor operating from, say, a 50-volt supply into a 5-ohm resistive load. When the transistor is saturated, the collector-emitter voltage is very low – about 0.15 volt maximum. This would leave 50 - 0.15 = 49.85 volts across the 5-ohm load, giving a collector current of 9.97 amperes. The input power to the transistor would be 9.97 X 0.15 = 1.495 watts, while the power in the resistor would be 9.97 X 49.85 = 497.00 watts.

With the transistor switched off, the collector current will be essentially zero. Therefore, no power is dissipated in either the transistor or the 5-ohm load. Theoretically a 1.5-watt transistor could deliver almost 500 watts to a 5-ohm load if we used the transistor as a switch. In practice, we use a pair of switching transistors which are alternately turned on and off to deliver power to a load. One transistor drives current through the load in one direction while the second transistor drives current through the load in the opposite direction. In the absence of an input audio signal, each transistor is "on" for exactly half the time so that the average current in the load is zero (after passing through a low-pass filter).

In order to have low distortion, the switching rate must be quite high – at least ten times the highest audio frequency to be amplified. Figure 1 shows the basic configuration. The pulse generator generates a square wave with a period "T," made up of two half-cycles of durations "T1" and "T2." In the absence of an audio signal, T1 = T2 = T/2 as mentioned above. With an audio signal present, the period (T) remains the same, but T1 and T2 change so that there is an unequal time for the output transistors to be in the "on" and "off" states. The result is that a current will pass through the load and develop useful output power.

The problem is that the transistor switches do not behave exactly as nice tame switches should, and they do not "turn off" exactly when we want them to. This is because the large number of carriers present in the base region of the saturated transistor must be removed before the device will turn off. If this is not done, then it is possible for both output transistors to be on at the same time, and an effective short circuit is placed across the power supply. This results in a very short lifetime for the transistors!

To overcome these problems, some elaborate circuitry is needed to ensure that one transistor is truly off before the other is allowed to switch on. This complex circuitry (usually calling for a lower switching frequency) has not given the digital audio amplifier the popularity it deserves.

This might change in the near future, as special FET transistors are now being developed which do not have the undesirable features of the bipolar transistors. There is no buildup of carriers in the channel because there is only one type of carrier in the FET, allowing it to switch *very* rapidly. At the same time, since the FET acts essentially as a variable resistance, it does not have the very low output resistance when it is switched "on" that the bipolar transistor has.

This means that it *will* dissipate considerable power when it is "on." However, it does an excellent switching job in the digital audio power amplifier. There are at least two commercially made audio amplifiers on the market today using high-power VMOS (vertical metal oxide semiconductor) FETs, and there will probably be many more in the future.

Digital Audio Processing

The problems mentioned above regarding saturated transistor switches are not a large problem when we are talking about switching small currents (milliamperes rather than amperes). This is what, in large part, makes computers and other digital systems possible, operating at switching speeds well into the tens of megahertz range.

In addition, advanced technology in the integrated circuit industry now allows many thousands of such switching-type transistors to be placed in almost unlimited configurations in a single, multi-lead package. Such ICs allow us to use extremely complex circuitry, which, to the outside observer at least, appears to be quite simple and miraculous.

One such complex circuit is the analog-to-digital (A/D) converter shown in Fig.2(A), and which is contained in a single IC package. The particular A/D converter shown is an eight-bit device, having eight output lines (0 through 7), an analog input line, and a clock input. The states (on or off, 1 or Ø) of the output lines are a reflection of the value of the input analog (audio) signal present at the particular time the input signal is sampled by the clock.

For example, at sample time T1, the output lines Ø, 2, and 5 are "high" (logic 1) and all other lines are "low" (logic Ø). Line Ø has a value or weight of 1, and each successively higher-numbered line has a value twice that of the preceding line. That is, line 1 has a value of 2 (2 × 1), line 2 has a value of 4 (2 × 2), line 3 has a value of 8 (2 × 4), line 3 has a value of 16

(2 X 8) and so on. Thus, at the sample time of T1 the digital combination of the eight lines is 1 + 4 + 32 = 37, as shown in Fig.2(B).

With an eight-bit A/D converter we can represent any signal within the

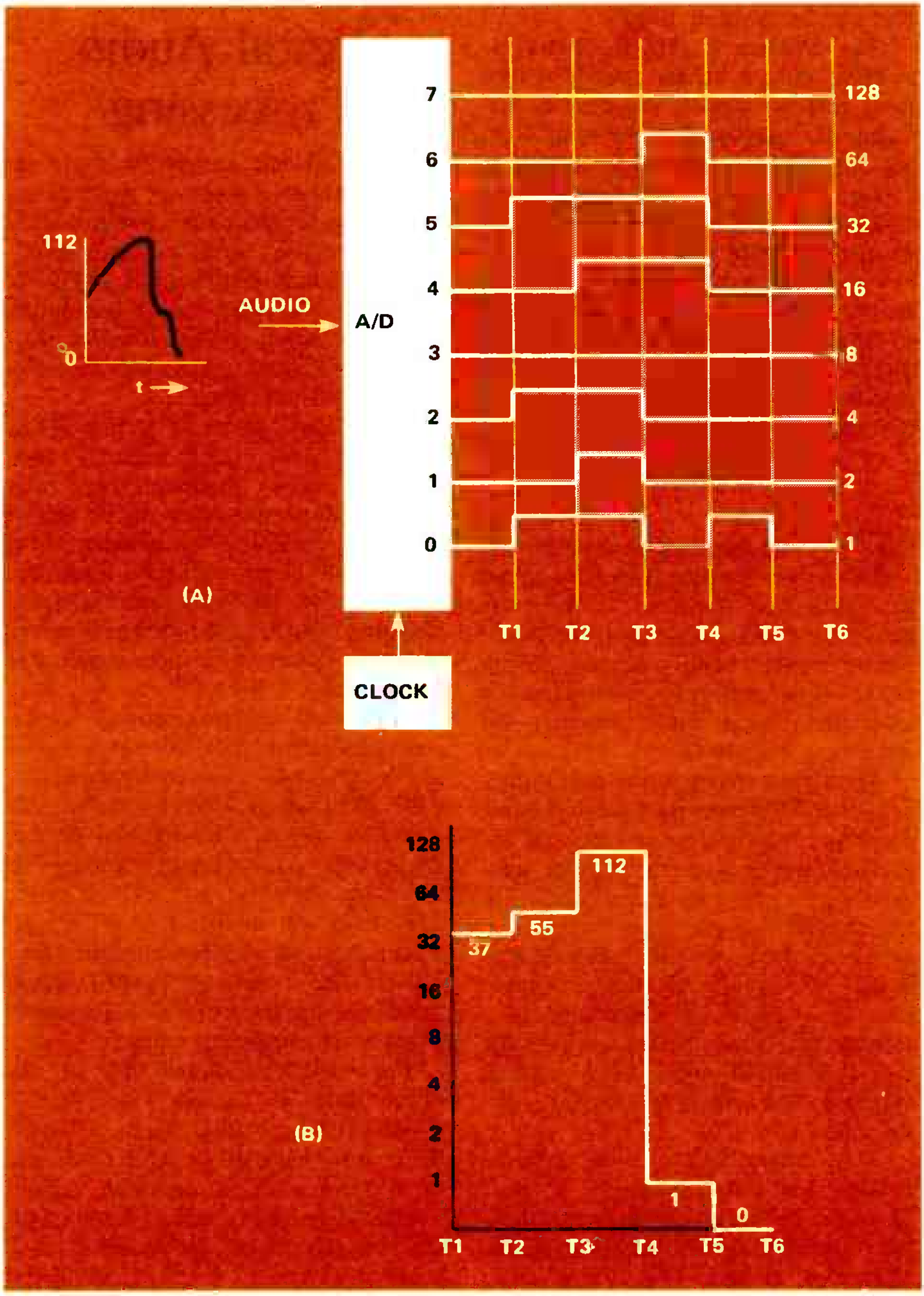


FIGURE 2. AN EIGHT-BIT A/D CONVERTER.

range of 0 to 255 in steps of 1. Using more bits would increase the complexity and allow more discrete steps to be evaluated. Common A/D converters today can give a 16-bit representation of the analog input, allowing for an extremely faithful binary representation of the analog signal. However, we'll stick with eight bits for our discussion.

The other factor that determines the faithfulness of the binary representation of the analog signal is the rate at which the input analog signal is sampled. Just as in the digital power amplifier discussed earlier, we must use a sample rate (clock) great enough so that the highest frequency component of the signal is sampled at least twice, and preferably five or ten times, each cycle. For high-quality audio, we would have a clock (sample rate) of perhaps 50,000 Hz or 100,000 Hz.

Now, what have we gained by all of this manipulation? What we have apparently done is taken a single audio (analog) channel and complicated things by generating eight digital channels in its stead. Where do the eight digital lines go? What do we do with them? The answer to these questions is the beauty of the digital audio system.

To begin with, we can easily *record* the binary signals on magnetic tape as eight individual tracks. Now, however, instead of having a varying analog signal we have a digital signal which has only two possible states—1 or ∅. The presence of any noise on the digital signal is ineffectual since we are only concerned with whether or not a particular spot on the tape is magnetized. We are not concerned about any specific amount of magnetization as we would be if we were to record the analog signal directly.

The result of such a digital magnetic recording is that you will have a copy of the original signal that will never develop any "hiss," "rumble," or any of the other annoying distortions that presently plague audio recordings.

Secondly, we can process the digital signals in a computer and alter the signal in any way we would like. What? In a computer? That's right. Such things are being done right now in the laboratory, and it probably won't be too long before a computer will become a standard "component" in the digital audio system. Such a system might look like the one in Fig.3.

The computer can dynamically process the digital audio to obtain many effects. For example, one could exercise control over the dynamic range of the digital audio simply by adding and

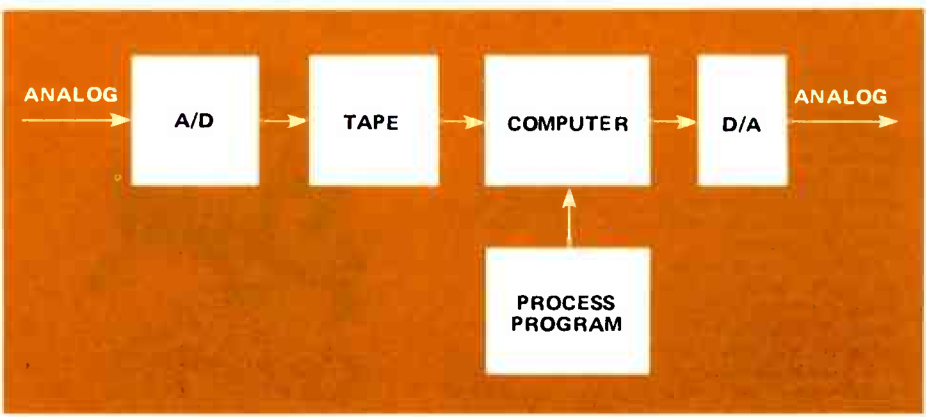


FIGURE 3. ELABORATE DIGITAL AUDIO SYSTEM.

subtracting fixed values (binary numbers) from the digital audio as required by the content of the signal itself. Or, you might insert a program which would digitally add the acoustic effects of some particular symphony hall to your program material. Acoustical Research (AR), a leader in consumer audio products, has demonstrated such a system. Their 16-channel system is called DITTO. Perhaps you might like to add some of the "space age" sounds so popular in today's modern music to an old recording. This can be done digitally by the computer as well. The possibilities are almost unlimited.

One researcher, for example, has taken old recordings of tenor Enrico Caruso made during the earliest days of recording using a mechanical recorder, and removed the unwanted resonances of the recording horn by highly specialized digital processing.

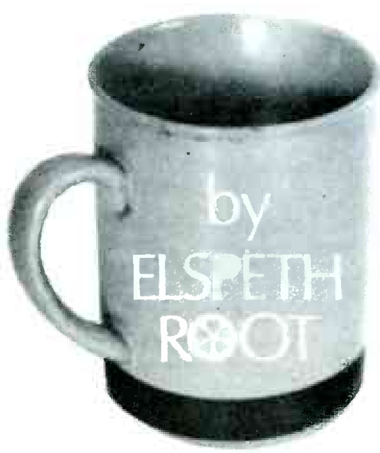
In a similar manner, elaborate digital filters can be "programmed" that can remove the singing voice from a piece of music! Using these and other digital techniques, monaural recordings can be digitally processed to produce stereo and even quadraphonic sound. While these are laboratory experiments today, they may be commonplace tomorrow.

The block on the right in Fig.3 is the final element in the digital audio chain. This is the digital-to-analog (D/A) converter that reverses the encoding process of the A/D converter. The individual binary channels are combined in the D/A converter to produce an equivalent analog signal at the output, forever free from the noise and distortion common to most audio systems.

It probably will not be too long before many audio systems will be fully digital. Combine the digital audio system of Fig.3 with the digital audio amplifier of Fig.1, and you will have a truly high-quality digital audio system.

Until very recently, percolators were almost the only coffee makers used in the home. Vacuum coffee makers and drip coffee makers were available and were widely used in restaurants, but in the home they were far outnumbered by percolators.

Today, a visit to any appliance store will tell you that the dominance of the percolator is a thing of the past. The drip coffee makers are taking over. Popularity of the drip makers is based on speedy brewing, simple operation, easy cleaning, reasonable cost, and good coffee—a combination that is hard to beat!



Appliance service shops are reporting that this change in coffee-making methods is also showing up at the service counter. Busy shops now may take in a hundred drip coffee maker repair jobs for every standard percolator. Repair technicians have to keep up with changes in the market to stay in business.

Part of the success of drip coffee makers is due to a design that puts the equipment into an attractive stand that holds a carafe of brewed coffee. There are two quite different methods of brewing drip coffee, which require different apparatus, but the two kinds of equipment are fitted into similar stands. In one type, the gravity-feed brewer, the main heating element and water tank are in the top of the stand, and a deep hood above the carafe is needed.

In the other type, the pump-feed brewer, the main element is near the base and the stand is usually more compact. The stand looks less top-heavy because the back of the stand, rather than the hood, holds the fresh water. The two types of stands are shown in Fig.1.

INTRODUCING MR. COFFEE

Mr. Coffee® is one of the most popular of the new coffee makers.* It is typical of the gravity-feed drip brewers. Repairing Mr. Coffee has become an important part of the business of many small-appliance repair shops.

***Mr. Coffee® is a registered trademark of North American Systems, Inc., Bedford Heights, Ohio.**

Figure 2 shows a water-flow diagram for Mr. Coffee. All of the photographs are of Model MCS-200C.

Mr. Coffee is not a "fully automatic" appliance. The two switches, one for the brewer and one for the warmer, have to be turned on and off manually. Once the switches are pushed, brewing temperature and rate of flow are controlled automatically. Without a thermostat, the warming element keeps the brewed coffee at the correct temperature for drinking.

Although the appliance needs attention at the beginning and the end of the brewing step, the time needed for coffee brewing is so short that this is not a major inconvenience. Sales of Mr. Coffee indicate that thousands of coffee drinkers certainly do not find it too much trouble to operate.

Coffee brewing with Mr. Coffee begins with placing the correct amount of drip-grind coffee in the coffee basket and measuring the proper quantity

FIGURE 1. A PUMP-FEED COFFEE MAKER (LEFT) AND A GRAVITY-FEED COFFEE MAKER (RIGHT). NOTE THE DEEP HOOD ON THE GRAVITY-FEED STAND.

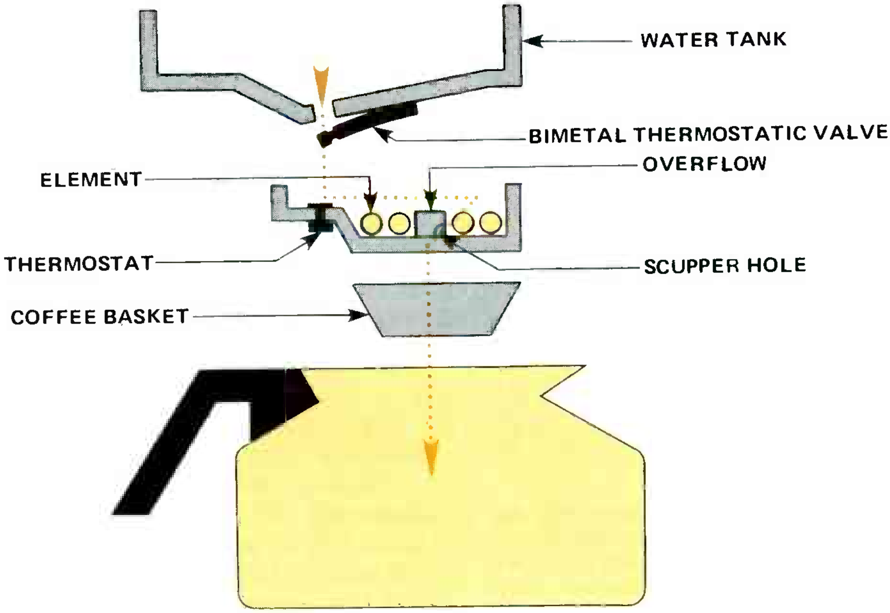


FIGURE 2. WATER FLOW DIAGRAM FOR MR. COFFEE.

of cold water in a graduated plastic pitcher. The brewer and warmer switches are both turned on, and then the water is immediately poured through a screen into the water tank. A tank is shown in Fig.3.

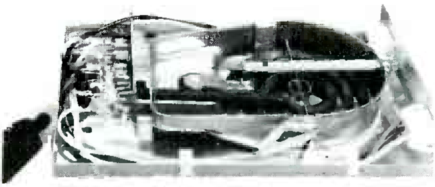
The heater pan directly below the water tank contains a 10-ohm shielded heating coil as shown in Fig.4. Water flows by gravity through a temperature-sensitive valve directly over the hot heating element. Heated to boiling temperature, the water trickles out of the exit tube and through the ground coffee, extracting its flavor and heavenly aroma. After passing through a paper filter, the coffee drips into the carafe, and is ready to drink.

The brewer element must now be turned off manually, while the warmer element is left on to keep the coffee hot. If the brewer is not turned off immediately, no harm is done, because the thermostat will prevent dangerous overheating. Thermostat failure will result in blowing one or both of the two fuses that are in contact with the heating element.

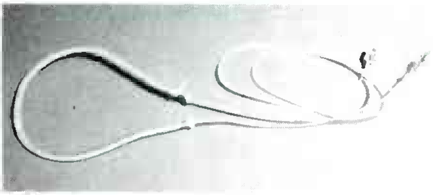
SAFETY AND FUSES

Mr. Coffee has gone through several design changes since it was first put on the market. The user is now well-

FIGURE 3. ALUMINUM WATER TANK SHOWING THE VALVE IN THE TANK BOTTOM.



(A)



(B)

FIGURE 4. (A) BREWER HEATING-ELEMENT ASSEMBLY (10 OHMS) MOUNTED ON HORIZONTAL SUPPORT PLATE. NOTE SWITCHES AT FAR RIGHT, TERMINAL BOARD AT LEFT, AND FUSE WIRE CLAMPED TO PAN RIM AT CENTER. (B) WARMER HEATING ELEMENT (200 OHMS).

protected from the viewpoint of both electrical safety and thermal safety.

Current production models of Mr. Coffee have a polarized plug with the grounding wire riveted to the aluminum plate that supports the heating element. The water tank, also aluminum, is in contact with the grounded plate. An aluminum raceway protects the wires to the warming element in the base of the stand, and also connects the base plate to ground.

Since 1975, Mr. Coffee has had fuses on both sides of the line to the main heating element; therefore, the user can be sure that any ground in the heating element that causes a heavier current flow will blow one of the fuses. There is a good chance that an appliance like this will be used (or misused) without a proper ground, or with the polarized plug damaged so that it can be reversed. With double fusing, safety of the appliance is improved.

There are also good thermal connections between the main heating element and the fuses. One end of an aluminum strip is wrapped around the heating element, the other end around a fuse at the rim of the pan as shown in Fig.4. Failure of the thermostat and serious overheating will cause the fuse to open.

CONSTRUCTION AND OPERATION OF MR. COFFEE

The clever part of Mr. Coffee is the valve in the floor of the water tank. It is a temperature-sensitive valve—a device seldom met with in appliances. Figure 5 shows how it operates. This valve is unique to Mr. Coffee.

It is a very simple valve. A bimetal strip (the kind usually found in thermostats) has one end riveted to the bottom of the tank. The strip has the iron side

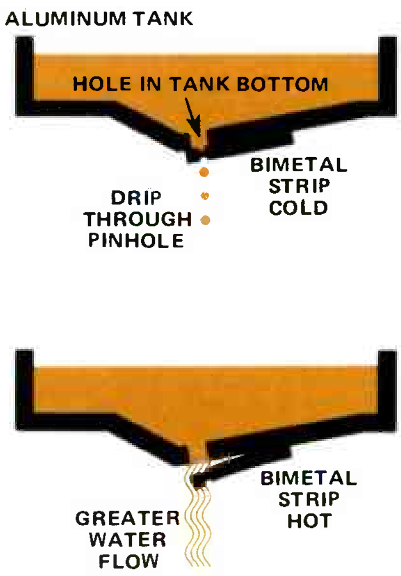


FIGURE 5. OPERATION OF TEMPERATURE-SENSITIVE VALVE. THE VALVE RESPONDS TO THE TEMPERATURE OF THE WATER IN THE TANK.

out. (You can check it with a magnet.) It will bend outward when it is heated. The free end seals a hole in the tank bottom, but the bimetal strip itself has a pinhole through it. When the hole in the tank bottom is closed, there is still a small water flow through the pinhole.

Operation of the valve can be seen through the water entry opening in the hood. The valve responds to the temperature of the water in the tank. When cold water is added, the bimetal strip is straight and seals the hole in the tank floor. The only water flowing into the heating pan is a drip through the pinhole. Though the heating element has not yet reached its full temperature, it can easily heat this small flow to boiling and discharge it through the exit port.

Because the heating element is directly beneath the water tank, the water in the tank gets quite warm as brewing proceeds. The valve then begins to open to allow a faster flow into the heating chamber. Flow reaches its maximum when two to three cups of water have passed over the heating element. At this time, the water in the tank is preheated so that the element can handle the larger flow.

Operation of this valve is critical to the appliance. Make sure that rust and deposits from the water have not plugged the pinhole, and that they are not interferring with the action of the bimetal strip.

The heating element is also susceptible to plugging with scale and lime from the boiling water. A coating on the heating element slows down coffee brewing.

Instructions to the user specify that a quart of white vinegar is to be dripped through the coffee maker to remove lime and scale if coffee-making time is more than seven minutes. Even if this procedure is followed, the unit may need scraping and brushing occasionally, especially in hard water areas. Because of its flow-through design, this appliance is partly self-cleaning.

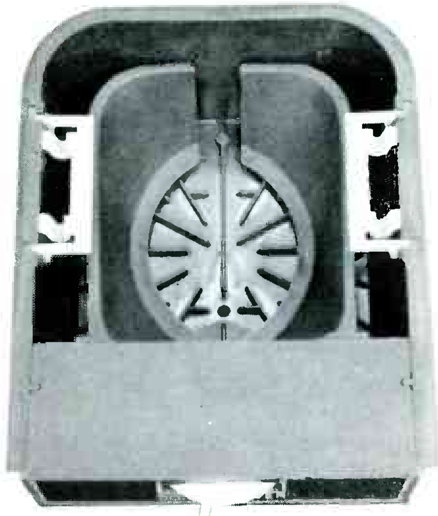


FIGURE 6. TOP VIEW OF COFFEE-SAVER BASKET, WITH SIDES MOVED INWARD.

The outlet from the heating pan is a raised tube with a hole in the front. The hole, appropriately called the "scupper hole," normally controls the flow of water into the coffee basket. If the hole is plugged, hot water will flow over the top of the tube.

The owner's manual calls for a regular cleaning of the scupper hole with a toothpick. Considering how well such instructions are usually carried out, it might pay the service technician to check the condition of the scupper hole.

The coffee basket slides into slots under the hood. In recent models, Mr. Coffee has been equipped with a coffee-saver basket. The supports at the sides of the filter move in to maintain a deep bed of ground coffee even when a small batch of coffee is being brewed. See Fig.6.

FIGURE 7. DISASSEMBLY OF MR. COFFEE IS JUST DIFFICULT ENOUGH TO DISCOURAGE AN AMATEUR.

DISMANTLING MR. COFFEE

Follow the warning stamped on the back plate, and pull the plug first. Loosening two hex-head screws on the back plate removes it, and lets you see where the terminals are. At this point, the water tank looks as though it will slide out and let you at the element. It won't–it catches on the equipment under it. The horizontal support plate, which holds the element and the terminal board, must be taken out with the water tank. A couple of clips at the front corners of this assembly yield to pressure with a screwdriver (Fig.7), and the entire unit slides partially out.

To completely remove this unit, you will have to cope with the warming element, which is a very flexible rope element. It is probably easier to remove the warmer element terminals from the circuit board and leave the warmer in place. Then remove the single screw that holds the wire raceway to the support plate. The tank and support plate are now ready to slide out. Alternatively,

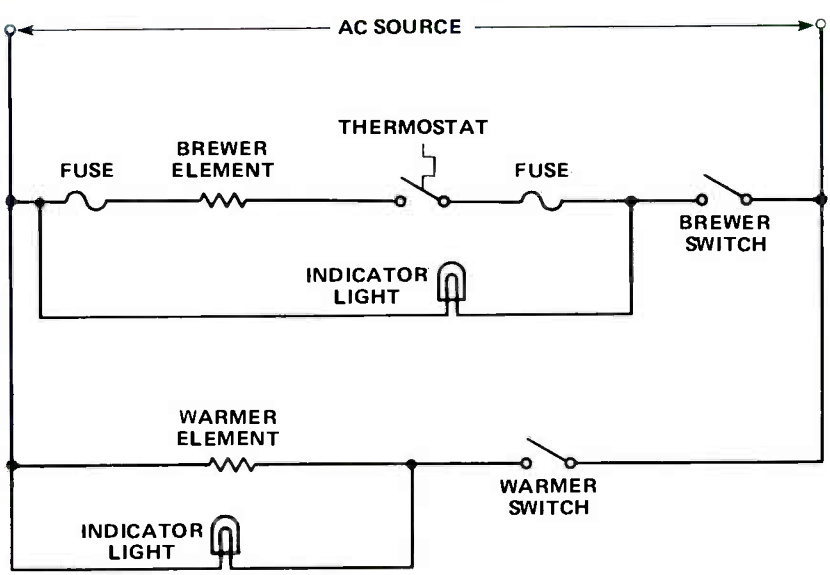


FIGURE 8. CIRCUIT DIAGRAM FOR MR. COFFEE.

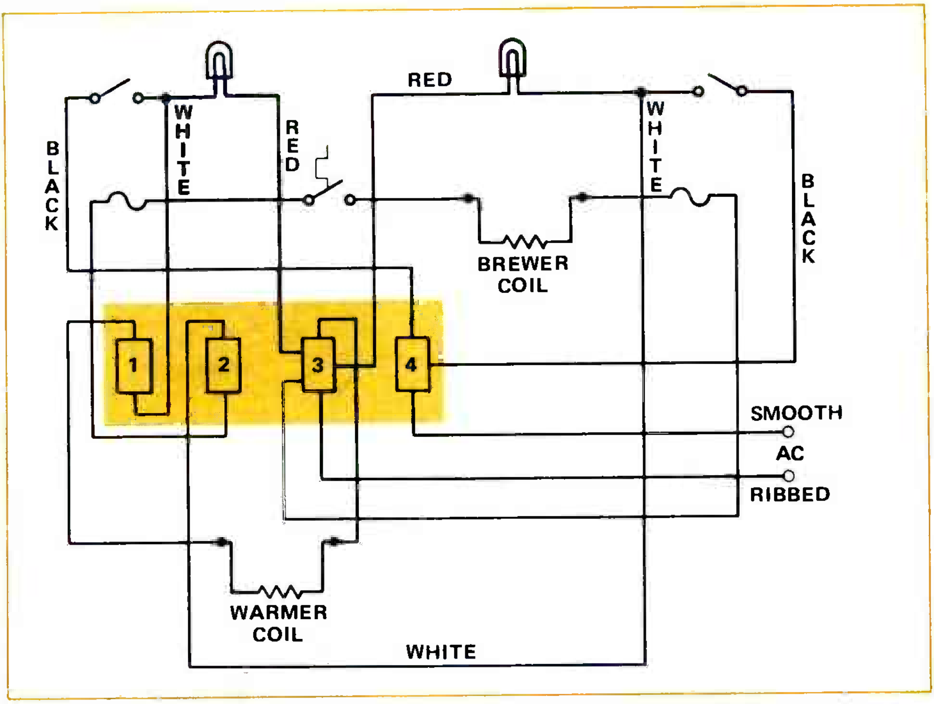


FIGURE 9. WIRING DIAGRAM FOR MR. COFFEE.

you can remove the warmer from its hotplate and pull it through with the support-plate assembly.

CIRCUIT AND WIRING

Mr. Coffee's circuit diagram is given in Fig.8, while Fig.9 gives a wiring diagram. Several points should be noted:

- **There are two elements, operated entirely independently by manual switches.**
- **The thermostat controls only the brewer element.**
- **There are two separate indicator lights, one for each switch. The brewer light does not go off when the thermostat opens.**
- **Two fuses protect the circuit in case of a ground in the brewer element.**

As noted, a polarized plug is used for Mr. Coffee and all metal parts are connected to ground. The cord is a three-wire HPN heater cord. Leads from the terminal boards to the fuses and elements are insulated with Teflon®. This material is impervious to water and will withstand a temperature of 360°F (180°C).

The connections in this circuit are made on a terminal board just behind the main heating element. As a result, the terminal board is surprisingly complicated for so simple an appliance. On

①

The ribbed side of the ac power line is connected to the bottom of terminal 3, the smooth side to the bottom of terminal 4. The green wire goes to a rivet near the left support clip. (This may be replaced with a screw and nut.) The short lead from the left-hand fuse goes under the pan to the thermostat, and a Teflon-insulated lead connects the thermostat to the left-hand heater terminal. The long wire from the left-hand fuse goes on the bottom spade of terminal 2.

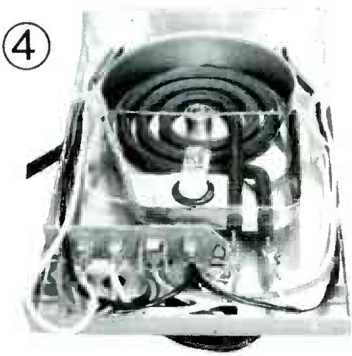
②

The brewer switch is wired by connecting the white wire to the top of terminal 2 and the red wire to the right-hand side of terminal 3. The black wire is piggybacked on the bottom of terminal 4.

③

The short wire from the right-hand fuse goes to the right-hand heater terminal. The long wire is piggybacked on the bottom spade of terminal 3. These stiff Teflon-insulated wires help to hold the plastic-insulated switch wires away from the heater coil and heater terminals.

④



The warmer switch is wired by connecting the red wire to the left of terminal 3, the black to the top of terminal 4, and the white to the bottom of terminal 1.

⑤

Bringing the Teflon-insulated warmer wires to the top of terminal 1 and the top of terminal 3 completes the wiring.

FIGURE 10. HOW TO WIRE MR. COFFEE.

this kind of board, never remove a wire without making notes on how to replace it.

The actual wiring steps are shown in Fig.10. Fitting all of the wires neatly into the space isn't easy, especially since the plastic insulation has to be kept away from the heating element and heater terminals. The photographs show how it is done for one model of Mr. Coffee. There's no guarantee that all models will always have the same wiring arrangement, so take a good look at yours before putting a wire on. However, the photographs will show you how to place the wires.

SERVICING MR. COFFEE

To begin with, voluntary recall notices have been issued for models produced in 1975, with serial numbers G through L. These models should not be serviced. The owner should contact the manufacturer for instructions regarding replacement. The address is:

North American Systems, Inc.
24700 Miles Road
Bedford Heights OH 44146

Mr. Coffee is a sturdy appliance that will operate for years without requiring more attention than cleaning as discussed earlier. Keeping a supply of glass carafes on hand is good business for larger shops.

A list of parts and parts assemblies available for Mr. Coffee can be obtained from the manufacturer or authorized repair centers. Not all of the parts are available separately. Thermo-

Troubleshooting Guide

Problem	Probable Reason	Service Needed
No power.	Line cord open; bad connection; dead circuit in house wiring.	Check connection or replace cord. Note that blown *appliance fuse* will not kill warmer circuit.
Indicator light out but the element heats.	Light burned out.	Replace.
Warmer does not heat.	Warmer element burned out.	Replace.
	Switch not closing.	Replace.
Brewer does not heat.	Blown appliance fuse; burned-out element; defective thermostat.	Replace element assembly.
Brewer heats, but coffee is too cold.	Temperature-sensitive valve not controlling flow.	Clean, or replace tank assembly.
Brewing takes too long.	Buildup of lime.	Clean element and valve.

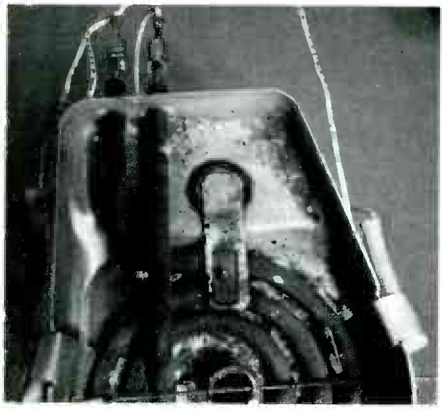


FIGURE 11. THIS ENTIRE ASSEMBLY HAS GIVEN LONG SERVICE AND IS READY TO BE REPLACED.

stat, fuses, and main heating coils are sold only in a heater block assembly.

Such parts as fuses and warming elements are available to Mr. Coffee representatives, but sales to the general public are discouraged. The manufacturer specifically disclaims responsibility for such repairs. If a part has failed after considerable time in service, the repair shop should usually replace the complete assembly.

Mr. Coffee's problems are usually caused by hot water. Metal corrodes and rubber gaskets deteriorate in this service. In the hot and steamy atmosphere, considerable rust forms on the bimetal of the valve and may close up the pinhole. The valve may not seat properly because of corrosion deposits or lime on the edges of the hole.

The brewer element and its pan shown in Fig.11 show considerable corrosion. The thermostat gasket is hard and brittle, and water has leaked through it to the underside. The appliance was brought into the shop with a blown fuse, but the technician decided to replace the entire assembly.

The various things that can go wrong with Mr. Coffee are listed in the troubleshooting guide. As you can see, the methods of repair are straightforward. They can be accomplished quickly to put the coffee maker back in action.

Almost all these problems could also be caused by a bad connection at the terminal board or by an open in the circuit. Such electrical problems should be located with an ohmmeter in the usual manner. When checking a wire for continuity, remove one end from its terminal to make sure that you do not get a false reading through a second circuit.

Once you understand the way Mr. Coffee operates, the appliance is simple to service. It can be a profitable item in a small-appliance repair business.

The Home Computer

A giant step into the future. On sale today.

Ken Bigelow

The newest appliance for the home is not a range, refrigerator, or freezer, although it can be used to maintain any desired temperature in a case, a room, or even a complete building. It isn't a sprinkler system, but it can be used to water your lawn only when needed, and as much as needed. It isn't a fire or burglar alarm, although it can be used to detect these dangers, telephone the fire or police department, and even give an appropriate recorded message. It isn't a cooking appliance, but it can produce complete menus for breakfast, lunch, and dinner, making sure that all family members eat a balanced diet. It can even keep track of the dietary restrictions imposed by complicated medical problems.

This appliance is neither a file cabinet nor an adding machine, but it can keep track of your family's finances in detail on a year-by-year basis, and maintain all the needed income tax information. Although it is neither a clock nor a calendar, it can keep a record of all your appointments and get you up in the morning to meet these appointments. It can also tell you when it's time for the children to go to bed, depending on whether or not it's a school night. It can even turn the lights off after everyone has gone to bed, or turn them on and off at irregular intervals when you go on a vacation.

Actually, this appliance can do all of these things—and more—at the same time. What is this Buck Rogers gadget? It's the new home computer, and a number of models are already available at prices as low as $600.

Originally, the home computer got its start with TV video games. Early ones were limited to one or two games which were "built in" and could not be changed. Strictly speaking, these were not computers, but were machines that consisted of fixed digital logic. However, they led to more flexible TV video games. Most of the ones available now have four to six or more games built in, often with the games in color rather than in black and white. Many video games have optional cassettes available which contain a variety of additional games. These machines are true computers, although their functions are limited to games. They are built around one of the microprocessor IC's now available, along with some control and support circuitry.

Unfortunately, TV video games are limited to playing these various games—they cannot be readily reprogrammed to do anything else. A true home computer can be programmed to perform any task the programmer chooses. The only additional requirement is an appropriate connection or "interface" between the computer and the device being controlled. Another form of interface is required between the computer and the devices used to enter instructions and data.

THE HOME COMPUTER

The simplest form of interface consists of a set of switches to enter addresses, data, and commands in binary form, along with a set of lights to display the results, also in binary form. This has been used for many years as the basic method of programming the computer. However, it is slow, tedious, and error-prone.

A better method is to adapt a typewriter, interface it with the computer, and program the computer to accept further instructions and data from the typewriter. The results of any computation would also be typed out on the typewriter. As an added bonus, a paper tape reader and punch can be included with the typewriter for the purpose of saving and entering programs and data more quickly. Unfortunately, special teleprinters to meet these requirements are expensive and therefore unsuitable for many applications including the home market. Also, many computer applications, especially in the home, do not require a permanent output. A lot of paper can be used up very quickly if no other means of output is available.

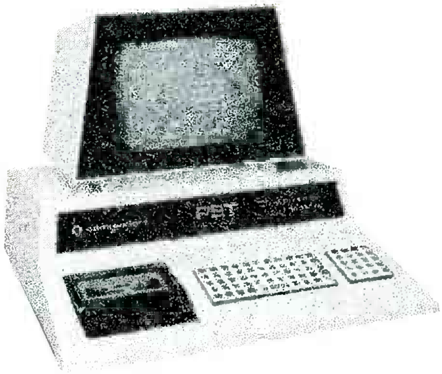
Fortunately, the same IC technology that made microprocessors and the home computer a reality has permitted a simpler, less expensive approach to input and output. The input device is still a typewriter-like keyboard, but it is encoded by a special IC into a form that the computer can understand. The output device, as with the video games, is any ordinary TV set. Another IC converts the computer's output signals into video signals to form the necessary characters.

A typical TV display will hold 16 lines of 32 characters each. This is entirely satisfactory for most home applications. Programs and data can be stored on or retrieved from standard magnetic tape cassettes, using ordinary audio cassette tape recorders. This is vastly superior to paper tape, because the magnetic tape can be reused when its existing contents are no longer needed.

Okay, now you have your home computer, complete with recorder, keyboard, and TV display. What will you do with it? Well, the possibilities are limited only by your own imagination. I realize that doesn't help much, so let's take a look at some possibilities.

A LAWN MINDER

In the beginning of this article, I mentioned a number of things that computers can do in the home, including some that might be required at any time of day or night. For example, consider the automatic sprinkler system. Ideally, each sprinkler should turn on only when the ground under and around it is too dry, and turn off again when the ground is properly watered.The exception would occur if the temperature



were too low, since that would cause ice to form. The amount of time required to turn a valve on or off by means of a computer signal is very short, and the requirement will not occur very often, so it isn't worthwhile to have the computer continually check to see if the sprinkler systems must be serviced. Instead, we can let the computer do something else most of the time, and interrupt it when the sprinkler system must be turned on or off. This gives us the following system:

- **A number of sprinklers, each of which can be turned on or off individually by the computer.**
- **A number of moisture sensors buried in the areas covered by the sprinkler heads and generating computer interrupts whenever the ground becomes either too dry or sufficiently wet.**
- **Temperature sensors to inhibit the interrupt to turn the sprinkler on, or to generate an interrupt to turn the sprinkler off if the temperature drops too low.**

KITCHEN HELPER

When it isn't turning the sprinklers on or off, the computer can be used for any number of applications. For example, how often has a person, having invited guests for dinner, decided on just the right recipe, only to discover that the recipe is designed to serve five people and there will be seven for dinner? Or, choosing the best menu may prove to be a problem. The computer can handle all of this easily, including a display of all the cooking and serving instructions. Furthermore, because the display is on a TV set, problems related to using a cookbook will be avoided. A tape cassette, holding a wide range of recipes can be inserted in the recorder. The computer can be told whether breakfast, lunch, or dinner is to be served and the number of people eating. The computer will pick a menu at random, determine the amount of each ingredient, and display the results.

HOME TUTOR

For families, the home computer can be an immensely powerful learning tool. This is as true for preschoolers as it is for school-age children, and even adults. Preschool children can have a lot of fun playing various games on the computer, and hardly realize that they are rapidly learning addition, subtraction, multiplication, and division. At the same time, they are encouraged to recognize letters and words and to spell correctly. Later, word games can be introduced to expand their working vocabulary. For school-age children, the math games get more complex, as do the word games. Of course, the computer should not be used to do their homework, but it can be used for practice on the same kind of problem.

Outside of school, regardless of the student's age, the computer can be used to assist in the learning of subjects not covered in schools. Subjects such as

Morse code can be learned much more easily by computer than by record or tape. The computer can be programmed specifically to reinforce right answers, but not wrong ones. Also, the student's problem areas are quickly pinpointed by the computer, which provides extra coverage of these areas.

Another application is in the design and/or analysis of electronic circuits, mechanical structures, etc. For example, suppose you want to build a garage or an addition to your house. Of course, the computer won't get your permits for you, but it will help by calculating the various stresses involved, determining the best placement of the foundations, and other important design considerations. In this way, the computer can help make certain that the structure will be sound and permanent.

In electronics the computer can be used either to analyze an existing circuit or design a new one. Of course, computers are used commercially for this purpose. However, electronics hobbyists can also use them at home for the same purpose.

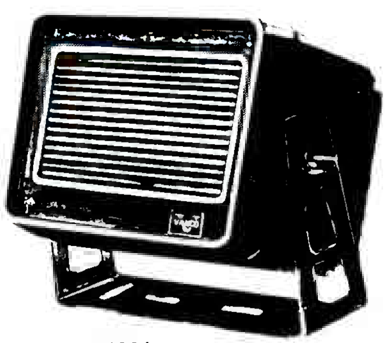
Well, I could go on and on—the list of possible applications is practically endless. When you get a home computer of your own, you will probably have your own application for it. I say "when" because although it is just getting started now, the field of home computers is likely to become as widespread as the TV set itself within the next several years. In any case, anyone who buys or builds a home computer will find that it is both useful and fun.

from CONAR...a special
CLOSEOUT SALE

CB External Speaker

A useful addition to your Citizens Band setup. At CONAR's fantastic closeout prices, you can hardly afford to pass this one up!

- Beatiful housing
- Swivel bracket
- Weatherproof
- Dustproof
- Six-foot cord with 3.5-mm miniplug
- 4-3/4" wide by 4-3/8" high by 3" deep
- Heavy four-inch speaker



Stock No.SK004

Now $6.95

Only ~~$11.95~~

LIMITED QUANTITIES

First Come, First Served!

Wayne C. Brandenburg

Television Casebook:

Practical TV Servicing Case Histories

1. AGC Circuits

The focus of the discussion in this issue is the repair of AGC circuits. First, I'll tell you a little about how typical AGC circuits work and then two stories about AGC problems I have dealt with in the past.

Virtually all television receivers have AGC or automatic gain control. It is used to automatically keep the contrast of the picture constant and, as you can tell by its name, it accomplishes this by controlling the gain of the TV receiver. Many of the signals reaching the television receiver come from different directions and over different distances. If it were not for the AGC circuitry, each channel would have a different contrast.

The most popular circuit used in modern television sets is the keyed AGC circuit. This is the best type of AGC system because it is not susceptible to noise pulses in the signal or disturbances such as aircraft flutter. In this system, the AGC circuit is on only during horizontal retrace time. Pulses are used to turn the circuit on at the same time the sync pulses arrive at the circuit. The AGC voltage developed is dependent on the amplitude of the sync pulse signal.

The AGC voltage is used to control the gain of the rf and i-f amplifiers. If the antenna signal is weak, the sync pulses will cause little AGC voltage. This action allows the rf and i-f amplifiers to run at maximum gain in order to compensate for the weak signal. When a strong signal is present, the sync pulses have a higher amplitude and the gain of the i-f and rf amplifiers will be reduced. As you can see, the action of the AGC circuit keeps the picture contrast constant, regardless of the signal strength.

Figure 1 shows a simple keyed AGC circuit. Positive pulses from the flyback are applied to the collector of the keying transistor. The pulses are necessary to turn the transistor on during horizontal retrace. At the same time, a video signal is applied to the base of the transistor. The circuit is really *keyed on* by two signals, the collector pulses *and* the sync tips. When both these signals arrive at the same time, the transistor conducts.

During conduction, the current flows from ground, through Q1, D1, and the flyback winding to charge capacitor C1 as shown. If the video signal is strong, there will be a high current flow through Q1 and a high voltage developed on C1. A low amplitude or weak video signal will cause only a little conduction and therefore very little charge on C1. So, as you can see, the AGC voltage changes as the input signal changes. C1 filters out any flyback or video signals so that the AGC voltage will be a clean dc voltage. Diode D1 prevents any discharge of C1 through the keying transistor.

I mentioned earlier that one advantage of keyed AGC is that it is not

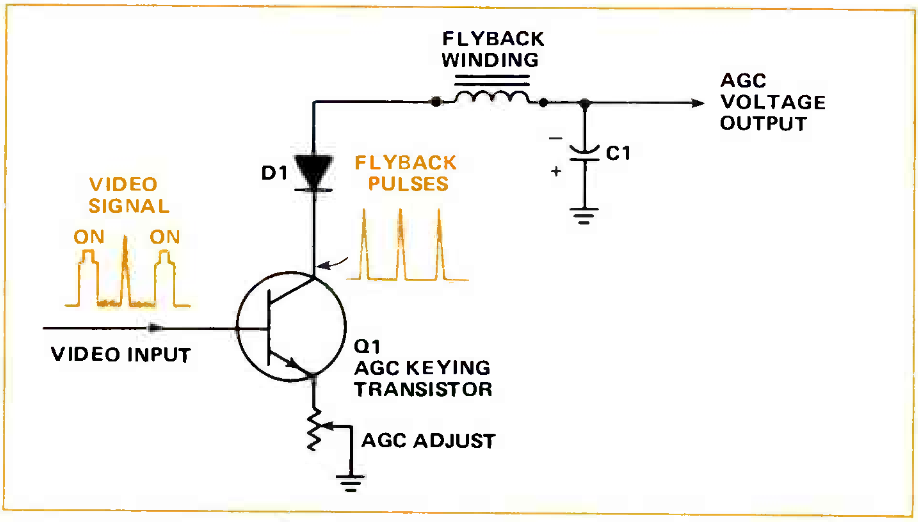


FIGURE 1. A SIMPLE KEYED AGC SYSTEM.

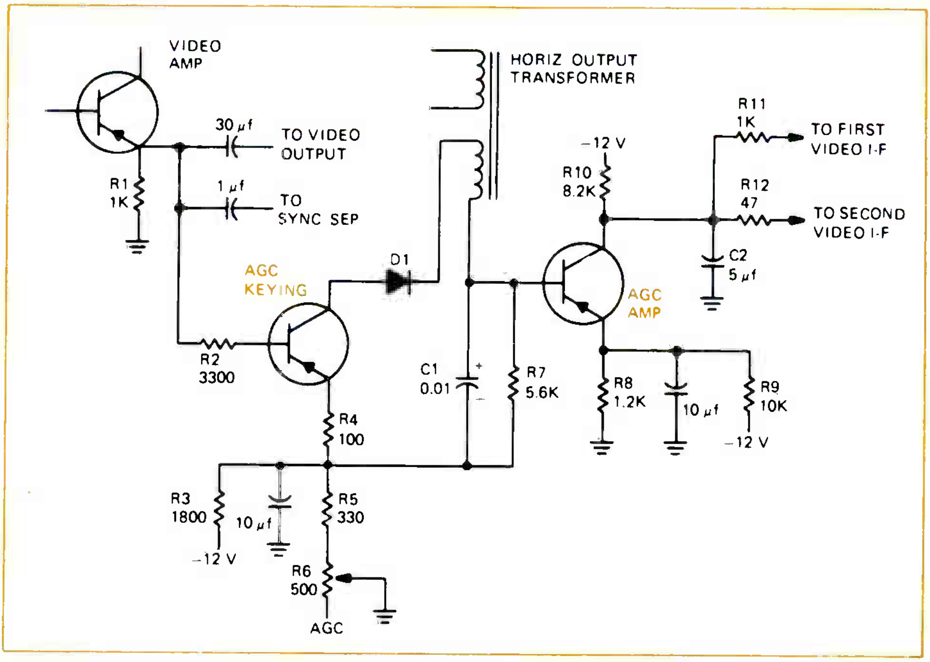


FIGURE 2. AN AMPLIFIED AGC CIRCUIT.

susceptible to noise. In Fig.1, you can see a large noise pulse in the video portion of the signal. This pulse will have no effect on the AGC voltage (or the picture) because it occurs while the transistor is off. The transistor is on only when both the flyback pulses and the sync pulses are present.

Sometimes the AGC circuit must supply a wider range of gain control than the circuit shown in Fig.1. An amplified version of this circuit is shown in Fig.2. Here the voltage developed across C1 is amplified by the AGC AMP transistor. The circuit is capable of providing gain control for several i-f and rf stages.

AGC REPAIR

The repair of AGC circuits is sometimes difficult. The rf, i-f, video, and AGC circuits form a loop that can be hard to troubleshoot. Any problem in the loop can cause the other circuits to go haywire also. Isolating the problem can be tough.

If you understand how AGC works, however, you can tell what some of the symptoms will be. Remember that the AGC voltage always reduces the i-f (and rf) gain from maximum. That means that a failure in the AGC circuit would cause the circuits to run at maximum gain. Some of the possible symptoms for loss of AGC voltage are listed in Table 1.

On the other hand, something can happen to the AGC circuit to cause excessive AGC voltage. When this happens, the gain of the i-f and rf amplifiers is reduced. This brings about the symptoms shown in Table 2.

There are two repair techniques that you can use when troubleshooting AGC

Table 1

Symptoms: Loss of AGC Voltage
1 Overloaded picture
2 Sync instability
3 Interference in picture
4 Negative picture
5 Windshield wipers across screen
6 Excessive contrast
7 Buzz in sound

circuits. One of these is voltage measurement. If you measure the AGC voltage, it should change as you switch from station to station. You can also connect and disconnect the antenna. If there is an AGC voltage change, the circuit might be working.

Check the service literature to see how much the voltage should change at the AGC test point. Whatever the range is, measure it to be sure it is correct.

Some checking can also be done with an oscilloscope. Figure 1 shows three of the important places to check when you think you have AGC trouble. In order for the AGC circuit to work, the keyer transistor must have both keying pulses and a composite video signal. Use the oscilloscope to check for the keying pulses at the collector. If the pulses are all right, then look for the video signal at the transistor base. Remember, both signals must be present for the circuit to work.

Use the oscilloscope to check the AGC voltage at C1. Because of the filtering action of C1, the oscilloscope should show nothing but a clean dc voltage. An open C1 would cause many pulses and other undesirable signals to be present. Remember that this voltage is to be applied to the i-f amplifier. Any ac signal on the AGC voltage will be amplified and will show up on the TV screen.

If you encounter AGC troubles in a circuit that has a wide AGC range, you can use a bias box. The bias box is simply a small variable dc power supply. You hook it to the AGC testpoint, adjust it to the correct AGC voltage, and see if the set works. I-F amplifiers that only need a change of a few tenths of a volt cannot be checked this way. The bias box will not adjust that closely.

Whenever you service a television receiver, adjust the AGC control. Usually the manufacturer gives a specific procedure for this. With the control set at maximum, the picture on the TV screen will appear very weak or will be absent entirely. Setting the control to minimum will cause an overloaded picture and sync instability on strong stations. If you can adjust the AGC control so that you have good contrast and a stable picture on all channels, you have it set right.

A "CRAZY" TV

When this customer called about her TV, she would refer to it as "the crazy TV." She used this name because the set would play fine for a long time and then it would go "crazy." I went out to her house three times to see these "crazy" symptoms, but every time I was defeated. On the first two visits the

Table 2

Symptoms: Excessive AGC Voltage
1 Picture and sound cut off
2 No snow on screen when off station
3 Weak contrast
4 Washed-out color
5 Poor sound
6 Poor sensitivity to distant stations

television set was working fine and I could not get it to break down. On the third visit, it was misbehaving but as soon as I started to remove the back, the problem cleared up.

However, while the TV was acting up, I did get a chance to see the symptoms and they were indeed crazy. The set had lost convergence. The three electron guns did not produce three overlapping pictures. What they did produce was three different color pictures that were at least one-half inch out of alignment with each other.

To complicate matters, the color was out of sync. This caused a barber-pole or colored-rainbow effect. Also, I noticed that the picture was overloaded and kept falling in and out of sync. Besides that, the adjustment of the AGC control was extremely critical. CRAZY!

I took the set back to the shop. Here is a list of the symptoms in more technical terms. What do you think could cause them?

1 Poor convergence
2 Color out of sync
3 Overloaded picture
4 Sync instability
5 Critical AGC adjustment
6 All of the above come and go intermittently.

I decided to look at the AGC circuit first because symptoms 3, 4, and 5 seemed like AGC problems. Also, I remembered what an old-timer once said: "AGC circuits are crazy circuits and produce some crazy symptoms." This set certainly qualified.

My first test was to connect a bias box to the AGC testpoint and adjust it to the voltage shown on the schematic. When I did this, two of the symptoms went away. The picture became stable and had the proper contrast. The set still had a color sync and convergence problem. I decided that this was a place to start and got out my oscilloscope.

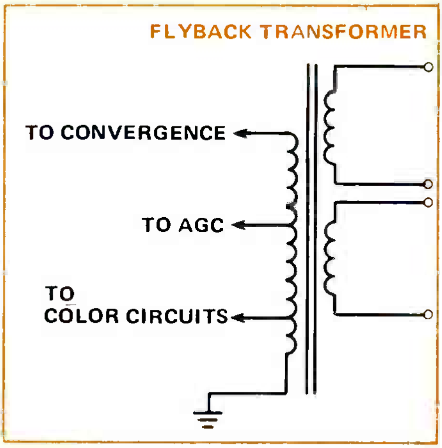


FIGURE 3. ONE WINDING ON THE FLYBACK SUPPLIES HORIZONTAL PULSES TO MANY CIRCUITS.

When I hooked up the scope, all the problems disappeared again. Even with the bias box disconnected, the set worked fine. This made me angry. While I was angry, I found out that banging on the chassis would make the problems come and go. Very interesting!

With the scope connected to the base of the AGC keying transistor, I found that the video waveform was normal. When I checked the flyback keying pulse, however, it was at least three times as large as that shown on the schematic. I hoped the schematic was not in error.

I followed the line on the schematic to the source of the pulses, which was the flyback transformer. Figure 3 is what I saw. I was excited! Figure 3 shows a flyback winding that supplies pulses to the AGC, color and convergence circuits. All of the symptoms of the "crazy TV" could be caused by this winding. In checking with my ohmmeter, I found that the bottom of the winding was not grounded. It was connected to a lug on the side of the flyback frame, but it was not soldered.

When I wiggled this wire with a screwdriver, the symptoms would come and go. After I soldered the wire, the television worked great. When I was finished, I said, "These AGC circuits are some crazy circuits and produce some crazy symptoms."

Incidentally, here is what the customer paid for the "crazy" TV repair job:

Service call	**$17.50**	Home service charge
Pickup/delivery	**10.00**	Additional charge for two-person pickup
Parts	**8.95**	Installed a new blue lateral magnet
Labor	**37.50**	The shop's flat rate charge for color TV
Total	**$72.95**	

THE CALL BACK

Another customer carried his portable color TV into our shop. He said he had just picked it up a week ago and it had since broken again. The customer left (a little warm under the collar) and I decided to look at the set right away. This is generally our policy for call-backs. Fix them first because the customer has already paid the bill and been inconvenienced.

I remembered repairing the set. It came in with a match pack jammed under the channel selector knob to keep the picture working. I recognized this as a dirty tuner. I took the set apart, cleaned the tuner, and it worked fine. I even installed a cleaning pad that will keep the contacts clean for a long time.

This time when I looked at the television, it definitely had a problem, but it was not being caused by a dirty tuner. The picture was normal on the right side of the screen, but the left side was shaded almost black. I was puzzled.

I connected the oscilloscope to the delay line to look at the video signal. As I suspected, the signal was distorted on one side as though horizontal pulses were getting into the video somehow. I followed the signal all the way back to the video detector. Here, I switched to a detector probe (I knew I would use it someday!) and followed the signal back to the input to the i-f amplifier. I could not imagine how a high-level horizontal pulse could be present at the input to such a low-level amplifier.

I unplugged the tuner cable, but the

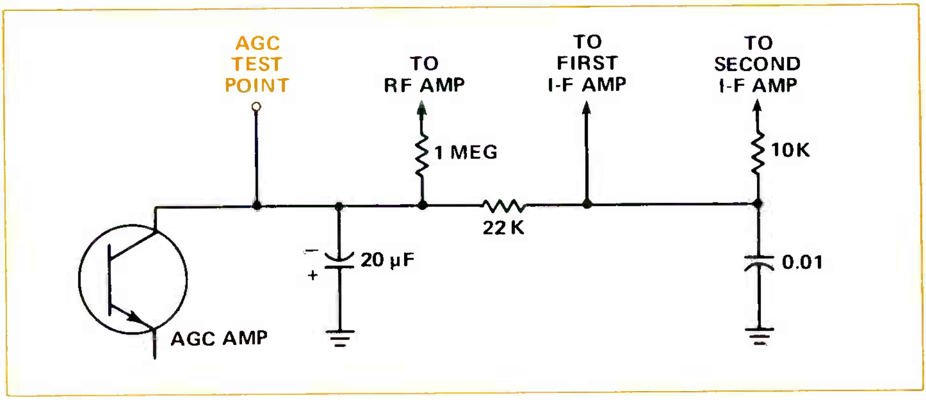


FIGURE 4. THE AGC TEST POINT.

raster was still shaded. Then I remembered that the first i-f amplifier has its base connected to the AGC circuit. I put the probe on the AGC test point and the signal was here also.

In checking the schematic, I saw what is shown in Fig.4. I couldn't find anything that would indicate that a waveform should be on the AGC test point. Also, there was the AGC filter, a 20-μF capacitor that should have eliminated any stray pulses.

I replaced the 20-μF capacitor and the set worked fine. I charged the customer $3 for the part and lost an hour's time. Do you think that the customer should have paid for the repair?

OPTOELECTRONICS

Harold J. Turner, Jr.

First of all, just what is optoelectronics? Briefly, optoelectronics is the area of science in which the principles of electronics meet those of optics. As you know, optics is the science of light and vision. An optoelectronic device is an electronic component in which light production or light sensitivity is an important characteristic. Optoelectronic devices can be grouped into three general categories: devices that produce light; devices that are sensitive to light; and electrical isolation devices that use light as a coupling medium. Let's look at these three areas and see what types of optoelectronic devices are in use in modern-day electronic equipment.

LIGHT EMITTERS

Traditional electrically operated light emitters include incandescent lamps where light is produced by the heating effect of an electric current in a filament; gas-discharge lamps, where light is produced by ionizing certain types of gas such as neon; and fluorescent lamps, where light is produced by bombarding a phosphorescent coating with electrons. When we speak of a light emitter in the modern sense, however, we are speaking of the light-emitting diode (LED). Just as its name says, the LED is a semiconductor diode that emits light when current is passed through it. Several LED's are shown in Fig. 1.

Most present-day LED's emit a red light. The color of the light produced by a LED is a function of the materials and processes used in its fabrication; diodes emitting red light are the easiest and consequently the cheapest to make, and are therefore the most popular. However, even now green and yellow LED's are available, and within a few years

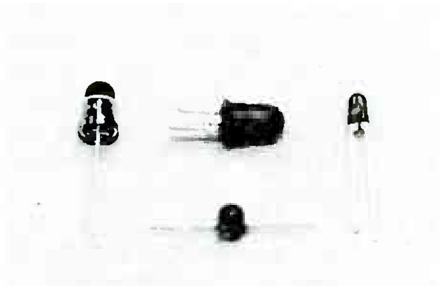


FIGURE 1. AN ASSORTMENT OF LED DEVICES.

may be priced competitively with the red emitting types. In addition to those LED's that emit visible light, there are those that emit infrared radiation, which is still a form of light, even though it is not visible to the human eye. Such LED's are used in optical coupling devices and in optical communications systems. Their output must be converted back to an electrical signal with a photosensitive device in order to be useful.

Although the light-emitting ability of an LED sets it apart from the garden-variety diode, the electrical operation of the LED is very similar to that of an ordinary silicon diode. Figure 2 shows the voltage-current relationship in a typical LED. All LED's emit light only when the diode junction is forward-biased. Light output is directly proportional to current through the device in the forward direction. The typical LED diagrammed in Fig.2 has a saturation voltage of 2.0 volts, and is shown operating at a forward current of 20 milliamperes.

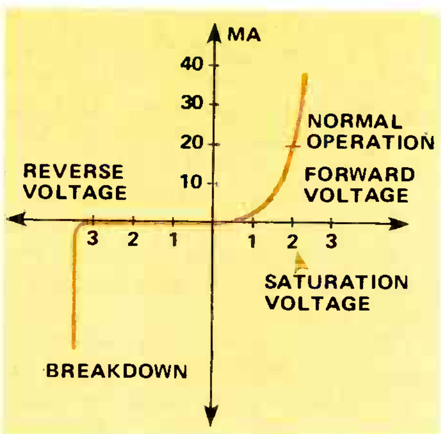


FIGURE 2. E-I CURVE OF TYPICAL LED.

Since the LED is a current-operated device, it cannot be connected directly across a source of voltage, or current will be excessive and the diode will quickly self-destruct. Some means of current limiting is essential. Usually this is simply a resistor connected in series with the LED. For example, if the diode of Fig.2 were to be operated from a 5-volt source, 3 volts would have to be dropped across the current-limiting resistor, at a current of 20 milliamperes. Using Ohm's law ($R = E/I = 3/0.02$), we see that the resistance would have to be 150 ohms.

LED's, or solid-state lamps, as they are sometimes called, have many advantages over older types of lamps. Among these are virtually unlimited life, high efficiency, narrow spectral range, and extremely fast turn-on and turn-off times. This last advantage becomes a particularly important one when it comes to optical coupling devices.

LIGHT-SENSITIVE DEVICES

Older types of photosensitive electronic devices include photomultiplier tubes and photoconductive cells (sun batteries). In the world of modern electronics, however, when we think of photosensitive devices, we think of such things as photodiodes, phototransistors, and photodarlingtons. Some manufac-

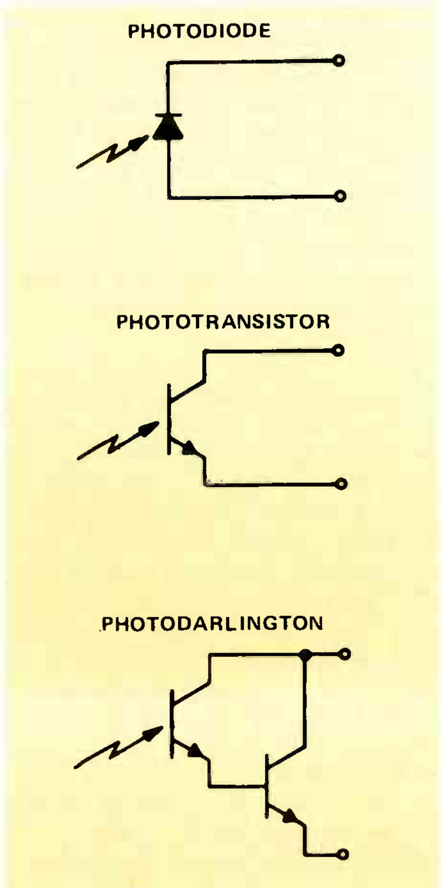


FIGURE 3. SOME COMMON LIGHT SENSORS.

turers even make such things as light-sensitive FET's and SCR's. The three most popular types of light sensors are shown in Fig.3. Each type has its advantages. In general, the higher the efficiency, or amount of output for a given input of a photodetector, the slower its speed of response. For example, the photodiode is the fastest of the three devices shown, with speeds in the 0.01-microsecond range, but its efficiency is very poor. Several stages of amplification are usually necessary before the signal can do useful work. The photodarlington has high gain, but it suffers from slow response, typically on the order of 50 microseconds. The phototransistor is the most popular of the three, as it offers good efficiency with moderate (1-microsecond) speed.

The photodetectors mentioned here can be used as a sensing element in industrial process control equipment, or as a motion detector in a burglar alarm system, in much the same way as older light-sensitive devices are used. But because of the high speed of response of these photodetectors, they are also useful in handling signals up into the megahertz region, either as a part of an optical isolator, or as the receiving end of an optical communications system.

OPTICAL COUPLERS

Now that we have briefly discussed the properties of light-emitting and light-sensing devices, let's put the two of them together into a single device: the optocoupler, or opto-isolator, as it's sometimes called. Figure 4 is a photograph of a typical optocoupler. The particular device shown is in a six-lead dual-inline package, roughly half the size of a standard dual-inline integrated circuit. Two of the pins along one side are connected to an internal LED, the third pin is unconnected, and the three pins on the opposite side are connected to a phototransistor. In some applications a connection is made to the base of the phototransistor for biasing purposes, but the base lead is usually left unconnected.

There are many applications in modern electronics where high- and low-frequency signals must be passed from one circuit to another while maintaining isolation between the two circuits because of operating voltage levels or grounding problems. One example

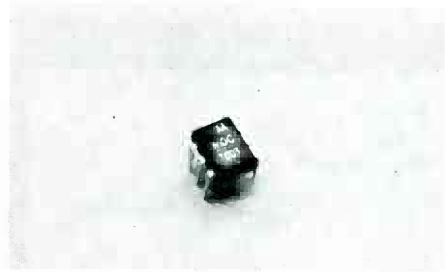


FIGURE 4. A TYPICAL OPTOCOUPLER.

would be in a data link between two pieces of digital equipment. Transformer or capacitor coupling are useless because they will not allow passage of extremely low-frequency signals. But the optocoupler has frequency response all the way down to dc. In other words, if the LED is on, the phototransistor is turned on, and will remain so indefinitely, as long as the input LED is on.

Another example would be the coupling of blanking pulses from the low-voltage signal circuits of an oscilloscope to the high-voltage CRT circuits. Since a square wave must be passed, good response is needed at both very low and very high frequencies for faithful reproduction of the input signal. And, since there may be 2000 volts or more difference between the two circuits, isolation is a must. The tiny device shown in Fig.4 can be operated at voltages up to 2500 volts.

In this article we have attempted to bring you up to date on what's going on in optoelectronics. For more information on this fascinating subject, we suggest *LED Circuits and Projects* by Forrest M. Mims III. This Sams book, #21006, is available for $4.95 from NRI's Conar Division, or from any Sams dealer.

EDWARD P. BRADY

CB – 2-WAY RADIOS
SALES – SERVICE – INSTALLATIONS

48 Linton Avenue
Albany, N.Y. 12205

Phone 459-5141

NRI Schools
3939 Wisconsin Avenue
Washington, D.C. 20016

Dear Sir:

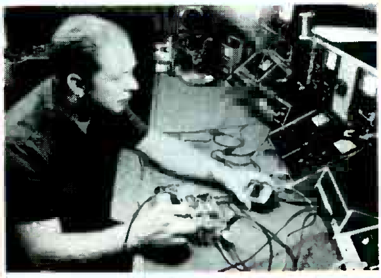
As a graduate of your Aircraft Electronics course, I have found your training most valuable. It has enabled me to start and operate a part-time two-way radio repair shop, serving CB, Marine and other two-way radios. My shop has been in operation about 14 months and gets more successful each month.

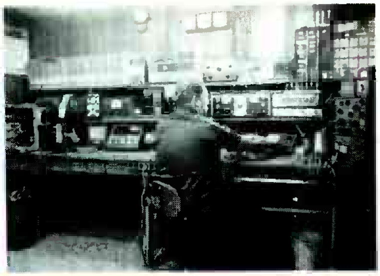
Most of the operation is devoted to service, but I do some sales and installation. It is amazing how much service work there is to be done, and without even advertising. Word of mouth from one customer to another seems to bring me all the business I can handle. I have not spent one cent on advertising, yet I spend between 30 and 40 hours a week in the shop, which is located in my home. I think this speaks well for NRI training.

Sincerely,

Edward P. Brady

AC73-R427G





Honors Program Awards

For outstanding grades throughout their NRI courses of study, these January and February graduates were given Certificates of Distinction with their NRI diplomas.

WITH HIGHEST HONORS

John F. Barrett, Bloomington IN
Carl Bigham, Sr., South Houston TX
Dennis G. Block, Ortonville MN
Joseph Brady, Ottawa ON Canada
Charles E. Brosche, Hamburg NY
William W. Brown, Asheville NC
T. E. Byerley, Stone Mountain GA
Ron Capelle, Mandan ND
James C. Cook, Bloomingdale GA
Calvin L. Creamer, Odessa TX
James E. Deadwyler, Gainesville GA
Rosario Di Fiore, Utica NY
Larry A. Doyle, New York NY
Kenneth A. Dusenberry, Virginia Beach VA
James P. Farley, Arvada CO
Robert E. Farley, Cameron LA
Samuel H. Fuller, Jr., Pittsburgh PA
Peter J. Gordon, Havertown PA
James D. Harvey, Walnut Creek CA
Robert T. Heffner, Virginia Beach VA
Richard W. Holt, Saint Paul MN
Willie J. James, Loris SC
Mitchel Jones, Harrison OH
Henry F. Key, Mantua OH
Kenneth K. Kinsey, Paradise PA
George Krajnik, Bridgeport PA
Lawrence M. Lampl, Bucyrus ND
Larry R. Mack, APO San Francisco
James C. McCarrier, Granbury TX
James T. McDonald, Mary Esther FL
Thomas L. McQueary, Arlington TX
John M. Millard, Cambridge ON Canada
Ralph R. Morley, Norwalk CA
Donald R. Morrison, Royal Oak MI
Francis Murphy, Gilbertsville NY
Melvin L. Newton, APO San Francisco
Cecil P. Norrad, Rothesay NB Canada
James A. Ojerholm, Auburn MA
Charles L. Otter, Baltimore MD
Frank T. Piecyk, Jr., Ardmore PA
Ronald A. Richard, APO New York
Richard Ryan, III, Cuero TX
Frank Sabbarese, Brooklyn NY
Peter U. Sinison, Ventura CA
Richard W. Sholly, Glen Burnie MD
Walter G. Soucy, Bayville NJ
Arthur K. Stone, Jr., Winchester KY
Everett R. Thompson, Chittenango NY
Eugene J. Triplett, Flint MI
Ronald K. Vigue, Camp Pendleton CA
George B. Wakefield, Dexter ME
James E. Weimer, Manassas VA

WITH HIGH HONORS

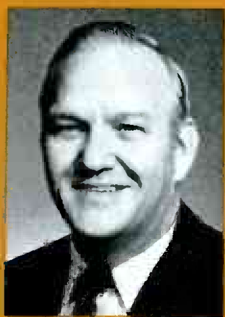
Joseph C. Abramavage, APO New York
Donald T. Adams, Salmon ID
Lonnie Adams, Jr., Nashville TN
Wilbert J. Adams, Sr., Galliano LA
Michael P. Agner, Leesville LA
John B. Airola, Springfield VA
Arthur T. Anstiss, Las Vegas NM
Robert C. Armstrong, Saratoga Springs NY
William D. Ashworth, Sand Springs OK
Russell W. Ault, Westport WA
Wayne M. Ault, Livonia MI
Scott D. Bailey, Juneau AK
Paul R. Balliett, Tiffin OH
Ronald L. Barnhart, Delaware OH
Kenneth H. Barz, Knoxville IA
James Battist, Pembroke ON Canada
Raymond I. Beeman, Watertown CT
James R. Berg, North Massapequa NY
Lawrence W. Berry, Connelly Springs NC
J. D. Bland, Virginia Beach VA
Timothy Blanton, Gratis OH
Wm. S. Blazyk, White Sands Missile Range NM
Angel L. Bou, Bayamon PR
Archibald C. Boyd, Exeter PA
Gerald W. Bozarth, Elizabeth CO
Marvin J. Breitkreutz, Vernon BC Canada
Thomas M. Bridges, Fort Thomas KY
Lester L. Brown, Jr., Baltimore MD
Stewart L. Bunnell, Springville TN
James J. Burger, Rochester NY
Vernon Button, Allegany NY
A. P. Caldwell, Jr., Covington VA
Bernard G. Campbell, Brandon FL
Mark A. Carlson, APO New York
Patrick L. Carolan, Stewartville MN
Noel L. Carrigan, O'Fallon IL
Orvill C. Clark, Albuquerque NM
Robert M. Clark, Vienna VA
Anthony J. Colasante, Williamstown NJ
Jackie R. Cole, Cockeysville MD
Douglas E. Cooper, Foley AL
Charles R. Coy, Avonmore PA
Richard J. Crawford, Rome NY
Ernest Cruz, West End NC
Charles Currier, Coral Gables FL
Troy J. Curry, Columbia TN
Thomas A. Dailey, Oakhurst CA
Robert J. Dalton, Little Catalina NF Canada
Roland De Blois, Lewiston ME
Anthony J. Del Prince, Ashtabula OH
Ronald A. Desantis, Bristol CT
Thomas J. Dini, Fort Wayne IN
William J. Dobransky, Ozark AL
Roy M. Duke, Jr., Washington NC
Leonard R. Dunn, Fullerton CA
Michael W. Eklind, Lisbon ND
Richard C. Engledow, Luling TX
Wayne L. Farley, Dayton OH
James D. Foucaud, Northford CT
James J. Franklin, Mill Spring MO
Joseph B. Furno, Iron Mountain MI
Luis R. Gonzalez, Rio Piedras PR
Wendell G. Goodwin, Pefferlaw ON Canada
Lawrence H. Gould, New Carlisle OH
James O. Grimm, Severn MD
Gary L. Grover, Garland UT
Phillip R. Gunsul, Aurora IL
George W. Hallgren, Potomac MD
William T. Hamer, Jr., Bennettsville SC
Eugene A. Harlow, Roanoke Rapids NC
Robert C. Harriff, Webster NY
Nolan F. Haynes, Charleston WV
Lee D. Heiney, Coopersburg PA
Anders C. Hellstrom, Jr., Virginia Beach VA
Ronald E. Herring, Altus OK
Steven A. Herron, Mountain Home AR
John H. Heyman, Rochester PA
George C. Higgins, Jr., Silver Spring MD
Arnold E. Hoelke, Douglas ON Canada
F. A. Holt, Lyons IL
Thomas W. Horton, Glen Mills PA
Harold A. Hubbard, Vidor TX
Lloyd B. Hudson, Farmington NH
William S. Hutchinson, Temple Hills MD
John G. Hynes, Cornwall on Hudson NY
Larry W. Izer, Williamsport MD
William J. Johnson, Bloomington IL
Roy T. Jolliff, Kansas City KS
Ken Joyce, Fort Erie ON Canada
Floyd F. Denyon, Selma OR
Theodore A. Kessel, Dublin CA
Roger A. King, Tennyson IN
Jack Kline, Berkeley IL
Eugene P. Kriz, Lake Mills IA
Philippe M. Lapalme, Sudbury ON Canada
Lawrence C. Lashley, Jr., Shreveport LA
Eugene A. Leary, Round Hill VA
Leo E. Le Blanc, Laval PQ Canada
Ralph Ledesma, St. Louis MO
Philip M. Lee, Cokato MN
Dwight F. Lile, Sr., Louisville KY
Tony Liu, Albuquerque NM
Jack J. Lively, Spring Valley CA
Kenneth A. Longo, Pease AFB NH
John D. Loop, Wheaton IL
Jackson C. Lynes, San Diego CA
Thomas J. Maher, Savannah GA
Robert B. Malone, Fort Leavenworth KS
John Logan Marsh, Jr., Salem IL
Jesse E. Martin, Catawba NC
Edward D. Matsalla, Medicine Hat AB Canada
Ernie C. McDaniel, Mt. Vernon MO
Robert S. McGilvray, Sioux Falls SD
Thomas R. Melee, FPO San Francisco
Thomas F. Mezynski, Jr., Carnegie PA
Mitchell E. Miles, APO San Francisco
Robert R. Miller, Bethlehem PA
Constantino S. Montalban, Santa Clara CA
Ronald S. Montgomery, EWA Beach HI
Charles E. Moore, Pittsburgh PA

B. P. Moran, Radford VA
Roger Nelson, Mc Guire AFB NJ
Richard C. Niemtzow, Galveston TX
Francis F. Novack, Santa Maria CA
Richard R. Oestreich, Milwaukee WI
Matthew Oliver, Las Vegas NV
Wes Osborne, Lauderhill FL
Donald L Oser, APO New York
Gary D. Overacker, North Las Vegas NV
James S. Owens, Jr., Flanders NJ
Wayne N. Parker, Stafford TX
Donald W. Partlo, Appleton WI
Harold H. Paulsen, Alto MI
Albert Pelate, Granite City IL
Armando F. Perez, Lackawanna NY
Carleton A. Pitts, Fort Lauderdale FL
Timothy Powell, Kingston, Jamaica
Kenneth A. Ratfield, Marengo IL
Raymond J. Reksc, Amsterdam NY
Alvin L. Rhoads, Summerville OR
Russell R. Rice, Jr., Roodhouse IL
Glen L. Riden, Jr., Newport News VA
Santos Rivera, Jr., Austin TX
Thomas C. Robertson, San Antonio TX
Authur C. Robinson, Milwaukee WI
Harold J. Rogers, Cypress CA
Ronald E. Rosser, East Gary IN
Steven L. Salenski, Yukon OK
George Salvador, Victoria BC Canada
Thomas R. Schaffer, Lubbock TX
Richard L Schell, Chesapeake VA
Otto W. Scheller, Jackson MS
Dennis L. Schepker, Astoria SD
Henry T. Schick, Katy TX
John K. Scott, North Clarendon CT
William A. Shook, Fenton MI
Gary P. Siesko, Berwick PA
John N. Sikes, Stansbury Park UT
Harry E. Spencer, Henderson NV
Timothy A. Spencer, Continental OH
Robert R. Spinelli, North Miami FL
Michael E. Stevenson, Irma WI
Richard R. Strack, Southbridge MA
Richard E. Strycker, Goshen IN
C. Lorne Strynadka, Vernon BC Canada
Allen W. Stuart, Jacksonville Beach FL
Bernard D. Stull, Fort Meade MD
Thomas G. Symon, Chicago IL
Louis F. Tate, District Heights MD
Ira H. Thomas, Okeana OH
Carol Thompson, Madison WI
Albert S. Tingley, Glendale AZ
Paul A. Tornavacca, Muscle Shoals AL
A. P. Van Den Heuvel, Arlington Heights IL
David Wagner, Lake Delton WI
John W. Waschek, Slatington PA
Ronald J. Weber, Hartland WI
Paul R. Wert, St. Petersburg FL
Robert H. Whiteley, Englewood CO
Ernest L. Williams, Fort Bragg NC
James R. Wilson, Flushing MI
Arthur T. Winters, Waterville ME
John H. Wong, Montebello CA
Clarence H. Wright, Clarksville TN

WITH HONORS

Argeo H. Aguilera, Bronx NY
James L. Albright, Topeka KS
Jimmy D. Allred, High Point NC
Kenneth D. Armbrust, Buhler KS
John M. Augustine, Louisville KY
William B. Bailey, Prince George VA
Kenneth Baker, Springfield IL
Donald L Banacka, Fremont MI
Robert R. Bane, Pittsburgh PA
Dennis W. Batey, Flint MI
Leonard A. Beach, Hopewell VA
Howard R. Beasley, Benson NC
Ray F. Beatty, Jr., Nashville TN
James B. Black, Brushton NY
Michael Black, Hennepin IL
Harry B. Blackston, Long Beach MS
Jon F. Botsford, College Station TX
Cecil L. Bowman, Elmsdale NS Canada
Mike Boyachek, Saskatoon SK Canada
Scott D. Brainard, Lewiston ID
James Buzzelli, Mt. Airy MD
Ernest H. Calahan, Yakima WA
Gary F. Caldwell, Mc Connell WV
Harold L. Calkins, Jr., Chalmette LA
Paul L Campbell, Mc Mechen WV
Joe D. Cannon, K I Sawyer AFB MI
Dennis L. Carrington, Peoria IL
Vernon L Carrothers, Jr., Sacramento CA
Robert L. Cash, Jr., Pekin IL
Ray M. Castleberry, Miami FL
August J. Catanzaro, III, Chalmette LA
Oliver L. Caywood, Sandy OR
Chris B. Chamberlain, Lakeland FL
Roger E. Chapman, Jr., New Castle DE
Raymond D. Cheek, Oxon Hill MD
Gary J. Clark, Livonia MI
Philip B. Clegg, West Hartford CT
Surjeet S. Colosie, Toronto ON Canada
George W. Cope, Shawnee OK
John H. Cox, Chicago IL
Eileen B. Crinnian, Lake Hopatcong NJ
Garry L. Croston, Philippi WV
Joe L. Crump, Mexico MO
Jack A. Currey, Choctaw OK
Phillip A. Curtis, Point Pleasant WV
Stanley C. Cybulski, Dupont WA
David N. Czewski, Bad Axe MI
Garry W. Damron, Doran VA
Bobby E. Davis, Boise ID
William Wallace Dennie, Frederick MD
Dale E. Detrich, Attica OH
Gregory S. Diehl, Honolulu HI
Eunicio DiMeo, Philadelphia PA
Rogelio B. Dineros, National City CA
Raymond J. Dobroski, Follansbee WV
Jerry Dolson, Jackson MI
David M. Doty, Mount Morris NY
Bernard J. Downey, Bayshore NY
Fred K. Eldred, Seaside OR
Charles W. Elliott, Spencerville IN
Steven A. Enzukewich, Homestead AFB FL
Rob Fearn, Plano TX
Charles G. Feltes, Milwaukee WI
Robert J. Ferenschak, Miami FL
Robert L. Ferrell, Junction City KS
Brian M. Folstad, Glenburn ND
John Forgey, Jr., Phoenix AZ
Raymond D. Foster, Hurst TX
Robert Standley Fox, Ford City PA
Lewis W. Frederick, Guadeloupe Neth Antilles
Robert A. Gamache, Bristol CT
James W. Giles, Jr., Bellaire TX
Charles A. Gillenwater, Harrisburg PA
Phillip C. Glass, Fort Leonard Wood MO
Colin B. Gordon, Fort Sill OK
Peter W. Gotay, Gainesville GA
Jeffrey H. Grass, FPO Seattle
Gary L Grunow, Fort Richardson AK
Albert Hall, South Hadley Falls MA
Philip Paul Hart, Lauderdale MS
Larry E. Henderson, Dayton OH
Michael T. Hickman, Wellsville OH
Bruce M. Hilton, Jacksonville NC
Roscoe H. Hinkle, Anson TX
Roger T. Hinton, Jacksonville FL
Paul K. Hollifield, Erwin TN
Richard D. Horn, Doraville GA
Joseph M. Hughes, Altoona PA
Wilson Ishida, Marion OH
Foster E. Johns, The Dalles OR
Armando H. Jones, Ogden UT
Kirby D. Jones, Lisbon Falls ME
Michael E. Jones, Kirksville MO
Randy L. Jones, Sayre OK
La Vern Kauth, Bloomfield NE
James W. Keech, Camp Springs MD
Duane D. Kelley, New London IA
Steve E. Kelley, Orient Hill WV
William K. Kennedy, Bristolville OH
Raymond L. Kentner, Broomfield CO
John F. Ketchum, Baltimore MD
Charles F. King, Grand Rapids MI
Samuel K. Kissi, Philadelphia PA
Lloyd G. Knettel, Cleveland OH
Dave F. Koch, Avoca PA
Henry J. Koehler, Hillsboro OH
Donald F. Kosling, Southampton PA
Edward E. Kratzberg, Laclede ID
Travis C. Kukor, Jackson MS
Eugen Kurylo, Saskatoon SK Canada
John Larribeau, Ellsworth AFB SD
Paul H. Lee, Century FL
Kenneth G. Leonard, Redwood City CA
Paul A. Lindenstruth, Cleveland OH
John W. Lips, FPO New York
Moses L. Little, Chesapeake VA
John A. Lowther, Lost Creek WV
Murray J. MacInnis, Toronto ON Canada
William Martinson, Hawkins WI
Floyd E. Mason, Brooklyn NY
Willard J. Mattingly, Linwood NJ
Kenneth W. McClane, Winnfield LA
Geoffrey McElven, Florence NJ
Earl J. McMinn, Morgantown WV
Steven J. Mendygral, Elk Grove Village IL
William J. Miller, Jr., Texarkana AR
Wilfredo Miranda, Bronx NY
Raymond A. Mitschke, San Diego CA
Graham Mittlestadt, Eau Claire WI
Donald M. Mothershed, Shalimar FL
Wallace A. Marry, Jr., Metairie LA
Jose R. Nevarez, San Juan PR
Donald A. Nicholls, Plain City OH
Henry E. Northrop, Yonkers NY
Frank L. Nott, Kinsman OH
Thomas R. Opperman, Monroe MI
Rene Ouimet, Vankleek Hill ON Canada
Carroll M. Pasley, Emmett ID
Michael L. Pavlichek, Novi MI
John D. Paxinos, Goldsboro NC
Richard F. Pettey, Pasco WA
John W. Pierce, San Diego CA
Charles N. Poulicakos, Manchester NH
Joseph Powers, Homewood IL
Dennis J. Rao, Hopewell Junction NY
Charles J. Ribelin, Oklahoma City OK
Richard A. Robinson, Biglerville PA
Paul G. Rogati, Essex MA
David G. Roy, Zion IL
Dennis R. Rueger, Mount Vernon IN
Albert B. Ruhl, Rock Hill MO
Burchardt Rupersburg, Jr., Mount Clemens MI
Paul E. Russell, Virginia Beach VA
Richard C. Salerno, Scarsdale NY
Wilfred A. Schmidt, New Braunfels TX
Desmond E. Schulemann, Huntley IL
Albert S. Scott, Jr., Fort Lee VA
William B. Sheaves, Jr., Colorado Springs CO
Joseph M. Shurgot, Hickam AFB HI
Gene Graig Sims, Fritch TX
David E. Skinner, Shenandoah IA
Clifford M. Slack, Ravenswood WV
Dennis A. Smith, Albert Lea MN
Willard J. Smith, Royal Oak MI
Arthur P. Smolinski, Rome NY
Ronald R. Spencer, Fort Worth TX
David R. Spradling, FPO San Francisco
Tom C. Stilwell, Hudson NH
Kenneth H. Stone, Seattle WA
Gary L. Stoner, Mount Union PA
Wayne Sutton, Cocoa FL
William D. Sweet, Holmen WI
Carl J. Tacci, Herndon VA
Brown Taylor, Nashville TN
Richard P. Taylor, Mannsville NY
Terry G. Terral, Fort Ord CA
Walter Thomas, Jr., Zephyrhills FL
Ronald B. Thompson, Biddeford ME
Terry L. Thompson, Shamrock TX
James H. Thorne, Fort Pierce FL
Charles D. Tonozzi, Granville IL
J. E. Trepanier, Sept-Iles PQ Canada
Andrew J. Vilk, Mechanicsburg PA
Wesley B. Vincent, Jr., Coatesville PA
John R. Warming, Hollis ME
James L. Watkins, Elmira NY
Gordon Weaver, Winnipeg MB Canada
William C. Weller, Timonium MD
James R. Wellington, Youngstown OH
Archie Wells, Sandia TX
Melvin F. White, West Hempstead NY
Kathleen I. Wilkes, Vienna VA
Bruce L. Wilson, APO New York
Kennith Woods, Fairview OK
Barron L. Zimmers, Somerset PA

Ham News



Ted Beach
K4MKX

You know, I think that perhaps the largest amount of mail I get from you all out there is on the subject of how to get a bit more "meat" into cw contacts. I can remember when I first started in ham radio it was very frustrating to call someone and not exchange more than names, QTHs, rig data, and weather before signing off. Golly, when I met someone new, I wanted to sit and chat for a while, even at 7 or 8 words per minute, although most people were talked out after a minute or two!

Anyway, after a few weeks of this nonsense, I decided that I would have to do something about the short contacts and try to liven things up a bit. After I had instituted my new procedures, I found out that most people really did like to rag-chew, given the chance! Here's what I found worked most of the time.

First of all, since I was a Novice myself, I knew what a lot of the Novice operators had taken up as bad habits; so when transmitting, I tried to compensate somewhat to make my contacts feel at ease. That sounds complicated, but what I mean is that when one first goes on the air, the natural thing to do is call "CQ" over and over again, waiting for someone to reply. Using this procedure, most newcomers could really swing along sending CQ DE WN1ABC over and over, at perhaps 10 or 15 words per minute.

However, when someone answered them at the same clip, they staggered and tried to back out of the QSO as quickly and gracefully as possible because they could not keep up the pace! Don't try to impress people that you are a speed merchant or you will probably send them scurrying for cover real quick. If you're talking to a Novice, turn the bug down and send at a rate your contact is likely able to copy comfortably. When you find out the person's sending speed for real, then you might speed up a bit, but if you want to rag-chew, don't overwhelm your contact with your blinding speed.

Back when I was a Novice, we were "rock bound," so I usually listened up and down about 5 kHz from my transmit frequency for someone calling CQ. I figured that if I could hear them with my poor antenna, they could hear me, so I would answer calls rather than call CQ myself and add to the QRM. What this means is LISTEN before you transmit. How many times have you heard two or more stations QRMing each other on virtually the same frequency calling CQ? Plenty, I'll bet.

Anyway, once you've made a contact and gone through the routine drill (name, QTH, signal, weather), then you're ready to rag-chew. This is most easily done by asking a question that requires more than a YES or NO answer. Try a statement like "Antenna hr is only 10 ft from gnd. Whats urs?" You might also mention interests of yours other than ham radio and ask if he (or she) shares similar interests.

If your contact happens to live in a town or city where you have friends or relatives, you might ask your contact to call them. Then, set up a schedule for another contact. You might even ask if your contact knows a nonexistent "friend," just to prolong the QSO, although this can sometimes get you in trouble if the answer is YES! Anything to keep the QSO going!

Actually, after you have tried these things for a while, you will probably not have to make things up, as you'll find more and more things to talk about on the air. Just be interesting yourself and indicate that you are interested in the other person as well, and things will usually roll right along. You may not make WAS in six months this way, but you will probably make quite a few friends.

Just remember to send with a good solid "fist" and don't try to be a speed merchant. Don't judge a person's speed by the way he sends CQ—this is probably twice the person's receiving capability! Ask questions—personal and impersonal—one can't help but answer, and perhaps ask a question in return! Be interested! Mention any other hobbies you may have (sailing, skiing, etc.) and be interested in the person's reply.

By following these hints, I'm sure that you should have no trouble "drawing out" the person and extending your QSOs to your benefit. In addition, by getting away from the stereotype QSOs, you will be using more Morse code than you normally would, so you will probably improve your sending and receiving skills at the same time. The person on the other end will similarly benefit. Try these ideas a few times, and I think you will have much more fun with your cw contacts.

Now, let's see who we've heard from since last time. Looks like there have been quite a few, although most are still from the ranks of NRI's electronics programs. Anyone out there in Automotive? Air Conditioning? We'd love to hear from you.

WB3HDJ received his General ticket back in November, but the information just got around to me recently. Fine business! Brother Nicholas is quite happy, and says that thanks to NRI (and his own hard work) he went through all amateur grades to General in less than a year. He has a new Atlas 350 XL and TA33 JR beam for the higher hf bands and uses a Tempo-1 with a dipole on 80. In addition, someone gave him a Heath SB102/SB200 combination which he soon hopes to have tuned up and working with the other rigs. He is also still very active on two meters with a TR33 which he took with him on a recent trip to Ft. Lauderdale, Florida. In addition to belonging to IMRA (as

Bill	WB2VJF	N	Clifton NJ
Bro. Nicholas	WB3HDJ	G*	Pittsburgh PA
Davy	WB3KTS	N	Philadelphia PA
Dennis	WB3KZH	N	Philadelphia PA
Bill	WD4JMD	N	Tampa FL
James	WD4NJS	N	Trenton TN
Ken	WA4TOP	G*	Brandenton FL
Inez	WD6ECS	N	Hathaway Pines CA
Foster	WB7QBX	G	Eugene OR
John	WB7SAU	A*	Astoria OR
Bob	WD8QPV	N	Glenn MI
John	WDØEDY	G*	Worthington MN
John	WB2LRO	T	Oneonta NY
Roger	WD4DIP	G*	Eden NC
Paul	AA4XX	E*	Raleigh NC
Daniel	WD5ETR	A*	Rougon LA
Earl	W6SKZ	G	Ventura CA
Robert	WD8PFE	N	Miles MI
George	WD8PNK	A	Goodells MI
Harry	W9ABF	A	Springfield IL
Harold	WBØPLS	A*	Golden CO
Maurice	VE2SV	–	Lavaltrie PQ
Grant	VE3IVU	–	Stirling ON

*Just upgraded—congratulations!

does Brother Ben Frey, mentioned in these pages recently), Brother Nicholas has joined the Steel City Amateur Radio Club in Pittsburgh and says he has not met a nicer group of people.

Dennis, WB3KZH, finished his NRI course on December 16 last year and took and passed his Novice test on December 19. Very fine, Dennis, and at that rate you should have the next step taken by now! Let us hear from you.

WD4JMD writes that he really enjoyed the course, but that he found the Rules in Part 97 to be somewhat on the obsolescent side. Yep, Bill, we know that, and that is the reason that we have been carrying the "FCC Update" table here in the Journal. As fast as these rule changes have been hitting us, the Journal is just about the only way we can even try to keep you all current.

WD4NJS writes that he recently got his Novice license and that a local Ham club was most helpful in administering the exam. James says he would like to thank all the members of the Humboldt Ham Club for the help they have given him.

WA4TOP is one of those who has taken good advantage of the comprehensive code test. Ken tried for the General ticket back in 1975 but, even though he could copy the tapes and records perfectly, he froze on the FCC code test and blew it. He scored 100 on the comprehensive test, and says perhaps they couldn't read his writing before. Congratulations!

WD6ECS writes "Thank you for making it possible (to get the Novice license). Now I'm working toward a 'General.'" Fine business, Inez, and welcome to amateur radio.

WB7QBX is one of our "dropouts." Foster has passed his Novice, Technician, and General tests and is going soon to take the Advanced test. During this time, he has built and used several Heathkits and experimented with antennas. All this activity left no time for his NRI course, although he did use many of the texts for reference purposes to get on with his upgrading. And, says Foster, one of these days he will sit down and finish the lessons and tests just because he should. I don't know, Foster, it looks like you have gotten from the course just what you wanted, and the FCC license is much more impressive than an NRI diploma. Or is it?

I got two QSL cards from WDØEDY. The second was an "update" of the first in which he said he was going to take the General test in April. The second card said he couldn't wait for Spring so he went 180 miles to St. Paul to take the test. Now John is thinking maybe he'll try for Advanced in April. His station consists of a Kenwood TS520 and an antenna farm in which he has a Hustler 4BTV vertical, dipoles for 80, 40, and 15 and a homebrew 10-meter quad. The latter suffered damage this past winter. At any rate, the system works well enough that he has 37 states confirmed for WAS. Fine business, John, and perhaps we'll hear you on the air this spring or summer.

WD4DIP got his Novice ticket in February after much help from some local hams in learning the code. Roger received the license in March so the processing time seems to be coming down. Glory be! Roger is planning to take the Advanced test soon (he probably has done so by now), and says that the NRI training has helped very much in his amateur studies.

AA4XX is almost finished with his Communications Course studies and is working on the two-meter transceiver kit at the present time. Paul says that he attributes his recent upgrade to Extra (former call WB4MQC) to his studies in the Communications Course. Thanks, Paul. Presently, he is using an elderly Gonset GSB-100 and a Heath SB315 (modified SB301) mostly on 40 and 80, although he does occasionally chase some DX on 40 and 20. Paul would like very much to schedule QSOs with other NRI hams, and would like you to write him at:

Paul Stroud AA4XX
Rt. 10, Box 305-C
Raleigh, NC 27603

WD5ETR writes, "June 6, 1977 I received my Novice license WD5ETR. December 27, 1977 I received my adv class amateur and my 2nd phone license. Just want you to know. Thanks to God and the great course I'm taking." Thanks to you, Daniel; we always like to hear those nice words.

Earl, W6SKZ, writes to say that he has had a General class license since 1958, and operates on both hf and vhf these days. For the latter, Earl uses an FDK Multi-7 with homebrew mobile and base antennas. On the low bands he uses a Drake TR-4C and Hy Gain 14AVQ/WB vertical.

WD8PNK is also taking the Communications Course and says he hopes to finish the two-meter transceiver real soon. George didn't tell us what rig he was using at present, but he did mention that he had a dipole for 80 and an inverted vee for 15. This summer he plans to do a bit of work outside and set up a bit more elaborate antenna farm. Must be nice to have all that room!

W9ABF sent us a very nice present the other day. Seems as how Harry took our course a number of years ago and had a couple of transmitting variable capacitors left over–from 1928! Thanks, Harry. They will be put on display down in our lobby. Harry didn't actually get these capacitors from our course in 1928. Rather, they were given to him by a neighbor in about 1936 when Harry was but a child. He has had them ever since, and thought we might like to have them. Thanks very much, Harry.

Also, he asked if we could get some information for him regarding the location and frequencies of marine stations operating in the 500-kHz region. I am sure that there is a published list of these stations, but so far have not been able to locate it. If any of you out there can help, please write Harry directly. His address is:

Harry Hubbart - W9ABF
1913 South 10½ Street
Springfield IL 62703

Finally, VE3IVU writes to let us know that there are active NRI amateurs up there north of the border and he would like very much to QSO with you all. Grant is a cw nut and is almost always on 3.650 or 7.015 weekday evenings about 1800 local time, and Saturdays and Sundays after 0800. Grant says he also operates on occasion as CZ3IVU, so give him a shout if you hear him on the air.

Well, that's about it for another time, so I'll say very 73 to you all and hope to hear from you real soon.

Ted – K4MKX

	Rule Change	Date Effective
1	Conditional Class License eliminated. Novice power limit upped to 250 W.	June 25, 1976
2	Technicians given Novice privileges.	July 23, 1976
3	No new distinctive Novice call signs, although Novices may sign "/N."	October 1, 1976
4	No requirement to sign "portable" or "mobile" except foreign operators using reciprocal licenses.	November 26, 1976
5	First "comprehensive" cw exam given in Washington, D.C. office. No solid copy for one minute requirement.	January 1, 1977
6	Court case "temporarily" suspends all license fees.	January 1, 1977
7	New "interim" licenses issued upon upgrade of license class at an FCC office.	March 1, 1977
8	Secondary station licenses eliminated.	March 3, 1977
9	97.95(a)(2) deleted. No notification of new address required.	March 9, 1977
10	New emission purity standards. All spurious emissions down 40 db for transmitters operating below 30 MHz, down 60 db for transmitters of 25 watts or more operating between 30 MHz and 235 MHz (97.73).	April 15, 1977
11	Code sending test deleted from Commission-administered examinations.	August 26, 1977
12	97.95(b)(2) rescinded. Maritime Mobile in Region 2 may use all amateur frequencies. In foreign waters may use only frequencies authorized by regional government.	September 12, 1977

Alumni News

Harry Taylor

DETROIT CHAPTER

The February meeting was cancelled due to a heavy snowstorm that clogged the streets and made travel almost impossible. The March meeting is scheduled to take place sometime after the Journal has gone to press. We will report on the March meeting in the next issue.

FLINT/SAGINAW VALLEY CHAPTER

On February 15, the chapter was invited to an antenna seminar held by A.C.A., an antenna distributor in Saginaw. We were shown new products in CATV and MATV systems.

At the February 22 meeting, the members tested and repaired a regulated power supply brought in by Chester Mazur. We had to replace a regulating transistor to restore the 12-volt regulated output. We also worked on a TV set that would blow the 5-ampere fuse in the primary of the power transformer. By substituting a circuit breaker, we were able to locate the trouble which turned out to be a bad power transformer.

At the March 8 meeting, Larry Myers brought in a Sencore combination tube and transistor checker for a demonstration. We compared the features of the transistor checker portion against a

B&K transistor checker. Of the two instruments we checked, we found the B&K to have many more features and therefore, was able to perform more thorough testing. We discussed how to make a VHF antenna splitter so that three TV sets could operate from a single antenna. We made a simple splitter using four resistors.

NEW YORK CITY CHAPTER

The first feature of the February meeting was a presentation by Pete Carter on the various methods of troubleshooting vertical sweep circuits in TV sets.

Steve Kross followed with a demonstration of the methods used for checking transistors. He showed how to check both silicon and germanium transistors out of the circuit by means of an ohmmeter on the R × 100 and R × 1000 ranges. Steve demonstrated the use of a scope and voltmeter to check operating transistors in their circuits. The chapter also discussed methods for checking integrated circuits and Darlington transistors with voltage readings and scope waveforms.

Our March meeting was off to a good start with a lively question-and-answer session during which we discussed a problem that Dick Sheftman had with an automobile radio. Bob Paganelli had questions concerning the use of a scope in checking the high-voltage section of a TV set. As it turned out, Bob's scope was defective which prompted his questions about the high-voltage circuits.

Pete Carter gave a presentation on microwave ovens. His discussion covered the theory of operation and troubleshooting procedures. He also talked about the difficult experience he once had in getting replacement parts.

Next, Willie Foggie gave a very interesting demonstration on the oscillo-

DIRECTORY OF ALUMNI CHAPTERS

DETROIT CHAPTER meets at 8 p.m. on the second Friday of each month at St. Andrews Hall, 431 E. Congress Street, Detroit. Chairman: James Kelley, 1140 Livernois, Detroit, Michigan. 841-4972.

FLINT (SAGINAW VALLEY) CHAPTER meets 7:30 p.m. the second Wednesday of each month at Andy's Radio and TV Shop, G-5507 S. Saginaw Road, Flint. Chairman: Dale Keys. Phone (313) 639-6688. Shop phone (313) 694-6773.

NEW YORK CITY CHAPTER meets at 8:30 p.m. the first Thursday of each month at 1669 45th Street, Brooklyn, N.Y. Chairman: Sam Antman, 1669 45th Street, Brooklyn, New York.

NORTH JERSEY CHAPTER meets at 8 p.m. on the second Friday of each month at the Players Club, located on Washington Square in Kearny, New Jersey. Chairman: Al Mould. Telephone 991-9299 or 438-5911.

PHILADELPHIA-CAMDEN CHAPTER meets on the fourth Monday of each month at 8 p.m. at the home of Chairman Boyd A. Bingaman, 426 Crotzer Avenue, Folcroft, Pa. Telephone 583-7165.

PITTSBURGH CHAPTER meets at 8 p.m. on the first Thursday of each month in the basement of the U.P. Church of Verona, Pa., corner of South Avenue and Second Street. Chairman: George McElwain, 100 Glenfield Dr., Pittsburgh, Pa. 15235.

SAN ANTONIO (ALAMO) CHAPTER meets at 7 p.m. on the fourth Thursday of each month at the Alamo Heights Christian Church Scout House, 350 Primrose St., 6500 block of N. New Braunfels St. (three blocks north of Austin Hwy.), San Antonio. Chairman: Robert Bonge, 222 Amador Lane, San Antonio. All San Antonio area NRI students are always welcome. A free annual chapter membership will be given to all NRI graduates attending within three months of their graduation.

SOUTHEASTERN MASSACHUSETTS CHAPTER meets at 8 p.m. on the last Wednesday of each month at the home of Chairman Norman Charest, 74 Redfern Dr., Springfield, Mass. 01109. Telephone 734-2609.

SPRINGFIELD (MASS.) CHAPTER meets at 7:30 p.m. on the second Saturday of each month at the shop of Norman Charest, 74 Redfern Drive, Springfield, Mass. 01109. Telephone (413) 734-2609.

TORONTO CHAPTER meets at McGraw-Hill CEC, 330 Progress Ave., Scarborough, Ontario. For information contact Stewart J. Kenmuir, (416) 293-1911.

scope. He used his dual-trace scope and showed its usefulness in checking i-f and color band-pass circuits in color TV sets. Unfortunately, time ran out before he could complete his demonstrations on an operating TV set. He will continue at the next meeting.

NORTH JERSEY CHAPTER

Our Chapter has been successful in getting some training films on electronics. At our January meeting, we saw two films from Bell Telephone Labs on the invention and development of transistors and microcircuits.

Executive Secretary Harry Taylor will attend the April 14 meeting.

PITTSBURGH CHAPTER

The Chapter held a meeting on radio and TV servicing. The principal topic was "Pricing and Profit." The members are looking for ways to continue to give good service at reasonable prices—profitably. We agreed that price increases must reflect the higher cost of both parts and labor.

SAN ANTONIO CHAPTER

The February meeting was canceled due to bad weather. Chairman Robert Bonge is recovering from a serious illness and expects to be ready to lead a meeting later this month.

Philadelphia-Camden's Bingaman Takes Office As NRIAA Chief

Boyd A. Bingaman is NRI's new Alumni Association President. Boyd comes to us from the Philadelphia-Camden Chapter where he served as a past secretary and chairman. When he first came to Philadelphia, way back in 1939, it was to work in a shipyard. After that he joined his dad and three brothers in the automobile business. The real inspiration to increase his technical knowledge came when he was working as a troubleshooter at an ammonia refrigeration plant in 1965. He enrolled in a TV and radio repair course at NRI and completed the course in April 1967. That same month he joined the Alumni Association. Since his retirement in March 1977, Boyd has managed to keep busy in his TV shop.

Boyd urges everyone who graduates from NRI to join the Alumni Association and the local chapters. "At the chapter meetings you will have things in common to discuss and enjoy the sociability of your fellow alumni," he says.

Boyd enjoys traveling and looks forward to meeting many new people. We all wish him good luck in his new position.

SPRINGFIELD CHAPTER

At our February meeting, Chairman Norman Charest, summarized the Chapter's past accomplishments, in preparation for future programs. We discussed whether or not we should broaden our meetings to cover subjects other than electronics. We finally agreed to stick to electronics subjects for our meetings. However, we welcome graduates from other NRI courses to attend our meetings.

Our past Chairman, Preston Atwood, brought in a Sears TV set that had an internal short circuit. This proved to be a "tough dog." We will have more to say about this set after the next meeting.

CONAR

A Division of the National Radio Institute
3939 Wisconsin Avenue
Washington, D.C. 20016

CHECK ONE:
- ☐ Cash order
- ☐ COD (20% deposit required)
- ☐ Select-A-Plan order

CHECK ONE:
- ☐ New Conar account
- ☐ Add-on Conar account
- ☐ Reopen Conar account

PLEASE PRINT

______________ NRI Student or Graduate No.

Name ______________

Address ______________

City ______________ State ______ Zip code ______

Social Security No. ______________

Ship to another address? Give directions here:

Name ______________

Address ______________

City ______________ State ______ Zip Code ______

c/o ______________

Moved since last order?

Previous address ______________ City ______________ State ______ Zip code ______

1. Name of Item	2. Stock No.	3. How Many?	4. Price Each	5. Total	Wt.

IMPORTANT:
To speed handling, any correspondence should be on separate paper.
All prices are net FOB, Washington, D.C.
Please include postage for weight shown and insurance on Parcel Post orders.
A 20% deposit is required on COD orders. Select-A-Plan orders: Please complete reverse side and sign payment agreement below. Thank you for your order.

6. Total cash price for merchandise		
7. Parcel Post and insurance		
8. 10% cash down payment and Parcel Post costs required on new Conar accounts.		
9. Unpaid balance of cash price (Items 6 and 7 less item 8)		
10. Sales tax (Washington, D.C. residents only)		
11. Unpaid balance (Amount to be financed) (Item 9 plus item 10)		

Prices in the Conar catalog and Select-A-Plan time payment privileges apply only to residents of the United States and Canada. Residents of Canada and foreign countries are responsible for customs charges.

PAYMENT AGREEMENT

Enclosed is a down payment of $ ______ on the merchandise I have listed on the Conar Order Form. I will pay Conar a minimum payment of 7% of the beginning unpaid balance or $5 per month, whichever is greater, until the full balance plus applicable interest is paid. Title to and right of possession of the merchandise shall remain in Conar Instruments until all payments have been made. If I do not make the payments as agreed, Conar may declare the entire balance immediately due and payable. In satisfaction of the balance, Conar may, at its option, take back the merchandise, which I agree to return upon request. I agree that the above conditions shall apply to any add-on purchases to my account. The statements on my credit application are true and are made for the purpose of receiving credit.

Date ______________ Buyer sign here ______________

Please do not write in this space.

RETAIL INSTALLMENT CONTRACT AND SECURITY AGREEMENT

CONAR SELECT-A-PLAN

SELECT YOUR TERMS TO FIT YOUR BUDGET

CONAR FINANCIAL RATES

The Finance Charge on balances up to $500 is 1½% per month. On any portion of a balance over $500, the rate is 1% per month. This is an Annual Rate of 18% and 12% respectively. The Finance Charge is computed on the month end balance of your billing cycle. You will receive a statement each month approximately 10 days before your payment is due. It will give you the current balance, finance charge, list payments made during billing cycle, date your payment is due, and amount of minimum payment due.

HOW TO DETERMINE THE AMOUNT OF YOUR MONTHLY PAYMENT

The minimum monthly payment on a Conar account is 7% of the original unpaid balance or $5, whichever is greater. The 7% is calculated to the nearest dollar. For example, if your original balance is $140, your payment would be $10. If your original balance is $160, your payment would be $11.

And remember—every purchase carries the Conar Guarantee—"the best in the industry."

TO SPEED SHIPMENT

1. Complete other side of this sheet.
2. Insert amount of down payment (at least 10% of total order) and other information in Payment Agreement on other side.
3. Sign Payment Agreement and fill in Credit Application.

IMPORTANT: Additional purchases—Once your credit is established and you have made at least three payments on your account, you can "add on" to your account with purchases of $20 or more. No down payment is required for add-ons of less than $100. If you are under 21, please have the Payment Agreement and credit application filled out and signed by a person over 21. He can make the purchase for you and will be responsible for payment. If you have a Conar account open or recently paid in full, just sign the Payment Agreement.

NOTICE TO THE BUYER: (1) Do not sign this agreement before you read it or if it contains any blank space. (2) You are entitled to a copy of this agreement.

IT'S AS EASY AS A B C TO OPEN A CONAR ACCOUNT

PLEASE ALLOW ADEQUATE TIME FOR NORMAL ROUTINE CREDIT CHECK. ONCE YOUR CREDIT IS ESTABLISHED, ONLY YOUR SIGNATURE IS NEEDED TO ADD ON PURCHASES.

WHERE DO YOU LIVE?

A ➔

Print full name ____________________ Age ______

Home address ____________ City ________ State ____ Zip code ______

Home Phone __________ How long at this address? ________ ( ) Own home ( ) Rent

Rent or mortgage payments $ ____ per month ( ) Married ( ) Single Wife's name ________

No. dependent children ______ Previous address ____________ How long? ______

WHERE DO YOU WORK?

B ➔

Your employer ____________________ Monthly income $ ______

Employer's address ____________________

How many years on present job? ________ Position ____________

Previous employer ____________________

Wife's employer ____________________ Monthly income $ ______

WHERE DO YOU TRADE?

C ➔

Bank account with ____________________ ( ) Checking ( ) Savings ( ) Loan

Address ____________________

Credit account with ____________ Address ____________

Credit account with ____________ Address ____________

Total of all monthly payments including car $ ________

from CONAR...a special CLOSEOUT SALE

RCA Meters

Check features on both of these RCA meters: ★ Meter movements diode-protected against burnout. ★ ±1 percent precision resistors on all ranges. ★ Three-color meter scales. ★ Easy-to-follow instruction books with test examples. ★ All meters come to you supplied with test leads.

The "Handyman" VOM

A rugged, easy-to-use portable pocket-sized tester with hundreds of uses. Specially designed for the handyman or hobbyist. Use for troubleshooting, servicing home hi-fi units, checking electrical and electronic systems in autos, boats, trailers, and many other uses.

Ranges: DC voltage—0 to 15, 150, and 1000 volts. AC voltage—0 to 15, 150, and 1000 volts. Direct current—0 to 150 ma. **Resistance**: R x 1K (measures 100 ohms to 100 kilohms). **Sensitivity**: AC/DC 1000 ohms per volt. **Battery**: (for ohms function, not supplied) one 1.5-volt penlite (RCA VS034A or equivalent). **Size**: 3-9/16" by 2-3/8" by 1-3/8". **Weight**: 5 ounces.

Stock No.WT539
Shipping weight
1 pound

Now Only
$9.95

Model WV-518

A superior quality instrument with a fuse-protected ohms network.

DC voltage: Ranges—0 to 0.5 volt, 1.5 volts, 15 volts, 50 volts, 150 volts, 500 volts. Sensitivity—20,000 ohms per volt. Accuracy—±3 percent of full-scale reading. **DC current**: Ranges—0 to 0.5 ma, 5 ma, 500 ma. Accuracy—±3 percent of full-scale reading. **AC voltage (rms)**: Ranges—0 to 15 volts, 50 volts, 150 volts, 500 volts. Accuracy—±4 percent of full-scale reading. Frequency response (15-volt range)—10 Hz to 100 kHz ± 1 db. **Resistance**: Ranges R x 1, R x 10, R x 100, R x 1K. **Accuracy**: ±3 percent of scale length. **Batteries**: (not supplied) two 1.5-volt penlite cells (RCA VS034A, VS334, or equivalent). **Size**: 5 1/8" by 3-1/2" by 1-7/8". **Weight**: 1 pound.

Stock No.WT518
Shipping weight
1½ pounds

Now Only
$36

NRI JOURNAL
3939 Wisconsin Avenue
Washington, D.C. 20016

MR LAWRENCE T ANDERSON B193-F424 G
3453 BALSAM NE
GRAND RAPIDS MI 49505

Second-Class
Postage Paid
at Washington, D.C.
and Additional Entry