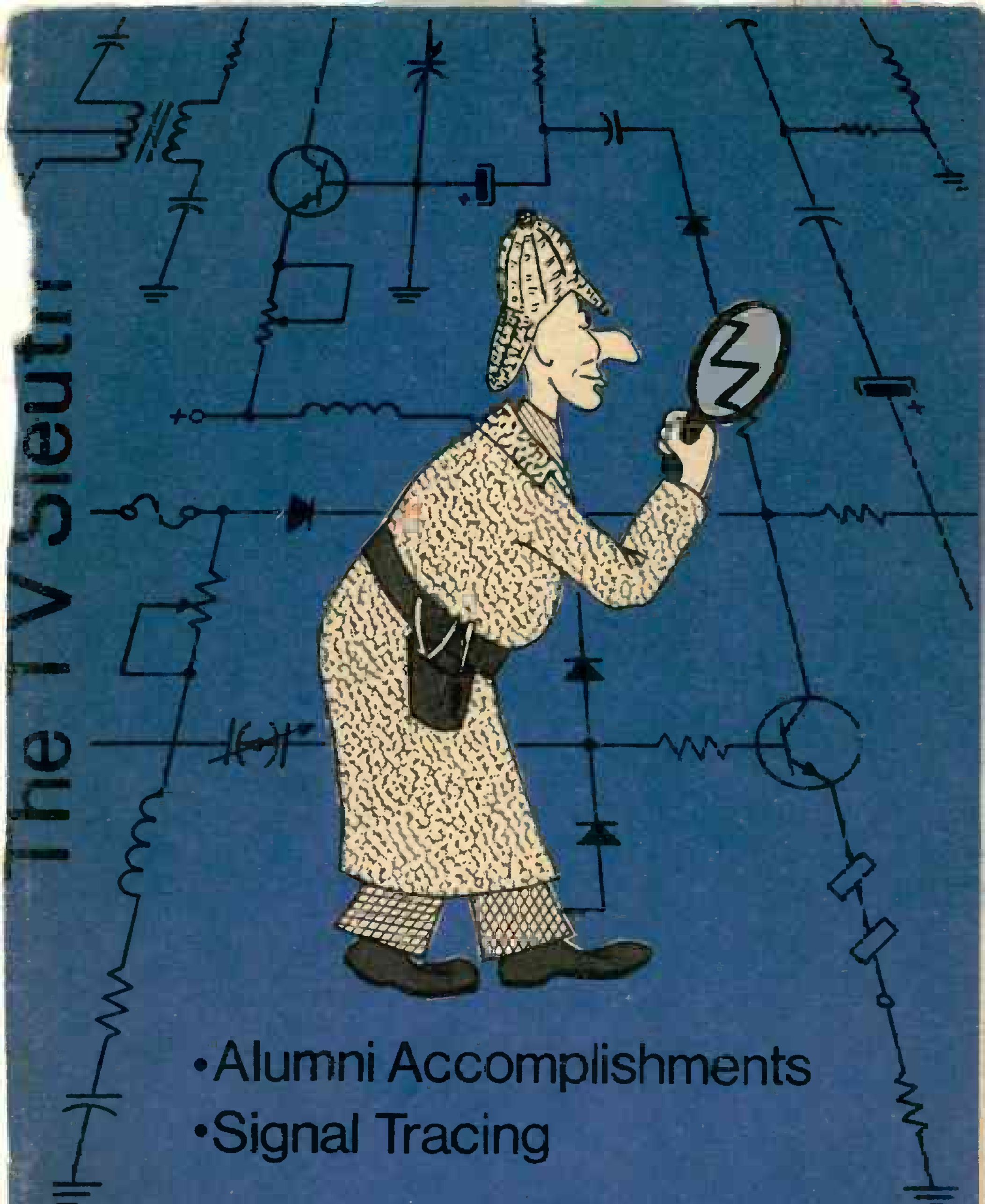

# The TV Sleuth

- Alumni Accomplishments
- Signal Tracing

nri journal

January/February 1980

# Washington's Birthday Sale

## B/W TV with AM/FM Radio

Electronic varactor TV tuner for UHF/VHF and electronic fine tuning for AM/FM radio ■ Powered 4 ways — standard ac, D-cell batteries, rechargeable battery pack, or 12 V jack system ■ 4-1/2" TV screen ■ Comes with ac cord, shoulder strap, earphone, and instruction book ■ Measures 4-3/4" X 9-3/4" X 10" and weighs 7-1/4 lbs

**$175.00**

Stock No. EN521

## Bearcat 210

### Automatic Scanning Radio

- No crystals to buy
- Decimal display
- Automatic search
- Automatic lockout
- Track tuning

**$249.95**

Stock No. EN210

As easy as a pushbutton telephone, the new Bearcat 210 lets you select, change, and search all the public service frequencies in your area. And, you never need to buy a crystal, thanks to Bearcat space-age solid-state circuitry. The Bearcat 210 scans ten channels twice a second and a special hold feature sets a two-second delay on selected channels, so you hear both sides of two-way conversations. A digital readout tells you the exact frequencies you're listening to. Never have you been able to hear so much so easily.

SPECIFICATIONS

**Frequency Reception Range** — Low band, 32-50 MHz; "Ham" band, 146-148 MHz; High band, 148-174 MHz; UHF band, 450-470 MHz; "T" band, 470-512 MHz. Also receives UHF from 416-450 MHz. **Size** — 10-5/8" W X 3" H X 7-5/8"D.

**This CONAR sale ends March 1, 1980.**

# nri journal

January/February 1980
Volume 38, No. 1





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In this issue, Wayne Brandenburg returns to relay his latest adventures in TV repairs. Laura Blalock tells us to get going on winterizing our cars. Colleen Bohr tells us about two more successful NRI alumni. And Doug Haggis says the time has come to stop signal chasing.


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Wayne C. Brandenburg, C.E.T.

# Television Casebook:

## 5. A Day at the Bench

My favorite TV shop in the entire world is situated on a very busy street in Washington, D.C. As a business, it has survived more than 75 years in the same location. It began as an electrical shop that did residential wiring and electrical repairs. Then, as electrical appliances became more and more available, the company expanded their operation to include the sale and service of these items.

This is probably the key to their success; they are equipped for the sale or service of just about any device that consumes electricity. Many shops that base their business solely on TV sales and service seem to experience a few "slumps" during the year. This is particularly true during the summer when the customer is more inclined to go on vacation rather than face the summer re-runs on TV. At the shop, however, they have air conditioner sales and service to keep them busy. They also have a large window display of electronic gadgets and gimmicks that visitors to the nation's capital can take home as a present for Aunt Betsy.

## Practical TV Servicing Case Histories

For the technician, the place is a virtual paradise. You can repair televisions, radios, air conditioners, lamps, hair dryers, toasters, vacuum cleaners, refrigerators, and on and on.

The place is owned by two gentlemen who are as different in personality and business philosophy as they are in physical appearance. This may be another key to success. The amalgamation of two such diversified points of view usually leads to the truth. Examples of this phenomenon would be when one man wants to charge too much while the other charges too little, or when one rules the staff with an iron hand but the other is more like a friend. In situations such as these, the compromise that is reached is usually the best for the business.

During the fall glut of television repairs, they often call me in as a TV bench technician on a piecework basis. I love to do bench work and visit with my friends. I usually manage to find time in my busy schedule to help them with the work load. I made the following repairs on just such a day.

## THE GE MAN AND OTHERS

For the first job, I was steered to a 19-inch solid-state GE color set. There is nothing really interesting to say about the TV except that three technicians had worked on it in the previous week. One of these was the GE service representative. I began to wonder how I get myself into situations like this.

One of the owners, who is a rather good technician in his own right, got me started by telling me what had been done so far. "The GE man found a shorted rectifier and a blown fuse in the power supply." Figure 1 shows the power supply for this GE19QB chassis. In Fig.1, the shorted rectifier is labeled Y400 and the fuse F404. When I

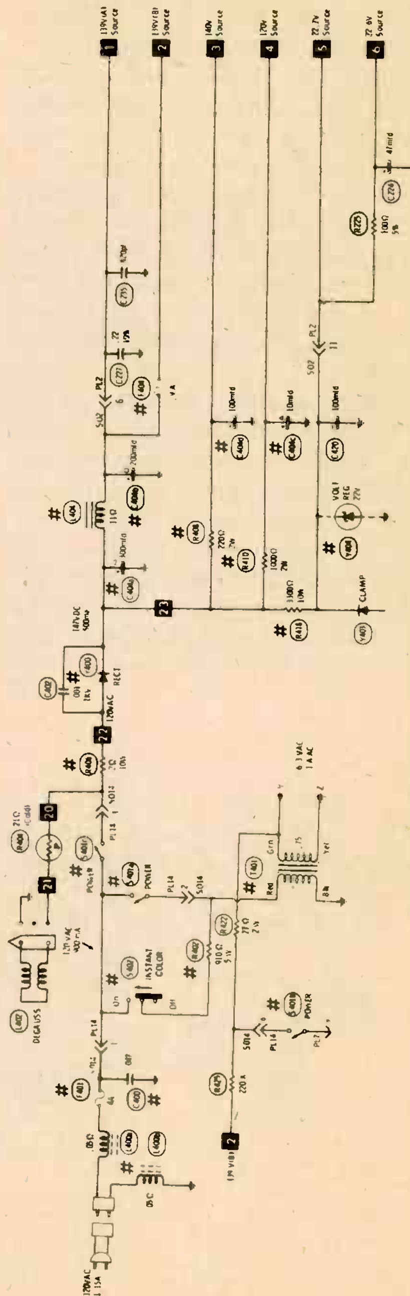


FIGURE 1. GE19QB CHASSIS/POWER SUPPLY.

*Courtesy Howard W. Sams*

examined the set, I found two shiny, new parts.

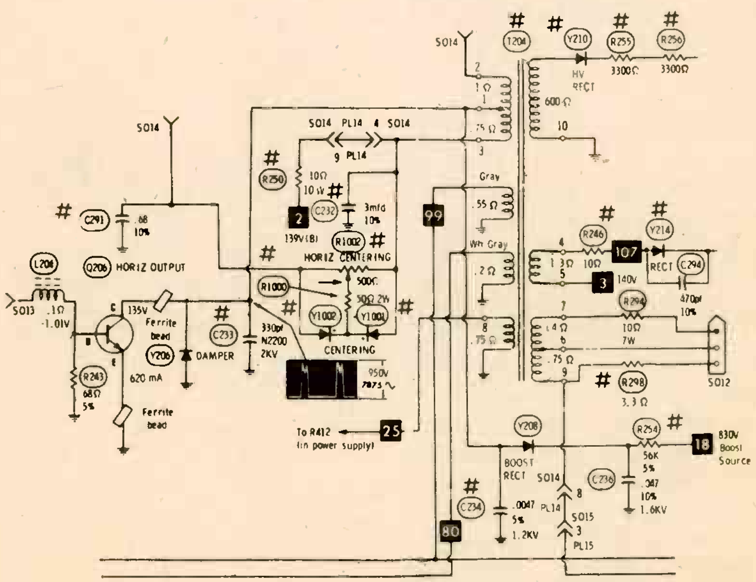
Since both parts had failed, I assumed that something connected to the 139 volt source had become shorted. This would cause considerable current flow, enough to short the rectifier, and open the fuse. My first test, then, was to measure the resistance between the fuse holder and ground. Any short would show up here. I was expecting a reading of zero ohms, but, much to my chagrin, the meter registered infinity – nothing like starting at a dead end!

I decided to apply power to the set and wait for a smoke signal or something. Nothing happened. A voltage test at the fuse holder proved that there was indeed 139 volts, but the set still acted like it was dead. Next, I reasoned that the 139 volt supply is used to power the horizontal sweep circuits shown in Fig.2. Aside from horizontal sweep and high voltage, this circuit uses rectified horizontal signals to supply some of the dc voltages used elsewhere in the set. Here was the place to begin.

A voltage test at the collector of Q206, the horizontal output transistor, produced a reading of zero volts. The collector is connected to the 139 volt source by way of the flyback, T204, and a 10 ohm resistor, R250. R250 was open.

This large resistor is mounted on the back of the chassis, down under the picture tube. Changing it was difficult, so I decided to check for shorts before applying any power. The resistance between the emitter and collector of Q206 was 200 ohms. Now, a shorted transistor will almost always read zero ohms from emitter to collector. The high reading of 200 ohms was unusual but still the transistor was defective so I replaced it.

When I applied power to the set, it worked for about 10 seconds, then Q206 shorted again and F404 blew. Oh




*Courtesy Howard W. Sams*

**FIGURE 2.** GE19QB CHASSIS-HORIZONTAL CIRCUITS.

boy! I had used a Sylvania replacement transistor (ECG163), which costs us about $13. Wonderful – I had made an expensive mistake.

In cases like this, I do what all experienced technicians do – grasp at straws! The collector of the transistor has three parts that are connected from it to ground: the damper diode (which tested good), C233 (which also tested good), and C234 (which fell apart in my hands). You can find C234 in Fig.2 somewhere below the flyback. If you follow the wiring, you will see that it is indeed between collector and ground. These capacitors are used as tuning for the flyback, especially during horizontal retrace. An open capacitor causes a much higher voltage to appear at the collector and the transistor dies a swift death.

So, I changed the capacitor and installed another $13 transistor, knowing that I had finally solved the problem. When I applied power again, the ac fuse (F401) blew in 10 seconds. Did I mention that "piecework" means that you only get paid for what you fix? Mercy!

Well, back to the power supply. I connected my vom to measure the current at the fuse, F404. Then I plugged the set into a variable line transformer and started to turn the voltage up slowly. When I had reached only 30 volts ac, there was already 1/2 ampere registering on the meter. I left the test set up in this condition and just stared at the set – a beaten man.

Then a thin column of smoke began to rise from a resistor in the power supply. This resistor was labeled R246, but don't look for it in the power supply schematic. Look instead at Fig.2, the horizontal circuit. You guessed it, Y214 was shorted. This caused the overheating resistor, and since the circuit is connected to the 140 volt supply, it also caused the fuse to blow.

It's amazing how much a repair like this can affect you – physically. Changing the rectifier finally completed the repair, but I was feeling a little damaged. I took the opportunity to escape for a very early lunch with one of the owners (the friendly one)!

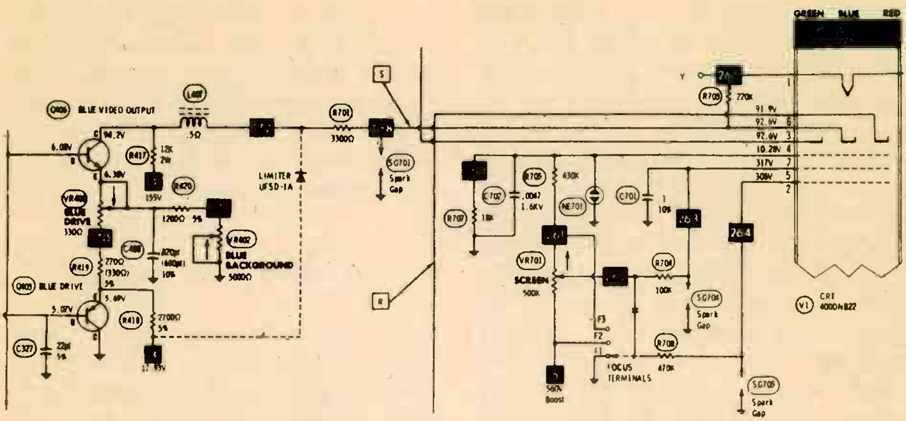
## MACHINE GUN SONY

The next set was rather easy. It was a 9-inch Sony color set, model KV9000U. The customer complained that the set made "machine gun" noises whenever it was turned on. Naturally, I immediately assumed that there would be a high-voltage problem that caused considerable arcing.

I was rewarded instantly. With the cabinet removed, I could see bursts of fire coming from the high-voltage multiplier and arcing to the metal chassis. The multiplier is the large sealed package shown in Fig.3. It's a little hard to get at in this Sony, but replacement is the cure.

FIGURE 3. A HIGH-VOLTAGE MULTIPLIER. THE BURNED SPOT INDICATES THAT THE DEVICE IS DEFECTIVE.

I called the local Sony representative to see about the cost and availability of the part. It was not in stock (meaning a delay of about four weeks) and the cost was $38 (or about $50 to the customer).




*Courtesy Howard W. Sams*

FIGURE 4. SONY KV1510 PICTURE TUBE CIRCUITRY.

## A TV WITH THE BLUES

I was greeted next by a Sony KV1510 TV. This is a 15-inch color portable that was displaying a predominantly blue picture. Everything else seemed to be fine so I began to disassemble the set.

In a case like this, I usually begin at the picture tube. Sony uses what it calls a "one gun" picture tube. The tube does have three separate sets of cathodes, however, so it is still possible to have a problem with one color but not another. The picture tube tester revealed the fact that the tube was good.

My next step was to measure the voltages around the picture tube socket. A wrong voltage here would steer me to the cause of the excessive blue in the picture. All the voltages were normal except the 30 volts that was present at pin 3, the blue cathode.

This then was the cause of the blue screen. A picture tube works like any other vacuum tube. A cathode is heated to produce free electrons that travel to the anode. In the picture tube, the anode is the phosphor coating inside the glass. This coating is connected to a high positive potential (around 25 kV) so that the electrons are attracted toward it. Between the cathode and the anode is a control grid. When a negative potential is applied to the control grid, it acts to limit the flow of electrons. A more negative control grid decreases the electron flow. This is how the tube is controlled. The important thing to remember is that the control grid must be more negative than the cathode.

Now, turn your attention to the Sony schematic in Fig.4. You will notice that the cathodes are at about +93 volts while the control grid is only about +10 volts. In other words, the control grid "looks like" it is more negative than the cathode. Doesn't seem right? Try this: Connect the positive lead of your voltmeter to the cathode and the negative lead to the control grid. What do you think it would read? In the case of this Sony, it would read −83 volts. The control grid is 83 volts more negative than the cathode.

Well, in this set the blue cathode had only +30 volts. That meant that the control grid was only 20 volts more negative than the cathode. No wonder the picture was so blue!

I next turned my attention to the blue video amplifier, Q406. The collector showed the 30 volts that I had measured at the picture tube but the other side of the collector load resistor, R417, was receiving 155 volts as advertised. The base and emitter voltages were normal so I suspected an open R417.

The resistor was not actually open. It had increased in value to about 100 kilohms. A new 12k-ohm resistor cured the blues.

## SNAKES TO UNTANGLE

The next repair was the type that I really dislike. The set in question was a 19-inch Philco color portable. The tuner had been diagnosed as being defective, so one of the other technicians had removed the tuner and sent it out for repair. So far, so good! Here was the problem: In removing the tuner, the technician simply cut all the wires (about 10 of them) so that one-half inch of each wire was left on the tuner for identification. Then when the tuner came back repaired, the technician could match the wires by color, solder them, and he would be done. Well, the tuner came back without the wires!

I was faced with a repaired tuner that somehow needed to be attached to a snake pit of wiring. When I do this kind of a job, I always draw a sketch of the tuner and a little road map of the wiring – just in case.

Anyway, the problem was solved through hard work. I had to follow each cutoff wire to the chassis to see where it was connected. Then I had to locate this point on the chassis schematic to see what part of the tuner was connected here. And finally, I had to use a pictorial view of the tuner to discover which lug on the tuner I should connect the wire to.

It wasn't a particularly difficult job, but it would have been much easier if it had been done properly in the beginning.

## WHEN A REPAIR REALLY ISN'T

The last job that I worked on that day was really a simple one. So much so that I won't bore you with a lot of schematics and explanations. It was simply a Zenith color set with a bad horizontal output tube. I replaced the tube and took a fast glance at the screen to be sure that the picture had come back. Then I set about doing all the routine work like tuner cleaning and reassembly.

Just as I was about to cash in and go home, one of the owners told me that the Zenith "wasn't acting right." I went back to take a look and sure enough, it was popping in and out of focus all by itself. I removed the back again and looked for the cause of the trouble.

Every picture tube has a grid that is used to focus the electron beam. If you can't see distinct scan lines in the picture, then you don't have proper focus. The focus grid is usually supplied with a voltage that is about one-fifth the second anode voltage (in conventional picture tubes). This voltage can be supplied in many ways, but Zenith uses the voltage-divider method. A voltage divider exists between the second anode and ground to supply the correct focus voltage. A control is provided to make fine adjustments.

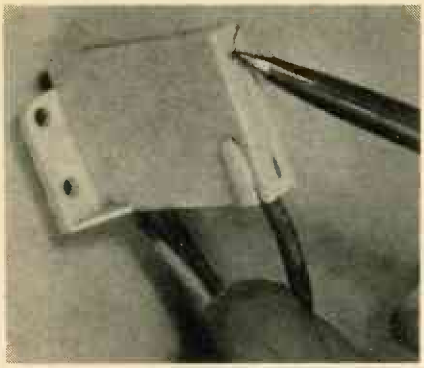
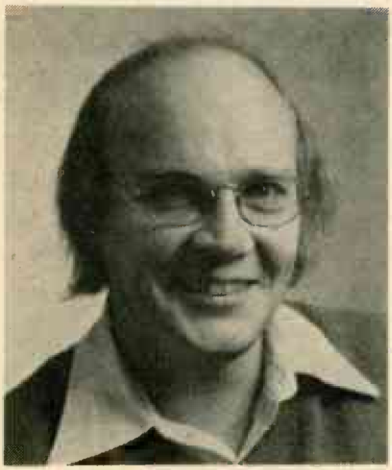


FIGURE 5. THE CRACKS IN THIS FOCUS VOLTAGE DIVIDER INDICATE THAT IT HAS FAILED.

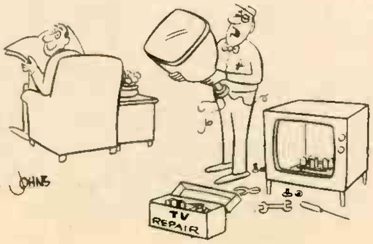
The Zenith voltage divider that was used 8 to 10 years ago was notorious for failure. The one that I removed from this set is shown in Fig.5. Notice the cracks running across the top of the divider. I have replaced hundreds of these, all with the same crack.

Well, I was finally on my way home. I had repaired four sets and ordered a part for one more. I couldn't decide if it had been a good day or not. The next time I visited the shop, they presented me with a brace of remote control televisions, all needing work on the remote circuitry. But, that's a tale for another time.

# About the Author



Wayne Brandenburg, who joined NRI's writing team in 1977, is currently a free-lance writer and TV repair technician. Wayne received a B.S. in Industrial Arts from California State College in California, Pennsylvania, and since graduating has been involved in the electronics field. He has taught electronics and industrial arts courses at the high school and college levels, and has also taught at an electronics school. Wayne has written three books for McGraw-Hill to be used in teaching high school electronics. Wayne says, "The world runs on technology – technical careers are the key to a good living."




" I FOUND YOUR TROUBLE – IT WAS JUST ONE OF YOUR TUBES "

CONAR

# Washington's Birthday Sale

## Test and Tune Kit

Get top performance from your car. This Test and Tune Kit includes the following instruments in an attractive, durable travel case.

- Vacuum and Fuel Pump Tester
- Dwell Tachometer
- Compression Gauge
- DC Timing Light
- Complete Instructions

Stock No. TO970 **$44.95**

## Spark Plug Cleaner

Easy to use! Just insert a spark plug into the neoprene grommet and press the button. Uses a 12 V battery to drive a 5000 rpm impeller that scoops up fine silicon carbide and cleans fouled plugs. Comes with a spark plug gauge for setting correct gap after cleaning.

Stock No. AC728 **$7.50**

## Inductive Tach

This precision electronic instrument can accurately determine the speed in rpm of any spark ignition engine. Hold the tachometer close to the ignition and read the rpm. For use when you need to know engine speed. It has two scales: 0 – 5000 and 0 – 15,000 rpm. Built-in battery check. No external power needed. Operating manual included.

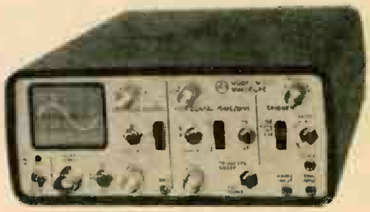
Stock No. AC040 **$35.50**

Sale Ends March 1, 1980

# CONAR PRESENTS

## Portable Oscilloscope from Non–Linear

This new portable 15 MHz oscilloscope includes external and internal trigger. It weighs less than 3 pounds and can operate from batteries or the ac line. Battery and charger unit are included.



**$318**

**Stock No. WT015**

**SPECIFICATIONS**

**Features** — 15 megahertz bandwidth, external and internal trigger, horizontal input, automatic and line sync modes, 3% accuracy on all functions. **Vertical Gain** — 0.01 to 50 volts per division (12 settings). **Time Base** — 0.1 microsecond to 0.5 second per division (21 settings). **Power** — less than 15 watts; battery or line operation with batteries and charger unit included. **Options** — 10:1, 10M probe and leather carrying case. **Dimensions** — 2.9" H X 6.4" W X 8.0" D.

## 5 MHz Solid State 3" Scope

This new 5 MHz, 3" scope has a vertical sensitivity of 10 mV/division and is equipped with a CB modulation monitor. It includes a Z-axis input for intensity modulation and can be externally synchronized. This multi-purpose instrument is ideal for bench testing, field troubleshooting, checking modulation waveforms, aligning i-f and rf amplifiers, tracing signals, and comparing audio signals for performance checks.

BK PRECISION

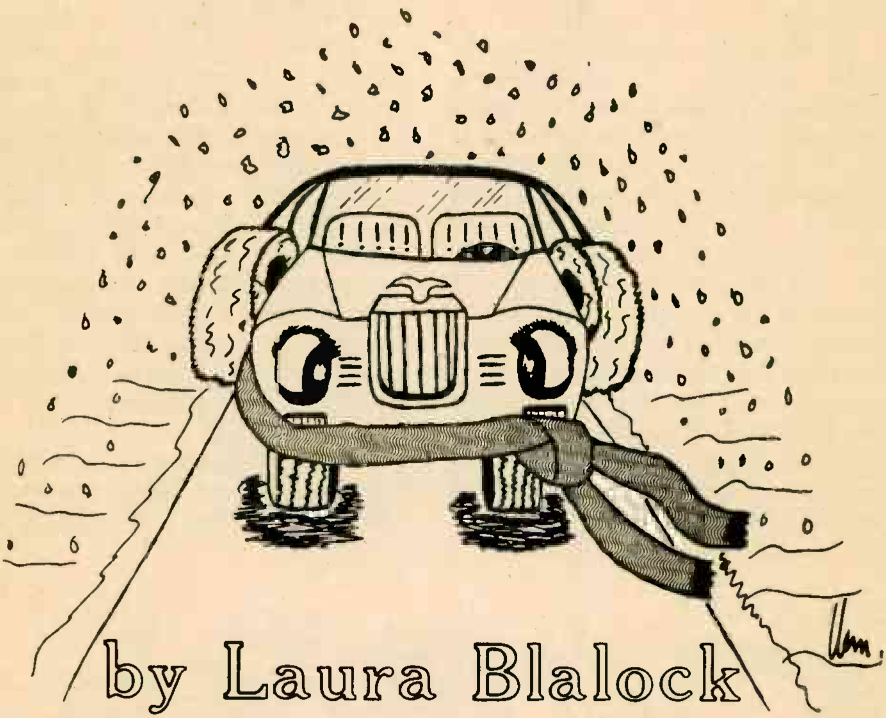
**$285**

**Stock No. BK1405**

**SPECIFICATIONS**

**VERTICAL AMPLIFIER** — **Deflection Factor:** 10 mV/division or better. **Response:** DC, DC-5 MHz (−3 dB), AC, 2 Hz–5MHz (−3 dB). (Direct deflection terminals allow waveform display to 450 MHz at reduced sensitivity.) **Overshoot:** 5% or less. **Maximum Input Voltage:** 300 V (DC + AC peak) or 600 V p-p. **Input Impedance:** 1 megohm shunted by 35 pF. **Attenuator:** 1, 1/10, 1/100 multiplier, ±5%. **Gain Control Range:** Continuously variable range greater than 22 dB. **HORIZONTAL AMPLIFIER** — **Deflection Factor:** 300 mV/division or better. **Response:** DC-250 kHz. **Input Impedance:** 1 megohm shunted by 30 pF. **Rated Maximum Input Voltage:** 100 V p-p. **SWEEP SYSTEM** — **Type:** Recurrent. **Time Base Ranges:** 10-100 Hz, 100-1000 Hz, 1-110 kHz; continuously variable between ranges. **Sweep Linearity:** ±5%. **Synchronization:** Internal, negative, external. **Signal Required for Sync:** (Internal) More than 1 DIV deflection on crt. (External) More than 2 V p-p. **Direct Deflection Terminals:** 10 V/division sensitivity or better; 2.2 megohms shunted by 25 pF (or less) input impedance. **GENERAL** — **Size:** 6" H X 7-1/2" W X 12" D (15 X 19 X 30 cm).

# Winterizing Your Car



by Laura Blalock

January is probably the coldest time of the year. It is also the time of year when most people experience problems with their cars. Many of you probably remember all too well rushing out to your car on a freezing morning last year, only to find the battery dead or, even worse, the radiator cracked.

This year you can avoid these inconveniences by winterizing your car. Winterizing your car is a form of insurance – it protects your car from major cold weather problems and costly repairs. If you have not winterized your car yet, it's still not too late to do so.

## CHECK COOLING SYSTEM

Making sure that your cooling system has the proper amount of antifreeze is probably the most crucial step in winterizing your car. Without antifreeze, the water in your cooling system would freeze. As water freezes it expands, and could cause pipes, hoses, and even the engine block to crack.

If you are unsure of the amount of antifreeze in your cooling system, you can purchase a hydrometer (for a very reasonable price) and check the antifreeze yourself. A hydrometer is a small eyedropper-like instrument with several colored balls in the tube. (Make sure that you get a hydrometer for checking the antifreeze, and *not* for checking the battery.)

To check the coolant, first run the engine and let it reach operating temperature to make sure that the water and antifreeze are sufficiently mixed. If you have just added antifreeze prior to the test, let the engine run for 15 to 25 minutes. Turn off the engine, allow it to cool a little, remove the radiator cap (do this carefully to avoid the risk of coolant spraying out), and draw a small amount of coolant into the hydrometer. The more balls that float in the coolant, the lower the temperatures your coolant will withstand. If the hydrometer uses five balls, all five balls floating indicates that your cooling system can withstand temperatures as low as -44°F (-42°C). If no balls float, your coolant is mostly water and will freeze at the normal freezing point of 32°F (0°C).

While checking your car's antifreeze, you should also check the condition of the radiator. Muddy or rusty coolant indicates that there are scale or rust deposits in the coolant. These deposits can clog your cooling and heater core system, and eventually cause overheating of the engine. It is always a good idea to flush your radiator with a cleaning agent, such as a solution of washing soda and water, and replace the antifreeze with a fresh solution. Most manufacturers recommend a 50/50 solution of water and antifreeze, or greater concentrations of antifreeze if you live in very cold regions.

You should also check for cracked or kinked radiator and heater hoses. Figure 1 shows the cooling and heating hoses

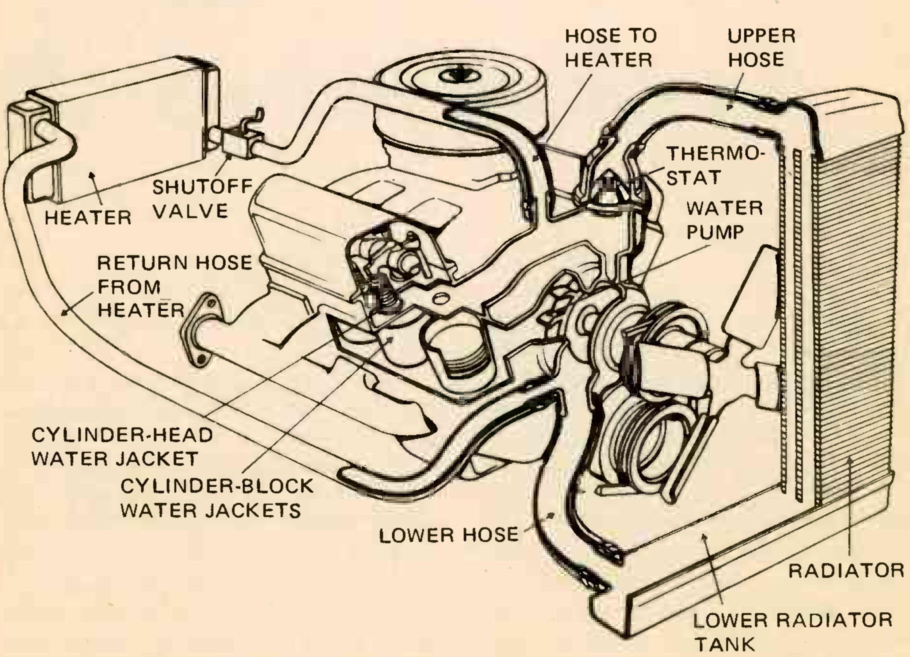



FIGURE 1. A CUTAWAY VIEW OF THE COOLING SYSTEM OF A V-8 ENGINE SHOWING HOSES THAT SHOULD BE CHECKED.

that should be checked in a V-8 engine. If the hoses are kinked, sufficient coolant may not be getting to the engine. Cracked hoses will eventually break.

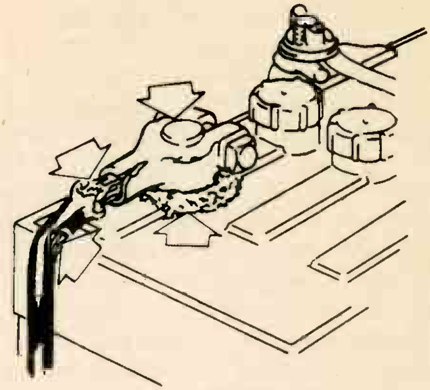
## BATTERY MAINTENANCE

A dead battery is no fun. You usually discover that your car battery is dead at the most inopportune times, like the morning of an important job interview or when you need to drive to the airport to catch a flight. At any rate, with proper battery maintenance, you won't have to deal with the inconvenience of a dead battery.

Check to make sure that there is an adequate supply of electrolyte in the battery. The electrolyte level should cover the battery plates visible just below the filler caps. If the electrolyte level does not cover the plates, add water to replenish the electrolyte. You should try to use filtered distilled water if possible.

Check the battery cables to make sure that they are tight, and that there are no frayed sections with bare conductor showing. Frayed cables can cause poor operation of the electrical system, and prevent proper charging of the battery. Therefore, you should replace frayed cables. If you cannot get a replacement cable right away, then wrap electrician's tape around the frayed section until you can replace the damaged cable.

Dirty battery terminals, like those in Fig.2, will also prevent proper charging of the battery. Scale and lime deposits build up on the battery parts and must be cleaned off periodically. A solution of baking soda and warm water applied to the battery posts and terminals with a toothbrush will usually remove these deposits. You can also scrape the top and sides of each terminal with a



*Courtesy Delco-Remy Division of General Motors Corporation*

FIGURE 2. BATTERY CABLES WITH DAMAGED INSULATION, BROKEN OR LOOSE STRANDS, OR EXCESSIVE CORROSION SHOULD BE REPLACED.

pocketknife to ensure a good charge, and then either grease the terminals or spray them with a silicone spray to keep them from oxidizing.

There are several other reasons why a battery may not be able to hold or take a charge. One reason is that the lead of the battery plates may be old and worn. This condition usually requires replacement of the battery. Another reason is that the battery may not be getting sufficiently charged by the alternator. This may be due to a loose fan belt that does not drive the alternator pulley fast enough. Make sure that the fan belt is tightened to the proper tension. Check your service manual for the proper tension specifications, or have the belts checked at your local service station.

If your battery is dead and you need to jump-start it, always remember that the red cable goes to the positive terminal and the black cable to the negative terminal or chassis ground. To properly jump-start a car, the positive cables should be hooked up first from the good battery (of the running car) to the dead battery. Then the black or negative cables should be hooked up in the same order. Don't stop the engine of the car with the good battery. Wait a few minutes to let the dead battery absorb some current, and then try to start the car. Do not grind away on the starter or flood the engine when doing this. Once the car has started, however, let it run for about 15 minutes to develop a good charge.

Other times the battery may not be dead, but current may not be passing between the terminal and terminal post. Sometimes you can revive a battery like this by driving a nail about a quarter of an inch between the terminal and post to complete the charge. This procedure should only be used in emergencies, and at first chance clean the terminals as mentioned earlier.

## PROPERLY TUNED CAR

Experts have estimated that 80% of an engine's wear occurs during the winter, so it is advantageous to have a properly tuned car to hold up against the wear and tear of winter. Aside from a tuneup, there are a few other checks to consider.

A cracked or ill-fitting distributor cap will allow moisture to get into the distributor, preventing starting. You should check the distributor cap and rotor for cracks and pits, and general wear. Even if a distributor cap does not appear to be loose, you may find that replacing it will help start a dead car.

If you suspect that there is moisture in the distributor cap, wipe the inside of the cap with a clean, dry cloth. If that doesn't work, you can spray the inside of the cap with silicone spray to displace the moisture. However, you should avoid doing this often because it *does* leave a film of silicone in the distributor.

## SAFETY CHECKS

Safety checks are an important aspect of winter driving because they protect you, your car, and the other

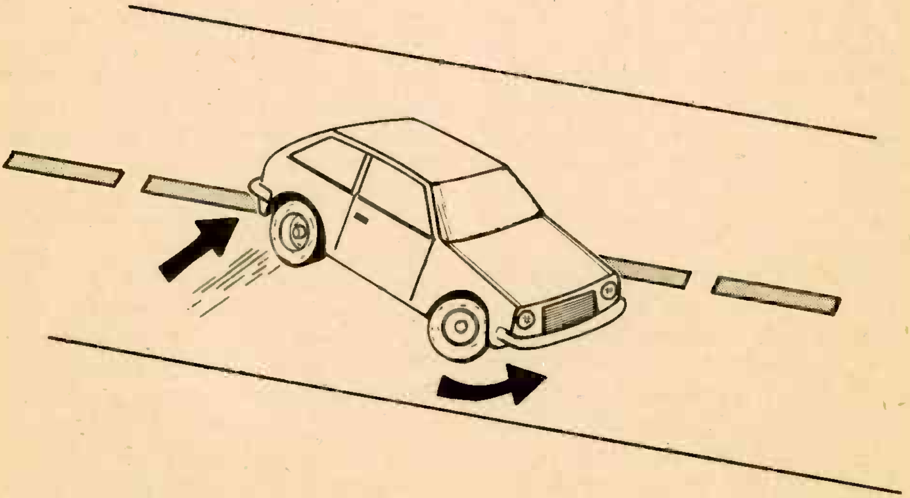


FIGURE 3. ALWAYS TURN YOUR STEERING WHEEL IN THE DIRECTION OF THE SPIN.

driver. One safety check is to make sure that your defroster works. Otherwise your visibility will be decreased. One day I had to keep pulling over every quarter mile on the highway to scrape my windshield because my defroster wasn't working, and it wasn't even sleeting outside!

Another safety point to remember is that if your car fishtails on ice or snow, always turn your steering wheel in the direction of the spin. This means that if the back of your car starts to spin out toward the left, then you should turn the wheel toward the left to correct the spin, as shown in Fig.3. Also, make sure that your tires have enough tread on them to avoid skidding.

If you follow the steps I've outlined, you should be able to depend on your car to start like a charm on those ice-cold mornings.

# About the Author...

Laura Blalock, a publications editor, has been with NRI for several years. Her interest in cars stems from her involvement in the preparation of NRI's Automotive course. Since then, Laura has become quite handy with automobiles. She enjoys making minor repairs and doing maintenance work on her own car. According to Laura, "I'm happy to see that more and more women are tackling repair and maintenance problems that formerly baffled them."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# Alumni Accomplishments

## by Colleen Bohr

This issue, we'll meet two alumni who have attained different types of success. One runs his own business; the other has written a book. Still, though their efforts were directed toward different ends, both have actually achieved the same result – the satisfaction that accompanies reaching a personal goal.

### HARRY WELCH: TV/AUDIO EXPERT

For over five years, Harry A. Welch, of Meredith, New Hampshire, has owned a TV/stereo sales and repair shop in the nearby college town of Plymouth. "My NRI course enabled me to set up my own business in TV and stereo. All the things that I am now doing are a direct result of NRI."

In 1974, Harry retired from the Air Force after a 20-year career as a navigator. Although the Air Force had given him an introduction to electronics, Harry had no prior training in TV/stereo servicing before enrolling with NRI.

Harry first encountered NRI through a friend. He examined his friend's textbooks and liked what he saw. Harry was particularly impressed with the balance of theory and practice in NRI courses: "NRI gives you the theoretical background to understand what you're doing, but it spends most of its time on the practical side of servicing. It shows

HARRY WELCH

you what you need to make equipment work."

Today, Harry sells television, audio, and car stereo equipment, handling most of the servicing work himself. "NRI brought me up to date with today's electronics and gave me the experience I needed to 'walk through' any servicing problem." Since opening his business, Harry has recommended NRI to his customers interested in learning more about TV and stereo equipment. "Just the other day, one of my customers walked into the shop and proudly announced that he was now an NRI student – on my recommendation."

Harry's training and experience qualified him to teach an adult education course in electronics at a community college. He is currently in an advisory position at a local technical school. Harry compares the quality of education at NRI with that of technical schools: "I consider NRI to be on an equal plane with technical schools. However, NRI costs less and gives you more time to work on your equipment."

Harry encourages NRI students to stick with their courses. He says the rewards will be well worth the effort: "Don't try to take shortcuts in your studies. Every word is a gem, and you'll only cheat yourself by hurrying through the course or stopping in the middle of it."

Harry also has advice for NRI alumni: "Once you take the course, all you need is self-confidence. As far as training is concerned, NRI has made you well-armed for success."

Harry has a large family, and three of his six children are still in school. His NRI training has allowed him to supplement his Air Force pension with the income from his profitable business. According to Harry, "NRI made me feel that the course was designed with me, personally, in mind."

## WILLIAM BOYER: W3AMQ

William H. Boyer of York, Pennsylvania, a 1953 graduate of NRI's Radio and Television Servicing course, has recently written *The History of York Amateur Radio Club*, a historical account of one of the country's oldest radio clubs. The York club dates back to 1932, 16 years after the formation of the country's oldest radio club in Tacoma, Washington.

William spent five years researching his book and two years writing it. According to William, "It took me a year and a half just to get all the names!" The result is a 67-page work, generously illustrated with photographs. William's book is endorsed by Senator Barry Goldwater (R-Ariz.), K7UGA, and by the American Radio Relay

WILLIAM H. BOYER

League (ARRL), of which William has been a member for over 25 years.

For most of his life, William has worked in jobs requiring an electronics background. For 18 years, he worked for General Electric in their electronics testing lab. He says that completing his NRI course led to a promotion. William's work involved a variety of responsibilities, including production, inspection, and supervision.

In 1958, however, GE relocated to Lowell, Massachusetts, but William chose to remain in York. He then worked for the Central York School District, in charge of all aspects of school building maintenance, including maintaining the electrical systems. William was employed by the school district for over 19 years.

William has been active in the ARRL and the York club since he received his amateur radio license in 1954. The late Charles K. Waelde, an active member of the York club for many years, persuaded William to write the club's history. William dedicated his book to Waelde, thanking him for his inspiration.

According to William, his work is "not a dry history book. It has a lot of humor and many interesting photographs to make it enjoyable for any reader."

William is particularly enthusiastic about the endorsement given by Sen. Goldwater, himself an amateur radio buff who acquired his first license over 50 years ago. Commentaries by Sen. Goldwater, officials of the ARRL, local historians, and radio experts are included in William's book. "Senator Goldwater received the finished book and was very pleased. He highly recommends it."

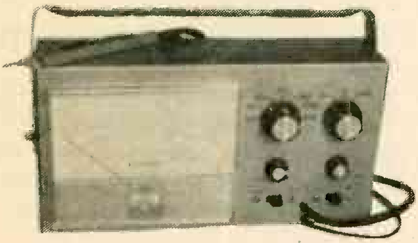
Copies of William's book are being placed in the Martin Memorial Library in York, the museum of the Historical Society of York County, and the American Radio Relay League Museum and Library in Newington, Connecticut. In addition, William has graciously donated a copy of his book to the NRI library in Washington, D.C. Inside, he wrote the following words:

"It is a pleasure to present this book to the National Radio Institute Library, Washington, D.C., with deep appreciation of the dedicated personnel who have helped make this accomplishment possible."

If you have an interesting story to tell, or if you know another successful NRI student or graduate, please drop a line to Managing Editor, *NRI Journal*, McGraw-Hill CEC, 3939 Wisconsin Avenue, Washington, D.C. 20016.

# CONAR Transistorized Volt–Ohmmeter

Washington's Birthday Sale



$49.95
**Assembled**
Stock No. WT212

$41.95
**Kit Form**
Stock No. UK212

**EASY TO BUILD – EASY TO USE**

■ Printed circuit board construction makes assembly easier and faster. The complicated and time-consuming job of wiring switches has been eliminated. Switches simply plug into the circuit board. ■ Battery operation means total portability, plus instant-on without warm-up ■ A single cable is used for all function – ac, dc, ohms – no switching. ■ Combination handle also serves as a tilt stand. ■ Calibration controls are accessible without removing cabinet. ■ Two extra zero-center dc scales provide for special measurements. ■ Huge, full-view 6" meter gives accurate readings at a glance. ■ Polarity reversing switch also works on ohms scale to make testing semiconductors easy

**SPECIFICATIONS**

**7 DC Voltage Ranges:** 0-1.2, 0-3, 0-12, 0-30, 0-120, 0-300, 0-1200. **7 AC Voltage Ranges:** 0-1.2, 0-3, 0-12, 0-30, 0-120, 0-300, 0-1200. **7 Ohms Ranges:** R X 1, R X 10, R X 100, R X 1k, R X 10k, R X 100k, R X 1 megohm. **Accuracy:** 3% of full scale, ac and dc. **AC Frequency Response:** ±3 dB-20 Hz to 6 MHz. Usable to 15 MHz. **Power Requirements:** 9 Volts dc – transistor radio battery; 1.5 volt "C" cell. **Dimensions:** 5-3/4" H X 10-3/4" W X 2-3/4" D.

# CONAR Model 214 Transistor Tester

$47.50
**Assembled**
Stock No. WT214

$36.50
**Kit Form**
Stock No. UK214

Special attention has been given to the development of this transistor test kit. The CONAR 214 is easily constructed, provides accuracy in test results, and is useful in day-to-day servicing work. Its usefulness is expanded by its ability to test field-effect transistors. Don't buy any transistor that does not have this important feature.

**SPECIFICATIONS**

**Tests** – Standard (bipolar) transistors: leakage, 0-200 μA; dc current gain (Beta): 2 ranges 0-50, 0-500. Field-effect transistors: bias point; Idss; 0-20 mA; transconductance; GM 0-50,000 μmho. **Accuracy** – ±10%. **Power Requirements** – Built-in battery supply. **Meter Movement** – 200 μA d'Arsonval, fully protected, burnout proof. **Size** – 5-3/4" H X 10-3/4" W X 2-3/4" D, 5 lbs.

## Sale Ends March 1, 1980

# Ham News

## Ted Beach K4MKX

Well, I had the opportunity to listen in on my first Get Together the other day. On October 23 I was visiting a fellow ham (WB4MJF) here in Arlington, Virginia. It suddenly occurred to me that it was Tuesday evening, and Randy has a Heath SB104A that works just beautifully. Unfortunately, I didn't have a copy of the latest *NRI Journal* with me, and I couldn't remember which band was scheduled for October 23!

I quickly called my home QTH and, after some rather wild explanations to my wife, found out that she couldn't find my copy of the *Journal*. A couple more phone calls to fellow employees also netted me a big fat zero.

By now it was getting on toward 9:00 p.m. so it looked as if I would miss out on the cw part, whatever band we were set for. Just then the phone rang. It was my wife saying that she had finally found my copy of the *Journal*. In less than a minute, she had found the schedule on page 34 of the September/October issue, and I had Randy's rig tuned up on 3730.

I'm not at all familiar with the SB104, so I decided to hunt around a bit and just listen to see if I could hear anyone calling CQ NRI or talking about NRI.

No luck. Looking at my watch I saw that it was a bit after 9:00 p.m., so maybe I'd better swing on up the band to try SSB on 3980. It could be that everyone had finished with the cw portion by then.

I heard a couple of very loud W3's and a couple of W4's near the frequency, but no one was talking about NRI. I thought I'd try to find a "quiet" spot and try calling CQ NRI myself a couple of times. Randy checked me out on the tune-up procedure, and after a couple of minutes I tried a couple of tentative "CQ NRI" calls.

No response. So I moved up a bit to just below 3985 and tried again. Still

## NRI "GET TOGETHER" SCHEDULE FOR 1980

| | 75/80 | 15 | 40 | 75/80 | 15 | 40 |
|---|---|---|---|---|---|---|
| JANUARY | 1 | 8 | 15 | 22 | 29 | |
| FEBRUARY | | | 5 | 12 | 19 | 25 |
| MARCH | 4 | 11 | 18 | 25 | | |
| APRIL | | 1 | 8 | 15 | 22 | 29 |

TIMES:

| | |
|---|---|
| CW | 8:30 - 9:00 p.m. EST |
| SSB | 9:00 - 9:30 p.m. EST |

| FREQUENCIES: | CW* | SSB* |
|---|---|---|
| 15 Meters | 21.150 | 21.400 |
| 40 Meters | 7.130 | 7.280 |
| 75/80 Meters | 3.730 | 3.980 |

*+5 kHz in case of QRM or QRN

nothing. In fact, I wasn't hearing anything but noise in the receiver about then. We tuned around some more and heard only a couple of very weak stations.

I asked Randy if he was sure the 75-meter antenna was connected to the rig, and he replied that he didn't have an antenna for 75 meters! He said he always used his slightly long 40-meter sloper on 75 and always had excellent results with his local QSOs! Wow! Surprisingly, the SWR wasn't too bad, so *some* power must have been getting out, but no one heard me, and I could barely hear anyone else.

We did some more tuning around, but I gave up trying to call CQ. After a few more minutes of listening, I thought I heard a couple of stations talking about NRI, so I listened very closely. Unfortunately, the two stations in QSO were both very weak (they were both W2's), and there was some sideband spillover covering them coming from a nearby station. This combination of circumstances made it impossible to get even a complete call sign from either of the stations, much less a name or QTH.

By this time it was well after 9:30 p.m., but I did stick around and tried listening up and down the band for a few more minutes before calling it quits.

All in all, I would have to say it was a rather discouraging evening, but on another night things might be better. As a result, I now have incentive to get going and repair my own rig (finally!) and try the NRI Get Togethers again. It'll have to be on one of the high bands, however, since I do not have antennas for anything lower than 20 meters right now. When the weather gets a little better I'm planning to do some antenna work, so perhaps this spring I'll be able to listen in on 40 or 80.

In the meantime, be sure to check out the box with the schedules for the Get Togethers for January through April, and try to get on for an NRI QSO. I'll be joining you when and if I can!

Now let's see who we have heard from since last time. Not too many people have written in recently, so the list is pretty small. Remember, if you haven't yet written in to let us know who you are and what you're doing, your name and call will never make it to the pages of the *NRI Journal*, and we'll never know you're out there! Please, do write to let us know you're there.

| | | | |
|---|---|---|---|
| Andy | KA4EIG | A* | Tavernier FL |
| Bill | W3AMQ | – | York PA |
| Ray | WD5CSW | – | Laverne OK |
| Ted | KB5OF | A* | Lake Jackson TX |
| Carl | W5XQ | E | Ada OK |
| Regis | WBØQNU | T | Wichita KS |

*Just Upgraded – Congratulations!

KA4EIG has graced these pages a number of times in the past, and we're pleased to announce that Andy has upgraded this time from Novice to Advanced. Andy says, "The code was fairly easy, although I failed it on my first attempt August 2. The General theory test was duck soup, thanks to my NRI course, but I just sneaked by the Advanced test." The important thing is that you made it, Andy, and we're sure you'll have no trouble with the Extra after you've been on the air for a while. Good practical experience is a real help, and also lots of fun!

Andy is the only correspondent from among our students and graduates of the Amateur License course. The other five in the list this time are from the ranks of other students and graduates.

Bill, W3AMQ, is written up in "Alumni Accomplishments" in this issue of the *Journal*, so be sure to read about him. He wrote to me to get his name on the list of those who want to get some of the NRI QSL cards when they become available. Things work slowly around here, Bill, but we'll keep your name on file, and you'll be notified when we're ready.

WD5CSW is a graduate of the Communications course. He and three fellow hams have installed their own open repeater in Laverne, Oklahoma. Ray says they have it operating on 147.96/36 using his station call. Real fine, Ray, and we're glad you now have your course transceiver working right.

The last time KB5OF wrote was when he upgraded to Technician as KA5EUG. Ted decided to get a "new" call this time when he made the upgrade to Advanced, and is doing lots of interesting things on 40 meters and 2 meters. Very fine, Ted. It's always nice to see "upgrade" next to a new call!

Carl, W5XQ, writes that he, too, has listened in for some of the NRI Get Togethers, but so far is batting zero. Don't feel bad, Carl, but don't give up either. I'm sure someone will be listening one of these Tuesdays!

WBØQNU writes that he has a brand new Technician ticket and would like to upgrade but is having trouble mastering the Morse code. That certainly sounds familiar. I dare say most of us have gone down that path before! I can only suggest, Regis, that you use your new Technician license down in the Novice bands of 80 and 40 and do lots and lots of practicing. Just like learning to ride a bicycle or drive a car, practice makes perfect. Once you've learned the code well, you'll never forget it. But practice and more practice is just about the only way to master your newly learned skill. Best of luck, Regis.

We also heard from one other person whose name does not appear in the list. That was Tim, from Enterprise, Alabama. Tim first became interested in amateur radio while working with some Army communications equipment a few years ago. He enrolled in the NRI Communications course and started preparing for his Novice examination. After a bit, Tim decided that he might as well go for Technician since he had to drive to Atlanta one day anyway. While he was there, he decided to give the Second Class Phone exam a crack, and was very pleased to pass it! Now he's waiting impatiently to receive his Technician ticket from the FCC so he can get on the air with his newly assembled HW101 transceiver. Hope you get the license real soon, Tim, so you can put all that neat equipment on the air.

Well, that's about it for this time, gang. Be sure to write in and let us hear from you. We'll also be looking for a QSO on one of the Get Togethers.

Very 73 – Ted K4MKX

# About the Author...

*Ted Beach has been with NRI for 18 years, and has been an active radio amateur for more than 25 years. He started writing Ham News shortly after NRI introduced the Amateur License courses in the late 1960's. Then we were most anxious to let everyone know about our new program and were trying to solicit NRI amateurs to help out as volunteer examiners for hopeful Novices.*

*In addition to being the technical editor of the NRI Journal, Ted sees that the material in all NRI electronics courses (lessons and kits) is technically correct before it goes out to our students. This means that he has been involved with industrial electronics, color television, amateur radio, computers, CB, and most recently, microcomputers. As you might imagine, Ted stays pretty busy most of the time!*

| | | |
|---|---|---|
| 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 Novice 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 license 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-administrated examination. | August 26, 1977 |
| 12 | 97.95(b)(2) rescinded. Maritime Mobil in Region 2 may use all amateur frequencies. In foreign waters, Maritime Mobil may use only frequencies authorized by regional government. | September 12, 1977 |
| 13 | Call sign restructured, making special calls available to various class license holders. | March 24, 1978 |
| 14 | Ban on commercial 10-meter linear amplifiers. | April 28, 1978 |
| 15 | Novice license term extended to five years, renewable. Technicians given full privileges above 50 MHz. | May 15, 1978 |

# Alumni News

Harry Taylor

## DETROIT CHAPTER

Although we still meet at St. Andrew's Hall, we changed our meeting night to the first Friday of each month. This was done to avoid conflicts with other activities at the hall. The management of the hall has been very accomodating to our needs.

During our October meeting, we discussed the theory and application of transistors and transistor equipment. The meeting was led by our chairman, Jim Kelley.

Harry Taylor brought a microcomputer to our November meeting. We cut our business meeting short in order to have more time for the demonstration and the question-and-answer session that followed. Few of us had seen a microcomputer up close. Therefore, we took the opportunity to examine the NRI microcomputer – circuit boards, keyboard, modulator, and all. It was interesting to note that the microcomputer, which is no larger than a briefcase, has more computing power than the early room-size computers that consumed kilowatts of electrical energy.

We saw a demonstration of a computer program that prepares income taxes. The computer asked for the information needed to prepare a tax return step-by-step and performed the calculations. The microcomputer made this dreaded task seem very simple.

At the conclusion of the meeting, there were four door prizes awarded, and we had refreshments. Ray Berus had selected the tastiest of cold cuts, cheese, and coffee. The meeting was enjoyed by all.

## FLINT/SAGINAW VALLEY CHAPTER

We worked on common – but troublesome – TV problems at the October 3 meeting. One was a Montgomery Ward black-and-white TV with a narrow picture. The horizontal oscillator and output stage were working, and we found approximately the correct dc voltages. Scope tests revealed improper waveforms that resulted in insufficient width. The improper waveforms were due to a broken slug in the horizontal oscillator coil. Replacing the slug restored the width.

Chester Mazer brought an antique radio with no audio (no reception) to another meeting. We are still trying to fix it. So far, we have remelted solder connections, cleared current paths between tube socket pins, cleared shorts in the band switch, repaired bad filament connections, etc. This is a practical exercise in looking for multiple troubles. At this point, it seems that no matter how many problems we solve there will always be at least one more!

Larry Myers raised the question of how to identify dial lamp bulbs. The answer is to determine the color of the bead inside the bulb. Two common examples are the No.44, which has a blue bead and a current rating of 0.25 ampere, and the No.47, which has a brown bead and a rating of 0.15 ampere.

We were pleased to have Harry Taylor attend the meeting in late October and show us what they are doing down in Washington, D.C. We enjoyed the demonstration and discussion of the NRI microcomputer. We found this particularly interesting because we are servicing microwave ovens that use microprocessors. (The microcomputer is based on a microprocessor. – Ed.) While microcomputers and microprocessors are new to us, we are willing to learn about them.

A lot of the discussion revolved around the subject of solar heating. Harry had brought copies of the NRI lessons on this subject for distribution. The high cost of heating has increased our interest in this subject.

We continue to meet every two weeks for discussion and to gain experience in service work. We are willing to tackle nearly any kind of electric equipment found in the home.

## NORTH JERSEY CHAPTER

Chairman Al Mould gave a demonstration of the conversion of a scope from recurrent to triggered sweep. The scope was donated to the chapter by Franklin Lucas and the conversion required a few simple modifications and about $10 worth of parts. Al also demonstrated a square wave generator based on a design in the *NRI Journal.*

The group was particularly impressed with the waveforms from a color and sync generator that Al used. The color burst and other displays had the look of service data and textbook accuracy, which can never be obtained from even the best receiver.

Later, we also spent some time working on service problems and sets brought in by Sam Britt, George Mitchell, and Bob Morello.

## NEW YORK CITY CHAPTER

We welcomed two new members to our chapter in October. Richard Oesterle and John Babick, both recent NRI graduates, joined the chapter after visiting our September meeting. Richard completed the Digital Electronics course, and John completed the Color TV Servicing course.

We recently purchased several pieces of TV test equipment and related electronics supplies from the estate of Henry Shoten, who recently passed away. We accepted the offer of the equipment from Mr. Shoten's son. We now have a good selection of instruments for both service work and our training sessions.

Chairman Sam Antman led a session on troubleshooting. We began with an XAM 19-inch tube-type color television set with a horizontal sync problem. First we noted that the chassis is very similar to one model made by General Electric. Furthermore, all of the tubes and many of the other parts are made by General Electric. We tested and/or changed the horizontal oscillator and output tube and a number of parts in the horizontal frequency control circuit. While we did not pinpoint the trouble, we got plenty of practice in checking components and circuit operation.

We later held a session on transistor radio servicing, using color slides, an audio tape, a demonstration board, and test instruments. From this we gained valuable experience in analyzing and correcting rf and audio frequency problems.

The chairman thanked Dick Sheftman for the excellent job he did over the summer taping the text of the last section of our transistor training program. We felt that the audio tape would be more effective than typed or printed material, and Dick volunteered to do it for us.

### DIRECTORY OF ALUMNI CHAPTERS

DETROIT CHAPTER meets at 8 p.m. on the first Friday of each month at St. Andrews Hall, 431 E. Congress Street, Detroit. Chairman: James Kelly, 1140 Livernois, Detroit. Telephone 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. Telephone (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. Chairman: Sam Antman, 1669 45th Street, Brooklyn.

NORTH JERSEY CHAPTER meets at 8 p.m. on the second Friday of each month at the Players Club, located on Washington Square in Kearney, N.J. For information, contact Paul Howard, 950 Carteret Avenue, Union, N.J. 07083. Telephone (201) 964-8492.

PITTSBURGH CHAPTER meets at 8 p.m. on the first Thursday of each month at the home of Jim Wheeler, 1436 Riverview Drive, Verona, Pa. 15147. Chairman: George McElwain, 100 Glenfield Drive, Pittsburgh, Pa. 15235.

SAN ANTONIO 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 Street, (three blocks north of Austin Hwy.), 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 Daniel DeJesus, 12 Brookview Street, Fairhaven, Mass. 02719.

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 at (416) 293-1911.

The chairman thanked Steve Pukatch for taking notes in the absence of our secretary, George Wolovick. George and Steve Kross are recovering from illnesses. We hope they will be back to full strength in the near future.

## SAN ANTONIO CHAPTER

Sam Dentler, our TV expert, has been leading technical sessions on TV servicing, and the members continue to bring in sets with interesting problems. We were glad to help a current NRI student repair his CONAR Model 600 color TV with a horizontal output/high-voltage problem. We traced the trouble to a bad high-voltage (flyback) transformer. There had been arcing between the windings of the transformer, causing an immediate loss of high voltage.

In the near future, we will begin using the NRI Discovery Lab for performing demonstrations of solid-state theory.

## SOUTHEASTERN MASSACHUSETTS CHAPTER

Our October meeting was held at the home of Chairman Dan DeJesus. Harry Taylor was the featured speaker. Harry discussed the various courses being offered by NRI and demonstrated the NRI microcomputer.

We were pleasantly surprised to find out how easy the computer is to assemble and use. Harry programmed the computer via the keyboard and cassette tape and ran a number of programs. One of the programs is designed to teach math. Once programmed, the computer presented math problems that the "student" answered by typing the answer on the keyboard. The computer then graded the answer, computed the cumulative grade average, and displayed another problem. The division problems, which had to be accurate to two decimal places, presented a pretty good challenge for the members. We found this enjoyable.

During the discussion, the members acknowledged that computers and computer circuitry are becoming widespread. This creates a need for greater understanding of this field. Most of us, therefore, look forward to more exposure to microprocessors and microcomputers in the future. The door prizes and refreshments added to our enjoyment of the meeting.

## SPRINGFIELD, MA CHAPTER

TV servicing was the topic of our October meeting. We located and repaired defects in several sets. Each servicing task was accompanied by discussion of the theory related to the failure, the troubleshooting procedure, and the correction.

One of the principal topics was silicon-controlled rectifiers (SCRs). We analyzed the operation and typical failures of the SCR horizontal sweep system found in various RCA sets. We also studied and discussed the SCRs used in the low-voltage section of some of the newer television sets on the market.

Chairman Norman Charest reported on a Magnavox 15-inch color set with a bad picture tube. The set had a blank raster (a lighted screen but no picture), although a good video signal was present at the terminals of the crt. There was also a sharp buzz, which sounded like arcing inside the crt at a 60 Hz rate. The trouble was traced to a bad crt.

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**In the tradition of NRI's pursuit of excellence in training, the following graduates who earned NRI diplomas in September and October also earned unusual recognition under the NRI Honors Program. On the basis of their grades, these graduates distinguished themselves by earning the right to honors listed below, in addition to their regular NRI diploma. This distinction is made part of their permanent NRI record.**

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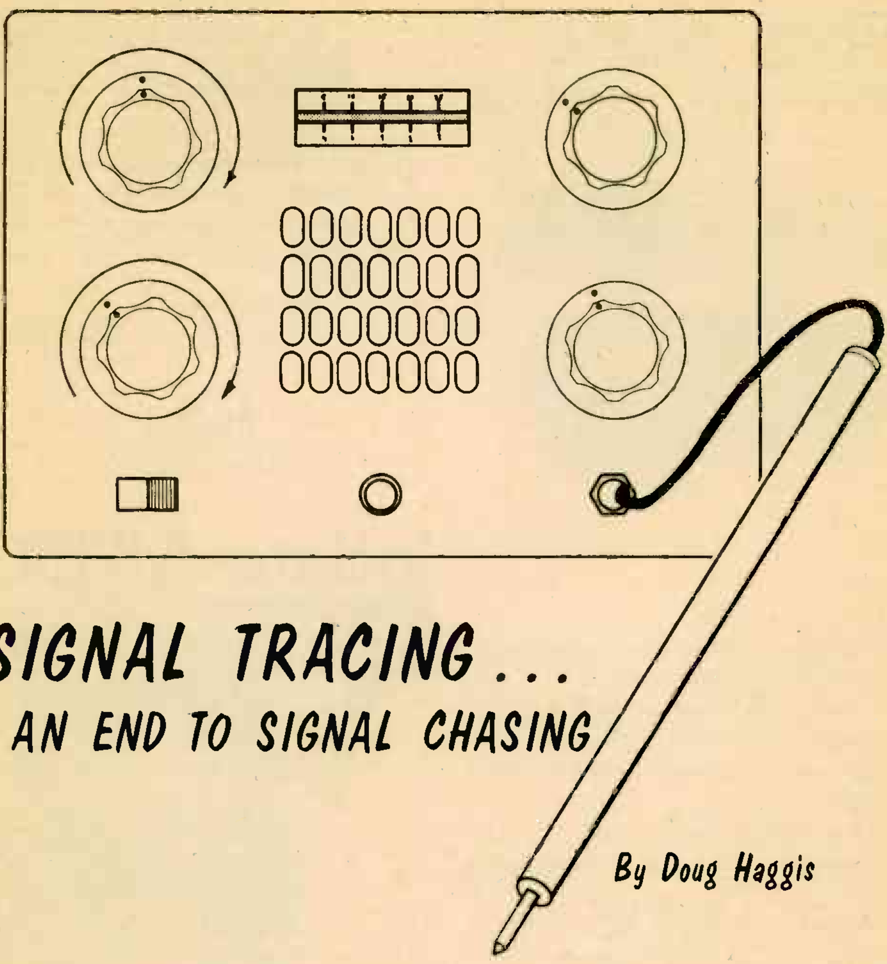


# SIGNAL TRACING...
## AN END TO SIGNAL CHASING

By Doug Haggis

Whether you service receivers and audio amplifiers full- or part-time, it is likely that you have had occasion to spend more time than you'd like searching for intermittent or uncommon problems.

Even with supply voltages checking out, you've probably found that you don't get the quick answers you need when using a voltmeter or even an oscilloscope in making these types of servicing problems profitable. If this is the case, you should be spending your time tracing, not chasing. It's time you turned to signal tracing.

### WHAT IS SIGNAL TRACING?

Signal tracing is a method of checking each stage of a receiver or amplifier by following or tracing a received or injected signal through the

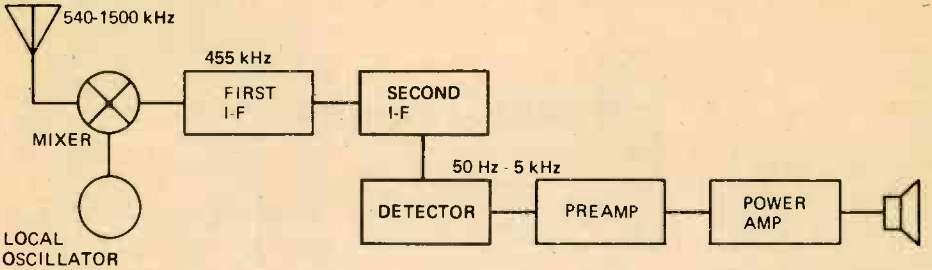



FIGURE 1. SIMPLIFIED BLOCK DIAGRAM OF A TYPICAL AM RECEIVER.

complete unit from input to output until the faulty stage is located. In tracing the signal through each stage, you check first for its presence and second for its quality or perhaps its amplitude.

Each section of a receiver or audio amplifier is responsible for performing a specific task. In an AM receiver, signals sent from an AM broadcast station on a frequency between 540 and 1600 kHz are intercepted by the antenna.

Assume that we are receiving a station broadcasting on a frequency of 1000 kHz. By tuning the receiver we select this particular signal and send it on to the mixer or converter. A block diagram of a typical AM receiver is shown in Fig.1.

When we tune the receiver to 1000 kHz, we also adjust the frequency of the local oscillator to 1455 kHz. This signal and the signal from the broadcast station beat together in the mixer stage to form two new frequencies, a sum and a difference. We are only interested in the difference or intermediate frequency of 455 kHz. A tuned circuit follows the mixer that selects this frequency and couples it into the first i-f amplifier.

The first i-f amplifier builds up the signal and feeds it to a second tuned circuit. This circuit couples the signal into the second i-f amplifier, where the signal is amplified to a level sufficient to drive the detector.

The detector stage demodulates and filters the 455 kHz signal until only audio signals are left. These signals are fed to the audio preamplifier, where they become strong enough to drive the power amplifier.

The power amplifier builds up the weak audio signals until they are able to drive the speaker. The speaker then reproduces the sounds that originated at the broadcast station. With this basic knowledge of how the signal should be acted upon by each stage, you will be able to compare the results of your signal tracing with what you know must happen in order for the receiver to perform properly.

## CHOOSING A SIGNAL TRACER

In order to use the signal tracing method of troubleshooting defective units, you must, of course, have a signal tracer. I recommend the CONAR Model 231. This unit was designed by NRI engineers to assist the technician in locating the cause of troubles in home or auto receivers and audio amplifiers.

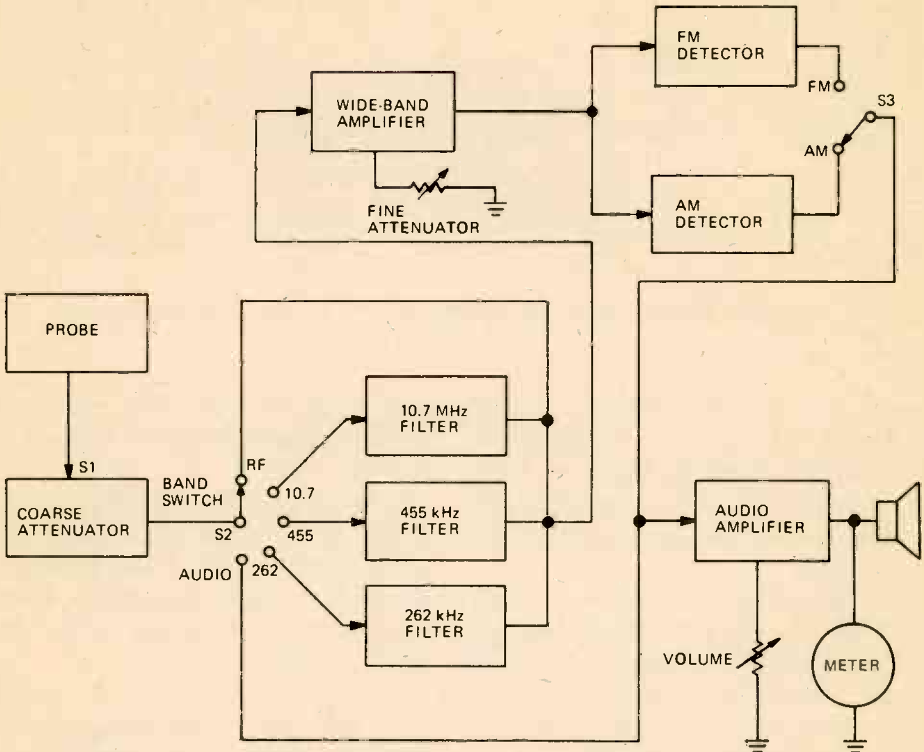



**FIGURE 2.** BLOCK DIAGRAM OF THE MODEL 231 SIGNAL TRACER.

The Model 231 is an easy-to-use, all solid-state tuned signal tracer. It is called a *tuned* signal tracer because it has three selectable ceramic filter tuned inputs covering the standard broadcast i-f frequencies. (They are 262 kHz, 455 kHz, and 10.7 MHz.) These tuned circuits eliminate the need for manual tuning as was required when using the earlier signal tracing units. This simplifies the operating setup, allowing you to spend your time where it counts – locating and repairing the defect. The Model 231 also provides two untuned input selections: rf and audio.

Let's take a closer look at the overall layout of the Model 231 circuitry by referring to the simplified block diagram shown in Fig.2. To begin, the signal under test will be applied to the probe of the tracer. The probe contains a high-impedance input circuit using an FET constructed in a source-follower configuration. This arrangement prevents loading the circuit being tested, ensuring accurate signal reproduction.

The signal at the output of the probe is then applied to the coarse attenuator switch, S1. This 5-position switch provides selectable signal attenuation in increments of powers of 10. The maximum amount of attenuation obtainable is approximately 1000 to 1.

From the attenuator the signal is sent to the band switch. This switch routes the signal either directly to the wide-band amplifier (RF position), through

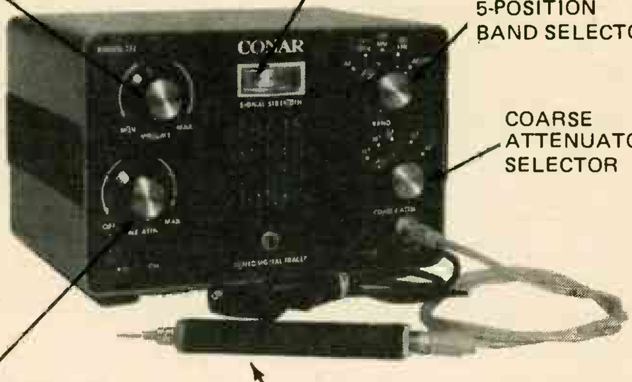



FIGURE 3. FRONT PANEL OPERATING CONTROL LAYOUT OF THE MODEL 231 SIGNAL TRACER.

one of the three ceramic filters covering the standard i-f frequency (10.7 MHz, 455 kHz, 262 kHz), or directly to the audio amplifier (AUDIO position). With the band switch set to the RF, 10.7 MHz, 455 kHz, or 262 kHz positions, the signal will be fed to the input of the wideband amplifier. A fine attenuator control covering a narrow range of attenuation is provided in this stage of amplification.

The output of the wideband amplifier is applied to both the AM detector and the FM detector. The AM/FM selector switch, S3, selects the detected signal from the FM detector or the AM detector. Independent of the band switch selection, the signal applied to the probe ultimately arrives at the input to the audio amplifier stage. This section of the tracer consists of an audio power amplifier contained in a single integrated circuit (IC) package.

In this stage a low-level audio signal (approximately 0.5 volt peak-to-peak) is boosted to a high-level signal where it is then applied to the loudspeaker. The volume control is provided at the input of this stage to enable the technician to set the desired output level. A signal strength meter is also provided. This aids in signal tracing because it provides a visual means of monitoring the signal strength. It will also help you to maintain the correct attenuator settings, preventing speaker overload (distortion). The locations of the controls and switches on the front panel of the Model 231 are shown in Fig.3.

## GETTING THE FEEL OF SIGNAL TRACING

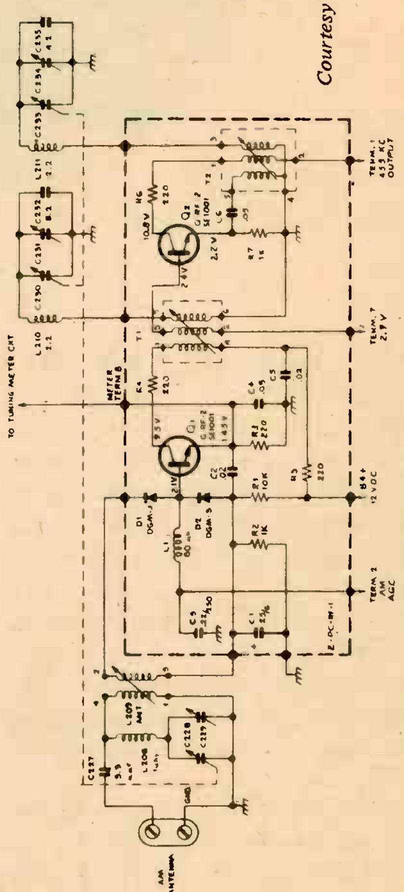
Now that you are familiar with the operation of the signal tracer, let's trace the signal through a typical AM/FM, FM-stereo receiver. A moderate-quality receiver manufactured by the H. H. Scott Company will be used in the following discussion. A schematic diagram of the rf section of the AM portion of the receiver is shown in Fig.4.

The rf section consists of the AM antenna tuning circuits, rf amplifier, and local oscillator. We'll assume the receiver is working properly for our first "trace through" using the Model 231.

Begin the signal tracing process by turning the receiver on and tuning in a strong AM station. Next, turn the signal tracer on and place the band switch to the RF position, with the AM/FM switch set to the AM position. Set the volume control to approximately mid-position, with the coarse and fine attenuators set to their fully counterclockwise positions.

By examining the schematic shown in Fig.4 you will note that the B– connection in this particular receiver is also chassis ground; therefore, we can connect the ground lead of the signal tracer to a convenient point on the chassis.

Now, touch the signal tracer probe to terminal 2 of L209. Turn the volume control of the receiver to minimum so that you can hear the station only through the speaker of the signal tracer. You will also note a fluctuation from the signal strength meter. Check the signal strength meter and adjust the fine and coarse attenuators to prevent the meter from swinging hard to the right ("pegging"). The attenuators and volume control should be set so that the signal strength indicator rides at about center scale.



Courtesy H. H. Scott, Inc.

FIGURE 4. THE RF SECTION OF A TYPICAL AM RECEIVER.

Now, adjust the receiver tuning control slightly to each side of the station as you observe the signal strength meter. You should notice that the signal strength meter swings slowly to the left of the center-scale position. This is caused by the antenna tuning circuit in the receiver. When the receiver is exactly tuned to the station, the meter indicator will be most nearly to the center of the scale, indicating that the receiver is properly tuned.

Leave both the receiver and the tracer controls in the position where you obtain the strongest signal and move the probe to the base of Q1, the rf amplifier. The signal will be about the same level here. Continue tracing by moving the probe to the collector of Q1. You should notice an increase in signal level. Adjust the coarse and fine attenuators as necessary to keep the signal strength meter about center scale. The exact amount of increase will depend upon the strength of the signal you are receiving.

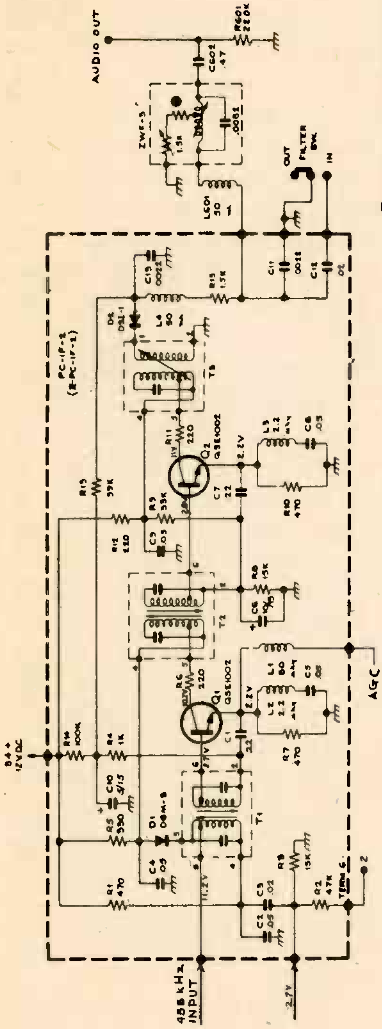
Next, check the signal at the base of Q2, the mixer/oscillator transistor. You will notice a reduction in the signal at this point. By referring to the schematic shown in Fig.4, you will see that the signal has passed through the tuned circuit. In transistor stages, the relatively high output impedance of the preceding stage must be matched to the low input impedance of the following stage. This will result in a voltage reduction and a smaller signal to the tracer, since it monitors signal voltages. However, transistors are current-operated devices and the signal will experience a current increase in passing through the transformer.

T1 has two high-impedance windings and one low-impedance winding. The collector winding (1-4) and the tuned windings (5-6) are high impedance, while the base winding (2-3) is low impedance. The mixer transformer, T2, also has three windings. The emitter winding (4-5) and the tuned winding (3-4) are high impedance, while the collector feedback winding (1-2) is low impedance.

You should be able to pick up the i-f signal at pin 1 of T2. Set the band switch on the tracer to the 455 kHz position. Touch the probe to terminal 1 and you should hear the signal. From here the i-f signal is sent to another circuit board that contains the i-f amplifier stages.

The i-f amplifier section is shown in Fig.5. The i-f signal is fed to terminal 5 of the first i-f transformer. This transistor couples the signal into the base of the first i-f amplifier, Q1. Touch the signal tracer probe to terminal 5 and then to the base of Q1 and check for signal at both points. Move the probe to the collector of Q1. You will notice a considerable increase in signal level at this point. You should then adjust the coarse and fine attenuators to obtain a proper signal strength indication. The i-f amplifier is responsible for most of the gain in any receiver. Check the signal at the base of Q2, where you will observe some signal reduction. Then, move the probe to the collector of Q2. Again, you will see that the signal has been amplified significantly.

The signal flows from the collector of Q2 through T3 to the cathode of the detector diode, D2. The detector circuit removes the audio information from the signal. Since the detector in the tracer is no longer needed, set the band switch to the AUDIO position and the coarse attenuator fully counterclockwise. The



Courtesy H. H. Scott, Inc.

FIGURE 5. TYPICAL TWO-STAGE AM I-F AMPLIFIER.

audio signal at this point will be quite weak. Touch the probe to the junction of C602 and R601. Adjust the attenuator and the volume control on the tracer until you are able to hear the signal. The components between this point and the anode of the detector are used to filter the audio from the rectified 455 kHz signal. Any remaining i-f signal is placed at ground potential while allowing only the audio signal to pass.

The audio signal is fed through the input selection switch of the stereo amplifier to the loudness control of each channel. Since this is a stereo amplifier, both the right and left channels receive the same signal when you are listening to an AM station. Since both the right and left channel amplifiers are identical, only one channel of the stereo amplifier is shown in Fig.6. The audio signal comes from the center tap of the loudness control to the base of Q2, the audio preamplifier. Touch the probe to this point and observe the effect of adjusting the loudness control. The sound from the signal tracer speaker will increase and decrease, and the signal meter will swing to the right and left.

Set the loudness control to a suitable level and move the probe to the collector of Q2. You will notice an increase in the signal level. The signal is fed through the bass and treble controls, and then coupled into the base of Q1, the second audio amplifier. Touch the tracer probe to the base and collector of this transistor. Again you will notice an increase in the signal level at the collector. The same will be true at the base and collector of Q3, the audio driver transistor. The output stage of this amplifier is a single-ended, push-pull

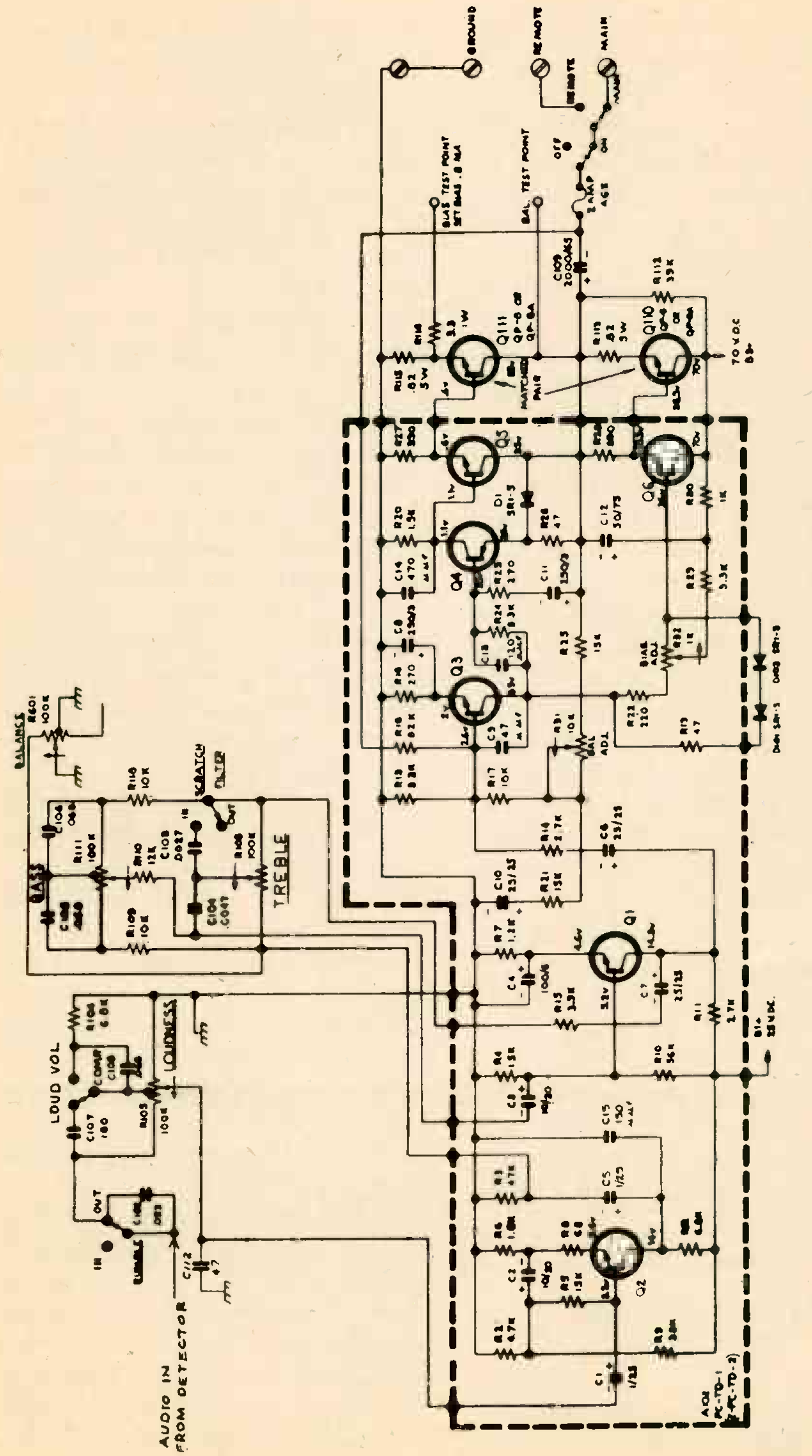



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FIGURE 6. A TYPICAL PREAMP/AF/POWER AMPLIFIER SECTION FOUND IN MODERN AUDIO EQUIPMENT.

circuit, driven by emitter-follower drivers. Emitter followers are used to achieve high gain in the output stage while maintaining a high output impedance to match the output impedance of the driver transistors. This allows the use of direct coupling for best high frequency response.

Since a push-pull stage must be driven by signals that are 180° out of phase, a phase inverter must be used between the base of one of the stages and the driver transistor. Touch the signal tracer probe to the base and then to the collector of Q4. You will notice no change in the amplitude of the signal. The stage has been designed to have a gain of 1, and its only purpose is to provide two out-of-phase signals.

By touching the probe to the base and the collector of each of the remaining transistors, you will be able to monitor the signal. However, you will not observe a very large increase in the signal voltage. Remember, these are power amplifier stages. Their purpose is to increase the signal current in order to drive the loudspeaker.

Now you have seen how the signal is checked in an operating receiver from the rf input all the way through to the loudspeaker. When troubleshooting a unit such as this, it is usually not necessary to check the signal in every stage of the receiver. The customer's complaint will help you to determine where you should begin tracing the signal.

## SERVICING "DEAD" RECEIVERS

Now that you've seen how to trace a signal through a properly operating receiver, let's see how we go about using the signal tracer to troubleshoot a defective receiver.

To begin with, the way you go about using the tracer depends upon whether you're looking for the defect in a dead receiver or trying to track down an intermittent defect. Let's start with a dead receiver.

First of all, make sure the receiver is being supplied with operating voltages. Then, start at the antenna-tuned circuit, as previously described, and see if you can pick up a signal by tuning the receiver with the probe of the tracer connected to the input tuned circuit. You'll probably need minimum attenuation of both attenuators at this point.

Move to the output of the mixer stage and switch to the correct i-f frequency setting. If you don't get a signal here, the mixer or the oscillator is defective and you should check components in these stages.

If you do get a signal at the output of the mixer, move to the output of the first i-f amplifier. No signal at this point means that the first i-f amplifier is defective.

Continue on, moving toward the audio circuits, until you locate a stage that is not passing (and amplifying!) the signal. At the point just past the stage where you lose the signal, stop and investigate the dc voltages in the amplifier circuit to see if you can find the actual defect.

This same procedure is used whether you are working on an AM receiver or an FM receiver. Just be sure to set the tracer to the proper detector for the type of set you're working on.

You will use the same procedure to check for distortion in a set. Start at the antenna and work toward the loudspeaker, listening to the quality of the recovered signal through the speaker of the tracer. The defective stage will be just *before* the point you first notice the distortion.

## WHAT ABOUT INTERMITTENT PROBLEMS?

Servicing intermittent receivers is really no fun, even with a signal tracer. However, the tracer can sometimes speed things up a bit if you follow these suggestions.

Start at some point in the i-f strip (perhaps after the first i-f amplifier) and monitor the signal with the tracer. Leave the receiver working so that you can hear both the receiver and the tracer output signals. Then go off and do something else. You'll hear it when the intermittent defect occurs, but note if both the set and the tracer are affected. If they are, the defect is *ahead* of the point at which the tracer is connected. Move the probe toward the antenna and continue monitoring to further isolate the intermittent. Eventually you'll find the stage that is causing the intermittent defect, and you can use disturbance tests or other means to isolate the component causing the problem.

## THE MODEL 231 . . . A WISE CHOICE

The Model 231 discussed in this article is available through CONAR, a division of NRI. This unit is available in both kit and wired form. If you purchase this unit wired, it will arrive fully assembled, "ready to use." Just plug it in and you are ready to begin.

If you purchase the Model 231 in kit form, it will arrive unassembled with clear, easy-to-follow, step-by-step assembly instructions. Even an amateur kit builder can complete the assembly in about one evening.

As you have seen, the Model 231 Signal Tracer can be a powerful servicing tool. There is no match to the value of this unit when it comes to AM/FM receivers and audio amplifiers where the complaints include weak, noisy, or distorted audio reproduction.

In future *Journal* articles I will be discussing a variety of test instruments used in the servicing of television and audio systems. I will look into specific problems dealing with television and audio servicing – and ways to determine what test equipment is best suited for that particular job. I'm certain that you will find these articles interesting and, more importantly, helpful.

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