# nri journal

OCTOBER 1963

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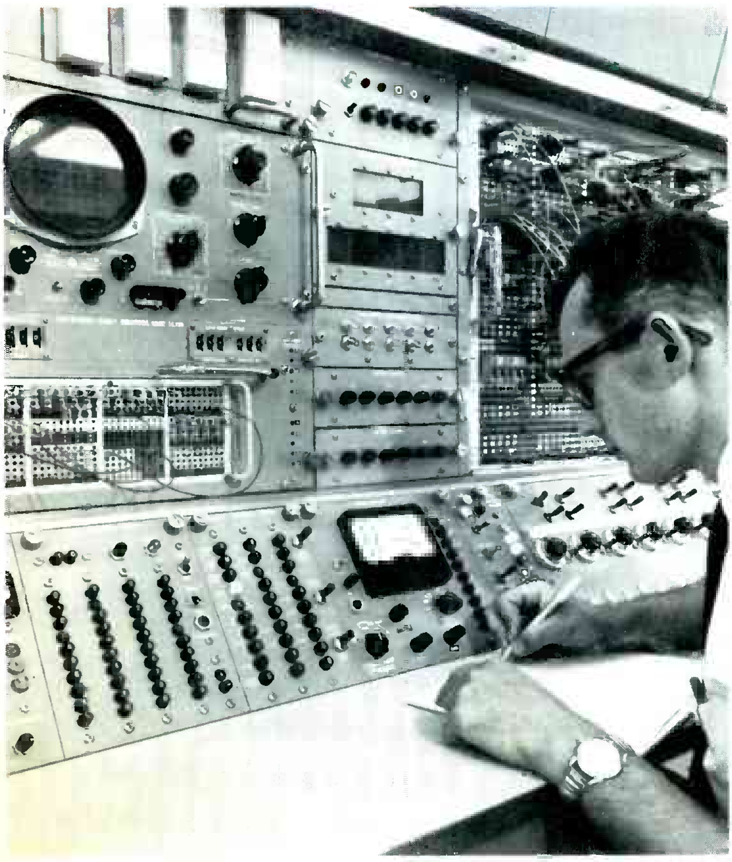

In this issue:



OFFICIAL MAGAZINE OF NATIONAL RADIO INSTITUTE

# NEW TWIN-TRANSISTOR SUPER POWERMATE


## BREAKS THE GAIN/OVERLOAD BARRIER

Servicemen and the public long wanted it, but were told they couldn't have it—a transistorized TV antenna preamplifier with the overload capacity to handle local signals without sacrificing the gain that brings in distant stations.

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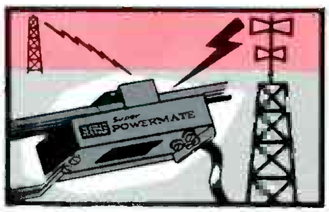


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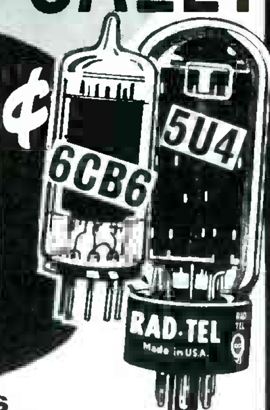


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| 5U4 | .60 | 6DT6 | .53 | 12AV6 | .41 | 25CA5 | .59 |
| 5U8 | .84 | 6DT8 | .94 | 12AV7 | .82 | 25CD6 | 1.52 |
| 5V6 | .56 | 6EA8 | .79 | 12AX4 | .67 | 25CU6 | 1.11 |
| 5X8 | .82 | 6EB5 | .73 | 12AX7 | .63 | 25DN6 | 1.42 |
| 5Y3 | .46 | 6EB8 | .94 | 12AY7 | 1.44 | 25EH5 | .55 |
| 6AB4 | .46 | 6EM5 | .77 | 12AZ7 | .86 | 25L6 | .57 |
| 6AC7 | .96 | 6EM7 | .82 | 12B4 | .68 | 25W4 | .68 |
| 6AF4 | 1.01 | 6EU8 | .79 | 12BD6 | .50 | 32ET5 | .55 |
| 6AG5 | .70 | 6EV5 | .75 | 12BE6 | .53 | 35C5 | .51 |
| 6AH4 | .81 | 6EW6 | .57 | 12BF6 | .60 | 35L6 | .60 |
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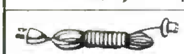

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## Features



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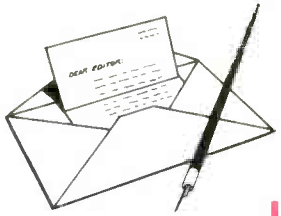
# On Our Cover

Mathematical analysis of process control problems is performed on high-speed and extremely accurate analog computers at new systems simulation facility of Minneapolis-Honeywell's Special Systems Division in Pottstown, Pa. Complex industrial processes are simulated on analog computers having special design features and then checked out on powerful Honeywell 290 digital process computer. Facility willl be used primarily in designing, analyzing and evaluating control systems. It is said to be most advanced in U. S. instrumentation industry for combined analog-digital solutions to control problems.

For digital computer-directed control systems, the analog computers simulate the dynamics of the industrial process and the digital computer performs the control function.



# Letters

■ I just want to take a minute to congratulate you on the new NRI Journal. I am a graduate of NRI and have always enjoyed reading the NRI News. I have always wished that the NRI News would be published every month. I am now reading the Journal and I think it is simply great! I will be looking forward to receiving the Journal every month.

Charles W. Yow
Greensboro, N. C.

■ I think many students and graduates starting in part-time work would get a lot of practical experience building up usable test equipment and odd pieces of radio and audio apparatus. It helped me a lot with my lessons. There are many articles in other magazines but I like the way you have of explaining things.

Another subject coming under electronics is Ultrasonics. Would it be possible to publish an article on that subject? They even use that equipment in the breweries.

Coming out monthly with the October issue will make it doubly welcome and, as far as the advertisements are concerned, I enjoy them as well as the rest of the text. They show what's new, and we will have more faith in them if NRI backs the ads.

Fred Dumbeck
Ville Lemoyne, P. Q.

**An article on Ultrasonics is now in the works and will be published in the Journal. Many breweries DO use Ultrasonics – Hic!**

(Continued on page 34)

# JOB OPPORTUNITIES IN SMALL BOATS

## A PROFITABLE SOURCE OF INCOME FOR THE COMMUNICATIONS TECHNICIAN

**BY ELBERT ROBBERSON**

A small motorboat moves slowly over the smooth sea, the shoreline a blur in the distance. The man at the helm chews a cigar, squinting through the smoke as he studies a dial alongside the wheel. Suddenly he waves at his companion.

"Here it is, Eddie. Drop the hook."

The other man goes forward and starts lowering the anchor toward the bottom as the helmsman puts the engine in reverse to stop the boat.

"The ledge is 90-feet down, and I can see fish over it--big ones!"

In other waters, at another time, a small boat pushes through a dense fog. Every minute the fog horn automatically sounds a long blast, and the skipper and his mate listen for the signals of other vessels, peering into the fog and occasionally glancing at the flashing light on an instrument above the dashboard.

"There's something ahead," the skipper says. "The distance indicator shows something at 200-feet. It's not moving, so we'll have a look. Keep an eye peeled."

The boat forges ahead, both occupants straining forward.

"It's about 50-feet away now, we should see it."

Then they spot the object, an oily water-soaked log, almost under the water, breaking the surface and submerging in the slight swell.

"Glad we found out about that in advance," the skipper said. "We might not have spotted it, and this is a poor place to crack a plank or bang up the propeller."

At still another time, the man in front of a loudspeaker at a Coast Guard lifeboat station becomes alert and grabs a microphone from the desk.

"This is Coast Guard radio back to the Yacht Mary Ann," he says. "Will you state your position, the nature of your distress, and the kind of assistance required."

A shaky voice comes back through the summer static. "This is the Mary Ann back to Coast Guard radio. We are three miles south of the sea buoy. Our skipper broke his leg. We need help to get in and medical assistance."

Any place where there are boats this large, you will find marine-electronics work obtainable. This means just about everywhere.

"Roger," the Coast Guard operator replies. "We are sending a boat. Stand by for further instructions on this frequency."

These happenings illustrate modern small-boat electronics in action. Equipment includes depth and distance indicators, radiotelephones, direction finders, radar, loran, and a multitude of other electronic devices.

The number of pleasure craft in use on the nation's waterways is estimated at over seven and one-half million. Some of them are only canoes and rowboats, but an important part of this number are vessels large enough to benefit from the use of electronic equipment. Not all that could carry such equipment are already equipped; and new boats are sliding down the ways and popping out of molds by the thousand. For the person who likes to work independently, this expanding number of small boats represents a fertile field of employment that, at the present rate of expansion of the sport, is not likely to dry up.

Another immediate spur to activity in the marine-electronics field is the fact that FCC Rules and Regulations, part 8.139, specifies that no new or renewal license will be issued for a radiotelephone transmitter that is not type accepted. In the fleets of commercial ocean steamships and inland-waterway vessels, a survey indicates that 50% of their present radiotelephone gear is not type-accepted. Nobody can guess how many radiotelephones in pleasure boats are not type-accepted. When the current FCC licenses for all of these stations with older equipment run out, new type-accepted equipment must be installed.

Comparing this to the days in the author's experience when spark transmitters

Shown are radar and automatic direction finder antennas on a sailboat mast. This is no place for a person who gets dizzy.

were outlawed, and a great flurry of installing vacuum-tube transmitters kept technicians working overtime, it is easy to imagine that a great number of new radiotelephones will have to be replaced on existing vessels, further increasing the market for equipment and willing and trained hands.

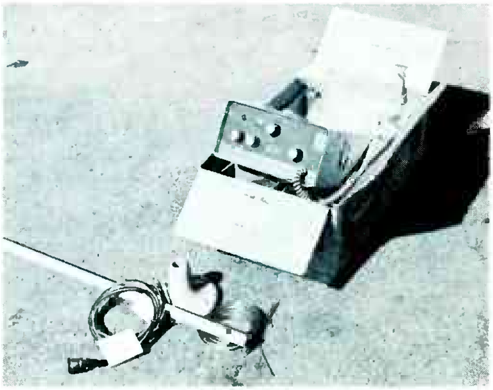
Large seaports have had manufacturer-maintained marine installation and service shops for years. The expansion in boating has meant the establishment of a number of additional service organizations—independents, specializing mainly in pleasure and fishing boats. Now the spread of boating from tidewater to fresh-water rivers and lakes has created a need for marine equipment inland, as well as on the ocean shores; a new employment opportunity for marine electronic equipment specialists.

There are various ways of getting into the field. One is the conventional method of applying to existing companies for employment. Look in the telephone book "yellow pages" for their names or contact manufacturers for information on the location of their service organizations. In some areas, union affiliation may be required, but these are in the minority.

Another avenue is to arrange with a number of boat sales and service agencies (some of which sell electronic equipment among their other accessories) to perform their installation and service work. Large marinas are another possibility for obtaining such a concession; some marinas have enough boats moored in their slips to keep a man hopping from breakfast to supper. When making such an arrangement, it may be possible for you to obtain a small shop or working space at a nominal or no charge.

But for the man with a little business acumen, the most rewarding opportunity still lies in founding his own company and engaging in the sale, as well as the service of the equipment. This requires financial resources in addition to technical knowledge, and more work at first than you'd ever devote to a salaried job, but the man who makes the grade enjoys the chance of greater profit and more independence than by taking any other course.

You'll find blueprints for every piece of equipment you might ever have to work



Modern equipment in kit form, with antenna, insulators and wiring, ready to install.

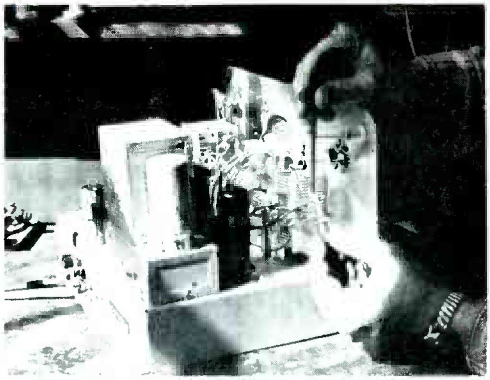
on; but there is no exact blueprint for individual success. You have to absorb every bit of knowledge you can get, and make your own plans to fit your locale and the circumstances. For whatever help it may be, here is my own experience in this field as an example.

Needless to say, I had mastered the technical end through working for others and through constant study. I had the necessary FCC commercial operator's license. I studied the little booklets of the Department of Commerce on founding a business, learned about bookkeeping, and gathered up everything available on marine electronics. Then I found a locality where boating was developing, with practically nobody else around to take care of its electronic needs. (I think there are many such areas that can still be located.)

I rented a small broken-down store on the waterfront, set up a desk, display shelves, a workbench, and all the tools and service equipment I could afford. I persuaded manufacturers to make me their local representative and to supply equipment. At first, I had to sell one piece of equipment to get the money to buy the next. I worked at another job to keep alive, doing my marine work after hours and on weekends; but soon I was able to make the marine shop a full-time operation. Besides hard work, this took careful budgeting.

Soon the time came when, mostly by word of mouth, boatmen came to know that

Installation wiring is simple, but getting it in place through the structure takes ingenuity.



In the tuning of a radiotelephone transmitter for maximum output, proper modulation with no splatter or harmonics is important.

there was a new fellow on the waterfront who could take care of their electronic problems, and my endeavor began to pay. Winters were difficult because all of the boats were under their winter covers. But I filled in this period with programs of removing, reconditioning, and storing equipment. I found that you can even sell boating electronic equipment during a snowstorm if customers know that they can get a better rate on off-season work than during the rush of spring and summer.

In addition to the purely electronic work, I found it profitable to act as a consultant for the local shipyards and boatmen in their electrical problems, even getting into such matters as the cause and cure of underwater metal corrosion. Besides providing more work, this increased my knowledge of boats and their peculiarities—all valuable in this field.

The attainment of security took a few seasons, but it was worth every minute of time and every foot-pound of work expended.

If you like messing around in boats and to work fairly independently, employment in marine electronics is worthy of the most serious consideration. In one way or another, you should be able to find a place for yourself in this growing and not yet overcrowded field.

# SUCCESSFUL SERVICING

BY CHARLES S. TEPFER

Have you ever tried a "special" TV antenna promotion? Many servicemen have, and found them just about as effective as a flyswatter in a grasshopper plague. But I was told recently by the head of one service company that his annual antenna promotion paid off in a big way this year, much better than ever in the past. Why? Because this year he had something really new to sell—a group of "hot" TV antennas and their "electronic" versions with built-in boosters.

Interest in the new breed of TV antenna ran high at the annual Parts Show in Chicago, and not without reason. High gain, broad bandwidth, and high front-to-back ratio are wrapped up in a single shimmering gold anodized package, good for FM and color TV reception too! Add a section to be available later and you'll get UHF. In an ultra fringe area? No problem, stack them on a tower and pull in the channels 200 miles away.

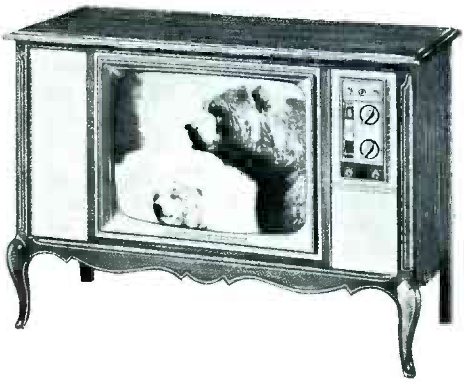
It all sounds like a hopped-up ad man's dream, and there's reason for suspicion, after all, we've heard some of these claims before. This time, though, performance lives up to claims, giving you a solution to satisfy today's channel hungry TV viewers. Once, a small town viewer would settle for two channels, now he wants three or more. He can get them too, now that there are better antennas to pull in a clean signal. Those viewers who torture their eyesight nightly by enduring snowy and rolling pictures don't know that a new, high-gain antenna can blow away the confetti.

How do you get the message across? Take a tip from one antenna maker who offers a booster demonstration unit and packages a demo antenna system which you can put up anywhere for a quick look see. Use it on all service calls and tell the customer that it helps you check out his set with the best possible signal available at his location. If it gives an appreciably better picture than he's getting with his old antenna, sell it hard. If not, nothing is lost—it was just a test, and he's impressed with your thoroughness. The advantages of using such a demo setup during an antenna "special" promotion are obvious.

Fact is, that I know of one TV service outfit that actually has a crank-up tower with antenna clamped to the back of their pickup truck. To test for the effectiveness of the new antenna at any location, the servicemen hook it up to the TV set via clip leads and crank up the tower. This setup paid for itself through the increased number of new antenna installations sold during the first couple of months it was used.

Incidentally, about 800,000 color TV sets will be sold this year, and many of the people who buy them, having spent all their money on the color set, will hook them up to their old TV antennas. In most cases this will work out fine, but I've hit more than a few cases where an old antenna hurt color reception. In one case there was color smearing due to ghosts. When I reoriented the antenna to eliminate ghosts, the signal strength dropped and so did the color. A new, more directional antenna did the trick and made color viewing a treat. It helped on black and white TV, too, because its higher gain cleared up the snow on a weak station—colored snow yet!

The color TV sweepstakes are getting more entries than a claiming race at the county fair. Motorola has just entered its "filly" sporting a rectangular color picture tube with 90 degree deflection and a shorter neck than the RCA version. This is the 23-inch tube that Motorola developed in its own laboratories and which the National Video Corp. is producing.



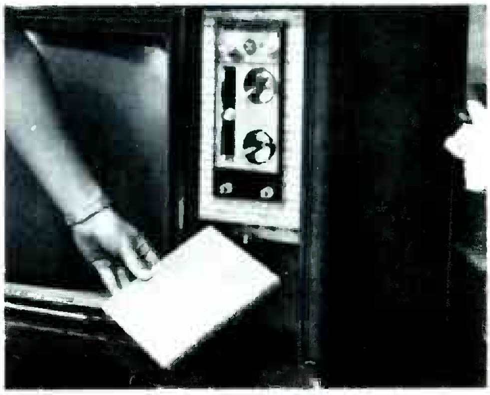
The Motorola 23" color TV set. Note the small light in the middle of the upper part of the control panel. It is the color indicator light and tells the viewer that the program is in color.

The rectangular tube makes for a more natural picture aspect ratio and shorter cabinet, a welcome innovation in this day of the "narrow" television set. But, the increased deflection calls for a beefed up horizontal sweep. To get it, two 6DQ6's are paralleled in the horizontal output stage (RCA and Zenith use a single 6DQ5). The high voltage for the CRT is the same husky 24 kv used for the RCA type.

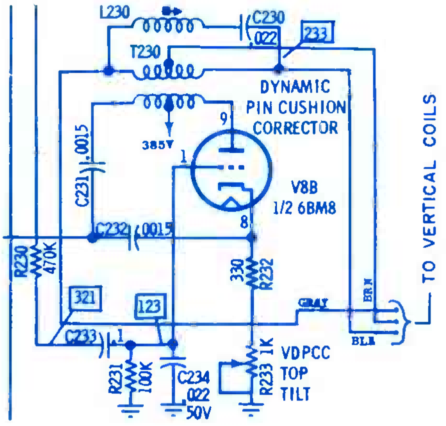
New to color is Motorola's vertical dynamic pincushion corrector (Motorola "Madison Avenues" this mouthful to VDPCC, and watch them play it up in the ads). This one-tube circuit is needed because of, you guessed it, the rectangular tube and its wider deflection angle. The magnets used in black and white sets to do this job can't be used on a color tube because they would mess up purity and convergence. So, a separate stage is needed to control the vertical yoke current and keep the beam uniform at the left, center and right of the CRT screen. This is done with a combination of horizontal pulse and vertical sawtooth modulation of the vertical sweep, applying maximum correction at the top and bottom limits of the vertical scan. Bottom and top tilt adjustments are provided to straighten out any bowing of the top and bottom lines of the raster. A negative vertical pulse is fedback to the flyback transformer to eliminate horizontal pincushioning.

Someone up at Motorola likes us. By conveniently locating the convergence adjustment controls behind a snap-in panel on the front of the set, they have made it a lot easier for the serviceman to converge the three guns. Now we don't have to have an extra long arm to adjust the controls at the rear while watching the face of the CRT.

There's even something extra for the viewer, an indicator on the front of the set that lights up when the program is



The bottom half of the right hand panel is removable to reveal the color convergence controls.




Dynamic Pincushion Corrector circuit of the Motorola set.

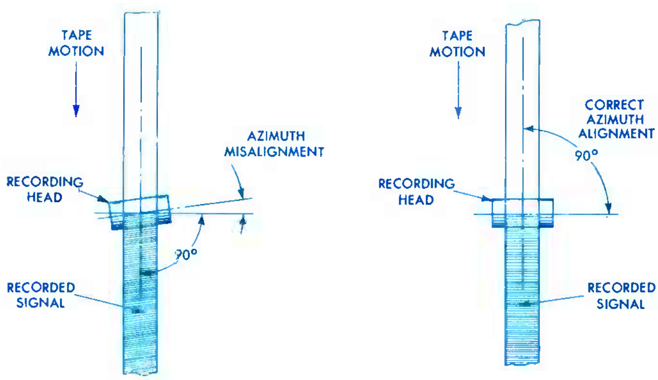
in color (for the color blind viewer?). Since this light is actuated by a color burst signal, it can be used to set the color threshold control.

Motorola has scheduled color TV clinics for every part of the country; contact your local Motorola distributor for information and an invite.

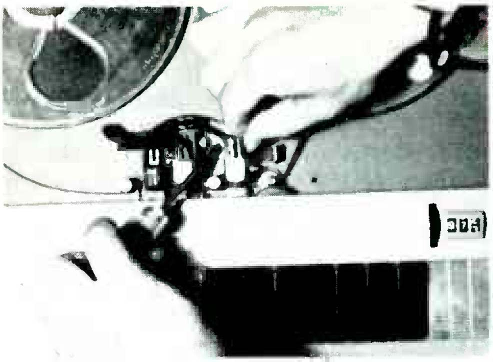
By the looks of it, if anyone in this country doesn't have a tape recorder he's an odd one. They are being sold everywhere, from toy stores for $10 to exclusive high fidelity salons for $1000.

Those who buy the $10 to $100 types to preserve their immortal sounds generally don't demand the same high level of performance from their machines as the high fidelity enthusiast. Repairs of the less expensive recorders are usually confined to the correction of mechanical troubles or the replacement of a tube. But it often takes less than that to disturn the audiophile who spent upwards of $300 for his stereo recorder. A slight loss of the stereo separation or drop in treble response will make the serious music lover vaguely unhappy—though perhaps not enough to send him to the local service shop. You may be able to lure him in with a mailer offering to tune up to "like new" performance any tape recorder, for a fixed price plus cost of parts.

A "must" in any tape recorder tune up procedure is head alignment, sometimes called azimuth adjustment. Many servicemen do not include this in the repair or tuneup of a tape recorder with the result that when the customer gets his recorder back he often has the uneasy feeling that "it just doesn't sound as good as it did before." It's not enough to clean the gap on the tape heads, a slightly moved head whose gap is not facing the tape correctly can cut down on recorder frequency response just as badly as a gooked up gap. To straighten a head, use a standard alignment tape and the re-




Recording and playback heads must be exactly perpendicular to motion of tape (as shown in the right hand sketch), for minimum distortion and maximum frequency response.



Recording and playback heads (or combination record/playback head) are mounted on brackets which may be moved slightly for alignment. Here, a Philips head screw is loosened to free the bracket for movement. Loosen the screw only slightly since the movement will be very small.

corder's own VU meters, or an audio voltmeter at the recorder output. Slowly move the head until you get maximum output. Sometimes a compromise is required with a four track head because a position that gives maximum output for one track may give a lower output for the other. In this case, watch both VU meters and move the head so as to reduce the maximum reading for the higher level track only slightly while increasing the reading for the lower level track.


Tape recorder head alignment tape. There are several brands available - instructions are packed with the tape.

**SERVICE PROBLEM OF THE MONTH:** (Send in your solution, we'll give the answer and name the expert diagnosticians in a forthcoming column.)

The trouble involves a color TV set, RCA model 211 CB 822, chassis CTC 10A. Symptoms: sound OK, picture is predominantly green on black and white reception, can be adjusted to include red-orange on color reception, by turning hue control fully counterclockwise to red. Customer claims that this condition came on suddenly with a "crack" while the set was on. Contrast and brightness are good and adjustable. What's wrong with the set?

**SERVICE HINT OF THE MONTH: Dead Transistor Radio.**

If battery checks out OK and a quick physical inspection shows everything in place, use this check of the audio output stage. For a typical superhet with push-pull output stage, use a 5- to 20-microfarad capacitor (electrolytic) to jump from the base of the driver transistor to the emitters of the output transistors. A buzz or click should be heard. No sound means that the audio output section is bad. Next step is voltage and continuity measurements.


"She was sure happy to get that set fixed!"

# What Would You Have Done?

TEST YOUR SERVICING KNOW-HOW BY MATCHING WITS WITH LUCKY LYTEL

**By GEORGE D. PHILPOTT**

The unluckiest TV technician in Suburbia, U.S.A. was 'Lucky' Lytle. "No buck, Lucky," he often reminded himself, when things seemed to be against him - like tonight.

As he crouched behind Mr. Bobo's huge TV set, he thought of his wife, Helen, waiting at home. He was an hour late, already. They had planned on going out. She would scalp him!

Lucky connected the cheater-cord and turned the set on. The complaint was common enough - a thin line across the screen, sound but no picture.

Mr. Bobo lounged watchfully in his chair by the window. He removed a long, black cigar from his mouth and said, "I've got faith in you, son. This is Fight Night, you know ... I never miss my fights."

Without answering immediately, Lucky studied the tube layout and then reached for the likely suspect. The Vertical oscillator/amplifier tube, an 8CM7, had probably kicked. Hopefully, he unwound himself from his position behind the set, plugged in the tube tester and tested the tube.

As Lucky pressed the 'short' button, the bright glow of a defective tube sort of made him glow inside. Talk about luck, his mind told him - maybe ... just maybe, some of the old luck was returning. "You'll have your programs in one minute," he grinned, glancing up at Mr. Bobo.

"Fine, fine, son. I told the Mrs. I knew what I was doing when I called your shop for service!"

The hair on the back of Lucky's neck seemed to ease slowly skyward, as he searched the open tube caddy for an 8CM7. No luck, either. Mr. Bobo seemed to be standing on top of him as he carefully rechecked each box. Lucky made a very diligent search, again. Still no 8CM7! "Well, I'll be ..." he remarked, disgustedly. He started to explain to Mr. Bobo that repair jobs seem to run in cycles; this very afternoon he had used his last 8CM7 and then forgotten to replace it in the caddy, when he spotted a lone 6CM7. It might just work, he thought, not forgetting the receiver was a series-string affair, requiring .45-ampere filament type tubes. A quick check of the tube manual disclosed .6 amperes for a 6CM7.

Lucky inserted the tube. What could he lose by trying?

Every tube in the TV came to life gradually when the cheater was inserted - every tube, that is, but the 6CM7. Lucky peered anxiously, hoping it too would respond. But five minutes of waiting told him that the filament would not light.

Mr. Bobo coughed and announced, "It looks like we'll have a rather flat evening around here with nothing but that bright line to watch."

Lucky began to agree - but didn't - as he reached for the open tube tester. Again, with a bit of luck, he knew he had temporarily solved the problem.

"I can get you going, tonight," Lucky answered, "but you'll have to be careful and not turn the set off until you retire. In the morning, I'll stop and finish the job."

"My boy, that's just what I told the Mrs. ..." repeated Mr. Bobo, as the TV screen suddenly came to life. "... I'll get Lucky."

What did Lucky do to get the set going?

Answer on page 34.

# SEMICONDUCTOR REVIEW

## # 1 The Field Effect Transistor

BY

JOHN POTTER SHIELDS

This month we'll talk a bit about the Field Effect Transistor....a new breed of semiconductor device which behaves more like a conventional vacuum tube than a transistor. These new units are now available from several leading semiconductor manufacturers in both silicon and germanium types, and you can expect to see them used in a variety of equipment in the not too distant future.

One of the outstanding features of the Field Effect Transistor (FET) is its very high input impedance; in the order of megohms. This makes possible the complete "transistorization" of many circuits that were heretofore only possible with vacuum tubes due to the high impedance involved. The FET generates less internal noise than most conventional transistors as well as exhibiting good performance at the higher frequencies.

Fig. 1 will give you an idea of how a typical "N-channel" FET, operates. As illustrated in Fig. 1, the FET consists of a length of N-type germanium with an electrical contact established at each end. These two contacts form the FET's "source" and "drain" electrodes which are analogous to the emitter and collector electrodes of a conventional transistor.

Two P-N junctions are formed in the middle of the germanium bar by the introduction of P-type impurities. These two P-N junctions are electrically tied together to form the "gate" electrode which roughly corresponds to a conventional transistor's base electrode.

The purpose of the gate electrode is to control the current flowing between the

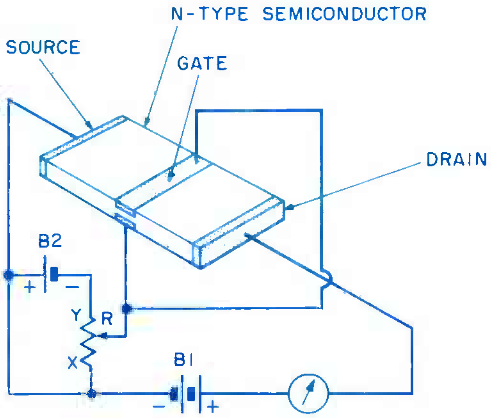



FIG. 1. The construction of a FET is different from that of an ordinary transistor.

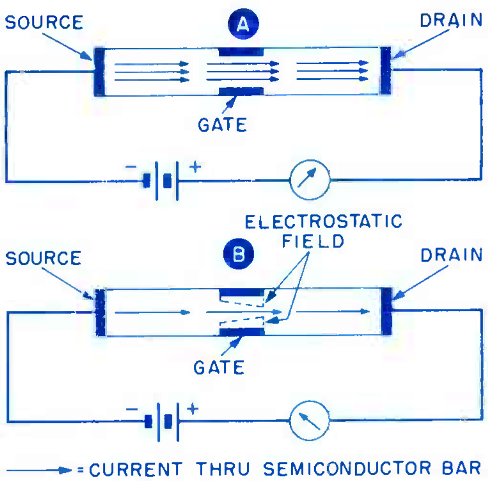



FIG. 2. The current flow through the bar from source to drain is due to the field effect.

FET's source and drain electrodes. As shown in Fig. 1, current flow is established through the germanium bar by the battery, B1. Battery, B2, provides the gate electrode's bias voltage. Referring again to Fig. 1, R's slider is set at point X so that the gate and source electrodes are at the same potential. Under this condition, the germanium bar will appear as a relatively low resistance and current will flow through the circuit as indicated by the meter.

Now, let's assume that R's slider is moved toward point Y, thereby applying voltage to the gate electrode. This voltage will establish an electrostatic field around the P-N junction .... this field penetrating into the germanium bar. This effect is illustrated in Fig. 2 A and B. In Fig. 2A the gate electrode is at the same potential as the source and hence produces no electrostatic field. Fig. 2B shows the electrostatic field produced with voltage applied to the gate. Notice that the effect of this field is to "cut into" the germanium bar, restricting the current flow through the bar from source to drain. When the voltage applied to the gate electrode is great enough, it completely "pinches off" the current flowing through the bar. Summing up, you can see that the current flow between the FET's source and drain is controlled by voltage applied to the gate electrode.

In Fig. 1, we see that the polarity of the gate electrode's bias battery is such that the FET's gate is reverse biased with respect to the source. Herein lies the secret of the FET's high input impedance. This reverse biasing is in contrast to a conventional transistor where the base is forward biased with respect to the emitter, resulting in a fair amount of current flow between base and emitter, this constituting a low impedance between base and emitter. The FET's reverse biased source-gate junction, on the other hand, draws negligible current, this exhibiting a very high impedance.

Well, that's pretty much the story on the FET. Next month, we'll talk about another interesting semiconductor type, the silicon controlled rectifier.

Noteworthy Semiconductor Circuits---

This month, we have several circuits which are a bit on the unusual side. The first is a transistor checker which checks out the transistor under actual operating conditions. As illustrated in Fig. 3, the

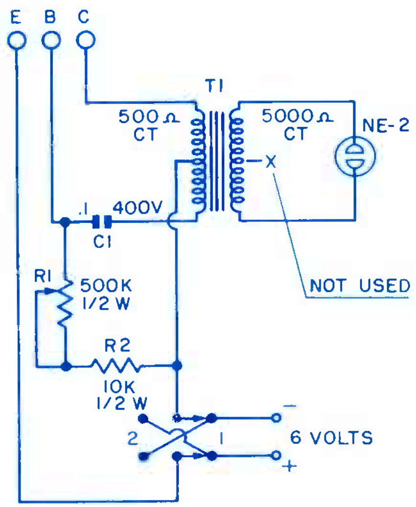



FIG. 3. The switch is thrown to the right for PNP transistors and to the left for NPN's.

test transistor is connected into a simple oscillator circuit consisting of T1, C1, R1, R2, and the NE-2 neon lamp.

Operation of the circuit is based on the fact that if the transistor under test will oscillate, it at least has reasonable gain (beta), acceptably low leakage, and is not shorted. T1 is connected so as to provide a voltage step-up to the NE-2.

To use the checker, simply connect the transistor under test to the E, B, and C (emitter base collector) terminals, set R1 at maximum resistance, and apply power. By slowly decreasing R1's resistance, a point should be reached where the circuit kicks into oscillation as indicated by lighting of the NE-2. The supply voltage reversing switch, S1, permits quick reversal of polarity for checking either P-N-P or N-P-N transistors.

The next circuit, Fig. 4, is that of a high quality AM tuner. More than just a simple "crystal set" this little tuner is capable of providing top quality AM reception when connected to the high impedance input of a Hi-Fi amplifier. Variable selectivity is incorporated .... sharp selectivity for separating closely spaced stations and broad selectivity for minimum sideband cutting required for maximum fidelity.

As you can see from Fig. 4, the circuit makes use of two "loopsticks" L1 and L2, to form a double tuned circuit; each loopstick being tuned by one section of a double section, 365 mmf variable capacitor. The second loopstick, L2, is tapped down to provide a correct match to the diode detector .... the output of which feeds a simple stage of transistor amplification.

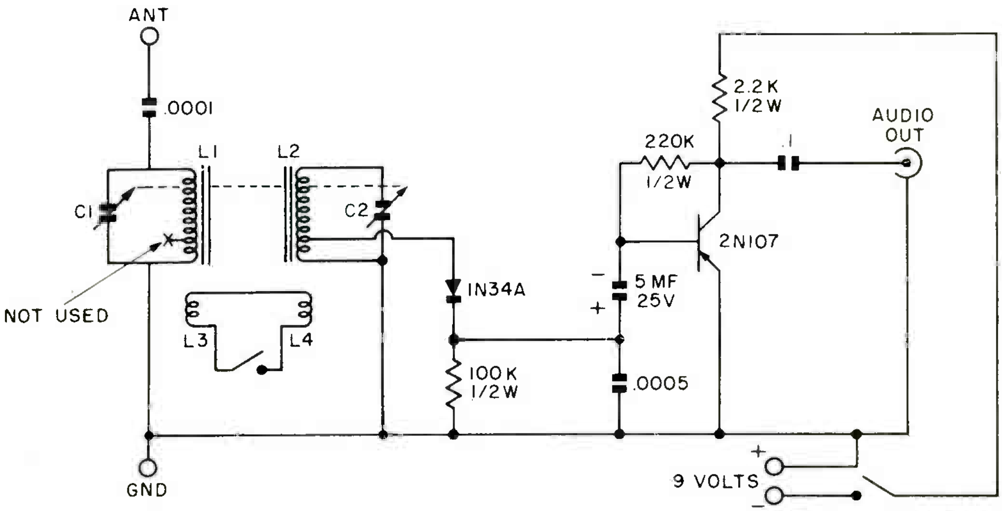



FIG. 5. The circuit of an AM tuner capable of providing top quality reception. C1 and C2 are 365 mmf variable (ganged). L1 and L2 are loopsticks (Allied Radio No. 91-C-057 or equiv.).

L1 and L2, are spaced 2" apart to obtain the desired selectivity characteristics. L1 and L2 are link coupled by the two windings, L3 and L4, whose free ends are connected to a SPST switch. When the switch is open, L1 and L2 are not link coupled and maximum selectivity is realized. Closing the switch link couples L1 and L2, reducing selectivity.

Readers are invited to submit their own pet semiconductor circuits. The best of these will appear in future columns. - Ed.

# GROUND:

## A VERY COMMON PROBLEM

by WILLIAM T. GOODWIN

The cause for many headaches in electronic circuitry is basically a very simple thing. Ground (the British call it Earth) is the culprit. This so-called ground derives its name from the fact that this point can be tied to earth without affecting the operation of the circuit. It is the reference point of the circuit, where all signals and power are common, or tied together. Ground usually is the chassis upon which the circuitry is mounted, since this is an excellent conductor and a definite elimination of bulky wiring. But, behold, when the frequency of operation increases, the problems increase likewise, and our simple chassis reference point becomes the source of oscillation, hum, interaction between circuits and many other unwanted effects.

We will discuss the effects and outline ways to lessen the effect, but in many cases the elimination of the trouble is simply a cut and try affair, since a logical explanation of the problem is very difficult to come up with. Being able to identify the problem as one of ground currents is as important as knowing what to do to eliminate it, since many hours can be wasted and much circuitry can be torn up looking for a feedback loop or a point of hum pickup when all the time it is built right into the piece of aluminum on which the circuit is constructed. A look at the reason for ground problems should be taken now to see electrically why they exist.

### THE CAUSE OF GROUND PROBLEMS

Whenever unwanted signals cause currents to flow through a resistance where wanted signals are present, the results are felt in the output of the circuit. We can consider the resistance of the ground conductor, even though small, to be the source of many troubles. When two signals are added across a common resistance, the output will be a complex waveform made up of components of both signals. We can see that two circuits sharing the same chassis could possibly share the same increment of chassis (Fig. 1) and therefore the signals would be dropped across a common resistance.

Another source of trouble is feedback paths through the resistance of the chassis from input and output in such phase that oscillations occur. This is very common in high gain amplifiers - even in the audio range. When this occurs, the answer to the problem can only be found by the cut and try method - a time consuming task!

In pulse circuitry, the ground loop will cause ringing, or oscillations of a sinusoidal nature (Fig. 2) on the pulse. This is due to tuned ground resistance, if you care to consider it this way, tuned to one component (frequency) present in the pulse. We know that many frequencies are present in a pulse; the faster the rise and fall time, the higher the frequency range

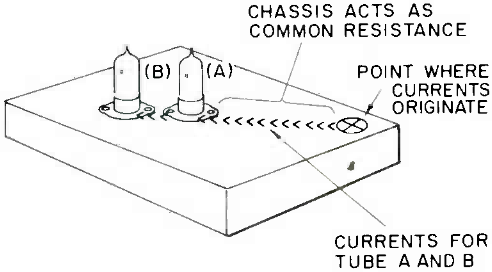



FIG. 1. An illustration of a chassis showing current flow through common area of metal.

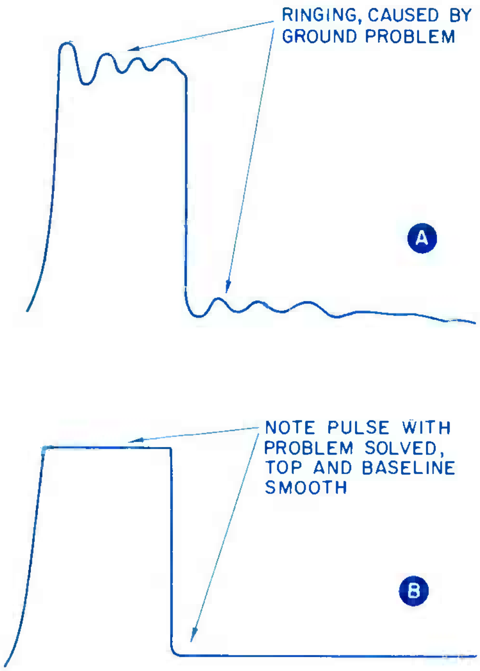



FIG. 2. (A) Pulse with damped oscillations on top and baseline. (B) Corrected pulse.

involved. The ground problem can also cause overshoot and undershoot (Fig. 3), and by just moving one ground connection can be improved or caused to get worse. The author proved this on a circuit that was giving considerable trouble.

The circuit was a ramp (or sawtooth) calibrator and a very high gain differentiator amplifier which took the ramp and constructed a pulse from it. By removing the ground connection from the calibrator and physically sliding the connection along the chassis, which was common to the amplifier, the overshooting spike actually could be nulled or peaked, depending on the location on the chassis to which the calibrator was referenced!

As was mentioned before, hum can be introduced into a circuit via a common resistance which shares both filament and cathode current flow. The low frequency of the filament or power source simply modulates the DC of the B supply and the result appears in the output. Sometimes the currents of the offender can be balanced out (added out of phase) and the problem is eliminated. The problem here is identifying the hum as ground currents, since electrostatic pickup is a great offender,

## IDENTIFICATION OF THE GROUND LOOP

When trouble occurs in a circuit being built for the first time, before accusing ground currents, try to eliminate all of the other possibilities by visual inspection. If the circuit oscillates or unwanted signals are noted in the output, check for components placed physically parallel where the signal may be coupled capacitively (stray) from one component to the other. In the case of hum, check filament wires running close to capacitors or resistors, especially if they are not twisted pairs. Note transformer orientation, since hum problems can usually be corrected by rotating a transformer or choke on its axis to reduce coupling between it and another transformer or reduce electromagnetic induction of energy into unshielded components. After care is taken to reduce these possibilities and the problem still exists, you can almost bet you have a ground loop.

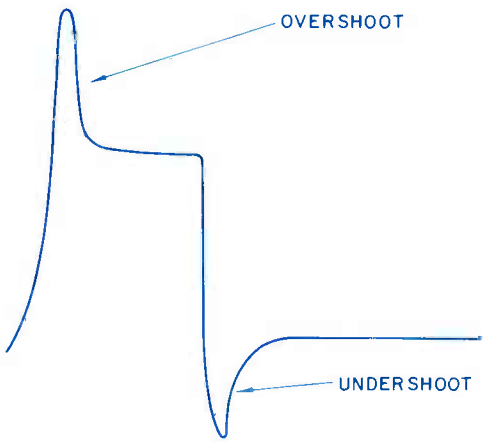



FIG. 3. Pulse with overshoot and undershoot caused by circulating ground currents. Pulse should have characteristics shown in FIG. 2B.

The best place to look now is for wires which tie components to a common point on the chassis (Fig. 4). Once an engineer friend of mine had six cathode followers of the same design operating on the same chassis. We know that cathode followers won't oscillate because their gain is less than unity, but, you guessed it, they were oscillating, or at least they appeared to be. The engineer never completely satisfied himself as to the theory, but the practical cure was to separate the cathode resistors at the ground end, and tie each resistor to the ground lug individually, since he had them tied together just below the body of the resistor and this point was joined to ground through a short piece of bus wire (as illustrated in Fig. 4).

In some pulse circuits, each part of the circuit should be grounded to a central common point through a bus wire (Fig. 5). This does not allow current from one circuit to flow through the return for another circuit, reducing possibility of trouble. But, if the circuit is to be reproduced on a production basis, it is better to solve the ground problems on the breadboard. Wherever possible, a printed circuit will help in keeping the ground problem solved, once a layout is achieved. In this way, we know that the wiring can be reproduced in the same manner as the breadboard.

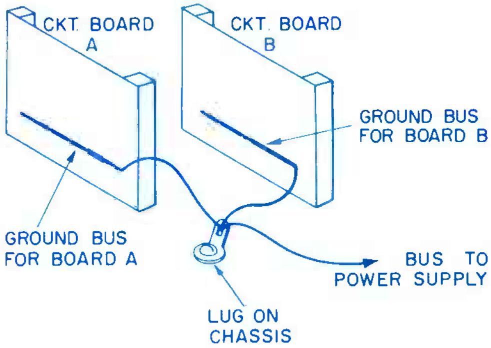



FIG. 5. Two circuit boards showing common bus for each board. Note that boards and power source are referenced to a central point to eliminate circulating chassis currents.

On occasion, test equipment will be the source of trouble. By connecting a few pieces of test equipment so that the return side of the line is not common in all cases, the power line can act as a big ground loop and ripple can be introduced into the circuit. If this is the case and ripple is excessive, rotate each plug 180° in the socket - one at a time - observing to see when the trouble disappears. In a lab with polarized plugs and a good wiring system, this problem should never occur if three wire line cords are used throughout the setup. Make sure that the oscilloscope is not playing tricks on you also. Reference the scope to the same point that the signal being observed is referenced. Taking a reference at another point adds a ground path that does not exist in the actual circuit, and can give a very misleading representation and cause unnecessary worry. This problem will occur most frequently when pulse circuits are involved, or when high frequencies are being worked with.

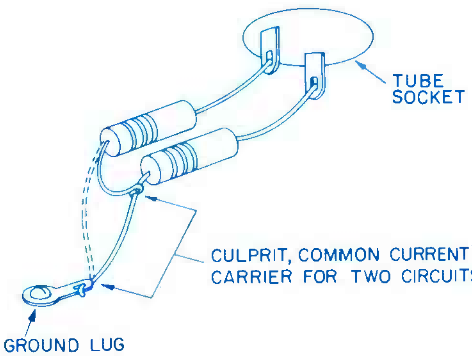



FIG. 4. Resistors connected between tube circuits and ground lug showing source of ground problem. The dotted line indicates a possible method of correcting the problem.

## SUMMING UP

We have not solved the ground problem, nor could we hope to. This information is given in hope that you will be more able to solve your own individual grounding problem when it arises (and I assure you it will).

# DEVICE OF THE MONTH

## The Unijunction Transistor

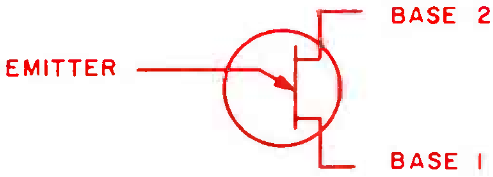
BY R. C. APPERSON, JR.

My name is Bob. I'm just an ordinary technician, who thinks electronics is here to stay. I'm one of those guys who spends hours in the home workshop after spending hours at the company workbench, simply because I enjoy the challenge of electronics. My philosophy is "learning is by doing", so I spend a lot of time doing. I hope we will be able to share a few experiments and discuss some of the many fascinating devices that have made our field what it is today. First we will find out the whys and wherefores of the device, then we'll discuss an actual circuit using the component.

I have a very useful little fellow to put through its paces for you this month. Although it appears to be a standard transistor in a TO-5 case, it is a very special type of transistor. It answers to the name of unijunction (one junction) which sets it apart right away from the standard two junction (PNP - NPN) transistor. Unlike its sisters, the NPN or PNP, this transistor has one emitter and two bases, instead of a base, collector and emitter.

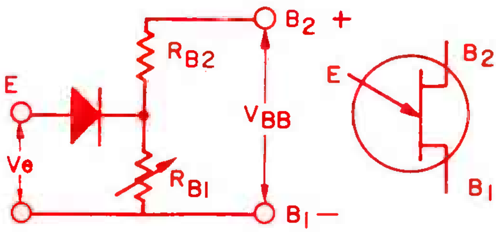
I know you are wondering why such a device was developed and how it is used. Everything has its advantages and disadvantages and its own specific application. The unijunction has it all over the standard transistor in stability and has a negative temperature characteristic which is uniform from unit to unit. This is a great advantage when component replacement becomes necessary. Cost is another argument in the unijunction's favor. They are relatively cheap for the job they will do. The unijunction can be found performing in oscillators, timing circuits, voltage sensing circuits and in conjunction with silicon controlled rectifiers (that's a solid state thyratron) in firing circuits.

Let's discuss the theory of operation now. One should always know how a thing works before trying to apply it to any application. This not only insures that the component won't be damaged from misuse but also that best performance will be derived from the component by proper design. Schematically, the unijunction appears, as such, very different from the regular transistor notation.



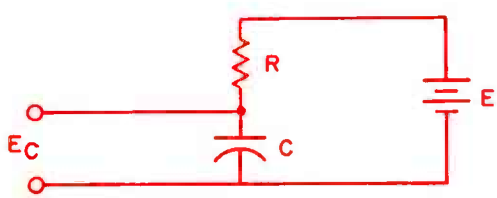

Note the emitter and two bases as we mentioned earlier. The controlling element is schematically represented on the left side of the valve, as in the radio schematic. The signal is applied to the antenna on the left of the conventional schematic and travels, left to right, to the speaker. This is a crutch I use in locating the controlling element.

When analyzing the operation of the unijunction, let's consider it as a resistive divider with a diode input. The lower resistor is variable, like this:



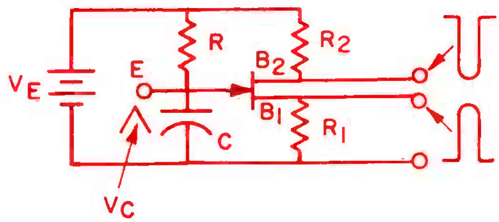

$V_{BB}$ is a positive bias (supply) voltage applied to base 2 with base 1 as the reference. When no emitter voltage ($V_e$) is present, RB2 and RB1 act as a voltage divider with a portion of $V_{BB}$ being applied to the cathode of the diode. This back-biases the diode so that $V_e$ must exceed this bias before the diode can conduct. When $V_e$ exceeds the divided down $V_{BB}$ - WHAMMO! - emitter current increases into B1 causing RB1 to decrease which in turn causes B1 to B2 current to increase. This is the load current so load voltage will change across the load resistor. The increasing current will continue until a saturated condition exists and will not stop until $V_e$ falls below the cathode voltage of the diode again. We can see this action readily if we consider a circuit using a unijunction as a relaxation oscillator. Let's see how it is used.

First, we'll take an RC network like this and let the capacitor charge through the resistor to the battery voltage.



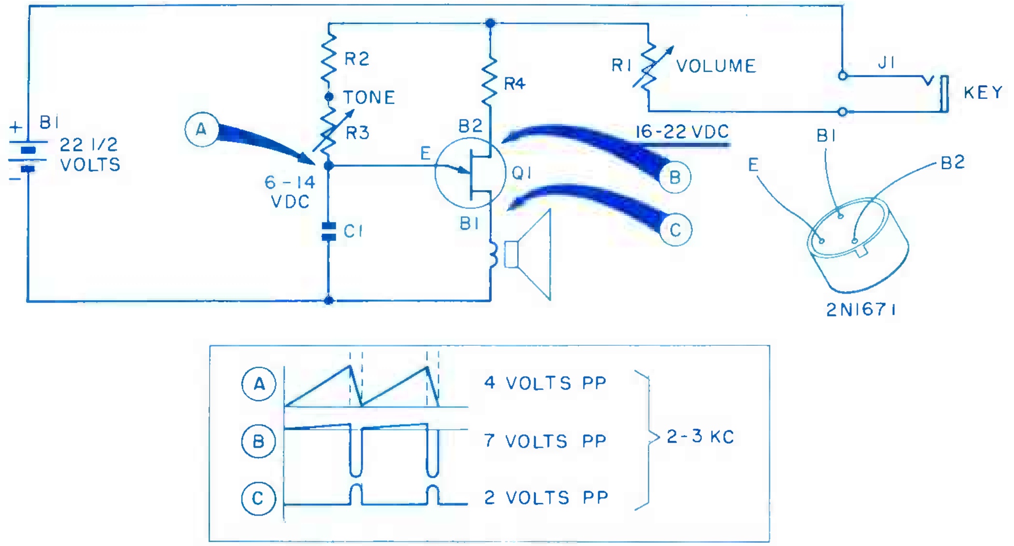

We know that it will charge in an exponential manner and that the first 63% of the capacitor voltage will be fairly linear - remember RC time constants?

O.K., now let's connect the unijunction into this circuit and see what happens.




We connect the emitter of the transistor to the junction of the resistor and capacitor and tie the two bases (between the battery) through two resistors. When $V_e$ reaches a voltage which exceeds the bias on the emitter diode, the capacitor is discharged into base 1, and base 1 to base 2 current increases as shown by the pulses. If the unijunction is biased so that it fires in one time constant of the RC network, we obtain a fairly linear sawtooth waveform across the capacitor. This is the action of a relaxation oscillator. We also have pulses available at no extra cost! Our circuit of the month uses the pulse current, but we will talk in more detail about that later.

Let's discuss briefly some of the terms found on a data sheet pretraining to a unijunction. The resistance between base 1 and base 2 with the emitter open-circuited is known as $R_{BB}$, or interbase resistance. Measurement with a vtvm is possible using a Low Ohms scale. The diode bias voltage is found by using the intrinsic standoff ratio ($\eta$). This defines the voltage at which the unijunction will turn on, which is known as the peak point voltage ($V_p$). Another parameter which is important is the peak point current ($I_p$). This is the emitter current required to control the unijunction. There are more terms, but these define the operation generally and one may refer to a good transistor manual if more are desired.




Unijunction Code Practice Oscillator

PARTS LIST

| | | | |
|---|---|---|---|
| R1, R3 | 1K (potentiometer) | J1 | phone jack (Littel-Jax type 11 or equiv.) |
| R2 | 1.5K 1/2 watt | | |
| R4 | 100-ohm 1/2 watt | Q1 | 2N1671 unijunction (General Electric) |
| C1 | .22-mf, 50 volts | | |
| B1 | 22-1/2-volt battery (Burgess Y15 or equiv.) | Speaker | Lafayette SK190 (or any 4- or 8-ohm pm speaker) |

Now that we understand the theory of operation, let's discuss the circuit of the month - a unijunction code practice oscillator. Here at a glance we recognize the relaxation oscillator we just discussed with a few added attractions. Only a short time is required to build this oscillator. Much can be learned from its performance and it makes a fine code oscillator for learning code or increasing your speed. Waveforms and voltages are given to help understand the operation of the unijunction, so if a scope and vtvm are available, check these points yourself after the circuit is completed.

Remember the pulses across the two base resistors in the relaxation oscillator? Well, here this pulse is developed across an 8 ohm speaker, causing it to produce a 2 to 3-kc audio tone. The capacitor charges and is discharged by the unijunction at an audio rate, so we find a sawtooth voltage across the capacitor. The time constant is varied by R3, which becomes the tone control, adjustable over a small range to suit your particular ear. R1 controls the current through the speaker, or it can be referred to as the volume control. R4 is for temperature compensation and gives a convenient point to observe the negative pulses shown previously.

All you need is a battery and a key to rap out that code now. If you don't wish to use it as a code oscillator, substitute a 100-ohm resistor for the speaker and put in fixed resistors in place of the pots so that you can experiment with the circuit. I'm sure you can come up with a use for it after it is built!

# SERVICING SMALL TRANSISTOR RADIOS

PROFESSIONAL SERVICING TECHNIQUES

**BY JOE GRIFFIN**

Most servicemen have little difficulty troubleshooting vacuum tube radio receivers. But judging from the number of letters received from both our students and alumni, transistor receivers, and especially portables, seem to present an unusually large number of servicing problems.

Perhaps some of the difficulty arises from the amount of emphasis placed on the similarity between tube and transistor type radios. While there are many similarities, there also are some important differences between the two types of equipment. Although the same procedures may be used in servicing both types, these differences make entirely different servicing techniques necessary.

Regardless of whether tubes or transistors are used in a receiver, they both perform the same functions, in the same basic circuits. That is, they control current flow, and they amplify. However, the manner in which this is done differs widely in the two types of equipment. You will recall that in a triode vacuum tube, the small voltage between the grid and cathode controls the large flow of current from the cathode to the plate. In a transistor, however, the small current flow between the base and emitter electrodes controls the large flow of current from the emitter to the collector electrode. From this you can see that vacuum tubes are voltage controlled while transistors are current controlled. This is one of the most important differences between the two types of equipment that makes different servicing techniques necessary.

Another important difference is in the cause of defects that occur in component parts in transistor receivers and in tube sets. As you know, in tube sets components frequently break down because of excessive voltage across them, excessive current flowing through them, or excessive heat. This seldom occurs in transistor receivers. The operating voltages required by transistors usually are so low that even when a defect is present, current flow is not large enough to damage components such as resistors, coils, and transformers. For this reason, very little heat is developed in transistor receivers, so deterioration of parts due to excessive heat is virtually eliminated.

From the foregoing it may seem that transistor receivers are not subject to breakdown, and therefore should never require servicing. Unfortunately this is not so, as many set owners as well as servicemen can tell you. So, since transistor receivers do require servicing, let us now look at some of the causes of defects that result in complaints.

## DEFECTS IN TRANSISTOR PORTABLE RECEIVERS

A top view of the printed circuit board chassis of a typical six transistor portable receiver, showing the parts layout, is shown in Fig. 1. A bottom view of the same chassis, showing the printed circuitry appears in Fig. 2. The loudspeaker has been purposely left out of both figures for the sake of clarity although in Fig. 2 the volume and tuning knobs are visible.

Some of the defects that frequently occur

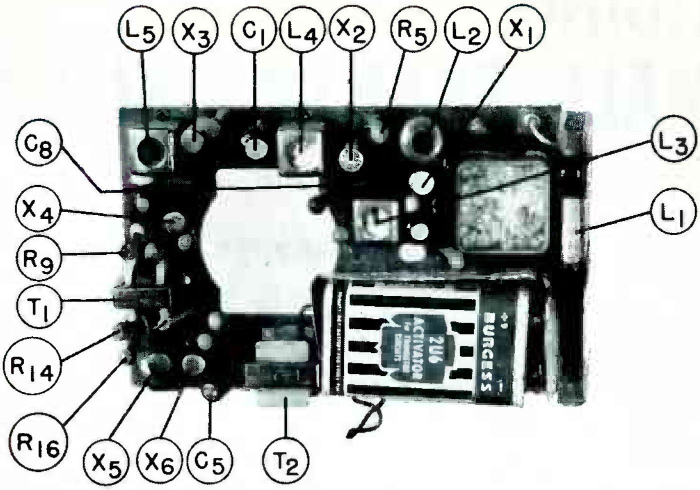



FIG. 1. Top view of the chassis of a transistor portable receiver showing the parts layout.

in this type receiver are: open loopstick antenna, L1, in Fig. 1, open oscillator coils, L2, in Fig. 1, and, open i-f transformers, L3, L4, and L5, in Fig. 1. These conditions may result from a broken wire near the terminal to which it is soldered, or from corrosion. Occasionally you may encounter a low Q resonant circuit coil in any one of the above parts. This may be caused by an internal short in the coil winding, or by a cold solder joint.

Both disc type capacitors such as C8 and C9, and electrolytics, such as C1 and C5 in Fig. 1, are used in transistor receivers. These sometimes open, short, or become leaky. These conditions are usually caused by defects in manufacture and not by excess voltage.

Transistors X1, X2, X3, X4, X5, and X6 in Fig. 1, are also subject to breakdown. Most defects in transistors are the result of an open in the lead to the base electrode inside the transistor case, or leakage, between electrodes.

The printed circuit board itself, as well as the printed circuitry, shown in Fig. 2, is another source of frequent trouble. Cracks or breaks may develop in the board, or the printed wiring circuitry. Breaks in the circuitry are sometimes so small that you will not be able to see them without a magnifying lens, which, by the way, is a handy servicing aid for working on transistor receivers.

Another weak spot in transistor portable receivers is the on/off switch, which is located on the volume control, R1 in Fig. 2. Because of its small size, this part is extremely fragile and therefore subject to breakage.

Resistors seldom open in transistor

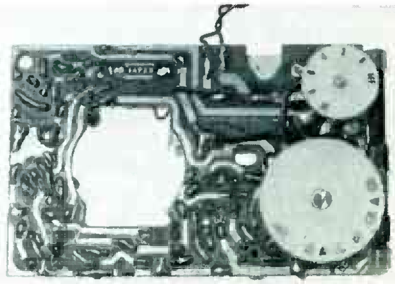


FIG. 2. Bottom view of chassis shown in Fig. 1, showing printed circuit board and circuitry.

portable receivers, unless they have a defect in manufacture. Four resistors, typical of those used in transistor receivers are labelled R5, R9, R14 and R16 in Fig. 1.

There are five basic steps in the procedure for servicing transistor portable receivers. These are:

1. Listening to, and verifying the customer's complaint.
2. Inspection for obvious, or surface defects.
3. Use of effect-to-cause reasoning to try to pinpoint the trouble.
4. Isolation of the defect to a section, stage, circuit, and finally the component part.
5. Removing the defective part and installing a replacement part.

Now let us see how we can use each of these steps to service a transistor portable receiver in the least possible time.

## LISTENING TO AND VERIFYING THE CUSTOMER'S COMPLAINT

When you get a set for repairs, first listen to the customer's complaint, then turn the set on and check its performance to verify the complaint. If the complaint is "a dead receiver", test the batteries under load and, if necessary, replace them or substitute a battery eliminator. If you verify a complaint of a "weak set", or one that has distorted, noisy, or intermittent reception, check the power supply and go to the next step in the servicing procedure.

## INSPECTING FOR SURFACE DEFECTS

One of the most valuable indications of a surface defect in tube radios has no counterpart in transistor receivers. That is inspecting the tubes for lighted filaments or feeling them to see if they are warm. Nevertheless, there are quite a few surface defects that you should look out for in transistor receivers. Check for transistors missing from their sockets, corroded batteries, broken leads, cracks in the printed circuit, or a broken printed circuit board. If this inspection does not uncover a defect that has disabled the receiver, check the current drain of the receiver before you remove it from the case. You can often learn much about a receiver's operation by measuring its current drain. Connect a milliammeter in series with the receiver and note the current indicated by the meter. Check the current drawn by the receiver with that given in the manufacturer's data to determine if it is near normal.

If the current drain is excessive you probably have a leaky or shorted transistor in the circuit. If, on the other hand, the current drawn by the receiver is much lower than that specified in the manufacturer's instructions, one of the transistors probably has an open internal base connection. If the transistors are mounted in sockets, you can remove them without further disassembling the set, and use your ohmmeter to check for shorts, leakage, or open electrodes. Observe the current drop as you remove each transistor from the circuit. If you notice a large drop in current when you remove a transistor from the circuit, that transistor is probably shorted.

If the transistors are soldered in the circuit, disconnect two of the leads. Always use a heat sink between the transistor and the connections when soldering. You can use your needle nose pliers or alligator clips for this purpose. They will conduct some of the heat away from the transistor.

## EFFECT TO CAUSE REASONING

This step is probably the most important one in the entire servicing procedure, because by using it properly, it can often lead you directly to the defect. Effect to cause reasoning is reasoning based on the observation of a receiver's performance, that will enable you to accurately determine not only the type of defect that is most likely to cause the receiver to perform as it does, but also the part most likely to be defective as well as its location.

Even in the case of a dead receiver, in

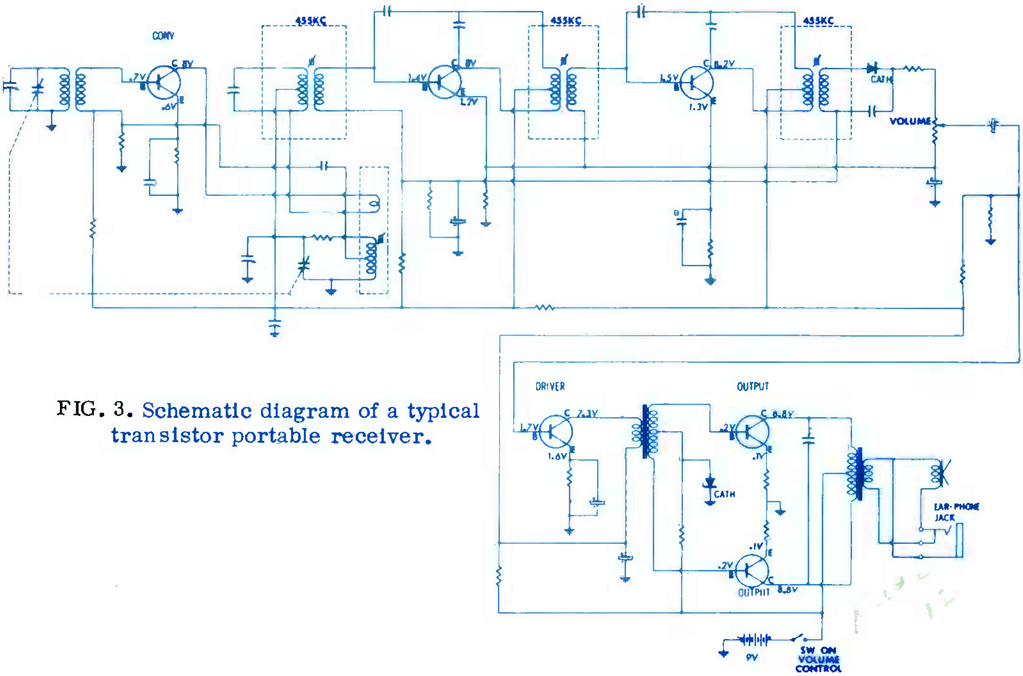



FIG. 3. Schematic diagram of a typical transistor portable receiver.

which effect to cause reasoning would be of the least value, you can still use it to determine the types of defects that could result in a dead receiver, thereby eliminating unnecessary checking.

## ISOLATION OF THE DEFECT

The exact isolation technique that you should use will depend largely on the type of complaint. For example, a circuit disturbance test is an effective isolation technique for locating the defect in a dead receiver. On the other hand, if the receiver is weak, you may have to use some other technique, such as signal tracing, or signal injection. Again, if the receiver's output is noisy or distorted, you may find the defect most easily by signal tracing only, using the stage blocking technique. A schematic diagram of a transistor portable receiver is shown in Fig. 3. We will now use this as a typical receiver as we go through several different techniques for isolating various defects that result in different complaints. Note that this receiver is a six transistor superheterodyne that uses NPN type transistors in all stages.

You will recall that a circuit disturbance test can be effectively used to locate the defect in a dead receiver. You will also recall that in a tube type receiver you could make a circuit disturbance test by touching the control grid of each tube with a screwdriver, while touching the metal blade of the screwdriver with your finger, and listening for hum in the loudspeaker. In a transistor receiver, the impedance of the transistor stage is so low that you cannot make a circuit disturbance test by touching the electrode with a screwdriver. You must use a voltage source to increase the forward bias of the base-emitter to disturb the circuit. You can use the batteries in your ohmmeter, or the ohmmeter in your VTVM to supply the voltage to increase the base-emitter forward bias to disturb the circuit.

First determine which ohmmeter lead is positive and then connect the positive lead to the side of the battery which is nearest in potential to the emitters. Remember that the receiver shown in Fig. 3, uses NPN type transistors. So, to disturb the circuit of this receiver, you can touch the positive tip of the ohmmeter lead to the base of each transistor, with the negative lead connected to the chassis, or the common negative point. When you touch the base electrode with the tip of the meter lead, a click will be heard in the speaker if everything between the points touched and the speaker is in good condition. The chart in Fig. 4 shows the points to touch with the tip of the meter lead and the type of click you should obtain at each point. Start at the base electrode of either output transistors and work back towards the antenna. The base at which you fail to receive a click when touched with the tip of the lead, indicates the stage that is defective.

To isolate the trouble to a section, touch the ohmmeter positive lead to the base electrode of the first audio transistor. Next touch the ohmmeter positive lead to the base electrode of the second i-f transistor. If a click is heard at the first audio base but not at the second i-f base, the trouble is localized between these points. This means that the defect is in the rf section. You can then check back towards the antenna until you reach the stage where you do not obtain a click.

If you can hear a click when you touch each base electrode, but the receiver is still dead, this indicates that the oscillator may not be working. You can check the oscillator with your VTVM. Switch the VTVM to measure AC voltage and connect its ground clip to the rotor of the tuning capacitor. Touch the AC probe to the oscillator stator. If the oscillator section is working, an AC voltage across the oscillator tank will be indicated on the meter.

We will now discuss the procedure for locating the defective part in a weak receiver. Once again you can see how the type of complaint determines the exact procedure required to localize the defect. In this case, we can use either a signal injection method, or a signal tracing method, of trouble shooting to localize the defect. We will first take up the signal tracing method.

You should use only a tuned signal tracer for localizing defects in the transistor portable receiver. With a tuned signal tracer you can begin at either end of the receiver, and check the input and output signal of each stage. In the audio stages, you should use an af signal from the signal generator if you wish to accurately measure stage gain. If you use the signals from the broadcast station, you can only make rough estimations of stage gain because the signal is constantly varying in amplitude. You can also locate the source of distortion or unwanted oscillation with the tuned signal tracer.

With the signal tracer, start at the output transistor and work back towards the antenna. If you do not receive output from the audio stages, the stage at which you do first receive output indicates that you have just passed over the defective stage. If you can obtain output from the second i-f stage, but not from the first audio stage, the defect is in the audio section. If, on the other hand, you can feed the audio signal from the volume control through the loudspeaker, but you cannot obtain output from the broadcast station, the defect is in the rf section or in the 2nd detector. Check each stage of the rf section starting with the second i-f stage and working back towards the antenna. The point at which you obtain output indicates that you have just passed over the defective stage.

| CLICK POINTS FOR DEAD RECEIVERS | |
|---|---|
| CHECK POINT | WHAT TO EXPECT IN NORMAL STAGES |
| Either Output Base | Weak Click |
| 1st Audio Base | Stronger Click |
| 2nd i-f Base | Weak Click |
| 1st i-f Base | Stronger Click |
| Converter Base | Stronger Click |

FIG. 4. Click points for dead receivers.

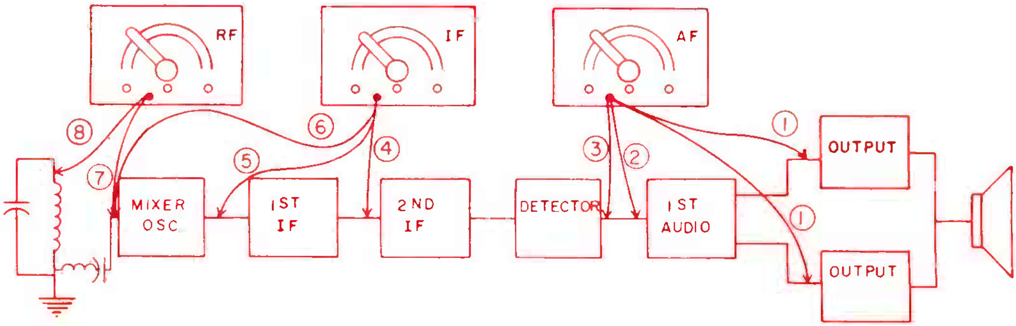



FIG. 5. How to use a signal generator to find a weak stage in a transistor set. The output of the signal generator is set to the correct frequency and moved from stage to stage to check loss in gain.

The block diagram in Fig. 5 shows how a signal generator can be used to find a weak stage in the transistor set shown in Fig. 3, while Fig. 6 shows a list of check points. The signal generator used should have a low impedance output stage, such as a cathode follower, to match the load requirements of transistor sets. The output should be adjustable to a very low level to avoid overloading the stage to which the signal generator is connected. Always use a blocking capacitor between the signal generator output and the stage being tested. (Conar Signal Generators use a cathode follower output stage and have a built-in blocking capacitor.)

Start at the output stage using an af signal in the audio section, and work back towards the antenna. Make sure the receiver volume control is fully advanced, and decrease the output level of the signal generator when necessary, to avoid overloading the receiver stages as you pick up gain. Be sure to switch the signal generator to the modulated rf output when you begin checking the rf section. As you progress from the output stage towards the antenna, the point at which you observe a decrease in output, indicates the defective stage.

When you encounter a noisy receiver, circuit disturbance, signal tracing, or signal injection tests will not be too helpful in isolating the defect. So you will have to use some other technique in this case. You can use the stage blocking technique, which is similar to the circuit disturbance technique, except that now you want to block the circuit to prevent it from amplifying a signal instead of introducing a surge voltage.

You can begin at any point in the receiver and work in any direction, although most servicemen start at the output and work back toward the antenna. By blocking each stage, you can locate the origin of the trouble.

To block a stage in the receiver shown in Fig. 3, you can short the base to the emitter electrode, or use a large capacitor to bypass the signal from the collector electrode to the common negative point, which in this case is chassis ground. If the transistors are plugged into sockets, you can also block a stage by removing a transistor from the socket.

When using the stage blocking technique to isolate noise in a receiver, always isolate the noise to the rf or the af section. To do this, turn the volume control all the way down. If you can still hear the noise, it must be originating in the stages, because it is not coming from the rf section through the volume control. On the other hand, if the volume control setting affects the noise, it is coming from the rf section and passing through the volume control.

After you have localized the noise to either the rf or the af section, block each stage of the section in which the noise originates, until you reach a stage where you can no longer hear the noise. You will have just passed over the stage where the noise originates, if you began at the output.

After you have localized a defect to a particular stage, you will have to make further tests to locate the defective part. You can often use effect to cause reasoning to do this. In many cases, however, you will have to make voltages or resistance measurements, as well as continuity checks to locate the defective component part, or the defect in the circuit.

Check the voltages at the electrodes of the transistors and compare them with those given by the manufacturer, to determine if they are normal. Check the continuity of each transistor circuit, (emitter, base and collector) from the electrode to the terminal connection for the battery that supplies voltage to the particular electrode. Be sure to disconnect the battery before you connect your ohmmeter leads to the circuit.

You can use your ohmmeter to check the continuity of coils, transformers, printed circuitry as well as to check for shorts in capacitors or transistors. Because of the low internal resistance of transistors, always remove the transistors from the circuit before making resistance measurements. You can also check for open transistor electrodes and resistors that have changed value. To check for an open capacitor, shunt a good capacitor across the unit that is suspected.

## REMOVING THE DEFECTIVE PART

Once you have located the defective part, you will have to remove it and install a replacement part. There are four techniques for removing parts from printed circuit boards. These are:

1. Cut through the body of the part with side cutters, dividing it into as many segments as there are leads. Then heat each lead connection on the copper side of the board and pull out each segment and its attached lead, one at a time.
2. When a lead has only two parts, place a thin screwdriver blade between the part and the board, heat one of the lead connections on the copper side of the board and pull the lead out by prying the part with the screwdriver. You can then pull on this lead while you heat the other lead connection and remove the part in one piece.
3. To remove switches, sockets, i-f transformers and shields, cut the leads at the body of the part and remove it from the board. Then heat the copper side of the board and pull out each lead from the opposite side of the board.
4. Cut off all of the part leads even with the copper side of the board and heat each lead in turn, rocking the part nearest the hot lead away from the board. The leads will easily come out of their holes as they are heated.

Armed with the above information and hints on testing and removing component parts and installing replacement parts, you should now be prepared to service any transistor receiver, portable or otherwise, with the utmost confidence.

| WEAK RECEIVER CHECK POINTS | | | | |
|---|---|---|---|---|
| STEP | CHECK POINT | S.G.SET TO | FREQUENCY SETTING | EFFECT NOTED IN SPEAKER |
| 1 | Output Base | Audio | Audio | Signal |
| 2 | 1st Audio Base | Audio | Audio | Increased Signal |
| 3 | Detector Output (Checks Volume Control and Coupling network) | Audio | Audio | Same as above |
| 4 | 2nd I-F Base | Mod RF | I-F | Signal |
| 5 | 1st I-F Base | Mod RF | I-F | Signal Gain |
| 6 | Mixer Base | Mod RF | I-F | Some Signal Gain |
| 7 | Mixer Base | Mod RF | Dial Frequency | Signal |
| 8 | Antenna | Mod RF | Dial Frequency | Signal |

FIG. 6. Check points for a weak receiver.

# Extending Readout Lamp Life


OF PRIMARY INTEREST TO THE

INDUSTRIAL SERVICE TECHNICIAN

**by RONALD L. IVES**

Commercial users of electrical readout devices, such as the Industrial Electronic Engineers' "In Line" readouts, usually find that the general performance is excellent, but that lamp life is disturbingly short, leading to much "down time" for bulb replacement. These repeated failures of readout lamps seem quite mysterious, for, an identical lamp, usually a No. 44, used on the same panel as a power pilot, and fed from the same supply, will usually last for more than its rated life (nominally 3,000 hours).

## LAMP CHARACTERISTICS

Rather exhaustive checking of lamp performance and characteristics discloses that standard lamps, operated continuously at their rated voltage, with either AC or DC supply, have an average life somewhat exceeding the manufacturer's rating.

Identical lamps, used in readout service, where they are switched on and off repeatedly, have a relatively short life, and tend to blacken excessively in service. Lamp life, under conditions of repeated switching, is slightly longer with DC supply than with AC supply.

Shortening of the life of lamps which are switched on and off repeatedly appears largely due to the nonlinear resistance characteristics of the filament, and to the resultant momentary heavy "turn on" currents. If these currents can be reduced, lamp life is extended, and lamp blackening markedly reduced.

To cite some specific figures, the No. 44 lamp, commonly used not only in readouts, but also in pilot lamp service, is nominally rated at 6 volts, .25 amps. In consequence, its hot resistance is approximately 24 ohms. Cold resistance of this same lamp, however, is only about 4 ohms! Momentary filament current, at the moment of "turn on", is, by Ohm's Law, 1.5 amperes. This, being six times the rated current, can burn up quite a bit of the filament life, even though it continues for only a few milliseconds.

## "TURN ON" SURGE REDUCTION

Quite obviously, if we can reduce the "turn on" current surges in readout lamps, we can increase their life appreciably. Ideal would be a constant-current supply, perhaps transistorized, of low bulk, low cost, and high dependability, which is immune to the effects of on-off operation. Such devices have been built, and work very well, but are still too costly for ordinary use.

Perhaps the simplest device for reducing the turn-on surge of an incandescent lamp is a series resistor. Where a slight loss of lamp brilliance can be tolerated, the circuit of Fig. 1A is excellent. Here, a 10-ohm resistor is connected in series with the lamp. Inflow current here, at the moment of turn-on, is 6.3/14, or .45 amps. The steady state current is approximately .21 amps (measured). As the lamp filament does not carry full current here, its resistance is not quite the rated hot resistance. Raising the supply voltage to 7.5, and the series resistor to 15 ohms gives us a momentary turn-on current of .39 amps and a steady state current of about .21 amps.

Where full lamp brilliance must be maintained, careful choice of supply voltage and series resistor permits surge reduction while operating the lamp at its rated voltage. Circuit is shown in Fig. 1B. Here, at the instant of turn-on, current is 12.6/31, or .39 amps; and steady state current is 12.6/53, or .24 amps. If we increase the supply voltage to 25.2, and the series resistor to 75, turn-on current is 25.2/79, or .32 amps, and steady state current becomes 25.2/100, or .252 amps.

By increasing both voltage and series resistor in the proper proportions, we can reduce the turn-on current surge to any value greater than zero. After a certain point, however, this leads to an empty gain and additional problems. With a 1,000 volt supply and a series resistor of 3975 ohms, the turn-on surge is too small to measure with ordinary laboratory instruments. Insulation problems and resistor cost become appreciable here, and the lamp will be noticeably sluggish in reaching full brilliance. Getting rid of the 248.5 watts of heat produced by the series resistor might also prove to be an embarrassment!

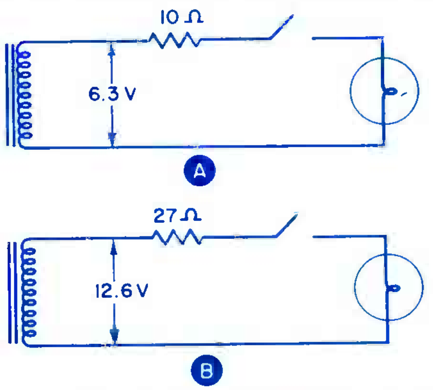



FIG. 1. Circuits for reducing turn-on surges by use of series resistor.

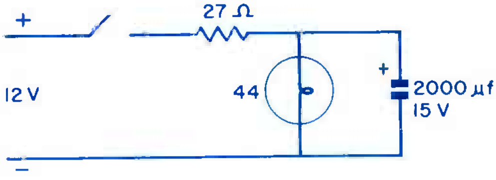



FIG. 2. Elimination of turn-on surge by use of R-C circuit.

Complete elimination of the turn-on surge is possible by means of an R-C circuit, used with a DC lamp supply. Simplest form of this circuit is shown in Fig. 2. Here, when the lamp circuit is energized, voltage across the lamp is dropped by the charging current of the capacitor. When the capacitor is fully charged, voltage across the lamp is that specified, and it lights to full brilliance.

When the switch is opened, the capacitor discharges through the lamp, and the circuit is ready for another operation in a few milliseconds.

This arrangement is ideal for single lamps, and several special configurations, but is not very economical in complex lamp arrays, as the capacitor must shunt the lamp being energized. Additionally, the slow charge rate of the capacitor, and its slow discharge rate, produces an appreciable slowing of the "reaction rate" of the lamp to switching operations.

The shunt capacitor has a specified voltage of 15, even though the lamp is rated, and operated, at six volts. The higher capacitor voltage rating is desirable, so that the capacitor will not be overvolted, and perhaps burned out, if the lamp opens, putting the full supply voltage across the capacitor. A capacitor of lower voltage rating, shunted by a Zener diode, will perform equally well here, but at considerably higher cost.

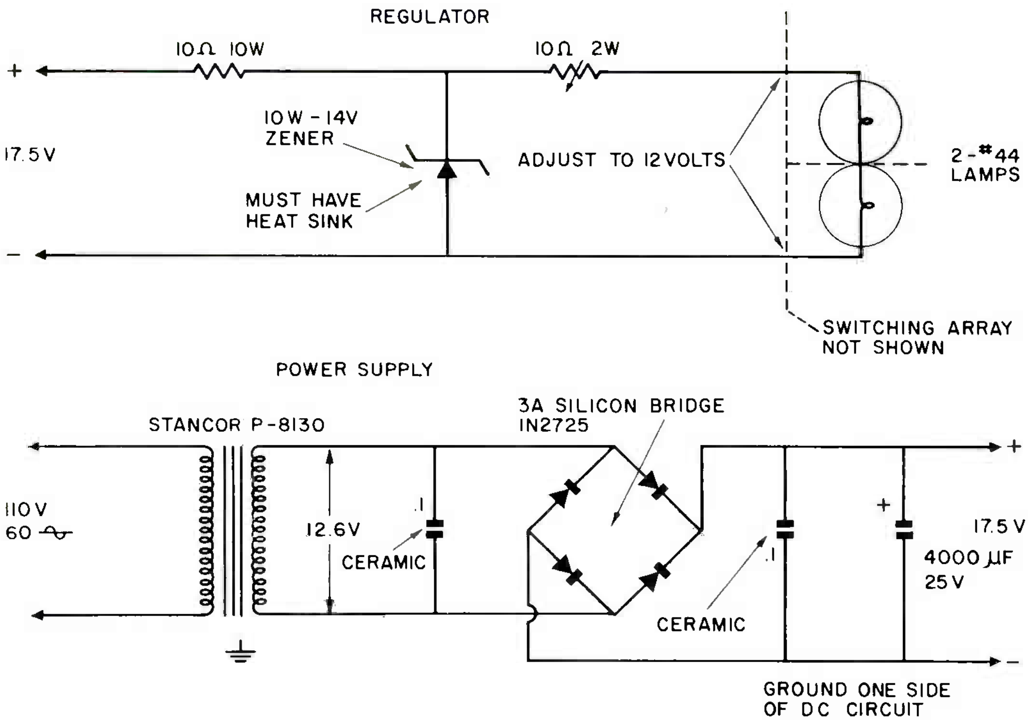



FIG. 3. Surge reducer for complicated lamp arrays.

For general industrial use with complicated arrays of readouts, a general system based on the series resistor principle, but incorporating Zener diode regulation, to eliminate the troubles due to line voltage vagaries, switching transients in the supply line, and other transients generated in the display system, has been found most satisfactory. This arrangement, shown in Fig. 3, is relatively inexpensive, of small bulk, requires no critical adjustments, and is remarkably trouble-free.

Here, the rectified and filtered DC supply is regulated, for the lamp load, at 14 volts by means of a Zener diode. This regulated voltage is further dropped to 12 by means of the adjustable series resistor, which is normally set at about 8 ohms. In consequence, the maximum current through the lamp circuit, with the lamps cold, is 14/8 + 8 = .875 amperes; and the sustained current, with the lamps hot, is the rated .25 amperes.

This practical circuit, which is a compromise, is not by any means perfect, but it extends the life of switched lamps by a factor of about 3, and markedly reduces lamp blackening in service. If the supply voltage can be increased economically, Zener regulation at a higher voltage is possible, and an increase in the adjustable resistor will then be possible, with a resultant reduction in the turn-on surge current.

It will be noted that the wattage ratings of the series resistors and of the Zener diode here used are considerably higher than needed for normal operations. The higher ratings are intentionally chosen so that, if the lamp circuit opens, the Zener diode and its dropping resistor will not be damaged by the increased load, even if the line voltage rises considerably above normal. The "excess" rating costs only a few additional cents—replacement of the components costs several dollars plus losses due to "down time".

# BOOKS

## RCA TRANSISTOR MANUAL

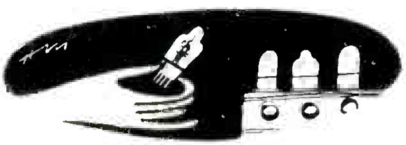
This manual is prepared to assist those who work or experiment with semiconductor devices and circuits. It will be useful to engineers, service technicians, educators, students, radio amateurs, hobbyists, and others technically interested in transistors, silicon rectifiers, and semiconductor diodes. The book covers basic theory, applications, and installation information. Many typical applications of semiconductor devices are illustrated in its circuit section.

Published by RCA Semiconductor and Materials Division. Available from RCA Distributors. 304 pages. Soft cover. $1.50.

## BASIC TRANSISTOR COURSE
By Paul Rodger Kenian

A non-mathematical approach providing the reader with the essentials of transistors. Author Kenian uses analogy-comparing everyday items and events to explain electronic processes and ideas. Clearly written and easy to understand - you may want to read it through in one sitting. In a matter of seconds, you'll find apparently complex terms and new principles of semiconductors no more difficult to manage than adding a column of figures.

Published by Gernsback Library, Inc., 154 W. 14th St., New York. 224 pages. Soft cover. $4.10.



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Use order blank page 35. Please be sure to give Model number of your tube tester. Price of new chart is $2.25, postpaid.

## ANSWER TO LUCKY'S DILEMMA

(What Would You Have Done? - Page 13)

As a TV technician, Lucky didn't have to rely on 'luck' to accomplish his purpose - he was a Class A man. It suddenly occurred to him that even though the 6CM7 required a filament current of .6 amperes (150 Mils. more than the current actually flowing in the series-string arrangement of the receiver) if he could activate the filament and get it heated once, thereby increasing its resistance to a passive operating point, he could quickly place the tube back in the receiver (from the tube-tester) and expect it to function normally - until, of course, the TV was turned off again.

This is exactly what Lucky did.

# Letters Continued from page 4.

■ Just a note to let you know what a great new magazine you have in the "NRI Journal." This is really one of the best magazines I have ever seen. I have paid seventy-five cents or more for magazines which do not begin to compare with it.

It also supplements your lesson texts quite closely. I especially like your "How-To" articles.

Keep up the good work. I believe this magazine by itself greatly increases the value gained by taking your course.

Gary Ingersoll
St. Louis, Mich.

■ Please vote "We like the new NRI Journal FINE."

Please add another page for us readers to sell and swap our electronic gear at 10 cents per word.

Ira Z. Zee
Henegar, Ala.

A good suggestion. We'd like to hear from other readers who would like a monthly classified "Sell and Swap".

■ I should like to express my thanks for the pilot issue of the NRI Journal, also, to compliment you and fine staff at NRI for the splendid job on the design. I found this publication to be every bit as interesting and informative as the NRI News, which it replaces.

The only disappointment I experienced with the JOURNAL came after I had read all the articles and was ready to put it away for future reference. I sadly discovered that it is about 1/4 inch too long to fit into the NRI LESSON BINDER.

Thanks for the fine service you continue to provide for all NRI Members.

Lionel A. Williams
Eatontown, N. J.

■ I would like to make a few comments and suggestions on what I would like to see in our new NRI Journal.

I would like to see in the new Journal a page or so on servicing tips for radio and television, etc. For example: interpretation of television waveforms using the oscilloscope, working on transistor radios, and transistor equipment, short-cuts on servicing transistor radios.

I have a little problem which I believe many others have also. While viewing some of the miniature components found in transistor radios, I was not sure as to what the part was. I would like to see an article with pictures showing many of the miniature components found in transistor radio equipment.

Terry Toole
Rochester, N. Y.

■ I find the new Journal a great deal better than the old News. I find it easier to read and understand than the old one. It seems more informative and useful as a reference text.

I really like it in its new form.

Philip Eadie
Durham, N. C.


"Number 69. TV Serviceman's Dream."

# ALUMNI ELECTION NEWS

J. Arthur (Art) Ragsdale of the San Francisco Chapter is out in front in the contest for Presidency of the NRI Alumni Association for 1964.

Ragsdale first began to make his influence felt in the Alumni Association when in 1958 he proposed the formation of the San Francisco Chapter. As a result of his efforts the San Francisco Chapter was organized and he became its first chairman, then its secretary. Then in 1961 and again in 1962 he was elected a National Vice President. Now he is making his bid for the Presidency.

Howard Tate of Pittsburgh would probably have given him more opposition except that Tate received more votes for re-election as a Vice President. The next highest number of nominating votes for the Presidency were those for Dave Spitzer of New York City, with John Pirrung close behind him. So, our two nominees for President are J. Arthur Ragsdale and David Spitzer.

As mentioned in the August-September Journal, of the current Vice Presidents only Howard Tate and Eugene De Caussin are eligible for re-election. The vote was strong for both of them. The other nominees for a vice presidency are Walter Berbee (who was a Vice President in 1962) and Paul Donatell, both of St. Paul, William Lundy of Pittsburgh, Frank Zimmer of New York, and Jules Cohen and Charles Fehn, both of Philadelphia.

Once again we caution our readers that only members of the Alumni Association are eligible to vote in this election. Vote for one man for President, four men for Vice Presidents, using the ballot on Page 36. Mail the ballot in plenty of time to reach Washington on or before October 25. The successful candidates will be announced in the December issue of the Journal.

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# ALUMNI ELECTION BALLOT

This Ballot is to be used by members of the NRI Alumni Association only.

All NRI Alumni Association members are urged to fill in this ballot carefully. Polls close October 25, 1963. Mail your complete Ballot to:

T. E. Rose, Executive Secretary
NRI ALUMNI ASSOCIATION
3939 Wisconsin Ave.
WASHINGTON, D.C. 20016

FOR PRESIDENT (Vote for one man)

☐ J. Arthur Ragsdale, San Francisco, Calif.

☐ David Spitzer, Brooklyn, N. Y.

FOR VICE PRESIDENT (Vote for four men)

☐ Jules Cohen, Philadelphia, Pa.

☐ Charles Fehn, Philadelphia, Pa.

☐ William Lundy, Pittsburgh, Pa.

☐ Frank Zimmer, Long Island City, N.Y.

☐ Walter Berbee, St. Paul, Minn.

☐ Howard Tate, Pittsburgh, Pa.

☐ Paul Donatell, St. Paul, Minn.

☐ Eugene DeCaussin, Hollywood, Calif.

SIGN HERE:

Your Name ....................................

Your Address ...............................

City ......................... State .............

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Enclosed is a down payment of $________ on the equipment I have listed on the reverse side. Beginning 30 days from the date of shipment I will pay you $________ each month until the total payment price is paid. You will retain title of this equipment until this amount is fully paid. If I do not make the payments as agreed, you may declare the entire unpaid balance immediately due and payable, or at your option, repossess the equipment. Your acceptance of this will be effected by your shipment to me of the equipment I have listed.

Date ________________ Your written signature ________________

CREDIT APPLICATION

Print Full Name ________________ Age ______

Home Address ________________

City & State ________________ How long at this address? ______

Previous Address ________________

City & State ________________ How long at this address? ______

Present Employer __________ Position __________ Monthly Income ______

Business Address ________________ How Long Employed? ______

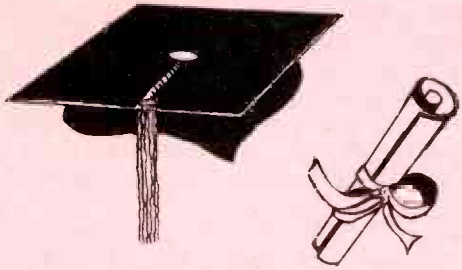
If in business for self, what business? __________ How Long? ______

Bank Account with ________________ Savings ☐ Checking ☐

CREDIT REFERENCE (Give 2 Merchants, Firms or Finance Companies with whom you have or have had accounts.

Credit Acct. with ________ (Name) ________ (Address) ________ Highest Credit ______

Credit Acct. with ________ (Name) ________ (Address) ________ Highest Credit ______



# ALUMNI NEWS

John Berka .......... President
Howard Tate .......... Vice President
James Kelley .......... Vice President
Eugene DeCaussin .......... Vice President
David Spitzer .......... Vice President
Theodore E. Rose .......... Executive Sect.

## John Berka Visits NRI

While on vacation, John Berka, President of the NRI Alumni Association for 1963, and his family stopped over in Washington, D.C. and paid a visit to NRI. They were given the grand tour of NRI's building and then were Executive Secretary Ted Rose's luncheon guests at one of the city's well-known restaurants. Come back again soon, John.

Alumni Election News and Ballot are on pages 35 and 36.

## Visits To Local Chapters

Last year J. B. Straughn, Chief of NRI Consultation Service, accompanied Executive Secretary Ted Rose on his annual visit to the various local chapters. Mr. Straughn's lectures and demonstrations on Radio-TV-Electronics were so enthusiastically received that he is repeating his visits this season. Below is a tentative schedule of the visits yet to be made. This schedule will be confirmed or modified in subsequent issues of the Journal.

| CHAPTER | DATE |
|---|---|
| Flint (Saginaw Valley) | October 10 |
| Detroit | October 11 |
| Philadelphia-Camden | October 28 |
| Hagerstown | November 14 |
| Springfield, (Mass.) | November 20 |
| New York | November 21 |
| New Orleans | January 14 |
| Minneapolis-St. Paul | April 9 |
| Pittsburgh | May 7 |
| Hackensack | May 29 |

All NRI students and graduates are welcome at the meetings whether they are members or not. Take advantage of this chance to meet Mr. Straughn and to hear him lecture on Electronics. See "Directory of Local Chapters" on page 40 for information on time and place of meetings.

# CHAPTER CHATTER

DETROIT CHAPTER is another of those which suspend meetings in the summer time. But the chapter is holding its regular meetings again -- twice-a-month -- and is looking forward to a busy season.

The chapter follows the practice of electing at the end of each season the officers to serve for the new season beginning each fall. The officers elected for the current season are: James Kelley, Chairman; John Nagy, Vice-Chairman, George Povlich, Secretary; John Karpolski, Assistant Secretary; Earl Oliver, Treasurer; Prince Bray, Librarian; Asa Belton and Leo Blevins, Entertainment and Finance Committee; and Asa Belton, Sergeant-at-Arms. Our congratulations to these officers.

FLINT (SAGINAW VALLEY) CHAPTER, like some of the other chapters, discontinued meetings during the summer. Some of the members, however, attended the Genesee County Radio Club as guests. This club is composed of quite a few hams.

The chapter is working on an interesting series of lectures for the season. One of the speakers the members hope to have as a guest lecturer is Dr. Franken, professor of physics of the University of Michigan, to conduct a lecture and program on lasers and masers. This is a highly fascinating subject. It has created a great deal of interest and every member should take advantage of any opportunity to learn everything he can about it.

It is hoped and expected that other programs this fall will be put on by distributors of Philco, Zenith, Westinghouse, and perhaps other manufacturers.

HACKENSACK CHAPTER, our newest chapter, was organized last May and at that time elected an incomplete slate of officers. Since then the remaining officers have been elected: Cres Gomez, Sergeant-at-Arms; George Stoll and Robert Cunningham, Financial Committee; Raymond Heinsman and Edward Heinsman, Program Committee. Our congratulations to you, gentlemen!

Cres Gomez gave a talk on servicing and customer relations. Customer relations is, of course, a matter of primary importance to every Radio-TV serviceman. It is well for members to give serious attention and thought to this problem.

The Program Committee has been busy and reports several interesting features planned for the fall meetings. One of the members brought up the subject of the new Motorola Color TV. This prompted a lively discussion of the features of the set and the importance of keeping informed on new developments.

A clinic was then conducted. One of the members brought in an NRI TV receiver which showed horizontal instability and phase shift. After determining that no faulty component was causing the trouble it was found that repositioning the wiring in the affected circuit cleared up the trouble. This demonstrated the importance of lead dress, especially in high frequency circuits.

Another member brought in a Philco TV receiver with a shaded area at the bottom of the raster. This was not affected by any of the controls and the trouble was pin-pointed as a faulty filter capacitor. Bridging this with a good unit cleared up the trouble. All the members present agreed that this was a very productive session.

The chapter recently admitted four new members: William E. Colton, Franklin Lucas, George Pitroff and Cesar Delgado. Welcome to these gentlemen!

LOS ANGELES CHAPTER, as reported in the June-July issue of the NRI Journal, last Spring obtained a slide projector for showing the various stages of TV circuitry on a screen to aid in discussions at the meetings. The Chapter has continued to use the device and finds it a valuable aid.

Most of one meeting was devoted to a discussion of TV tuner troubles, also the effects of faulty AGC on tuners. At the subsequent meeting the new California licensing law was discussed at great length.

Earl Allen talked to the members about two TV repairmen in one rather large area in central California. Because they are the only two men in this area they have somewhat of a monopoly on TV servicing, and are believed to follow the undesireable practices which this encourages.

MINNEAPOLIS-ST. PAUL (TWIN-CITY) CHAPTER members entered into a spirited discussion led by John Berka on service charges: what labor to include in the service call and what to charge extra for. There is some disagreement among Radio-TV servicemen on this subject but it is nevertheless a good idea to examine these charges once in awhile.

John Berka took up a good part of the next meeting to tell the members about his visit to Washington and to NRI.

NEW YORK CITY CHAPTER, after having suspended meetings in July and August as is customary, is once again going full steam ahead. This Chapter always has a heavy program of interesting and instructive features. By the time this issue of the NRI Journal is distributed, the Chapter's program for the 1963-1964 season should be well under way.

PHILADELPHIA-CAMDEN CHAPTER, as in former years, held only one meeting per month during the summer -- the Service Night meeting. But the regular twice-a-month meeting have now been resumed and the chapter has a full schedule of interesting programs lined up for the new season.

Bill Davis gave a talk on servicing transistor receivers using a VTVM. This was an excellent talk, practical and helpful.

Secretary Jules Cohen, with his usual energy and initiative, is trying to work out a deal with the Philco Corporation to allow members of the chapter to make a tour of the plant to see how printed circuits are made. There are complications in this project but if it can be done we know that Jules will bring it off.

PITTSBURGH CHAPTER's Jim Wheeler, Howard Tate, and Ed Lowther put on a demonstration in which they employed the B and K TV Analyst, a Television receiver and a scope. They introduced defects into the receiver, then used the B and K Analyst to find the defects.

The scope was used to show normal waveforms at various points in the receiver. When defects were introduced in the set, the changes in waveform were noted and the reasons for the changes discussed. This program was well received by the members.

SAN ANTONIO (ALAMO) CHAPTER, besides welcoming back former member Sam Dentler, who renewed his membership, has also admitted two new members, John Chaney, Jr., and William Hancock. A warm welcome to all three of these members.

The Chapter has been experimenting with "controlled bull sessions" on a particular subject. The first of these experiments was led by Joe Garcia. It was a round table discussion on horizontal circuits. This first trial was so successful that at the next meeting Sam Dentler led another "controlled bull session" on "FM Multiplex Stereo" based on an article by Harry Taylor of the NRI Staff in the October-November, 1962 issue of the NRI News. All members are instructed to bring any information they may have on any subject selected for discussion in these sessions.

SAN FRANCISCO CHAPTER's former chairman and now a candidate for National President of the Alumni Association, Art Ragsdale, gave an interesting discussion of the brightness control circuits in Hoffman Television receivers.

The former chairman of the Program Committee, Ross Alexander, left California to take up permanent residence in Washington, D.C. Just before leaving he donated a 17" Zenith TV receiver to the Chapter as a parting gift. Ed Persau gave a service demonstration with the set, which showed a lack of sync. By using alignment tools and adjusting the horizontal control, he corrected the sync perfectly.

The newest members of the Chapter are Martin Bienstock and Oscar Simpson. The latter celebrated his admission to membership by delivering a talk dealing with his technical experiences with color Television.

SOUTHEASTERN MASSACHUSETTS CHAPTER's Walter Adamiec, who was chiefly responsible for organizing the Chapter back in 1957, told the members at length about an Electronics course he recently completed.

Walter was followed by Oscar April, employed at a U.S. Government Nuclear Research Center, who addressed the members on harmonics and how to eliminate them with wave traps.

SPRINGFIELD (MASS.) CHAPTER is another Chapter which elects officers at the end of each season to serve for the next season beginning in the Fall. The officers chosen for the 1963-1964 season are: Steve Chomyn, Chairman; Gus Lorenzatti, Treasurer; and Al Dorman, Secretary.

Because it represents a change from last season, members (and any students or graduates who may be interested in visiting the Chapter) are reminded that meetings are now held only once a month, on the last Saturday of each month.

## Directory of Local Chapters

*Local chapters of the NRI Alumni Association cordially welcome visits from all NRI students and graduates as guests or prospective members. For more information contact the Chairman of the chapter you would like to visit or consider joining.*

CHICAGO CHAPTER meets 8:00 P. M., 2nd and 4th Wednesday of each month, 666 Lake Shore Dr., West Entrance, 33rd Floor, Chicago. Chairman: Frank Dominski, 2646 W. Potomac, Chicago, Ill.

DETROIT CHAPTER meets 8:00 P.M., 2nd and 4th Friday of each month. St. Andrews Hall, 431 E. Congress St., Detroit. Chairman: James Kelley, 1140 Livernois, Detroit, Mich., VI-1-4972.

FLINT (SAGINAW VALLEY) CHAPTER meets 8:00 P. M., 2nd Wednesday of each month at Chairman Andrew Jobbagy's Shop, G-5507 S. Saginaw Rd., Flint, Mich. OW 46773.

HACKENSACK CHAPTER meets 8:00 P.M., last Friday of each month, Hackensack YMCA, 360 Main St., Hackensack, N.J. Chairman: George Schalk, 471 Saddle River Rd., Ridgewood, N.J.

HAGERSTOWN (CUMBERLAND VALLEY CHAPTER meets 7:30 P. M., 2nd Thursday of each month at the YMCA in Hagerstown, Md. Chairman: Francis Lyons, 2239 Beverly Dr., Hagerstown, Md. Reg 9-8280.

LOS ANGELES CHAPTER meets 8:00 P. M., 2nd and last Saturday of each month, 5938 Sunset Blvd., L. A. Chairman: Eugene DeCaussin, 5870 Franklin Ave., Apt. 203, Hollywood, Calif., HO 5-2356.

MINNEAPOLIS-ST. PAUL (TWIN CITIES) CHAPTER meets 8:00 P.M., 2nd Thursday of each month, Walt Berbee's Radio-TV Shop, 915 St.Clair St., St.Paul. Chairman: Paul Donatell, 1645 Sherwood Ave., St. Paul, Minn., PR 4-6495.

NEW ORLEANS CHAPTER meets 8:00 P.M., 2nd Tuesday of each month at Galjour's TV, 809 N. Broad St., New Orleans, La. Chairman: Herman Blackford, 5301 Tchoupitoulas St., New Orleans, La.

NEW YORK CITY CHAPTER meets 8:30 P. M., 1st and 3rd Thursday of each month, St. Marks Community Center, 12 St. Marks Pl., New York City. Chairman: David Spitzer, 2052 81st St., Brooklyn, N. Y., CL 6-6564.

PHILADELPHIA-CAMDEN CHAPTER meets 8:00 P.M., 2nd and 4th Monday of each month, K of C Hall, Tulip and Tyson Sts., Philadelphia. Chairman: John Pirrung, 2923 Longshore Ave., Philadelphia, Pa.

PITTSBURGH CHAPTER meets 8:00 P.M., 1st Thursday of each month, 436 Forbes Ave., Pittsburgh. Chairman: Thomas Schnader, RD 3, Irwin, Pa., 731-8327.

SAN ANTONIO ALAMO CHAPTER meets 7:30 P. M., 3rd Wednesday of each month, Beethoven Hall, 422 Pereida, San Antonio. Chairman: Jesse De Lao, 606 Knotty Knoll, San Antonio, Texas.

SAN FRANCISCO CHAPTER meets 8:00 P.M., 1st Wednesday of each month, 147 Albion St., San Francisco. Chairman: Peter Salvotti, 2534 Great Hwy., San Francisco, Calif.

SOUTHEASTERN MASSACHUSETTS CHAPTER meets 8:00 P. M., last Wednesday of each month, home of John Alves, 57 Allen Blvd., Swansea, Mass. Chairman: James Donnelly, 30 Lyon St., Fall River, Mass. OS 2-5371.

SPRINGFIELD (MASS.) CHAPTER meets 7:00 P.M., last Saturday of each month at shop of Norman Charest, 74 Redfern St., Springfield, Mass. Chairman: Steven Chomyn, Powder Mill Rd., Southwich, Mass.

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KIT ONLY $29.95 | Assembled: $44.95 #211WT

## 5" WIDE BAND PROFESSIONAL OSCILLOSCOPE

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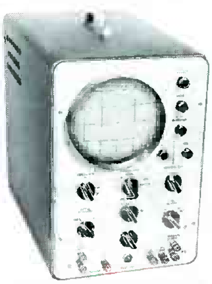
- High sensitivity
- Brightest trace in a low cost scope!



KIT PRICE: $89.50 | Assembled: $139.50 #250WT

This Conar scope provides vertical sensitivity of .023 VRMS; horizontal sensitivity of 1.0 VRMS. Compare with any other popular priced scope and you'll find the Conar 250 way out in front. Features include built-in fly-back transformer tester, dynamic checking of vibrators, measuring ripple output of power supplies.

## 6 TRANSISTOR PORTABLE RADIO

Model No. 291

Assemble it in one evening, enjoy it for years. Big 4" speaker for console audio quality. Operates on 4 penlite batteries. Matched pre-aligned IF transformers; hi-Q loop; matched oscillator coil; leather-type case. Rugged. No printed circuits!


LOW KIT PRICE: $23.95 | Assembled: $32.50 #291WT

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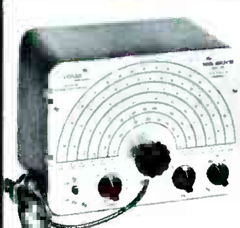
Model No. 280UK



A professionally styled unit designed for rapid, accurate AM-FM-TV alignment and trouble-shooting. Average accuracy better than ±1% on all bands. Covers 170 kc to 60 mc on fundamentals; harmonic freq. coverage is over 120 mc. 9" dial.

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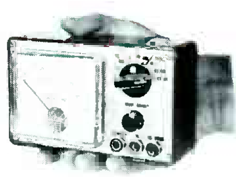
Make accurate, essential AC and DC voltage measurements plus 3 resistance ranges. 20,000 ohms-per-volt sensitivity. Includes mercury cells, 48" test leads. Has jewelled d'Arsonval movement meter. Precision in a portable.



KIT PRICE: $17.95 | Assembled: $19.95 #240WT

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