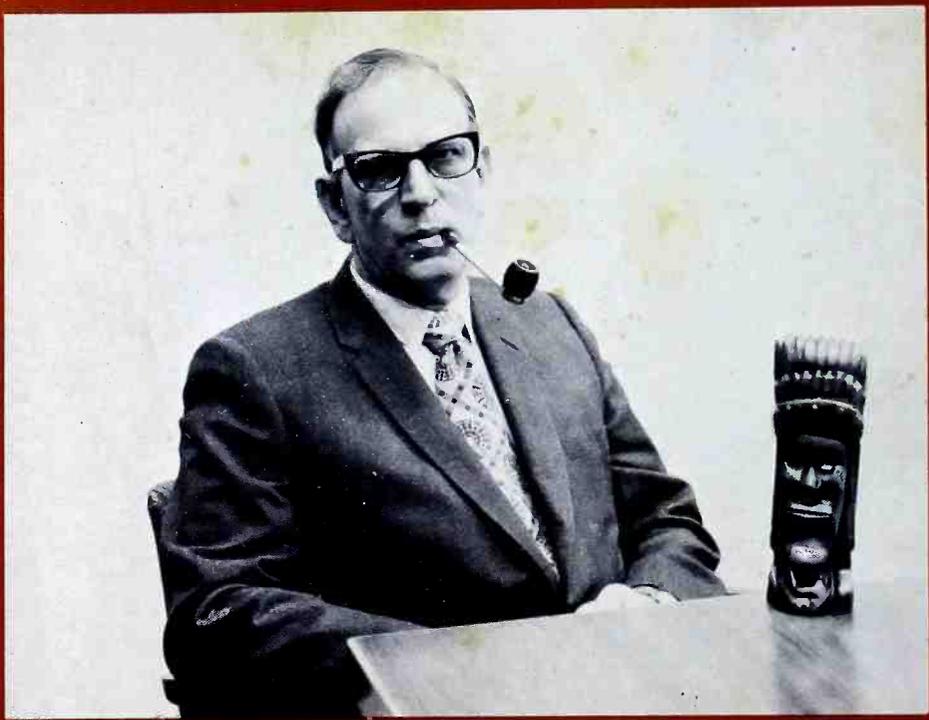




JOURNAL

May/June 1972



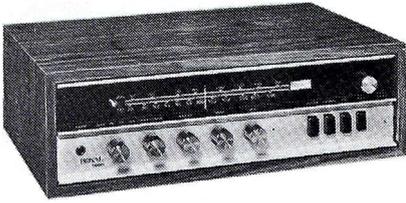
● ● *Morrison Smith and 'The God of Science'*

- *Our most important 'product'*
- *Adventures of a part-time serviceman*
- *Ham News*

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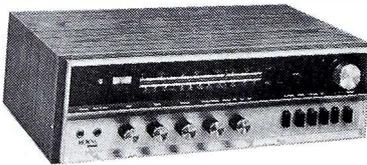
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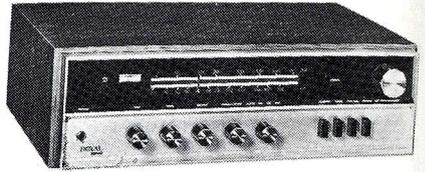
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Journal

May/June 1972
Volume 29, No. 3

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I have several pieces of test equipment for sale for reasonable prices.

To obtain a list, send a self-addressed, stamped envelope to:

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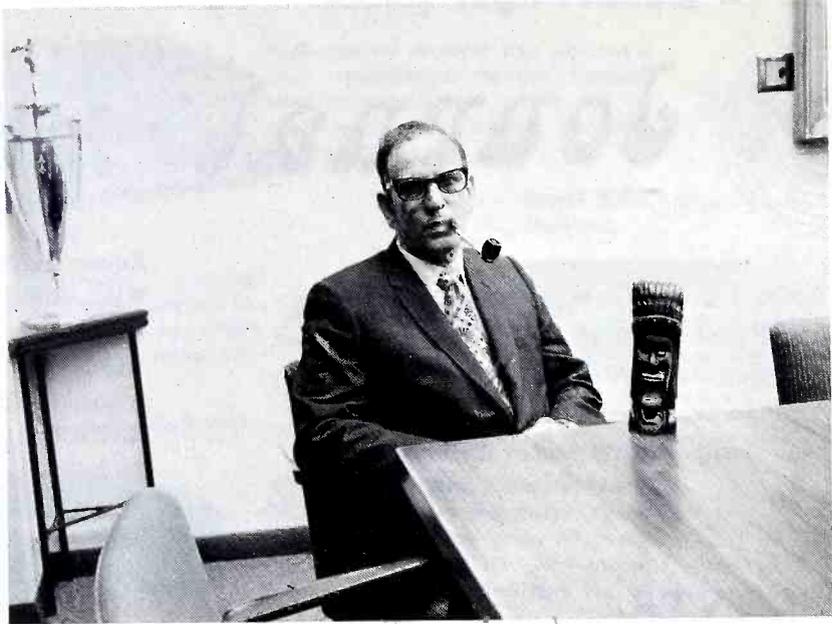
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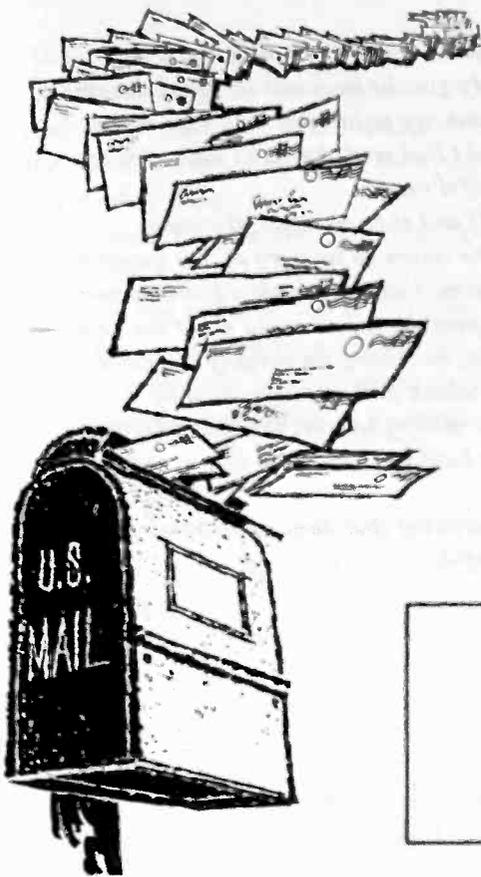
Morrison Smith and 'The God of Science'



That's the Mayan God of Science, 'Ich Nahun', that Morrison Smith, National Radio Institute President, is eying reflectively in the picture on the front cover of this issue of the NRI Journal. (See closeup at left.)

The hand-carved wooden head was sent to Mr. Smith by Student George Wesley, who lives in Belize City, British Honduras, Central America, in appreciation of "all the wonderful help NRI has given me," wrote Wesley. "This jade head is made of British Honduras ziricote wood, and represents the Mayan Chief, 'Ich Nahun', the Mayan God of Science. A painting of the god was seen on the walls of a Mayan monument in the area supposed to have been the conference room of the Mayan chiefs."

You'll find other letters and stories of students and graduates throughout this issue of the Journal, which is a way of letting you know, to borrow a phrase, that we know you are "our most important product".



TO THE EDITOR
NRI JOURNAL

Dear Editor:

I have been following J. B. Straughn's servicing adventures with unusual "dogs" as described in the NRI Journal and I thought perhaps he would like to hear of an experience I had recently to add to his list of mystifiers.

The set in question was an Airline model GEN-8147 Color TV. It came into the shop with the complaint of sound but no picture. First off I tested the tubes associated with the high voltage circuit and they all tested good. My next step was to replace each of these tubes with a new one. This could be done with the exception of the horizontal amplifier 26DQ5 tube. I found this tube is one of those rare Japanese things that could only be obtained in certain places like Montgomery Ward or Sharp Electronics in Paramus, N.J. at the full price of about \$8.50. No profit here!

The scope showed a beautiful pattern on the grid of the horizontal amplifier tube, but that was it. While standing with the set turned on I got the urge to wiggle the tubes associated with the high voltage circuits in their sockets.

My First Steps in Electronics

(Are You Sure Marconi Started Like This?) By Al Aaronson, WA3RNW

Reprinted from THE MODULATOR, monthly publication of the Baltimore Radio Club

Although most of the hams like to go on the air and chew the rag or chase DX, I have found my chief interest to be in the study of the theory of radio and electronics. So it was with great joy and excitement that, in September 1971, I came across a fellow who had purchased a course from National Radio Institute and barely started it before he had to give it up. After a decent amount of haggling, I paid him and the course was mine.

My joy was even greater when the NRI school told me they would be happy to enroll me as a student in the other fellow's place. They were extremely nice about it, and their whole attitude was one of cordial cooperation.

As for the course, it has been a sheer delight. I have just finished lesson 20 and am working on Kit 5. (The course has roughly 86 books and 7 kits.) I have already built a beautiful vacuum tube voltmeter, which worked beautifully when completed and is very accurate. Also a circuit board audio oscillator which is a little gem. There is a considerable amount of soldering, desoldering, and experimenting which gives you the feel of working on "real" equipment and not just models.

I have been through dc and ac theory — resistors, coils, capacitors, transformers, chokes, tubes and transistors — theory and practice.

Also, books on ac and dc circuit calculations, algebra, etc. I have just finished the third multiple-choice exam, which is a copy of a "real" FCC type exam composed of 50 multiple-choice questions. There are 14 of these exams in the course.

My Instructor answers questions that arise promptly and in full detail. In fact, I feel that I am closer to the instructor in this course than if I were enrolled in a course in person at a school. My grades are good — although I must confess that a lot of the material (for me) is still "hazy". But if I stay with it long enough, the answers begin to come, so I feel satisfied as long as I feel I'm learning. I just received a certificate of completion of the first two units with a ribbon attached, "with high honors". It would have been with "highest honors", but I boomed two lessons early in the course, which must have brought me down some.

All in all, it is a very rewarding experience and I certainly hope more of the fellows in the club decide to join the fun and learn electronics and radio from the basics right on up. And I must say that I have never studied a more rewarding or more satisfying or better run course of study than the one I am now enrolled in at National Radio Institute.

For the record, the course is called "NRI Course in Complete Communications", National Radio Institute, 3939 Wisconsin Avenue NW, Washington, D.C. 20016. Tell 'em Al sent you!



Dear Editor:

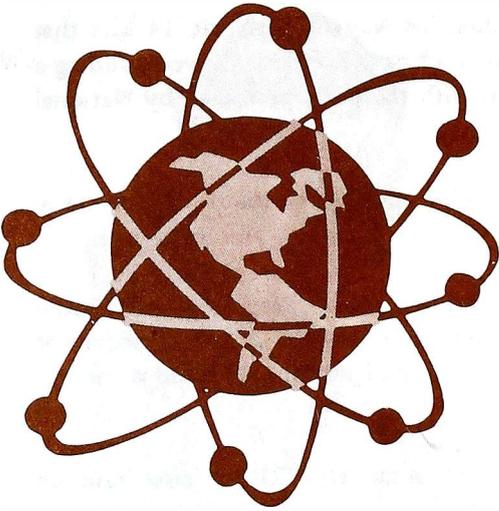
I just received your letter asking for pictures and a story of my work here in Cotabato. Comparing my work to what you publish in the Journal makes me feel so small, but anyway I can say I am the music librarian. We operate for 17 hours (a day) with an old 10 kW transmitter, a console Gatesway II with eight channels having a capacity of 16 inputs. At times I get the privilege of pitching in for the technician on board, especially when all are busy. Every week I take care of recording one locally written and produced drama, plus a weekly program staged by the Order of Notre Dame Sisters, all songs. For quite a while I did some standby for soap operas and took care of throwing in the commercials within the drama, and then giving the station breaks.

Later I had to pitch in for an announcer who was sick, and finally today I find myself a disc jockey for two programs a day. At 9:30 a.m. I do "Jukebox 880", all popular tunes, and then I do another program at 2:30 p.m., "Instrumental Favorites". I am better known on the air as "Proud Mary" because of the song.

Once a month we have movies for the Sisters, which are usually shown in three houses. We make use of an RCA movie projector and slide projector. Every now and then we stage programs for different occasions, like welcoming or sending off someone, and for these I take care of the lighting effects, tape recorders, and amplifier. Above all, I am also "chief janitor" of Station DXMS, the only FM station in Cotabato.

In Our Lady is your student,
Sr. Mary J. Quintos
Station DXMS
Cotabato, the Philippines

HAM NEWS



By Ted Beach, K4MKX

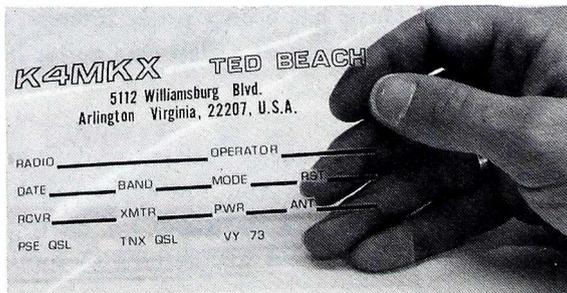
As this is being written, we have had no response so far on the last column about the silk screen QSLs. Actually, I guess that there really hasn't been enough time to hear from you guys as the last Journal has only been out a very short time.

At the risk of boring you with the QSL bit, I am including a couple of shots of the card I whipped up the other day. I'll be the first to agree that it doesn't show a great deal of style, but it certainly was simple to whip up in a hurry. The card was pasted on a sheet of acetate to be

used as a positive transparency to make the photo-silkscreen (not made yet!).

The letters are the cut-out-and-rub-on type available at art supply houses. Choose letter styles that are pretty heavy or you may have difficulty reproducing them with the screen. The other picture is a print of the finished card which will ultimately be screened on the back of a "penny" postcard. (How many of you can remember the penny postcard?)

Enough of the rambling; I seem to recall that I slighted a couple of fellows in the last column because I carried on to



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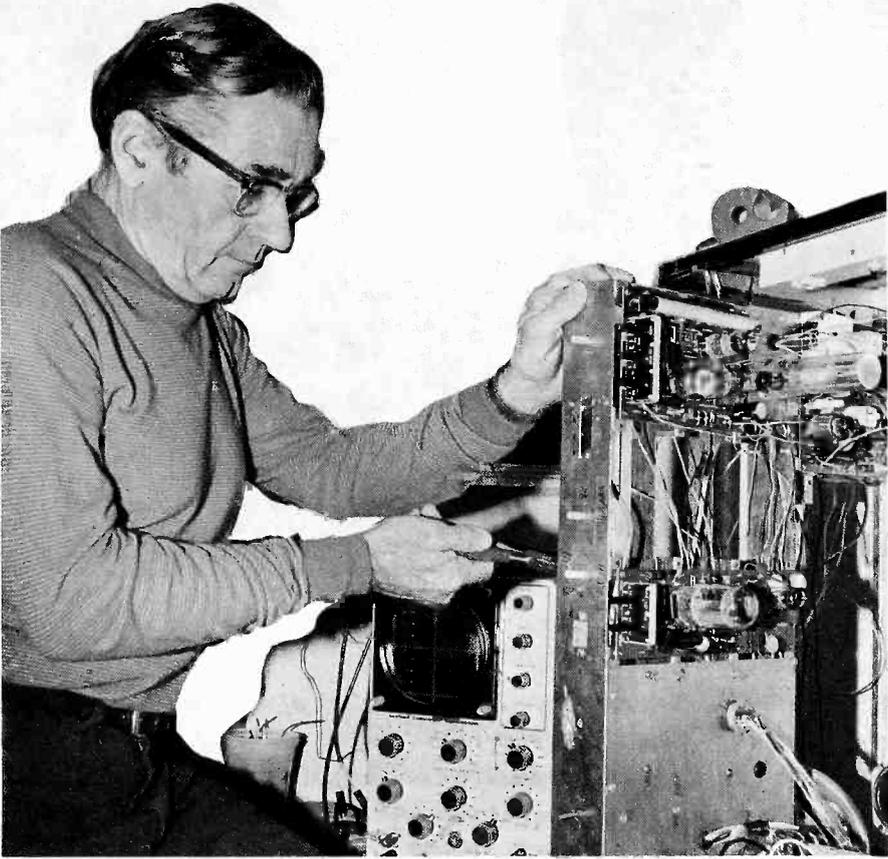
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The Ol' Rockin' Chair Has A Long Wait for Murphy

Courtesy of the Minnetonka Sun, Minnetonka, Minneapolis

Minnetonka, Minn. --For a man whose interests and activities could cover several lifetimes, John Murphy of nearby Mound is by no means ready to take to the rocking chair. Instead, about three years ago he reactivated a youthful interest he had in radio back in the 1920's. Back when he built crystal sets, he had intended to search further into the mysteries of radio and electronics, but had been diverted.

FIRST, MURPHY ENROLLED in the Brown Institute of Electronics in Minneapolis for a basic course, in which he spent three months studying and applying class lessons. Then he enrolled for an advanced correspondence course at National Radio Institute in Washington, D.C., covering radio and television servicing. The course included the basics once again, and required approximately an

Decided I had better look at the vertical tube again; found that another substitution had been made. This time a 13DE7 in place of the 13FD7. Looked up the two tubes in my tube manual and decided the substitution was a reasonable one, but replaced it anyway with a new 13DF7. Again had to readjust all vertical controls, as would be expected due to the internal resistance of the two tube types. However, in a short time the intermittent trouble reappeared. Figured heat had something to do with the trouble. So I checked all resistance values in the vertical circuit with the ohmmeter, and did not find anything amiss.

Next decided the trouble was due to a capacitor which charged in some manner with heat. Looked the circuit over again and decided there must be leakage in some capacitor in the feedback network, as adjustment of the size, linearity, and sync controls would stop the intermittent action but would not give an acceptable picture. Looked like changing the adjustment of these controls varied the amount of signal in the circuit and that with a lower signal level the signal was not enough to cause some capacitor to leak the vertical sweep to collapse as before. For example, the sync control had to be adjusted so it had zero resistance. A restudy of the schematic showed the capacitors in the feedback network to be C_{40} , C_{38} , C_{36} , and C_{39} . Didn't think that C_{39} could cause the trouble, as leakage in it would reduce the amount of sweep signal in the circuit. It would also short out one of the vertical windings on the yoke, with the sync control set for zero resistance. Didn't have all these capacitors in stock so the next time I went to town bought all of them. A 1kV, .0015 mfd was not available, so I got the next highest working voltage, which was a 1.6kV at .0015 mfd. Debated on picking up a new yoke but decided to wait.

Removed the chassis, as C_{36} , the .068 mfd coupling unit, was at the rear of the printed circuit board where it could not be reached with the chassis in the cabinet. This was quite a job, but after having to remove the picture tube from the front of the cabinet, and some 20 bolts and screws, the chassis came out. Coupling capacitor C_{36} was mounted flat on the circuit board so was able to cut the leads, leaving enough sticking up to solder to the new capacitor leads.

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K4MKX

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PSE QSL TNX QSL VY 73

such lengths about the QSLs, and I don't want to make the same mistake again. Let's start now by mentioning the doings of those slighted last time.

The first on the list is WA3QFG who is a student of our FCC License Course. John had easy going taking the General test because of his studies with NRI. By now he should have gotten his Advanced, having planned to take the test in February. John runs an HW-101 and SB200 to a 15-meter beam at present. He is planning to erect a tri-band beam soon so that he won't be restricted to 15.

Bill, WN4VZL, wrote a two-page protest on my previous comments regarding the 11 meter fraternity. Bill is a brand new novice and also a CBer who, while he doesn't like all that he hears on CB, has a lot to say for the Citizens Radio Service.

First, he correctly points out that the graduates of our various communications courses will in all likelihood earn their living repairing CB equipment. True enough, Bill. Second, Bill says the Ham types who populate 80 and 40 cw could

use a bit more consideration in their "tuning-up" and not interfere with QSOs in progress and not "break-break" when they're not invited.

Very good points, Bill, and I certainly didn't mean to ruffle any CB feathers — I was merely trying to point out the poor operating practices (sometimes blatantly illegal) carried on by a large percentage of the CB operators. I also know that there are a lot of poor operators on the ham bands, and have noted this before. However, the ease with which almost anyone (who has the money) can get a CB license puts very little front-end regulation on the entire service. As a result there are many too many operators abusing the intended purpose of the service and too few FCC "police" to keep them in line.

Anyway, thanks for the letter, Bill, and try to forgive us!

As I sit and reread the letter from WB8KIS, I find once again that my secretary has been most lax! Lee's letter arrived in December, and short of listing his call last time, he has gotten no

NRI HONORS PROGRAM AWARDS

For outstanding grades throughout their NRI courses of study, the following January and February graduates were given Certificates of Distinction along with their NRI Electronics Diplomas.

With Highest Honors

Subramaniam Arumugam, Toronto, ON, Canada	Sgt. John E. Leib, Baton Rouge, LA
Herald C. Barnes, Siloam Springs, AR	James Charles McMurdy, Don Mills, ON, Canada
Charles E. Bishop, Du Quoin, IL	John B. Pyle, Springfield, MD
Reginald L. Bullis, La Porte City, IA	H. W. Rector, Birmingham, MI
Gerald R. Frey, York, PA	Andrew J. Secula, Gaithersburg, MD
Charles R. Holder, Winston Salem, NC	Alfred L. Wade, East St. Louis, IL
Lawrence H. Jungwirth, Minneapolis, MN	William R. Williams, Sacramento, CA
J. Kahn, Camp Springs, MD	Gregory A. Zarnoch, Philadelphia, PA

With High Honors

Wayne D. Allen, New Carlisle, OH	C. L. Harvey, Du Bois, PA
Kenneth M. Biffle, Broken Arrow, OK	Edward J. Herzog, Naples, FL
James A. Bostic, Hillcrest Heights, MD	David H. Hinze, Rochester, MN
Donald J. Boul, Belleville, IL	Andrew Jackson, Jr., Annapolis, MD
Donald M. Bowers, San Jose, CA	B. Jackson, West Nyack, NY
Kent Bradford, Toledo, OH	LCDR Richard Jastremski, Orange Park, FL
Robert H. Brown, Ilion, NY	Robert Keegan, Colchester, CT
Frank M. Buchanan, Southaven, MS	George J. Kerstein, Reading, PA
Larry T. Bumgardner, Durham, NC	Constantin Kouvertaris, Montreal, PQ, Canada
Harrell G. Campbell, Ore City, TX	Michael L. Lindstrom, San Diego, CA
Norberto S. Caoili, Algona, WA	Lester G. Mann, Reno, NV
James C. Carmack, Redlands, CA	Wilbur McDaniel, Portland, OR
J. Michael Carreiro, Tiverton, RI	A. J. McLean, Waldorf, MD
Edward L. Ciampa, Brunswick, ME	Malcolm N. McQuarry, Elmvale, ON, Canada
Douglas Cooper, Moundsville, WV	Richard J. Milligan, Rantoul, IL
Charles P. Corbett, Methuen, MA	Robert R. Nash, Jackson, MI
Germain M. Cormier, Kent, WA	Bob Newman, Colorado City, TX
Freddie L. Davidson, Wilmington, NC	Otis R. Pannell, Alexandria, VA
D. N. Dearen, Texas City, TX	Walter E. Prusik, Port Clinton, OH
Robert A. Denny, Greenacres, WA	Charles Ramsey, Oak Creek, CO
Thomas N. Dixon, Jr., Pensacola, FL	Brian S. Rivette, Claremont, NH
J. Neal Dow, Charlottesville, VA	McKinley Robinson, Jr., US Embassy, APO NY
Frank E. Drake, Jr., Moline, IL	Erwin J. Roustio, East St. Louis, IL
Clifford R. Drew, Oshkosh, WI	Paul Sabol, Reno, NV
H. R. Gard, Palmyra, MO	Robert W. Saunders, San Antonio, TX
William Lloyd Geist, Levittown, NY	Wilbur G. Schneider, Sharon, PA
Ralph A. Giangordano, Greenville, PA	Marshall Scott, Houston, TX
John H. Gilligan, Cincinnati, OH	Billy C. Shelley, Minooka, IL
Irving Given, Medford, NJ	Richard J. Smith, Belle Fourche, SD
Joseph M. Grebowsky, Kensington, MD	Michael S. Speyrer, Albuquerque, NM
Robert L. Haley, Akron, OH	Leslie Z. Stone, Erie, PA
Robert G. Hamlin, Jr., Greenwich, NJ	John A. Stowers, Indian Head, MD
Dale M. Hamilton, Akron, OH	Thomas O. Talley, Paradise, CA

as he finishes the course. I trust he will have the required two years in harness for that one.

Jerry, WNØGFL, didn't intend to start his ham career as a Novice but his code speed didn't cooperate so there he is. Don't worry, Jerry, time spent as a

Novice is not wasted. As long as you can get on the air and get a little experience under your belt the time will go quickly. And you'll have lots of fun at the same time.

Now — on to the other NRI Hams we have heard from since last time:

Dave	WA1JSD	G	Derry, NH
Pop-Pierre	K2IPK	—	Haddon Heights, NJ
Steve	K3HBP	G	Claymont, DE
Harry	WA3NRT	G	Greensburg, PA
Judson	WN3QES	N	Dunbar, PA
L.C.	WB4MJN	—	Gadsden, AL
George	WB5CKH	A	Longview, TX
Charles	WB5GCZ	—	APO San Francisco, CA
George	WB6NYX	A	Sacramento, CA
Leon	WA7SNX	T	Portland, OR
Ray	W7YKN	—	Reno, NV
Ron	WN8JGF	N	Kincheloe AFB, MI
Jeff	WB9CYI*	G	Algonquin, IL
Frank	K9FEI	—	Indianapolis, IN
Nicholas	WA9MOU	G	Rock Falls, IL
Martin	WNØFAL	N	Leslie, MO
Doug	VE2ADV	—	Montreal, PQ, Canada

* Just upgraded; congratulations!

Wow! Looking back at this list of names I notice that every mainland call area is represented; 1 through Ø (and VE2 as well).

Looking back a bit further, I see that California is the only call area not represented in the other list. How about that?

WA1JSD needs KH6 for WAS on 80 and would like to sked KH6AD. Well, Dave, you can write Bob at the address given in the January/February Journal, but do you *really* expect to work Hawaii on 80 from New Hampshire? Good luck!

K2IPK has a problem. Seems as how Pop-Pierre has an elderly Heath HW29 (NOT an HW29A) and needs a manual for

it. Heath is out of them and couldn't help. If anyone out there has a manual or can latch onto one, let Pop-Pierre know, would you? He says he will buy or borrow. You can write him at:

Peter R. Turchi — K2IPK
1420 Maple Ave.
Haddon Heights, NJ 08035

K3HBP used to run a Knight T-100, HQ-100 and a 10 through 40 vertical. Steve is temporarily QRT, however, as his signals were getting into the MATV system in his apartment building and that's a no-no. However, Steve and family are



Alumni News

Andrew Jobbagy.....	President
Charles Traham.....	Vice-Pres.
John Rote.....	Vice-Pres.
William Simms.....	Vice-Pres.
Andrew Perry.....	Vice-Pres.
T. F. Nolan.....	Exec. Sec.

DETROIT CHAIRMAN ENROLLS IN COLOR COURSE

The first meeting this year was a huge success. *Jim Kelley*, the Detroit Chapter Chairman, has signed up for the NRI Color Course. He brought the color TV chassis to the meeting and showed the members some of the experiments which he has completed in the course so far. The Chapter expects to continue these experiments with Jim's TV chassis.

John Korpalski brought in an oscilloscope to be checked out. Most everyone took a hand in examining that piece of equipment.

There were four visitors for the meeting: *Carl Ceruti*, *Mike Hooper*, *Mike Lawrence*, and *John Gary*, who by the way has completed the NRI Color

Course. We certainly do welcome students who pay us a visit!

FLINT-SAGINAW CHAPTER ELECTS NEW OFFICERS

New officers were elected at the January meeting of the Flint-Saginaw Chapter. They are: Chairman, *Stephen J. Avetta*; Vice-Chairman, *D. Olney White*; Secretary, *William P. Salerno*; Treasurer, *George Rashead*; and Good-Will Ambassador, *Joe Washington*. Also elected are: Sergeant-at-Arms, *Gilbert Harris*; Entertainment, *George Maker*; Educational Director, *Harry Hubbard*; Photographer, *LeRoy Cockrell*; Membership Committee, *Clyde Morrissette* and *George Martin*. Chairman *Stephen J. Avetta's* address is G2026 Gerard St., Flint, MI 48507. His telephone number is 239-0461. At the

same meeting, a new school of diagnostic testing was started. Waveforms and the use of new kinds of meters, including digital, were shown.

Wendel McKeown and *Larry McMaster*, two new members, traveled 80 miles in a snowstorm of no small dimension to attend the meeting.

General troubleshooting was the order of the day at our second session of the school, held during a February meeting. Testing of yokes, beam benders, and ion traps was discussed in detail.

At the second February meeting, *Steve Avetta* gave a diagnostic lecture on capacitors. Also, some of the members constructed the first transistor curve tracer, with the rest of the members checking it over. Later each member will make one for his own use.

Our following meetings will include more of the diagnostic checking, which we feel is very valuable to the membership.

NEW YORK CHAPTER HAS TRANSISTOR LECTURE

At the January meeting, *Pete Carter* continued his discussion on compact stereos. He also showed us how to check a transistor that is interlocked in a circuit with other transistors. On the same diagram, *S. Gross* showed how he found two capacitors that were bad instead of the ones that were suspected.

Chairman, *Sam Antman*, read a letter dated November 15, 1971 from *Joe Bradley*, wishing us a very good season. Joe also wrote that he is working for the telephone company and a university in Frankfort, Germany.

Robert McFeeley, a guest for the first time, was introduced. He is an NRI student.

Willie Foggie brought his B&K analyzer. With the help of *Jim Eddy*, he repaired a television receiver right on the spot.



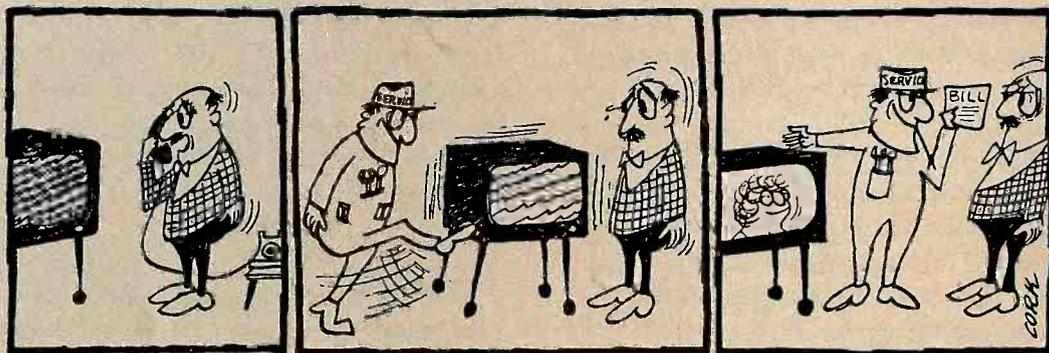
Some of the Flint-Saginaw Chapter members at their newly begun diagnostic clinics.

At the next meeting, *Lionel Williams* gave a lecture and chalk-talk on the new electronic tuner. A little history was given concerning the varactor tuner, as it is called, that RCA and Sylvania now have on the market. It is a little expensive at the present time and is not used in all sets.

Willie Foggie will be the speaker at the next meeting.

TV ANTENNAS SUBJECT FOR SAN ANTONIO CHAPTER

J. C. Jones, Manager of Electrotex, one of San Antonio's leading electronic wholesale suppliers, gave an outstanding lecture on TV antennas, their theory, and application. The presentation was so good that it lasted until 11 p.m. and Mr. Jones didn't completely cover the subject *then!* Our May speaker, he will try to complete the discussion at that time.



NORTH JERSEY CHAPTER CONTINUES GOOD PROGRAMS

Vice-Chairman *Franklin Lucas* gave a lecture and demonstration using a radio transistor demonstration board at the January meeting. The question and answer period was so active that it will be continued at later meetings.

Due to bad weather and low attendance at the February meeting, the normal program was not held, but again *Franklin Lucas* saved the day by continuing his lectures on troubleshooting transistors.

Alfred C. Mould, an NRI student formerly of Rochester, New York, was welcomed as a guest of the Chapter that evening. *Mr. Mould* is presently residing in Kearney, New Jersey.

A new member was welcomed at this meeting. He is *Henry G. Prince*, 418 Scotty, San Antonio, Texas 78227. Welcome to our Chapter, Henry!

Seventy per cent of the members attended, which indicates that the San Antonio Chapter is really on the ball!

PHILADELPHIA CHAPTER ENROLLS NEW MEMBERS

Philadelphia Chapter members welcomed *Henry Kilian* as a new member at the January meeting. His address is 308 19th Street, Burlington, N.J. 08016. Another new member, *Sam Louie* of 439 West Somerset Street, Philadelphia, PA 19132, was approved at the February meeting.

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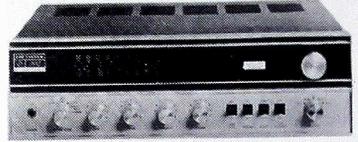
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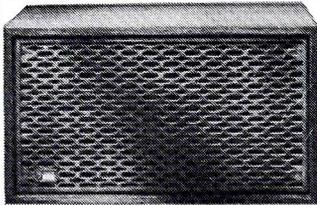
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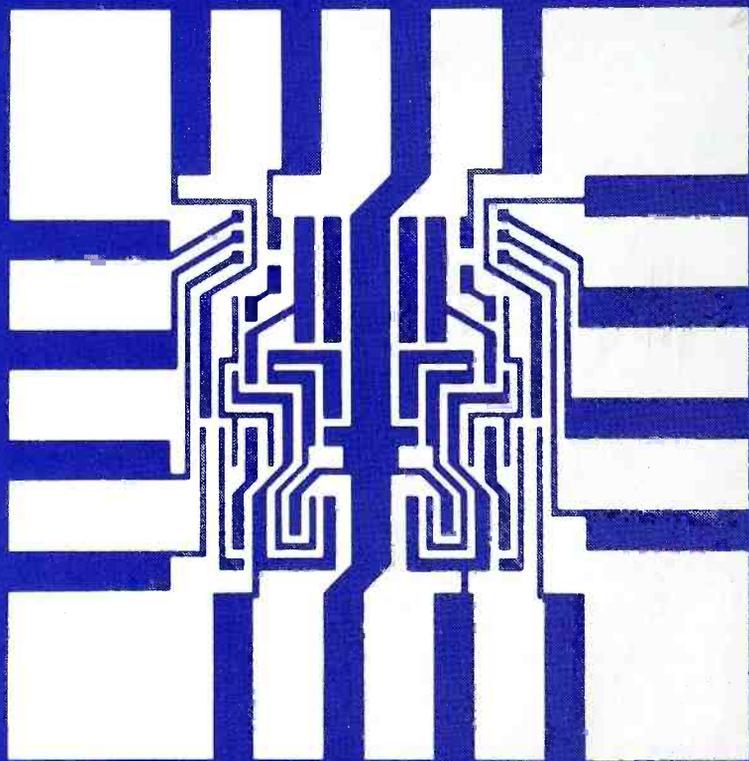
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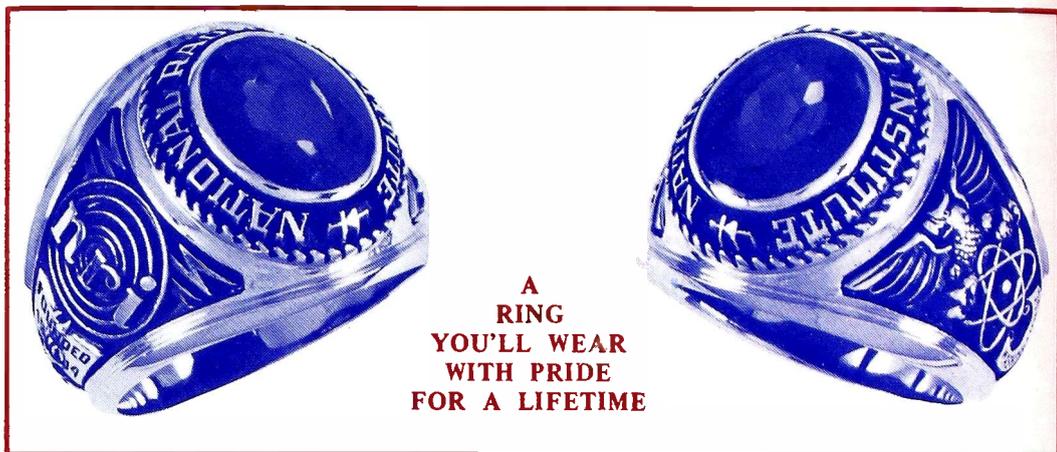


journal

July/August 1972



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July/August 1972
Volume 29, No. 4

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Cover Illustration: An integrated circuit used in a digital computer. Courtesy of Champion Papers.

AUTOMATIC FINE TUNING

By James Lytle

Jim Lytle, a technical editor on the NRI staff, has been with the company since March, 1970. He has written and edited lessons in Communications and Servicing. Presently, Jim is working on a new training kit for the Color Television Servicing course.

Before coming to NRI, Jim wrote system level technical manuals for naval surface missile installations and operating and test procedures for electronics equipment used at manned spaceflight network tracking stations. He also served as technical consultant to station personnel during manned missions.

With the blessing of all lazy people (and I hasten to include myself among them) more and more of the things we use every day are being made automatic — things like toothbrushes, can openers, transmissions, etc. — and life is made a little easier.

With the blessing of all TV viewers, more and more automatic features are being built into the color TV sets being produced nowadays. To name just a few of the “automatics” available, we have: automatic fine tuning, automatic degaussing, automatic tint control, automatic color control, automatic gain control and automatic intensity control. All are designed for increased viewing pleasure. For those of us who spend our working (or leisure) hours poking around the inside of a malfunctioning TV set, however, these automatics can be a source of something far removed from pleasure. In this article we’ll take a look

at one of the most popular automatic circuit features of present day color sets — *automatic fine tuning*.

You’re all familiar with the “squiggly” line pattern produced in a color TV picture when the fine tuning is mis-adjusted. If, in an attempt to correct this condition, you turn the control too far, you lose the color altogether. The correct setting of the fine tuning control obviously lies somewhere between these two extremes. Finding that setting complicates the whole business of TV watching. Furthermore, since oscillators of the type found in TV tuners are not famous for their long-term stability, the need to fine tune is a recurring one.

The purpose of automatic fine tuning is to perform the fine tuning operation continuously and automatically. It does this by electronically controlling the frequency of the tuner local oscillator to

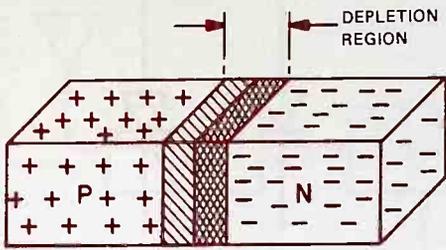


Figure 2. A PN junction showing the depletion region.

ENTER THE VARACTOR DIODE

The varactor diode, sometimes called a voltage-variable capacitance diode or vari-cap, is the solid-state equivalent of a conventional capacitor. This solid-state device also has the unique characteristic of undergoing a capacitance change with a change in applied bias voltage. To see how this device works, refer to Fig.2.

In Fig.2 we see the semiconductor structure which makes up an ordinary diode. As you'll recall, the current carriers in N-type semiconductor material are free electrons, and the current carriers in P-type semiconductor material are holes. In the vicinity of a PN junction, some of the free electrons in the N-type material move across the junction to fill holes in the P-type material. This movement results in an area, centered about the PN junction, where no free current carriers exist. This area, called the *depletion region*, has the characteristics of an insulator.

Since those portions of the device outside the depletion region still contain their free current carriers, they retain their characteristics as conductors. What we

have, then, is two conductors separated by an insulator, which just happens to describe a circuit component called a capacitor. All PN junctions have some capacitance, and in most cases this is a nuisance. In the case of a varactor diode, however, this capacitance is the most important characteristic of the device.

We know that the value of a capacitor is dependent upon, among other things, the distance between the plates. Increasing this distance decreases capacitance and vice versa. Referring to Fig.3A you can see that we have applied a small reverse bias to our PN junction. The result is that

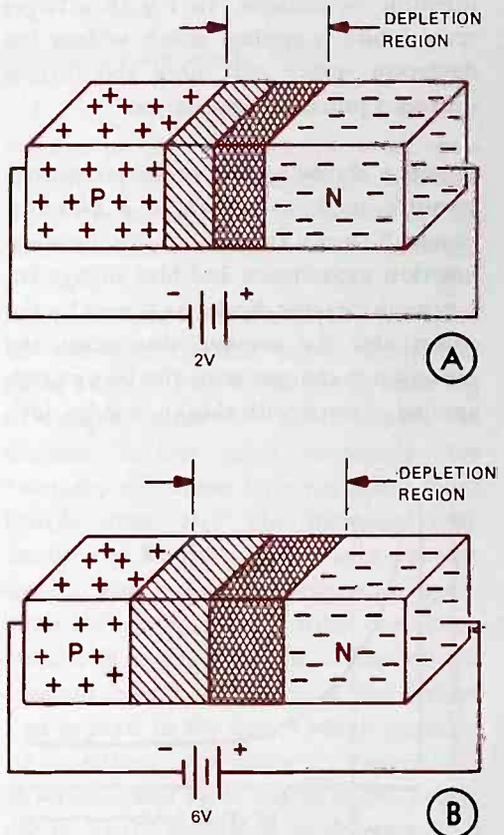


Figure 3. PN junctions showing the effect of reverse bias on the width of the depletion region.

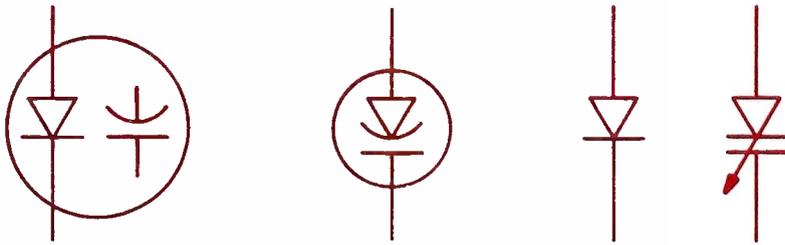


Figure 4. Several of the schematic symbols used to designate varactor diodes.

the current carriers in the P-type and N-type materials are drawn away from the junction, effectively widening the depletion region. This means a greater distance between the plates and decreased junction capacitance. In Fig.3B a larger reverse bias is applied which widens the depletion region still more and further decreases junction capacitance.

Figure 4 shows several of the schematic symbols used to designate a varactor. Figure 5 shows the relationship between junction capacitance and bias voltage for a typical varactor diode. As shown by the curve, and the previous discussion, the capacitance changes with the bias voltage applied. Armed with this knowledge, let's

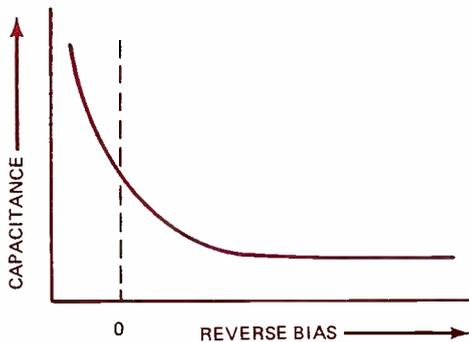


Figure 5. Graph showing the relationship between junction capacitance and bias voltage in a typical varactor diode.

see how the varactor is used in a practical AFT system.

A PRACTICAL AFT SYSTEM

The setup shown in Fig.6 overcomes the disadvantage of the motor driven system previously discussed. Here we have replaced the tuning capacitor in the local oscillator tank with a varactor diode and we have done away with the motor altogether. We can now apply the dc output of the discriminator directly to the varactor in the tank circuit. Capacitors C_1 and C_2 isolate the correction voltage from the local oscillator circuit. As before, any change in local oscillator frequency will cause a corresponding change* in the picture i-f carrier frequency. This change will then cause the discriminator to produce an output which, when applied across the varactor diode, causes a capacitance change in the local oscillator tank to bring the oscillator back on the correct frequency. Unlike the motorized circuit, no minimum discriminator output voltage is necessary to bring about a capacitance change in the varactor. This all-electronic circuit is capable of almost exact frequency control of the tuner local oscillator. It illustrates the principle of operation of all AFT circuits in use today.

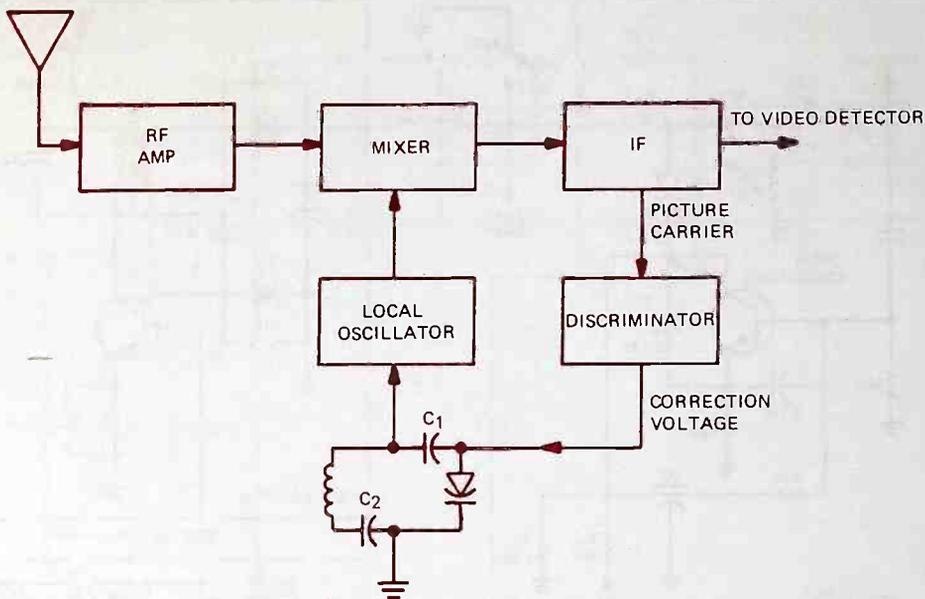


Figure 6. A practical AFT system using a varactor diode.

SOME CIRCUITS

Figure 7 is a complete schematic diagram of an AFT circuit. The i-f signal at the collector of the third video i-f amplifier is coupled into the discriminator circuit through a 1 pf capacitor. Coupling through a small value capacitor like this prevents the discriminator from loading the i-f amplifier and thereby keeps it from affecting the i-f response curve.

When the input to the discriminator is exactly 45.75 MHz, the circuit is balanced and the average conduction of diodes D_1 and D_2 is equal. Equal diode conduction results in zero voltage developed across C_3 and no correction signal from the discriminator. The zero volt output of the discriminator is applied to the anode of the varactor, as shown in the figure. Notice that the cathode of the varactor is connected into a voltage divider made up of R_1 and R_2 . The

voltage at the junction of these two resistors is 14 volts positive; therefore, when this set is correctly fine tuned, a 14 volt reverse bias exists across the varactor.

Any deviation from the 45.75 MHz value of the discriminator input signal will cause an imbalance in the circuit resulting in unequal conduction of the diodes. An increase in the input frequency, for example, will cause D_1 to conduct more heavily than D_2 . The increased conduction of D_1 develops a positive charge on C_3 and a positive correction signal from the circuit. The positive correction voltage is applied to the anode of the varactor where it decreases the reverse bias applied to the device which increases its capacitance. Increasing the capacitance in an oscillator tank, as you know, causes the oscillator frequency to decrease. This decrease is exactly the effect we need to restore the picture i-f carrier to its 45.75 MHz value.

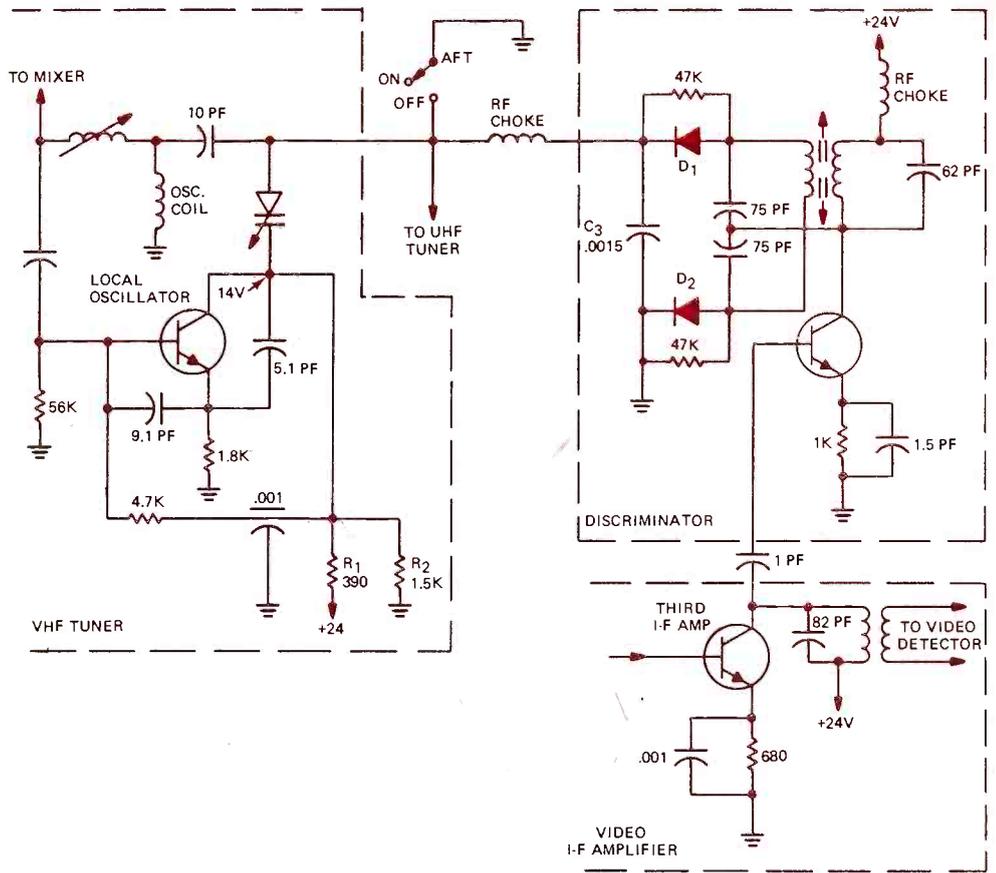


Figure 7. Schematic diagram of a complete AFT circuit.

If the local oscillator frequency decreases and causes the picture i-f carrier to go below 45.75 MHz, then D_2 conducts more heavily than D_1 and a negative correction voltage is generated by the discriminator. The negative correction voltage increases the reverse bias on the varactor, decreasing its capacitance and increasing local oscillator frequency.

When the AFT on-off switch is placed in the off position, the output of the discriminator is grounded and remains at zero volts regardless of changes in the picture i-f frequency. Thus the capacitance of the varactor remains fixed and

the local oscillator is free to drift or to be fine tuned manually.

The discriminator circuit shown in Fig.8 is a little different from the one in Fig.7. This circuit generates a differential correction voltage across its two output terminals in response to a deviation in the picture i-f carrier frequency. In use, the outputs of this kind of discriminator are either connected across the varactor or are connected in series with a bias voltage supplied to the varactor. In either case, its action in controlling local oscillator frequency is the same as previously described. The AFT defeat switch on the

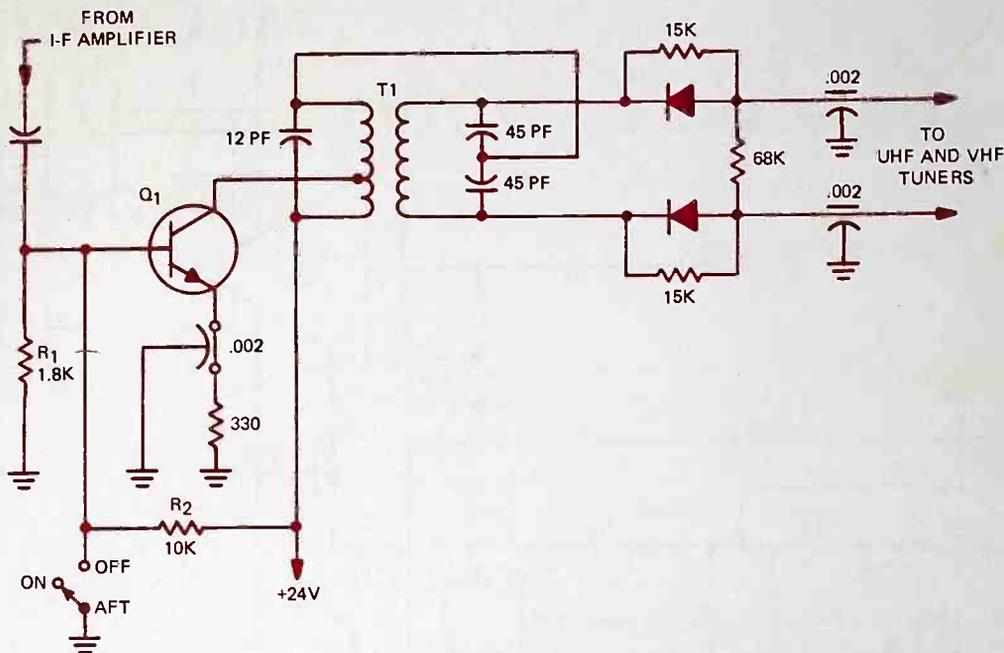


Figure 8. Discriminator circuit with a differential output.

circuit in Fig.8 disables the circuit by removing forward bias from transistor Q_1 . With this transistor cut off, no signal can reach the discriminator transformer (T_1) and the differential output voltage remains at zero.

Just as transistors have gradually replaced tubes in various circuits of TV models produced in recent years, the integrated circuit now challenges, or has already replaced, transistors in many circuit areas. Though still in the minority, some of the more recent sets use an IC in the AFT system. Such a system, shown in Fig.9, is functionally no different than the ones we've already examined. The picture i-f carrier is still supplied to the input of the monitoring circuit, which in this case is the AFT IC. The output of the IC is a differential correction voltage which is applied to the voltage-variable capacitance (VVC) element in the tuners.

Notice that the base-collector junction of a transistor is used as the VVC in the VHF tuner shown in Fig.9. This comes as no great surprise since we know that the base and collector of a transistor form a PN junction just as surely as do the P-type and N-type regions of a varactor.

The AFT defeat switch for the circuit of Fig.9 short-circuits the differential output of the IC when placed in the off position. With the switch in this position, as with previous circuits, the capacitance of the VVC remains fixed despite changes in the picture i-f carrier caused by manual fine tuning or oscillator drift.

In closing, we should mention that all of the AFT systems described work with both the VHF and UHF tuners. Operation of the system with the UHF tuner is the same as with the VHF with just one minor exception. Many of the sets which

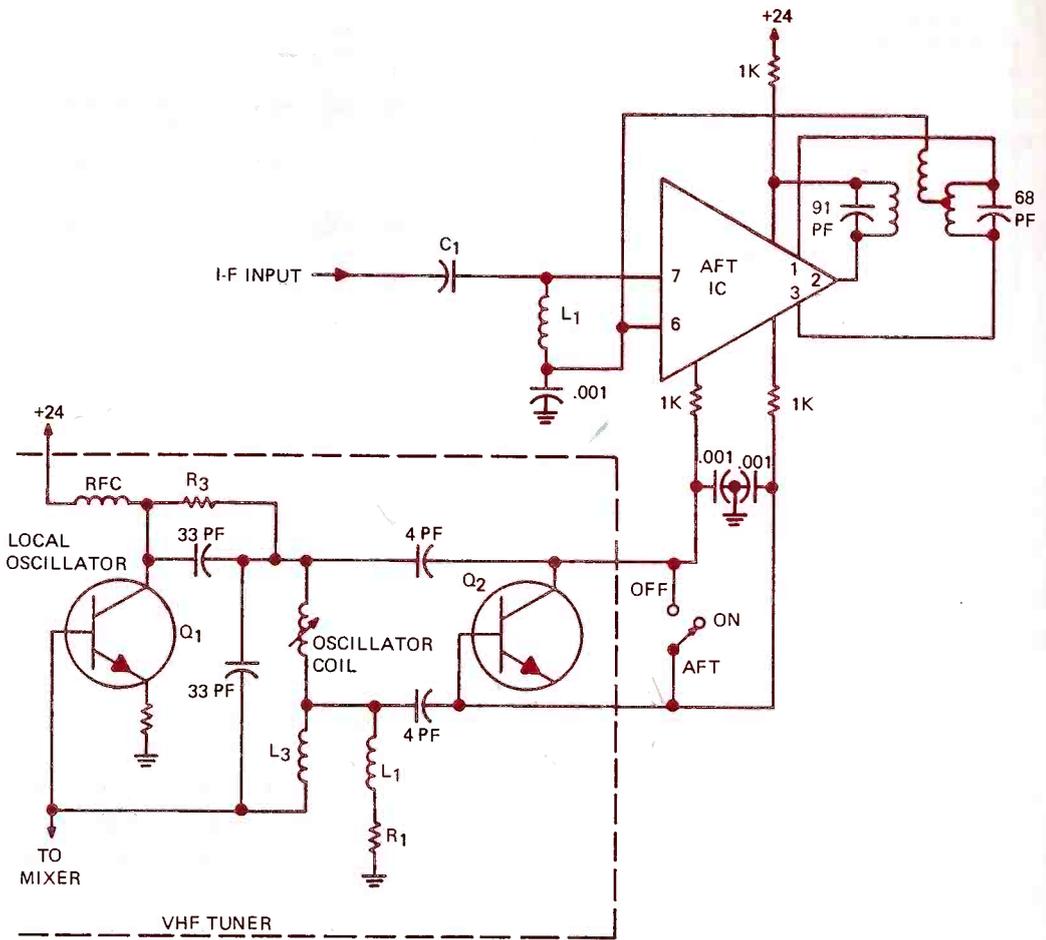


Figure 9. An integrated circuit automatic fine tuning system. A transistor is utilized as a voltage variable capacitance in the local oscillator circuit.

use a discriminator with a differential output use only one of the outputs for UHF fine tuning control.

Some recently developed tuners use varactor diodes in the rf and mixer tuned

circuits as well as in the oscillator tank. This design feature gives them the capability of being tuned through all of the TV channels electronically. We will discuss these tuners in detail in a future article.

Dear Students and Graduates: So that we might serve you faster and more efficiently, please remember to include your student number on all correspondence that you send to us. This would include lessons, payments, questions, requests, etc. **Thank you.**

For Our NRI Automotive Servicing Students

By Edward D. Cochran

Ed Cochran has been a technical editor for the National Radio Institute since February, 1970. As project leader for the new automotive course, it has been his job to see that the training materials are as clear and explicit as possible.

Ed's been interested in cars all his life, and as a boy listened in on the shop talk of many top mechanics. His aim today is to make certain your lessons give you the same kind of person-to-person instruction. Before joining NRI, Ed served on the staff of the Director of Naval Communications, wrote and edited technical manuals, and edited engineering technical plans. Presently, Ed is a member of the Society of Automotive Engineers.

First, I want to welcome our NRI Automotive Servicing students to our thousands of readers of the NRI Journal. I sincerely hope you find the Journal interesting and informative. The NRI Journal is published bimonthly and distributed to NRI students and alumni.

An article in a recent issue of the Journal traced the history of NRI to its present position as part of the McGraw-Hill Continuing Education Company (CEC) with headquarters in Washington, D.C. The Continuing Education Company is a union of the National Radio Institute (NRI) and Capitol Radio Engineering Institute (CREI), both leading and highly respected home study schools in the field of electronics.

One of the prime objectives of the new McGraw-Hill Continuing Education Company was to expand the many courses offered to fields other than electronics. The first of these new courses was the NRI Automotive Servicing course. The new course presented two options for the student. He could enroll in the shorter training program in "Automotive Tune-up and Electrical Systems" or he could study the longer course for training as a "Master Automotive Technician." Our goal in the preparation of these courses was to make sure that our students got the best, most comprehensive and up-to-date home training program in automotive servicing in the world. We are confident that we have succeeded,

The lessons are written clearly in a manner easily understood by the novice who is just becoming interested in cars, yet they still contain the technical information needed by the master mechanic. The courses can benefit people from all walks of life who enjoy the satisfaction of accomplishing something with their own hands. This includes the hobbyist who does his own car maintenance on the weekends for enjoyment and to save money. And, you would be surprised at the number of women who have enrolled, and are making exceptional grades. Ages of our students range from 16 to 68 years.

For those students who intend to make automotive servicing a career, the Master Technician course will prepare them to pass the written test for any certification program now in use. For those who want to go into business for themselves, the course contains some tips (and the pitfalls) of starting a new small business. As we stated earlier, these courses are comprehensive and up-to-date and should satisfy the training needs of anyone interested in any area of automotive servicing.

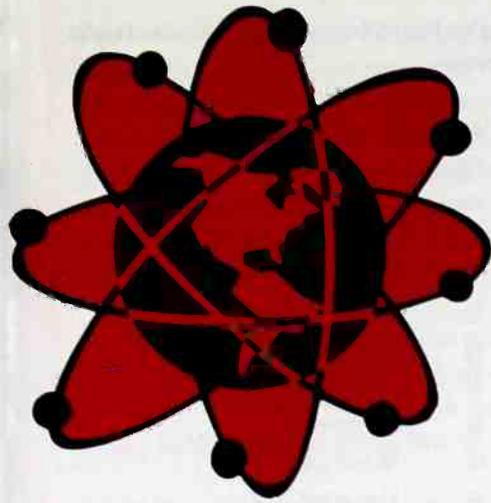
Future automotive articles in the NRI Journal will include new developments in the field, service tips, discussions of new innovations that continually come out of Detroit, and any other information of interest to the automotive enthusiast. We will also discuss the legislation concerning emission control and safety laws, and the manufacturer's solutions to these laws.

The continuation of this series of articles in the NRI Journal will depend entirely on the reader's interest. I will be personally interested in your comments and suggestions for subjects for future articles.

Please do not expect an individual response to your comments or suggestions. But, rest assured that all comments and/or suggestions will be given careful consideration and will determine the path this series will follow in the future. Address your comments to:

E. D. Cochran
NRI Automotive Training
3939 Wisconsin Avenue N.W.
Washington, D.C. 20016

HAM NEWS



By Ted Beach K4MKX

Well, now that good weather is here at last, I've been thinking about getting outside to put up a really good antenna to see if I can make a go of the QRPP scene. However, the more I think of climbing around in trees, erecting towers, etc., the less enthusiastic I get. Especially at my age. The YML and harmonics here wouldn't be much help because none of them really understand "why daddy plays with all that electronic stuff" anyway. Besides, our yard is in such a mess that I'm afraid if I don't give it a little attention this summer the neighbors will call the civil authorities. Not to mention what they would think if I started stringing wire and cable all over the place.

Anyway, it looks as if the Ranger and SX100 will gather another layer of dust and I'll have to content myself with local ragchews on 40 with the little Ten-Tec some more. Unless... anyone heard of 2 meter fm? I, like anyone who reads the amateur magazines, have recently become aware of a tremendous interest in VHF. However, reading some of the articles is like reading a foreign language — repeaters, pre-prog, 94/94, mobile/base, simplex and who knows what all.

At any rate, I have decided that I shall not remain ignorant. At least as far as VHF is concerned. My plan of attack is to get my hands on any and all literature that I can on this subject and *study*. I have learned quite a bit already and fully expect that by the end of the summer I'll be throwing the VHF jargon around with the best of them. I may also become an appliance operator and buy one of those neat transistorized rigs I see advertised all the time. Or I might try to convert some commercial surplus gear or brew my own (not likely this year because I'm always BUSY!). At any rate, I fully expect to broaden my knowledge of our own amateur interest by studying this subject. Will keep you informed of the progress.



Alumni News

Andrew Jobbagy.....	President
Charles Traham.....	Vice-Pres.
John Rote.....	Vice-Pres.
William Simms.....	Vice-Pres.
Andrew Perry.....	Vice-Pres.
T. F. Nolan.....	Exec. Sec.

DETROIT CHAIRMAN ENROLLS IN COLOR COURSE

The first meeting this year was a huge success. *Jim Kelley*, the Detroit Chapter Chairman, has signed up for the NRI Color Course. He brought the color TV chassis to the meeting and showed the members some of the experiments which he has completed in the course so far. The Chapter expects to continue these experiments with Jim's TV chassis.

John Korpalski brought in an oscilloscope to be checked out. Most everyone took a hand in examining that piece of equipment.

There were four visitors for the meeting: *Carl Ceruti*, *Mike Hooper*, *Mike Lawrence*, and *John Gary*, who by the way has completed the NRI Color

Course. We certainly do welcome students who pay us a visit!

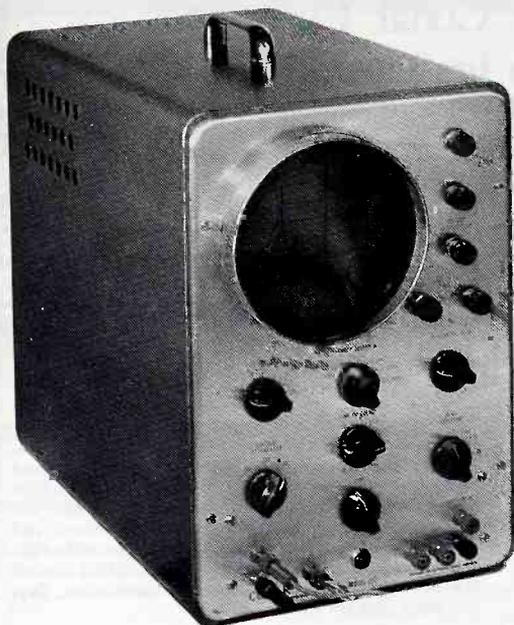
FLINT-SAGINAW CHAPTER ELECTS NEW OFFICERS

New officers were elected at the January meeting of the Flint-Saginaw Chapter. They are: Chairman, *Stephen J. Avetta*; Vice-Chairman, *D. Olney White*; Secretary, *William P. Salerno*; Treasurer, *George Rashead*; and Good-Will Ambassador, *Joe Washington*. Also elected are: Sergeant-at-Arms, *Gilbert Harris*; Entertainment, *George Maker*; Educational Director, *Harry Hubbard*; Photographer, *LeRoy Cockrell*; Membership Committee, *Clyde Morrissette* and *George Martin*. Chairman *Stephen J. Avetta's* address is G2026 Gerard St., Flint, MI 48507. His telephone number is 239-0461. At the

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		Catalog price	Student price
WIRED	250WT	\$139.50	\$129.75
	250PB	17.70	17.70
	GL472	4.95	FREE
		<u>\$162.15</u>	<u>\$147.75</u>

ADVANCED DESIGN · NEWEST CIRCUITRY · EXCLUSIVE FEATURES

Advanced design, newest circuitry, exclusive features—a truly professional oscilloscope for laboratory or service shop. The Model 250 is ideally suited for color and monochrome TV, AM-FM and transistor radios, hi-fi and stereo amplifiers, plus numerous industrial electronic applications.

Note these CONAR Model 250 features:

- Uses 2400 volts on the cathode ray tube—50% more than most scopes. Trace remains, clear, distinct, bright, with increase in sweep frequency or vertical-horizontal expansion. Forget about darkening room to observe traces on your Model 250 screen!

- Vertical gain control is calibrated for direct reading of peak-to-peak voltages. Simply multiply vertical gain control setting by attenuator setting by trace height for quick, accurate peak-to-peak readings. No need to remember special formulas or "feed-in" calibrating signals.

- New improved scope circuitry gives excellent linearity at low frequencies without limiting the production of frequency sweep signals.

- Two stage retrace blanking amplifier gives 100% retrace blanking at all frequencies produced by the scope sweep generator. Retrace lines will not confuse the display at high sweep frequencies.

- Accurately measures ripple output of power supplies; checks auto radio vibrators dynamically.

- Intensity and focus controls use special insulated high voltage potentiometers to eliminate leakage and shock hazards.

- Has push-pull outputs balanced by separate phase splitter tubes in both horizontal and vertical amplifiers.

- Built-in flyback checker gives rapid, in-circuit testing of flybacks, transformers, yokes, coils, loopsticks. Eliminates need for a separate flyback tester costing from \$40 to \$70.

- Sweep range—10 cps to 500 kc—five times the range of most other scopes, using special linearity circuit.

The Model 250 can be assembled in less than 15 hours—even by an inexperienced kit builder. Uses only top grade components. Most components are overrated, giving you an extra margin of dependability plus years of trouble-free service. And—there's no trouble finding replacement parts if ever needed. (Of course, we stock a complete inventory of parts, too.)

Step-by-step assembly instructions include big 17" x 22" picture diagrams plus 12 full pages of comprehensive operating instructions with more than 30 illustrations showing waveforms and connecting points.

SPECIFICATIONS

VERTICAL SENSITIVITY: .023 VRMS. VERTICAL FREQ. RESPONSE: Flat 13 cps to 2.5 mc, Down .05 db at 11 cps, Down 1.5 db at 3.58 mc (color burst), Down 3.5 db at 4.5 mc. HORIZONTAL SENSITIVITY: 1.0 VRMS. HORIZONTAL FREQ. RESPONSE: Flat 20 cps to 90 kc, Down .8 db at 12 cps, Down 3 db at 250 kc. RISE TIME: .05 ms. SWEEP FREQUENCY: 10 cps to 500 kc. TUBES: 11 (equivalent of 19 using dual types). PUSH-PULL ON-OFF does not upset other adjustments. CONTROLS: Intensity, Focus, On-Off, Astigmatism, Horiz. Centering, Vert. Centering, Horiz. Gain, Vert. Gain, Sweep Selector, Vert. Attenuator, Fine Frequency, Sync Selector, Sync. CABINET: Heavy gauge steel, baked-on rich blue finish, rubber feet, chrome handle. PANEL: Satin finish aluminum (not painted) with red lettering. BINDING POSTS: 5-way type to accommodate all connectors. DIMENSIONS: 9 3/4" x 13 3/4" x 15 1/2". POWER SUPPLY: 110-120 volts, 60 cycle AC, fused circuit. ACTUAL WEIGHT: 21 lbs.

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CLOSE-OUT SALE



Roll-Around TV Table for your Conar Custom 75 TV (also fits Custom 70)

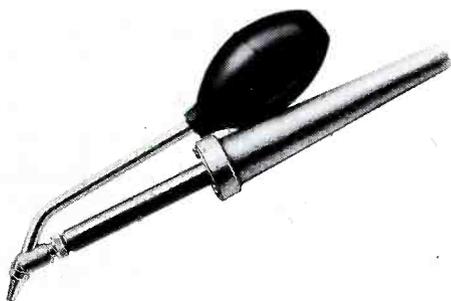
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TREAT YOURSELF TO EASIER SOLDERING

The New

One-hand operation

WELLER Desoldering-Resoldering Tool



Not only removes soldered components, but also re-solders printed circuit boards faster and better than regular resoldering irons. It requires only one hand to operate, leaving the other hand free. Its hollow tip fits over the connection; vacuums all solder for easy removal of the component; leaves terminals and mounting holes clean. Then, it resolders with 360° tip coverage and capillary action of the solder around the component lead for a perfect connection. Pays for itself quickly in time saved.

Stock #40TO **\$10⁹⁵**
Wt. 11 oz.
Parcel Post

SOLDERING AID KIT



BEAU-TECH Soldering Aid Kit includes six hard-chrome plated tools: Printed circuit type reamer and scraper tips, angled reamer and forked tips, straight reamer and forked tips, regular type brush and scraper tips, angled reamer and forked tips, and straight reamer and forked tips. Kit comes in handy plastic case.

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10 oz. Parcel Post

SOLDAPULLT



SOLDAPULLT is the best desoldering tool we've seen yet. This tool incorporates easy handling, swift vacuum action and a self cleaning feature. Soldapullt is loaded by pushing plunger knob down until it latches. Molten solder is drawn into its cylinder instantaneously with a high impulsive vacuum by release of the spring loaded piston.

\$5⁹⁵
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Standard
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\$9⁹⁵
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1. NAME OF ITEM	2. STOCK #	3. HOW MANY?	4. PRICE EACH	5. TOTAL	WEIGHT
"Working with the Oscilloscope" (with order for scope and probes)	GL472	1	4.95	FREE	

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To speed handling, any correspondence should be on separate paper.

All prices are net F.O.B., Wash., D.C.

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Thank you for your order.

Prices in the CONAR catalog and Select-A-Plan time payment privileges apply only to residents of the United States and Canada. Residents of other countries and territories may obtain CONAR products, through SIGMA INTERNATIONAL CORPORATION, our Export Representatives. Address inquires and send orders to: Sigma International Corporation, 13 East 40th Street, New York, N.Y. 10016.

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RETAIL INSTALLMENT CONTRACT & SECURITY AGREEMENT

CONAR SELECT-A-PLAN SELECT YOUR TERMS TO FIT YOUR BUDGET

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STANDARD PLAN—The ANNUAL PERCENTAGE RATE is 17.75%
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IT'S AS EASY AS A - B - C TO OPEN A CONAR ACCOUNT

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

SELECT-A-PLAN SCHEDULE				
PLEASE CHECK ONE: <input type="checkbox"/> STANDARD PLAN <input type="checkbox"/> EXTENDED PLAN				
IF UNPAID BALANCE IS	STANDARD PLAN		EXTENDED PLAN	
	Financial Charge	Monthly Payments	Financial Charge	Monthly Payments
20.01- 25.00	1.05	3.50		
25.01- 30.00	1.50	4.00		
30.01- 35.00	2.05	4.50		
35.01- 40.00	2.65	4.75		
40.01- 50.00	3.00	5.00		
50.01- 60.00	4.15	5.50		
60.01- 70.00	5.50	6.00	6.40	4.50
70.01- 80.00	7.00	6.50	8.00	5.00
80.01- 90.00	8.00	7.75	10.10	5.00
90.01-100.00	9.00	8.75	12.60	5.25
100.01-110.00	10.00	9.75	14.80	5.50
110.01-120.00	11.00	10.75	16.20	6.00
120.01-130.00	12.00	11.75	17.60	6.50
130.01-140.00	13.00	12.75	19.40	7.00
140.01-150.00	14.00	13.75	21.60	7.50
150.01-160.00	15.00	14.75	23.20	8.00
160.01-170.00	16.00	15.75	24.80	8.50
170.01-180.00	17.00	16.75	26.20	9.00
180.01-200.00	18.00	17.00	27.90	10.00
200.01-220.00	20.00	18.50	29.80	11.00
220.01-240.00	22.00	20.00	32.40	12.00
240.01-260.00	24.00	22.00	35.20	13.00
260.01-280.00	26.00	24.00	38.20	14.50
280.01-300.00	30.00	24.50	41.20	15.50
300.01-320.00	32.00	25.50	44.20	17.00
320.01-340.00	35.00	27.00	47.80	18.00
340.01-370.00	38.00	28.00	52.40	18.50
370.01-400.00	42.00	29.50	57.20	20.00
400.01-430.00	46.00	31.50	62.20	21.00
430.01-460.00	49.50	34.00	69.00	22.00

ON ORDERS OVER \$460.00 THE FINANCIAL CHARGE ON THE EXTENDED PLAN WILL BE 15% AND PAYMENTS WILL BE IN PROPORTION TO AMOUNTS SHOWN ON ABOVE SCHEDULE.

WHERE DO YOU LIVE?

PRINT FULL NAME Age

HOME ADDRESS CITY STATE ZIP CODE

HOME PHONE HOW LONG AT THIS ADDRESS

() OWN HOME () RENT RENT OR MORTGAGE PAYMENTS \$..... PER. MO.

WIFE'S NAME MARITAL STATUS () MARRIED () SINGLE

PREVIOUS ADDRESS HOW LONG?

WHERE DO YOU WORK?

YOUR EMPLOYER POSITION

EMPLOYER'S ADDRESS MONTHLY INCOME \$.....

Street City State HOW MANY YEARS ON PRESENT JOB?

PREVIOUS EMPLOYER HOW LONG?

Name Address

WIFE'S EMPLOYER MONTHLY INCOME \$.....

Name Address

WHERE DO YOU TRADE?

BANK ACCOUNT WITH () CHECKING

Street City State () SAVINGS

CREDIT ACCOUNT WITH () LOAN

Street City State

CREDIT ACCOUNT WITH TOTAL OF ALL MONTHLY PAYMENTS INCLUDING CAR \$.....

Street City State

New IC Voltage Regulator For Consumer Products

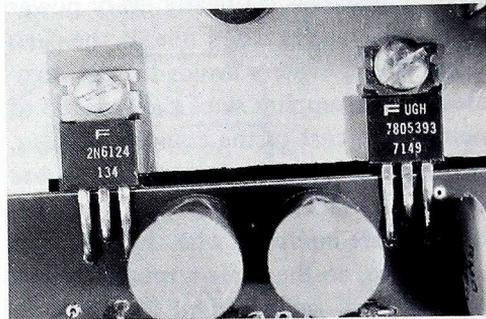
By
Harold J. Turner, Jr.

One of the fastest-changing areas in consumer electronics is that of power supplies. No longer do you see the huge filter chokes and capacitors of old. Solid-state filters and regulators are here to stay.

In the following pages you will read about a brand new device which will soon begin appearing in many different types of electronic equipment. This new device is called a *three-terminal voltage regulator*.

WHAT IS A THREE-TERMINAL VOLTAGE REGULATOR?

Just as its name says, a three-terminal voltage regulator is a voltage regulator with only three terminal connections: input, output, and common (ground). This device is revolutionary because, in a single low-cost package, it provides the dual functions of regulation and ripple filtering that have traditionally been accomplished by fairly complex networks of much larger and more expensive components. A three-terminal regulator is a subsystem in itself; that is, it accomplishes a specific function, namely regulation and filtering, without the aid of any other external parts.



Can you tell them apart? The "transistor" on the right is really a three-terminal regulator.

For several years a 5-volt, three-terminal regulator has been available. This device has met with widespread acceptance in the industrial electronics and computer fields. However, 5-volt supply lines are not commonplace in consumer electronic equipment, which is why most of us have not been exposed to the three-terminal regulator until now.

Late last year Fairchild Semiconductor announced its 7800 series of three-terminal voltage regulators. Each member of this family of voltage regulators provides the functions of regulation and filtering, but each is designed to deliver a specific output voltage. The 7800 series regulators are designed for output voltages of 5, 6, 8, 12, 15, 18, and 24 volts. The output voltage of a given type is designated by its type number; the 5-volt member of the family is the 7805, 6 volts is provided by the 7806, and so on up through the 7824.

NRI HONORS PROGRAM AWARDS

For outstanding grades throughout their NRI courses of study, the following March and April graduates were given Certificates of Distinction along with their NRI Electronics Diplomas.

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Robert F. Dorer, Montrose, NY
John F. Golubski, Erie, PA
Richard A. Holmquist, Horicon, WI
Joseph Meeks, Oxon Hill, MD
James R. Piech, Rochester, NY
Richard E. Porter, Clinton, IL
John V. Rudolph, Ridley Park, PA

With High Honors

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Alden L. Antczak, Anoka, MN
Stephen E. Balog, Woodbridge, NJ
Rudolph J. Bednarz, West Warren, MA
Jimmie N. Boozer, Fayetteville, NC
Gary O. Brindamour, Yakima, WA
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