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1DN5	.55	5BR7	1.01	6BC8	1.04	6DJ8	1.21	6U8	.83	12AT7	.76	12DWB	.89	19T8	.85
1G3	.79	5BR8	.83	6BE6	.55	6DK6	.59	6V6GT	.54	12AU6	.51	12DZ6	.62	21EX6	1.49
1J3	.79	5CC8	.81	6BF5	.90	6DN6	1.55	6W4	.61	12AU7	.61	12ED5	.62	25AX4	.70
1K3	.79	5CL8	.76	6BF6	.44	6DG6	1.10	6W6	.71	12AV1	.61	12EG6	.62	25C5	.53
1R5	.77	5CQ8	.84	6BG6	1.70	6DT5	.81	6X4	.41	12AV7	.82	12EK6	.62	25CA5	.59
1S5	.75	5EA8	.80	6BH8	.98	6DT6	.53	6X8	.80	12AX4	.67	12EL6	.50	25CD6	1.52
1T4	.72	5EUB	.80	6BJ6	.65	6DT8	.94	7A8	.68	12AX7	.63	12EZ6	.57	25CU6	1.11
1U5	.65	5J6	.72	6BJ7	.79	6EA8	.79	7AU7	.65	12AY7	1.44	12F8	.66	25DN6	1.42
1X2B	.82	5T8	.86	6BK7	.85	6EB5	.73	7EY6	.75	12AZ7	.86	12FA6	.79	25EH5	.55
2AF4	.96	5U4	.60	6BL7	1.09	6EB8	.94	7Y4	.69	12B4	.68	12FM6	.50	25L6	.57
3AL5	.46	5U8	.84	6BN6	.74	6EM5	.77	8AU8	.90	12BD6	.50	12FR8	.97	25W4	.68
3AU6	.54	5V6	.56	6BQ6	1.12	6EM7	.82	8AW8	.93	12BE6	.53	12FX8	.90	32ET5	.55
3AV6	.42	5X8	.82	6BQ7	1.00	6EU8	.79	8BQ5	.60	12BF6	.60	12GC6	1.06	35C5	.51
3BC5	.63	5Y3	.46	6BU8	.70	6EV5	.75	8C7	.63	12BH7	.77	12J8	.84	35L6	.60
3BN6	.75	6AB4	.46	6BX7	1.11	6EY6	.75	8CN7	.87	12BL6	.56	12K5	.75	35W4	.42
3BU8	.78	6AC7	.96	6BZ6	.55	6FG7	.69	8CS7	.74	12BQ6	1.16	12L6	.73	35Z5	.60
3BY6	.58	6AF4	1.01	6BZ7	1.03	6FV8	.79	8EB8	.94	12BR7	.74	12SF7	.69	36AM3	.36
3BZ6	.56	6AG5	.70	6C4	.45	6FV8	.79	8FQ7	.56	12BV7	.77	12SK7GT	.95	50B5	.69
3CB6	.56	6AH4	.81	6CB6	.55	6GH8	.80	9CL8	.79	12BY7	.77	12SL7	.80	50C5	.53
3C56	.58	6AH6	1.10	6CD6	1.51	6GK5	.61	11CY7	.75	12BZ7	.86	12SN7	.67	50EH5	.55
3DG4	.85	6AK5	.95	6CG7	.61	6GK6	.79	12A4	.60	12CN5	.56	12SQ7GT	.91	50L6	.61
3DK6	.60	6ALS	.47	6CG8	.80	6GN8	.94	12AB5	.60	12CR6	.87	12T7	.62	70L7	.97
3DT6	.54	6AM8	.78	6CL8	.79	6H6	.58	12AC6	.55	12CU5	.58	12V6	.83	117Z3	.85
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3Q4	.63	6AS5	.60	6CN7	.70	6J6	.71	12AE6	.50	12CX6	.54	12X4	.47		
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4BQ7	1.01	6AU4	.85	6CS6	.57	6SA7GT	.99	12AF6	.67	12DL8	.88	18FW6	.49		
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ON OUR COVER



CONAR Model 500, 3-band, high-gain Novice Receiver, left; and Model 400, 25-watt, 3-band Novice Transmitter, right.

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BOOKS

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By Jack Darr

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

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By the Editorial Staff of Tech Press Publications

Lists over 4000 transistor types (many foreign) and gives the important characteristics of each type. This book should be a big help to the technician in finding replacement for obsolete transistor types.

Published by Tech Press Publications, 4552 S. Kedzie Ave., Chicago 32, Ill. 96 pages. Soft cover. \$1.95



AMATEUR RADIO IS NOT ONLY
USEFUL AND EDUCATIONAL - - IT'S FUN

BY WILLIAM F. DUNN

LET'S GET A HAM LICENSE

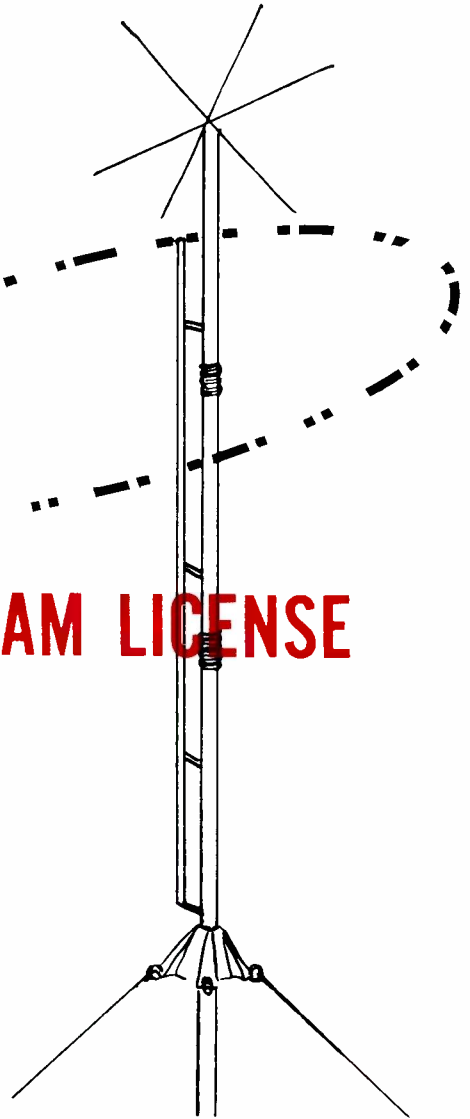
Do you want to have some fun? Do you want to learn more about electronics? You can do both at the same time with amateur radio. Read on and see how easy it is to get a Ham license; this could be the beginning of a most enjoyable undertaking. There are over 250,000 licensed amateurs in the United States; you would be surprised how easy it would be for you to join them.

As a licensed radio amateur you will be able to communicate with over 250,000 licensed amateurs in this country and with amateurs all around the world. Let's go ahead with the story of ham radio.

Amateurs are allowed to transmit on certain frequencies assigned for amateur use. These frequencies are called bands. The most widely used of these bands are:

80 meters	3.5 - 4.0 mc
40 meters	7.0 - 7.3 mc
20 meters	14.0 - 14.35 mc
15 meters	21.0 - 21.45 mc
10 meters	28.0 - 29.7 mc
6 meters	50.0 - 54.0 mc
2 meters	144 - 148 mc

In addition to the bands listed there is one lower frequency band in which limited operation is permitted and many higher frequency bands which are not too widely used but whose popularity is growing.



SIGNAL TRANSMISSION

To get a better understanding of the type of communications possible by amateur radio, here is a brief explanation of the action of radio waves.

There are two basic waves of interest to the amateur, the ground wave and the sky wave. The ground wave travels from the transmitting antenna along the surface of the earth. It does not travel very far before it becomes

so weak that it is no longer usable for communications. The signals from standard broadcast stations that you receive during the daylight hours are ground-wave signals. Amateur communications over distances from about 50 to 100 miles are about all that can be expected consistently by ground wave.

The sky wave is of far more interest to most amateurs. You've heard distant broadcast stations during the hours of darkness on the standard broadcast band. These signals are sky-wave signals. It is by means of these sky waves that world-wide amateur communications are possible.

The sky wave is a signal that travels off into the upper atmosphere and is reflected back to earth by an ionized layer in the upper atmosphere. There are two of these layers that make most amateur communications possible. They are the E layer and the F layer. The E layer is about 75 miles high and the F layer (which may actually consist of two layers during daylight hours) is about 150 miles high.

Now look at Fig. 1 to see how long distance communications are possible. Here we see the two layers above the earth. Under certain conditions signal A, which is from an amateur station operating in the 80-meter band, strikes the E layer and is reflected back to earth at a distance of 200 to 300 miles from the transmitter. At the same time signal B, coming from another transmitter in the same general location and operating in the 20-meter amateur band, penetrates the E layer and travels on to the F layer which reflects it back to earth at a much greater distance from the transmitter. A third signal, C, from a transmitter operating in the 10-meter band penetrates both the E and F layers and travels off into space--it is useless for long distance communications.

Whether or not a radio signal will be reflected back to earth depends on the frequency of the

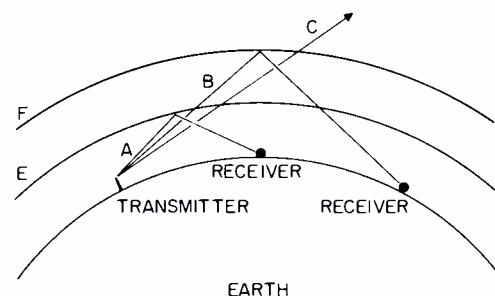


FIG. 1. Illustration of how E and F layers reflect radio signals back to earth.

signal and the degree of ionization of the upper atmosphere. Generally speaking, the higher the degree of ionization, the higher the frequency that will be reflected back to earth. The degree of ionization varies with the season of the year and with an eleven-year sun cycle called sun spots.

During the sun spot maximums reliable world-wide communications are possible on most winter days on frequencies as high as the ten-meter band. In fact on many occasions even the 6-meter band was open for long distance communications.

There is one other thing about the ionosphere you should know; it absorbs some energy from the radio signal. The higher the frequency of the signal the less energy is absorbed. Thus at the high frequencies in the 10- and 15-meter amateur bands the absorption is quite low. Therefore if the F layer is ionized enough to reflect these signals, very strong signals may be received at the receiving location even though the transmitter power may be quite low.

There is one other layer which causes all kinds of interesting communications. This layer is called the Sporadic E layer. It is a very highly ionized layer that occurs sporadically between the E and F layers. This layer appears most often during the summer months and is so highly ionized it often reflects signals as high as TV channels 2-6. Thus long distance communications using the 6- and 10-meter amateur bands are often possible because of Sporadic E ionization when normal communications by the F layer are impossible.

This brief summary of amateur radio transmission is not intended to give you the whole story but rather to arouse your interest. There are many good books for amateurs that go into much more detail on what might be expected from each band. However, the following brief summary may be of interest:

80 and 40 meters - short to medium distances, generally good reliability.

20 and 15 meters - medium to long distances, 20 meters more reliable than 15, but longer distances more likely on 15 than on 20 with low power.

10 meter - very long distances possible with low power when band is open.

6 meters - usually ground wave contacts only except during periods of Sporadic E ionization, then coast-to-coast contacts are possible.

2 meters - local contacts only except when unusual weather conditions may permit contacts of 100 miles or more.

GETTING A LICENSE

Before you can go on the air and begin making contacts with other amateurs, you need to get a license. Licenses are issued by the Federal Communications Commission (FCC), a branch of the federal government. There are four classes of licenses issued, a General Class, Conditional, Technician and Novice Licenses. The easiest license to get is the Novice License.

You might at first shy away from getting a Novice License, thinking perhaps this type of license is just for young boys--but this is not the case. The FCC instituted the Novice License so that those interested in Amateur Radio could get on the air as easily as possible and then learn more about it so they can qualify for the General Class License.

Operation with a Novice License is restricted to four frequency allocations. In the 80-meter band, operation by the Novice Operator is restricted to the band of frequencies from 3.7 to 3.75 mc; in the 40-meter band from 7.15 to 7.2 mc, in the 15-meter band from 21.1 to 21.5 and in the 2-meter band from 145 to 147 mc. In the 80, 40 and 15-meter bands, code (called cw or A1 emission) only is permitted. In the 2-meter band, phone operation is permitted as well as cw operation. The power input to a Novice transmitter is limited to 75 watts and the transmitter must be crystal controlled.

There are a number of excellent books available from the American Radio Relay League (ARRL), which give instructions on how to get a Novice License, so we will not go into detail. However, briefly, to get a Novice License, you must be able to send and receive code at a speed of 5 words per minute. You must also pass a theory test, which can easily be passed after a few hours of study. The Novice test can be administered by any licensed operator holding a General or Conditional Class license and there is no charge for the license.

Perhaps you've thought about getting a license before, but gave up the idea because of the code requirement. This is one of the reasons for the Novice License. It's easy to learn the code and get up to a speed of 5 words a minute. When you have reached this speed you can get your license and get on the air. Once on the air your sending and receiving speeds will soon increase and before long you'll be

able to send and receive fast enough to qualify for a General Class license.

One of the factors that has kept many people interested in amateur radio from getting on the air is the cost of the equipment. While it is true you can spend a lot of money on a transmitter or receiver, you can also get started for surprisingly little. The CONAR Division of NRI has just announced two new kits, the Model 400 Novice Transmitter and the Model 500 Novice Receiver. These two kits are designed to help those interested in amateur radio to give it a try as economically as possible. The cost of the two kits if they are purchased together is only \$64. This price includes a key for the transmitter, a built-in speaker in the receiver, and a copy of the ARRL Manual telling you in detail how to get your license. Both kits are described in detail elsewhere in the Journal; read over their specifications and you'll be sure to agree that they are hard to beat at their price.

AMATEUR COMMUNICATIONS

So what do you do after you get a ham license? There are all kinds of simple antennas you can put up or you can put up a Multiband antenna so you can work several bands with the one antenna. You can make your own following the directions in the ARRL Radio Amateur's Handbook or buy one of the antennas advertised. In either case, the antenna can be put up quite inexpensively.

Once you have your antenna up you're ready for business. Probably at first you won't care whether you contact distant stations or an amateur across the street. Getting on the air--communicating by radio with another amateur is a real thrill. You'll soon get to know many amateurs through contacts with them and make many new friends.

Soon after you've been on the air you'll be looking around for distant stations to contact. On the 80-meter and 40-meter bands there will be many distant stations coming through during the night. It's almost a sure thing that some Friday or Saturday night when you do not have to get up early the next morning for work, that you'll burn the midnight oil trying to work distant stations (or DX as distant stations are called). Coast to coast communications during the night are easy on both bands, in fact contacts across the Atlantic and Pacific Oceans often take place on these bands.

Many amateurs try to make contact with at least one station in each state. This is called Working All States and abbreviates WAS. This is not easy to do because often one of the

states you might think would be easy to work turns out to be quite difficult. This is particularly true of states that are too far to contact on ground wave, but close enough to you that your sky-wave signal skips over it. States like this must be worked when unusual weather conditions produce extended ground wave communications or when very strong ionization of one of the layers in the ionosphere results in a shorter than normal skip.

If you want to try real DX, try 15 meters. On this band world wide communications are possible during daylight hours. Conditions in the 15-meter band are at their best during the winter months. Amateurs in the United States and Canada regularly contact amateurs in Europe, Africa, South America, Asia, Australia and New Zealand. Imagine the thrill some Saturday afternoon of talking to an amateur in New Zealand where it is already Sunday morning.

QSL CARDS

Another pleasant part of amateur radio is exchanging QSL cards. Fig. 2 is my QSL Card. When you contact a station you may wish to exchange these cards. The idea is to have some proof that you really did contact those distant stations you told everyone about. It's sort of like keeping a fisherman honest. As a matter of fact, when you are trying to work all states, you can't really count a state as worked until you have a QSL card from a station in that state to prove it.

Thousands of amateurs have WAS, many have WAS using only one amateur band which can be quite difficult. In fact, in spite of the fact that long distance communications on 6 meters are not supposed to be practical, there are many amateurs who have WAS on 6 meters. I have contacted 36 states on 6 meters without really trying.

Another challenge is to Work All Continents, and get QSL cards from the other amateur to prove it. I've made WAC and to keep me

honest, the cards to prove it are shown in Fig. 3. The toughest contact to make was Japan, the others are relatively easy and can be made almost anytime when conditions are right.

If you've ever considered getting an amateur license, why not go ahead and get it now. You'll find that ham radio is more than a hobby; there are many interesting phases which have not been touched on in this article. One important phase that has not been detailed is the increased technical knowledge you will gain. You cannot become a ham without becoming interested in your transmitter, receiver and antennas. Once the interest is aroused, it will become a pleasure to seek out more information on how they work and how to get them working better.

Amateur Radio is not limited solely to a hobby; amateurs perform many useful services. One example is the large number of messages transmitted to and from servicemen located in distant parts of the world. Many of the servicemen stationed at the South Pole as well as others on remote islands in the Pacific have been able to talk to members of their family at home via amateur Radio.

Amateurs perform valuable emergency services also. When such disasters as the hurricanes that strike the east coast occur, often the only communication with the disaster area is by amateur radio. During the recent earthquake that struck Alaska, most commercial communication between Alaska and the continental United States were out and many first reports of the damage and requests for assistance were handled by amateurs.

There are amateur networks organized to aid civil defense in the event of a national emergency. These networks consist of base stations plus mobile stations installed in automobiles so assistance can be given to authorities wherever it might be needed.

There is also the social side of ham radio. There are many amateur radio clubs - most large cities have several. Amateurs in these clubs meet regularly for technical programs, but also have many social events such as banquets, picnics, etc.

These are but a few of the activities of ham radio operators that might interest you. But before you can participate in them you must take the first step and get your license. If you've been thinking of getting a ham license, why not get started on it now!

Hope to work you on one of the ham bands, 73's.

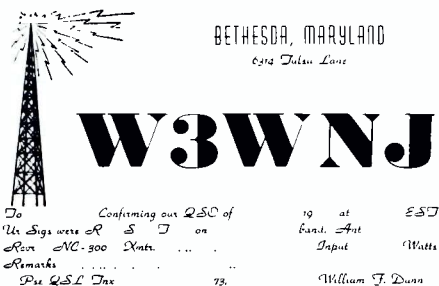


FIG. 2. The author's QSL card.



FIG. 3. QSL cards from all continents.

ADAPTERS FOR AC POWER PANELS

BY ROBERT JONES

Five adapters for AC power panels will greatly increase the convenience and use of this equipment. By mounting a low voltage high current transformer on the chassis with a suitable plug, as in Fig. 1, AC voltage is available for tube heaters, relays and pilot bulbs. Adding a chassis to this (Fig. 2) containing a rectifier and filter, DC voltage becomes available to operate small motors, relays, transistor circuits. It may also be used as a low current battery charger.

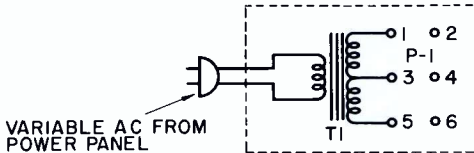


FIG. 1. Low voltage AC supply.

As we see in Fig. 3, the addition of a high voltage low current transformer allows for insulation testing. High voltage DC at low

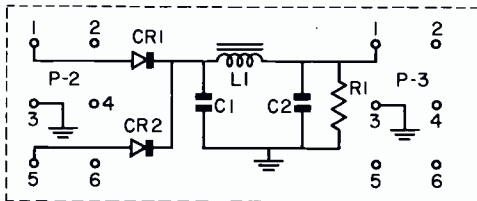


FIG. 2. Full wave rectifier with filter.

current is supplied for voltage substitution in servicing (Fig. 4) and is available for experimental circuits.

In all cases, the adapter in Fig. 5 is used with test clips, to allow each chassis to be connected to the load under test. If mating plugs are used on the chassis, they can be connected

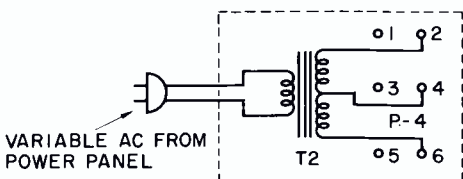


FIG. 3. High voltage supply.

without any troublesome connecting cables between them.

Since the power panel will supply a variable voltage AC, this is utilized in varying the output from each of the adapters just described. Further refinements that could be included in the DC chassis (Figs. 2 and 4), if available, would be a voltmeter and ammeter of appropriate scales.

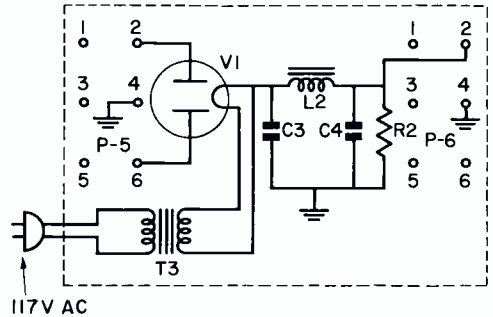


FIG. 4. Basic tube rectifier used to obtain high output voltage with Fig. 3.

PARTS LIST OF TYPICAL COMPONENT VALUES

T1	25.0 volt center tapped 3 ampere
T2	600 volt center tapped 100 milli-ampere
T3	5.0 volt 3 ampere
L1	140 millihenry 3 ampere
L2	10 henry 100 milliamper
C1	100 mfd 50 wvdc
C2	500 mfd 50 wvdc
C3	20 mfd 500 wvdc
C4	20 mfd 500 wvdc
R1	500 ohms 5 watts
R2	50,000 ohms 5 watts
P-1	} Jones s-306-fp or equivalent
P-3	
P-4	
P-6	
P-2	} Jones p-306-fp or equivalent
P-5	
P-7	} Jones p-306-cct or equivalent
V1	5z3, 5u4g, 5t4, 5v4g, 5w4g
CR1	} Sarkes Tarzian 10Lf
CR2	

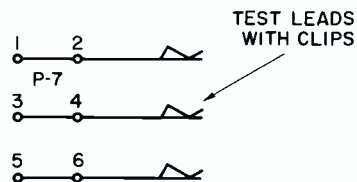


FIG. 5. Test leads to interconnect circuits.

CONAR Model 230 Tuned Signal Tracer

POTENT TROUBLE-SHOOTING TOOL: DIAGNOSES WITH DEFINITE RESULTS

BY J.B. STRAUGHN

The Model 230 is the most potent trouble-shooting tool available to the radio serviceman. With this one instrument you can combine the diagnostic results of CIRCUIT DISTURBANCE testing, STAGE BLOCKING, and SIGNAL INJECTION. Also the results achieved with Signal Tracing are definite and positive and not subject to the sometimes uncertain interpretations of the other basic service methods. Perhaps a better name for the Signal Tracer would be the "Trouble Finder."

THE SIGNAL TRACER

The Model 230 is a calibrated rf-af voltmeter with provisions for listening to the quality of the modulation present on the rf-i-f carrier or the signal in the audio section of a broadcast receiver; it works just as well on the signal in a record or tape player using either tubes or transistors. The instrument is not calibrated in volts as this is not a desired feature. Instead it is calibrated so the relative strength of two signals, taken at the input and output of a stage may be compared. This permits an accurate measurement of stage gain. For example, if the output of a stage is 100 times stronger than the input the stage gain is 100.

TUNED VERSUS UNTUNED SIGNAL TRACERS

Why do we refer to the Model 230 as a tuned signal tracer when other instruments available on the market are just known as signal tracers - aren't all signal tracers basically the same? This is a good question but you should know that there is a vast difference in results between a tuned and an untuned signal tracer when investigating trouble in the rf-i-f section of a radio receiver. The untuned types can pick up and reproduce the modulation on rf-i-f signals but they cannot measure the relative strength of the rf or i-f carrier - in other words they cannot measure the rf or i-f stage gain. Also, any

modulation present on a carrier will be mixed with the desired modulation beyond the possibility of separation. The effect is the same as if a DC voltmeter used to measure the voltage at the input of the power supply filter also responded to and added in the high ripple voltage present at this point. Such a measurement would be worthless.

With a tuned signal tracer you can reject all undesired signals normally present at any point in a receiver and pick up and analyze only the significant signal. For example, in measuring gain in a converter stage you compare the amplitude of the rf signal with that of the i-f signal. The tracer rejects the oscillator signal, the original rf signal and their sum frequency signal which are also present at the output of the mixer. Without question a signal tracer should be of the tuned type.

WHAT YOU CAN DO WITH MODEL 230

With the CONAR 230 you can localize the source of any complaint rapidly and accurately. Once you have pinpointed the defect to a certain stage in the receiver it is a simple matter to find the defective part and make repairs. In service work the replacement of a part is no great feat - it's knowing quickly what part to replace that puts the profits in your pocket.

The signal tracer enables you to sample and examine the signal at various points in a radio set as the signal passes from the antenna through the receiver to the loudspeaker. In using the signal tracer you localize the defective stage when you go from a point of normal signal to a point where the complaint is reproduced by the tracer.

The signal tracer lets you examine the frequency, the quality, and the amplitude of the signal. If the set is dead you can determine where the signal stops. If the complaint is weak reception you can see which stage

causes a loss rather than a gain in the strength of the signal. Undesired audio signals such as hum, noise, distortion, squeals and motorboating can be tracked down rapidly to a stage and often to the defective part. There is nothing as good as a signal tracer for running down intermittents of all types.

If the tracking is poor (set weak at one end of dial) you can see how the i-f frequency produced by the set mixer shifts away from the i-f amplifier frequency as the receiver is tuned over the broadcast band. As a matter of fact many service men prefer and can do an alignment job faster and more accurately with the Model 230 than with a signal generator.

HOW THE INSTRUMENT WORKS

The circuit of the Conar Signal Tracer is shown in Fig. 1. Without going into a detailed description of the circuitry here is a brief rundown on its operation. Stage gain measurements are made with the COARSE and FINE attenuators marked SW1 and R12.

The Coarse Attenuator lets you vary the strength of the signal before it is applied to the amplifier system of the signal tracer. This switch works in steps from 1 (no attenuation) to 10,000. Each step gives a signal one tenth as strong as the preceding step so that the last position is one ten thousandths of the original signal at the cathode follower output.

The Fine Attenuator gives continuous gain control of the amplifier with full gain at a setting of 1, and 1/10 full-gain setting at 10. Both controls are adjusted when making stage gain measurements so the tuning eye just closes. When gain measurements are not being made the attenuators may be set in any position - just as long as the eye does not over close since in this case overloading of the tracer could distort the signal. The cathode follower, in the probe, and both attenuators work on either rf or af signals.

When the function switch is thrown to RF the instrument is a two-band TRF receiver tunable from 170 kc to 1500 kc. The tuning eye monitors the rf signal level at the output of the diode detector (pin 6 of the 6AV6 tube). The signal input of tube V2 is controlled by the coarse attenuator (SW1) and the gain of V2 is controlled by varying its bias by means of R12.

With the function switch set to AF, V2 is changed to an audio amplifier and its output is monitored by the tuning eye, before its

signal is fed through the regular audio amplifier to the loudspeaker.

USING THE MODEL 230 TO CHECK A TUBE RECEIVER

Fig. 2 shows a typical AC-DC receiver of the type serviced by the thousands every day. Let's see how you would go about sampling the signals present in the various stages of an operating receiver. The ground lead of the Signal Tracer always connects to B- which may or may not be the chassis. B- however is always the set side of the On-Off switch, the cathode of the first AF amplifier (V3) and the common negative lead of the electrolytic filter capacitors. If any of these points connects directly to the chassis, clip the Signal Tracer ground lead to the chassis, otherwise clip it to the B- point which is easiest to reach.

With the set turned on and adjusted to bring in a station with normal volume turn on the Signal Tracer, set its Coarse Attenuator to X1 and the AF-RF switch to AF. Touch the probe to the hot side of the set volume control (the junction of R4, R5 and R6) advance the Signal Tracer volume control and adjust the fine attenuator so the audio signal is heard from the Tracer loudspeaker. If the tuning eye overlaps prevent this by adjustment of the attenuators.

Now move the probe to the grid of V3. Since the signal level may be down, here you may have to turn up the Signal Tracer volume control or the receiver volume control to hear the Signal Tracer speaker. Next move the probe to the plate of V3. The increased signal level present will require readjustment of the attenuators. The signal level should remain unchanged at the grid of V4 but at the plate of V4 you may have to switch the Coarse Attenuator to the X10K position to reduce the signal enough to prevent overloading and distortion at the Signal Tracer output.

If one side of the voice coil is connected to B- as shown in Fig. 2, shift the probe to the ungrounded side of the voice coil (otherwise the Signal Tracer ground clip must be attached to one of the voice coil leads. Since the signal amplitude at the voice coil is only a fraction of that at the plate the coarse attenuation must be readjusted. Now as a matter of interest switch the probe to the cathode of V4 (reconnect the Signal Tracer ground to B- if you had to connect it to the voice coil). You have now sampled the signal at the strategic points in the AF section of the receiver.

Before going further it will be interesting to

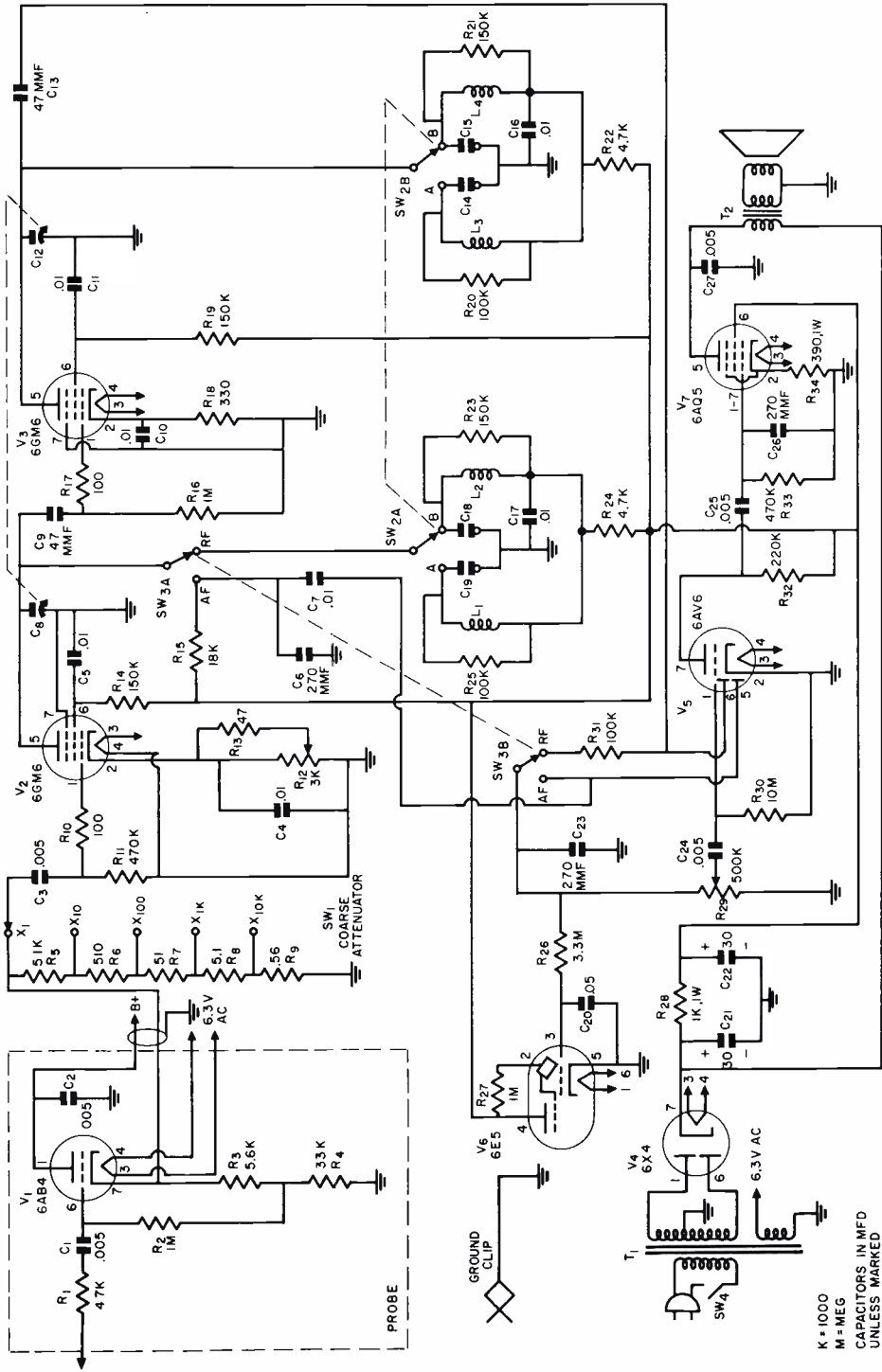


FIG. 1. Schematic of the CONAR Model 230 Signal Tracer.

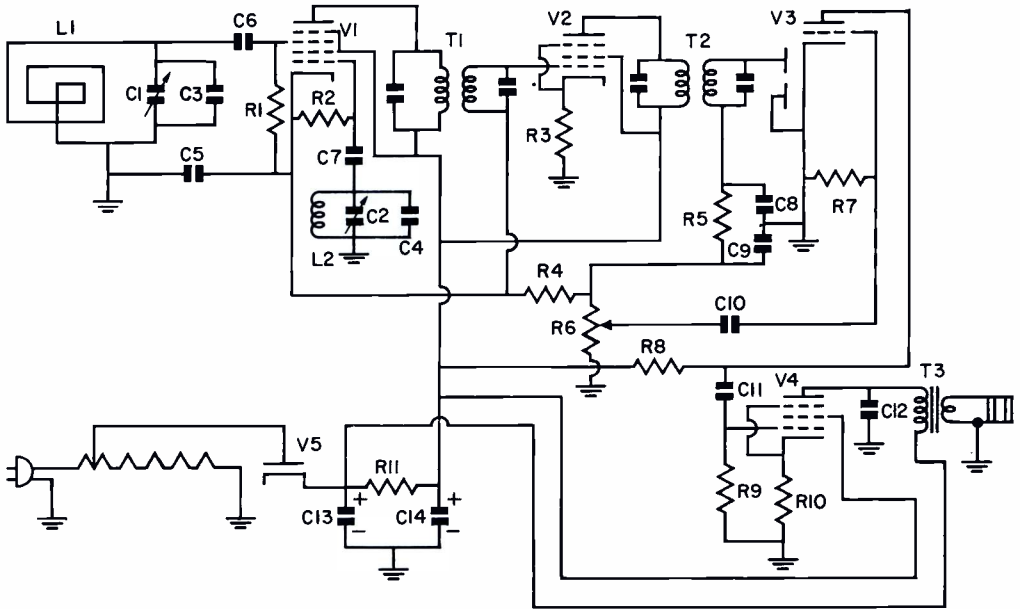


FIG. 2. Schematic of a typical AC-DC receiver.

turn the receiver volume control down to the point where no signal is heard in the set speaker. Then touch the probe to the plate of V4 and adjust the sensitivity of the Signal Tracer to see what if anything will be heard at the plate of V4. Turn to page 16 to see if you have correctly figured out the normal effects present in the receiver.

CHECKING THE RF-IF SECTION OF THE RECEIVER

To sample the rf-i-f signal the ground clip is left attached to B-, the switch is thrown to RF and the Signal Tracer tuning dial is adjusted to the frequency of the signal to be observed. The band switch is thrown to the dial position (A or B) covering the frequency to be traced. The attenuators and Signal Tracer volume control are adjusted in the same manner as when tracing in the AF section.

You could start by tracing from the diode detector in V3 back to the antenna or you could trace from the antenna to the diode detector.

In this case we will trace from the antenna to the second (diode) detector. The set should be tuned to a powerful local station and then its volume turned all the way down.

Set the bandswitch to B. Tune the Signal

Tracer dial to the station frequency and touch the probe to the mixer grid of V1 (junction of the grid C6 and R1). The signal should be heard with the Tracer. Adjust the tuning of the tracer for maximum signal. Now touch the probe to the plate of V1. Readjust the attenuators so the signal is still heard. It will be fairly weak because the primary of T1 is a low impedance plate load at the station frequency. See if adjustment of antenna trimmer C3 will bring up the signal strength; leave it at maximum.

Set the bandswitch to A and tune the Signal Tracer to the receiver i-f (in most cases 456 kc). A relatively strong signal will be present. Adjust oscillator trimmer C4 for maximum signal. Note by moving the probe that there is somewhat less signal (shown by increased opening of the eye) at the control grid of V2 - a normal condition in a double tuned i-f transformer. A very large increase in signal will be found at the plate of V2. At this time adjust the trimmers or slugs (whichever is used) of T1 for maximum signal at the plate of V2. Now switch the probe to the diode plate of V3 - again the signal will be less than at the primary. Touch the probe to the junction of R5 and the i-f transformer secondary, adjusting the attenuators as required to nearly close the eye. Now adjust the trimmers or slugs of T2 for maximum output. You have now not only sampled the rf-i-f signal in each stage but have also COMPLETELY ALIGNED the receiver, more

easily and accurately than you could have done with any signal generator.

Since you now know the procedure for tracing the signal through an operating receiver you can also use the tracer to locate unwanted signals such as noise, hum, distortion or oscillation. When you find the defective stage you can concentrate on it and rapidly clear up the trouble. You can also use the signal tracer to check the effectiveness of bypass, filter and coupling capacitors. Signals present at the plate of V3 but not at the grid of V4 show C11 to be open. AF or rf signals across C5 show C5 to be open. Hum across C14 shows it to be defective and in the case of oscillation an rf or i-f signal across C14 (hum normal) indicates the power factor of C14 is increasing. Its life, however, may in many cases be preserved indefinitely by permanently installing a .1mfd 200-volt paper capacitor across C14 to act as an rf bypass.

CHECKING FOR WEAK STAGES

This is an extremely simple check - you just measure stage gain and compare it to the normal values given in the Signal Tracer operating manual. If you can measure gain in one stage you can check it in any stage and since we are set up for i-f measurements let's check the gain in the i-f stage (tube V2). Connect the probe to the control grid of V2 and adjust the Coarse and Fine attenuators so the eye just closes. Suppose the Coarse is at X100 and the Fine at 10. Multiply these values together ($100 \times 10 = 1000$) and remember the product. Connect to the plate of V2 and repeat the procedure. Suppose to close the eye the Coarse is at X10K and the Fine at 1. 10K or $10,000 \times 1 = 10,000$. We know that if we divide the output settings by the input we have the gain of the stage. 10,000 divided by 1000 is 10 and a gain of only 10 in an i-f stage is far below

normal (it should be close to 100). So we check the tube, operating voltages and the alignment. If one of the alignment adjustments is quite broad there is a defective i-f transformer or a cold soldered joint in the transformer.

SIGNAL TRACING TRANSISTOR RECEIVERS

Fig. 3 shows a fairly typical six-transistor receiver. It is interesting to note that the only oddity in this set is the overload diode, shown in the collector circuit of the converter. This diode is reverse-biased by means of the voltage divider formed by R18 and R4, so it does not normally conduct. When the signal at point 4 of T2 becomes greater than the reverse bias, CR2 conducts and places R4 across the primary of T2, thus cutting down the signal level and preventing overloading. So it must be remembered that with excess signal strength normal gain will not be indicated. It is the ability to pick out things like this in schematics that speeds up servicing.

DIFFERENCES BETWEEN TRANSISTOR AND TUBE RECEIVERS

In a tube receiver, signals are sampled at the control grid and plate of a stage. These points correspond to the base and collector of a transistor, the base occupying the signal circuit position of the grid and the collector the position of the plate. It must be remembered, however, that in a tube receiver we are working with signal voltages and each tube amplifies the signal voltage. In a transistor set we are working with signal currents and it is not the purpose of a transistor to amplify the signal voltage. Invariably you will find that the signal voltage at the base of a stage is only a fraction of the voltage at the preceding collector. Because of this, stage gain measurements are

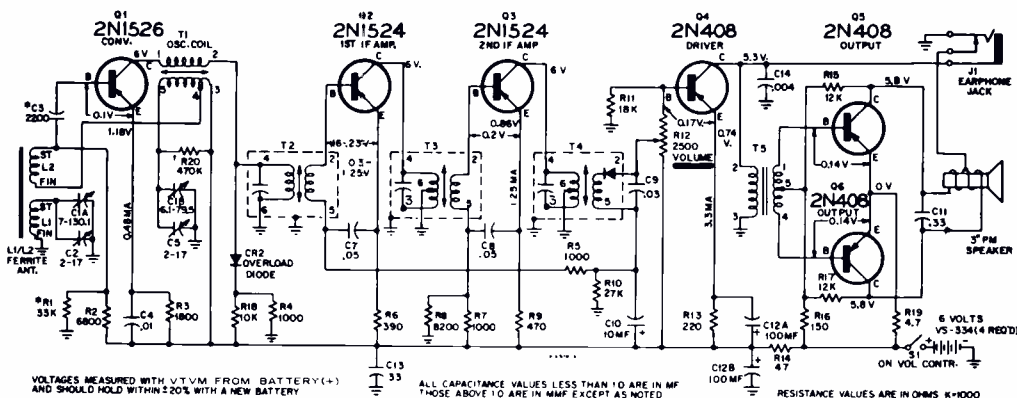


FIG. 3. Schematic of a six-transistor receiver.

not made from base-to-collector but from collector-to-collector, or between the points where maximum signal voltage exists. In the first stage of a transistor receiver, such as the converter in Fig. 3, the input measurement is not at the base of Q1 but across the tuned section of the loopstick, while the output is taken at the collector.

Of course the signal can be sampled at the base of each stage, but you must expect the signal voltage level to be very low at these points.

Notice that the primaries of i-f transformers T3 and T4 are tapped. This is done so the collector can be properly matched to the following base while maintaining a large Q in the resonant circuit. You will find that the signal voltage between the chassis and point 4 on the primary is far less than between the chassis and point 3. When point 3 is available it is a good check point in the case of very weak receivers, although gain measurements in an i-f stage are taken from collector-to-collector, as previously stated.

HOW SIGNALS ARE TRACED IN A TRANSISTOR SET

Suppose we want to trace the signals in the set shown in Fig. 3. A station is tuned in on the set, the Signal Tracer ground clip is connected to the frame of the tuning capacitor to any point readily accessible and in contact with the tuning capacitor frame (in this set the negative lead of the battery). The Function switch is turned to AF and the probe is touched to first one of the output collectors and then to the other (Q5 and Q6). Next, move the probe to the base of Q5 and then the base of Q6. The gain of the Signal Tracer must be increased as you move from the output towards the input. The probe may now pick the signal off the collector of Q4. The signal voltage here will be greater than at the base of Q5 or Q6, due to the step-down action of T5.

A much smaller signal will be present at the base of Q4, even with the set volume control advanced to maximum.

The Signal Tracer is switched to RF, set to band A and adjusted to 456 kc, which is the i-f of the receiver. Touch the probe to point 3 and then to point 4 of T4. Note the signal at point 3 is stronger than at point 4. If signal is present at the primary but no AF is present at the base of Q4 you would suspect a defect in the crystal diode second detector, which the schematic shows to be inside the shield can of T4.

Continuing, you can move the probe to the

base of Q3, to the collector of Q2, and then to the base of Q2. The signal level will normally be quite low at Q2 base. At the collector of Q1 the signal will be stronger. Also at this point you can switch the Signal Tracer to the B band. Band B picks up the incoming signal carrier and the frequency of the local oscillator.

Leaving the Signal Tracer set for the incoming carrier frequency, touch the probe to the start (ST) of loopstick coil L1A. Again you will sample the station signal. We speak of L1A and the start of the winding because these points are readily identified on the schematic. In a set the point in question is the stator of the rf section of the condenser gang. This, in turn, is identified by the fact it usually has more plates than the oscillator section; but the positive identification lies in the fact that this stator connects to the loopstick, while the oscillator section stator connects to the oscillator coil.

ALIGNMENT

The i-f alignment of any receiver is the same with a Signal Tracer. However, with this set the rf-oscillator alignment is quite different than for the tube set in Fig. 2. This is not due to the use of tubes in Fig. 2 and transistors in Fig. 3, but in the circuitry employed.

The schematic of Fig. 3 shows that the oscillator coil (T1) has a variable slug. This means that the shape of the oscillator tuning capacitor plates are the same as the plates on the rf section of the gang.

In Fig. 2 there is no slug in the oscillator coil, so tracking of the oscillator and rf section over the dial is obtained by using specially shaped oscillator plates. If the tracking is OK at one frequency it will be correct over the entire dial, providing the correct i-f is used.

ANSWER TO QUESTION 1

A loud 60-cycle hum will be present at the plate of V4 because the B+ lead of the output transformer connects back to the rectifier cathode where a high ripple voltage exists. The set speaker does not reproduce the hum because the plate of a pentode is insensitive to fairly large changes in supply voltage. Since the ripple voltage does not affect the plate current of V4 there is no ripple current flowing in the primary of T3 and no ripple voltage induced into its secondary.

Transistor sets invariably use a slug (adjustable core) in the oscillator. This is done because miniature-size tuning capacitors are used, and with such a small size, manufacturing cost of specially shaped oscillator tuning capacitors increases. Also somewhat better tracking can be obtained with the oscillator slug.

Some tube receivers, particularly auto sets, use a slug in the oscillator coil for tracking. Alignment with a signal generator is rather complicated and involves "rocking" the receiver dial so the oscillator will exactly track the rf. This is covered in the Servicing Course and will not be repeated here.

ALIGNMENT WITH SIGNAL TRACER

With a Signal Tracer the alignment is quite simple. Strong stations at the high and low frequency ends of the dial are chosen. The receiver volume control is kept down during alignment. The following oscillator adjustments are repeated two or three times or until no further improvement can be obtained. First, tune in a station at the high frequency end of the dial. Pick up the station carrier with the Signal Tracer (band B) at the collector of the mixer (Q1 in Fig. 3). Adjust the rf trimmer this one time only for maximum output. Turn from band B to A and tune the Signal Tracer to 456 kc. Adjust the oscillator trimmer for maximum i-f output.

Tune the receiver to a station at the low frequency end of the dial and pick up the station carrier at the collector with the Signal Tracer. Adjust the dials only of the receiver and Tracer for maximum output. Shift the tracer to the i-f and adjust the oscillator slug for maximum i-f output.

Now go back to the high frequency station and readjust the oscillator trimmer only for maximum i-f. Repeat the slug adjustment on the low-frequency station. Keep going from one station to the other, adjusting the oscillator trimmer and slug until no further improvement is noted. Tracking is now perfect and the receiver i-f amplifier may now be aligned in the usual manner. In most cases connect to point 2 on T4 and adjust the slugs in all three i-f transformers for maximum output.

WHAT WOULD YOU DO?

Here is a little brain teaser which I presented to the various chapters this year.

Suppose you have the receiver in Fig. 3 to service and it is dead. The trouble has been localized to the mixer stage (Q1). The oscil-

lator does not work and no rf signal can be picked up at the collector of Q1. You see that some serviceman has worked on this stage as there is evidence of soldering. However, tracing the circuit shows it to be wired exactly as indicated by the schematic. All parts and connections are good and the battery is OK. There is no voltage between the base and emitter and no voltage drop across emitter resistor R3. Collector voltage is normal. Study these facts and the circuit and then decide how you would restore operation.

See correct solution below.

ANSWER TO QUESTION 2

There is an error in the diagram and the previous serviceman blindly changed the circuit to correspond to the diagram error. Notice in Fig. 3 that the base is floating, removing forward bias on Q1. This cuts off emitter and collector current. The circuit should appear as shown in Fig. 4 and when this change is made proper operation will be restored. Moral: don't believe everything you see in print and try to understand circuit operation. Only three members of all the chapters visited were able to solve the problem.

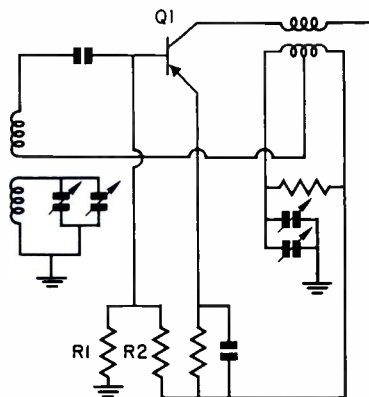


FIG. 4. Corrected circuit of receiver shown in Fig. 3.

Zip the Mail With ZIP Code

Remember to include your ZIP Code number in all your correspondence with us. By cutting down on time in handling it will speed our replies to you.

The ZIP number should be placed at the end of your address — after the state. Our address, for example, is now:

National Radio Institute
3939 Wisconsin Avenue
Washington, DC 20016

DEVICE OF THE MONTH

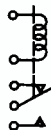
RELAYS

BY R. C. APPERSON, JR.

Did you ever stop to think where we would be without the relay? Can you imagine throwing bank upon bank of switches to program a computer or set up signal paths in a complex test set? The relay is the electronic traffic cop, directing the currents to the proper place in the circuit, acting as a protecting device in overload circuitry and even seeking out culprits when used in continuity testers for checking for proper wiring, opens and short circuits. The relay is handy and is used quite often. There are many kinds and various applications for each. Let's discuss relays.

The relay may be defined as a magnetically operated switch, requiring current through its winding to create the magnetizing force. The current causes flux to be set up in a pole piece which then becomes a magnet, and attracts a cantilevered arm to it. Contacts are connected to the opposite end of the arm which open and close as the magnetic material becomes magnetized and demagnetized. This is basic relay action, we will elaborate on advances made in the manufacture of relays later.

The schematic representation of the relay is as shown here. There are variations of this for different applications, but they all have these basic elements - contacts and coil.



We mentioned different applications, let's point out a few. Press-to-talk buttons on communications equipment actuate relays, adding many more contacts to the simple button switch which was used to actuate the relay. The high frequency transmitter may even use a special coaxial relay to switch the antenna coaxial lead. These relays are

designed to maintain impedance in the line to avoid standing waves. There may be a relay controlling the application of B+ to the tubes until the filaments have had adequate warm up time. This is a special time delay relay with a thermal breaker built in. A certain time is required to cause the breaker to "make" the circuit after current has started flowing. When the breaker makes, the relay pulls in, switching the desired voltages.

Another form of communication, the telephone, uses many relays to tie your phone to any desired location in the world. Similar relay matrixes are used to route programs into computers. Automatic checkout equipment uses this type of programming also.

Mentioned earlier was overload protection. This is achieved by having the current to the device to be protected flow through the contacts of an energized relay, whose coil is in circuitry which can detect a condition harmful to the device. Whenever this condition is detected (as in a mismatch in the case of a magnetron), the relay drops out, disconnecting power to the device until the condition clears itself or is corrected.

These are only a few applications. The relay is used whenever a single action is required to control many actions or when a low current capacity switch needs help in carrying high currents.

There are many types of relays, a few are shown here. The number of contacts, current carrying capability of the contacts, pull-in current required for the coil and switching action are things that must be taken into consideration when choosing a relay. Another thing to note is whether the operation is in AC or DC circuitry. When specifications are given in a catalog, they include frequency (if AC), volts (AC or DC), switch action (number of contacts), contact rating and

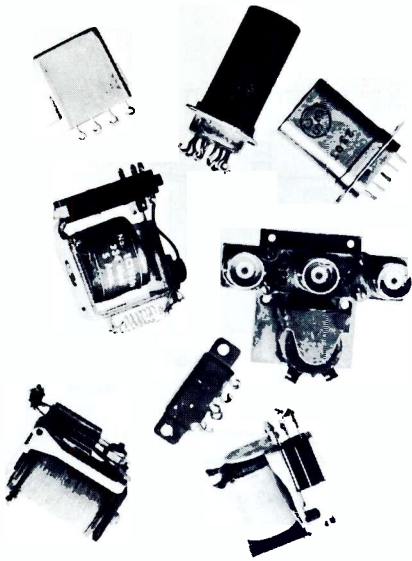
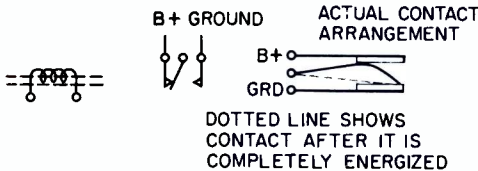


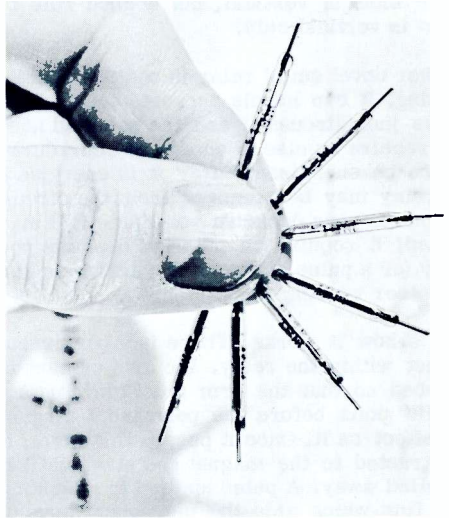
Photo by Court Bartlum

sensitivity, or the current required to energize a relay. These are the things you must be familiar with. One other thing to note is that some relays are "make-before-break"; some are "break-before-make." The make-before-break type has a contact which stays in contact with the normally closed contact until it touches the normally open contact. This can cause trouble unless you are aware of it. It is possible to short two circuits together which you want to keep separated, as shown here. When the relay is being commanded, or latched on itself, this is a nice feature. Most of the cheaper relays are break-before-make.



Speed of operation enters into the choice of relays for certain applications. Where speed is required, the relay usually has to be capable of many, many operations without failure. The reed switch unit is usually used for contacts in this case and the contacts are sealed in glass which is filled with an inert gas to prevent contact damage due to arcing. The International Business Machine Company has a new reed switch available which is fast, small and has extended life. The operating time is less than one millisecond and has a life of 125 million operations before first error. Fabulous for a relay.

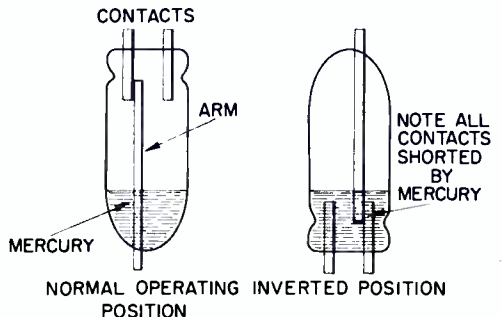
The sealed unit is placed in a solenoid which magnetically attracts the reed when current flows through the solenoid. Note that more than one sealed unit may be placed in the solenoid to obtain the number of contacts desired.



Courtesy IBM

Another relay with long life expectancy is the mercury wetted type. It has reed contacts which are mounted in glass as the reed switch is. Also in the vial is a portion of mercury which coats the contacts and lengthens their life. The vials are mounted within a solenoid also, and the whole unit is hermetically sealed for rugged operating conditions. These relays are make-before-break types and the method is very interesting. When the reed moves from one contact to the other a thin strand of mercury is pulled along with it. This is safer, since the slightest current will break the strand.

Mercury wetted relays have good current



carrying capabilities and fairly good sensitivity. They are used quite frequently in government applications where life and ruggedness are a criterion. One thing to keep in mind when working on a piece of equipment which uses mercury wets - don't operate it in any position other than up-right. The mercury runs to the contact end of the vial and shorts all contacts. The relays may explode if shorted. They may be operated 30 degrees either side of vertical, but a good rule to follow is vertical only!

Another novel small relay is one that is self-latching. It can handle currents equal to the relays just discussed and the solenoid need only receive a pulse of energy of short duration to be energized. After it is energized, the relay may be removed from the circuit and put in your pocket if you like - it'll stay latched! It requires a pulse of opposite polarity (or a pulse of the same polarity applied to another winding) to unlatch.

Here's how it works. There is a permanent magnet within the relay. The arm contact is balanced so that the arm must move past a certain point before the permanent magnet has effect on it. Once it passes this point, it is attracted to the magnet and stays until it is pulled away. A pulse applied to a winding adds flux which aids the permanent magnet long enough to offset the balance. Another pulse of the opposite polarity pushes it away far enough so that the arm returns to its normal state. The only power required is during the pulse - a very useful feature in relay design.

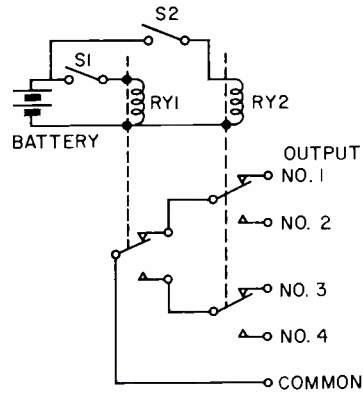
THE CIRCUIT OF THE MONTH

The circuit of the month this issue is purely academic in nature, but I feel that it demonstrates a very important use of relays. Much can be gained by building the circuit and operating it.

The circuit is a relay tree, as used in logic circuitry and relay programming. It may be added to as many times as desired and the ground (or whatever is connected to the initial arm) may be distributed to any number of points by simply energizing the proper sequence of relays. Here's how it works.

Looking at the circuit, the common is connected to the top output point (1). By closing S2, RY2 energizes and the common is connected to output 2. Open S2 and close S1. This moves the common to output 3. Now close S2 again, the output shifts down to output 4.

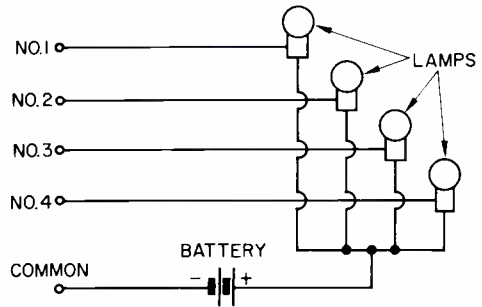
This method is used for connecting ground to



PARTS LIST

- RY1 6VDC SPDT relay (Allied Catalog 75 P167)
- RY2 6VDC DPDT relay (Allied Catalog 75 P168)
- S1, S2 SPST Switches
- 6V DC Battery.

chosen points when programming is done using a tape reader. You could use it for rapid testing of continuity in cables by using it in conjunction with four pilot lamps if you'd like. Simply connect the lamps to pins at one end of a long harness and connect the other end of the harness to the output points. Tie the other side of the bulbs to the battery (as shown in the test diagram).



By throwing switches and watching the lamps, you can check out a long cable quickly. Think about it, I'll bet you will come up with a lot of uses for the relay tree.

The relay is a very important device, knowing how to choose the proper relay to do your job for you will make your circuits much more efficient. Also, observing certain precautions while working on equipment using relays will make you a better technician and that's the goal of us all!

What Would You Have Done ?

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

BY GEORGE D. PHILPOTT

Things has been going smoothly at Lucky's TV Shop lately. As he meticulously reworked the horizontal section of an old 630 chassis he thought about this and other matters; tonight, it was his turn again to be speaker at the local RTVA meeting and the subject posed a problem.

"Which angle of the service business would make a good subject for discussion at the meeting tonight?" he asked Super-Sonic.

The young technician snapped-off an RF Signal Generator he had been using, faced his questioner and sighed, "That's an easy one, Boss - give 'em a pep talk on radio tune-ups."

"Tuning radios! Rather a naive portion of the spectrum, wouldn't you say ... considering the fact that most of the men are pretty darn good TV technicians?"

"You asked me, I told you," said Super. "TV experience never tuned a radio yet. I've got plenty of television experience and some of these foreign radios cut my bias off, quick! It's the little things about the procedure that stump me all the time, the slugs, trimmers - which way do you turn them to increase the inductance - stuff like that."

Lucky thought the idea over a moment, then said, "It's certainly an interesting suggestion. Alignment is important, too! I'll give it a try. Tell me, Super, in your opinion, what is the most difficult part of alignment procedure?"

"Another easy one, Boss - it's the 'touch'. Getting the 'touch'. For instance, when you tune-up a radio it ticks-off stations straight down the dial like a communications job. Your FM is smooth. No distortion to speak of between sidebands. Me - when I peak one up - things happen ... should I continue?"

Lucky had to chuckle at the lad's expression. He replied, "You're no different from the average apprentice at this work. Trimmers and coil slugs are very intriguing. It's a terrible temptation to observe these important adjustments just waiting to be turned a little bit to the right or left. This is one

reason why every service shop needs a good RF Generator, schematics, and plenty of alignment tools. Am I right?"

Super squirmed uncomfortably on his stool, grinned sheepishly. In the past, he had been guilty of screwdriveritis. In fact, at this very moment, he was guilty of something even worse. A tiny tremor shivered along his spine-bone as he thought back to the slight wisp of smoke which had oozed along the front panel of the Signal Generator while using it just before this conversation. It must have been some B-plus voltage from the receiver traveling back into the instrument. He shuddered. "Frequencies confuse me," he suddenly uttered, trying to pass the vision from his mind. "I always peak the coils where the book tells me, but afterwards the sets just don't have the drive ..."

Unaware of this mishap, Lucky prepared to make a few notes. He found a pad and pencil and moved his stool closer to Super. "Don't take it so hard, my boy; you're actually pale. During my younger days, I had my troubles with certain tuned circuits, too," he said, pausing. Then he continued, "Thinking it over, I'll give a run-down on LC circuitry, bring out some of the more elusive points that may have been forgotten ... As an example, one of the first mistakes a lot of students make using a signal generator is injecting too much signal into the receiver. All this does is overload the stages, upset normal AVC action, which you are depending upon to give an indication on the VTVM, and swamp the circuit. I have always stipulated that it is a good policy to consider your generator as a variable broadcast station; one that is tunable to a desired frequency. Think of it in this way and control the output accordingly. Few broadcast stations are capable of blocking a receiver, unless they are located within a few blocks."

"That's my technique," Super gulped.

"Now, take the coils, or inductances, if you would rather call them by this name, they are comparatively simple to understand. It makes no difference if the coil is shielded, in the open, potted, or has an air core, when used in conjunction with a specific amount of capacity in series or in parallel, it will resonate at one certain frequency. This capacity is always the combined capacity of the cir-

cuit; tubes, wiring, chassis, and ground proximity, and the fixed or variable capacitor used with the coil. An inductance thus installed, is supposed to tune to a chosen frequency, or in the case of a variable tuner, to a certain range of frequencies. No more and no less."

"Heck, Boss, I know all that story."

Lucky's eyebrows raised one kilocycle as he murmured, "you do? Well, you won't mind explaining then why you perch on that stool like a railroad brakemen, cranking i-f's, padders, and trimmers on some sets, actually wishing for more screws to turn - when you know, admittedly, these circuits tune to one frequency, only - and that's it!"

"Yeah, I suppose I do waste time, sometimes. But the part that always confuses me is, when you turn a slug into a coil, will it raise or lower the inductance?"

Lucky gave him a weak smile. "Let's be practical and temporarily forget the term inductance. We'll say frequency. After all, receiver dials are calibrated in kilocycles, megacycles, or meters - often all three - but never in inductance values. To answer your question, ferrite-type cores always lower the tuned frequency of the circuit when entering the coil. Brass and aluminum cores do just the opposite and raise the resonant frequency. Most receivers with ferrite cores in the rf and oscillator coils have them for low-frequency tracking. Trimmer capacitors take care of any minor high-end alignment necessary. Split-rotor plates on the variable capacitor may be bent slightly to compensate for middle-of-the-band tracking. Is the fog starting to lift?"

Super blinked his eyes and nodded thoughtfully. "When you spread the windings of an FM oscillator coil, does this raise the frequency or lower it?" he asked.

"Turn separation means less capacity between turns, which means the LC network will resonate at a higher frequency."

"No wonder some of my tune-up jobs bounced back at - you," the young technician exclaimed, "I was doing things backward. Boss, all things being considered, what one step of an alignment procedure is truthfully the most important, in your book?"

Lucky considered the question thoughtfully before replying, then said, "The best technician in the world will have trouble aligning sets when the dial pointer is not positioned correctly on the cord. Always check the pointer - first."

"Makes sense, for sure," Super countered. "Usually it's the tiny, insignificant thing that's really important."

"One more suggestion before we switch channels and get down to stranger things - such as the aroma of burnt carbon seeping from Signal Generators," Lucky remarked.

Super blanched like a hot peanut: "Okay, Boss," he choked.

"Even when a generator is known to be practically perfect, it still is never as accurate as broadcast stations. To comply with government regulations they must hold to within 20 cycles, plus or minus from center. Use such stations to check your receiver after aligning it. Know their correct, operating frequencies," advised the shop-owner.

Lucky grinned mischievously and his knowing eye caught the pained expression on Super's face. "Just un-plug the Signal Generator and get it on the bench where you can work on it. I know you cooked the attenuator network resistors and fried the controls. It's happened to me several times. Open the panel and I'll show you a quick way, after replacing a small handful of parts, to avoid these embarrassing incidents," he said.

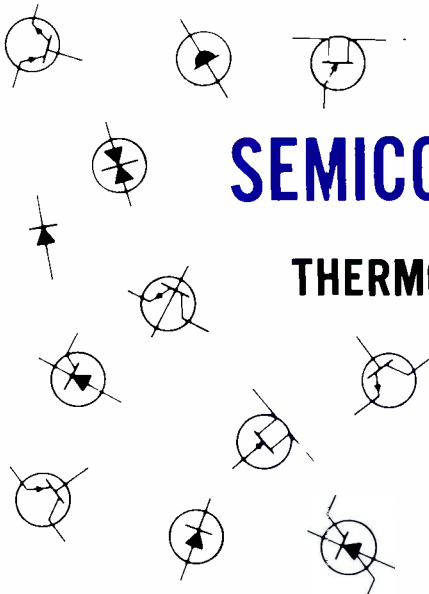
Answer on page 32

The sages do not consider that making no mistakes is a blessing. They believe, rather, that the great virtue of man lies in his ability to correct his mistakes and continually make a new man of himself.

-Wang Yang-Ming.



"Mr. Gilroy, was that your new pair of diagonals you just handed me?"



SEMICONDUCTOR REVIEW

THERMOELECTRIC CONDUCTORS

BY

JOHN POTTER SHIELDS

This month we're going to delve into a class of semiconductors that are paving the way to intriguing new devices ranging from a refrigerator with no moving parts to super-sensitive infrared "eyes" for our guided missiles. Specifically, we are talking about a class of materials which exhibit thermoelectric properties. When two dissimilar materials having thermoelectric properties are joined, and a current passed through them, one section will heat and the other cool.

Before getting into the modern thermoelectric semiconductors let's first take a look at some of the history of thermoelectricity. The whole thing started back in 1822 when John Seebeck noted that a current would flow through a circuit made of two dissimilar conductors when one of their junctions was heated while the other cooled as pictured in Fig. 1.

Later, in 1834, a Frenchman by the name of Peltier found that when a current is passed through two certain types of dissimilar metals, heat is generated at their junction. He also noted that a drop in junction temperature would occur when the direction of current flow was reversed. He also noted that the magnitude of temperature change was determined by the combination of metals used.

Little was done with Peltier's work until fairly recently. Renewed interest in the Peltier Effect, as it is known, has brought to light a number of semiconductor materials which make the direct heating and cooling

by an electric current both practical and economical. Several low capacity "motorless" refrigerators utilizing thermoelectric coolers are now commercially available, as are specialized cooling units for electronic gear.

Let's now take a look at how the basic semiconductor thermoelectric cooler operates. Fig. 2A shows a familiar NPN semiconductor "sandwich" connected to a battery. Electrons leave the battery and enter the N-section of the NPN "sandwich." At this point, the electrons are at a certain finite energy level. In order to pass over into the P-section, these electrons must first cross the PN junction. In doing this they lose energy in the form of heat. The electrons continue their travel through the NPN sandwich, reaching the second PN junction. At this second junction crossing the electrons gain potential energy from the thermal energy

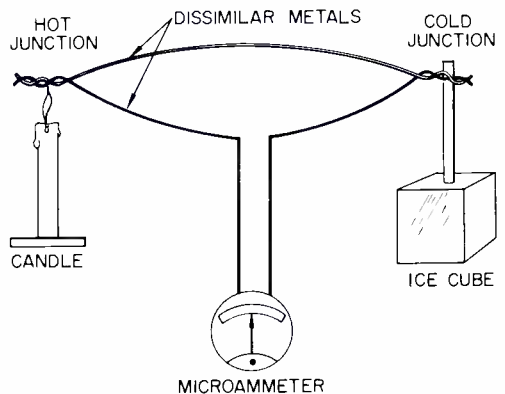


FIG. 1. Classic experiment which proves the existence of thermoelectricity.

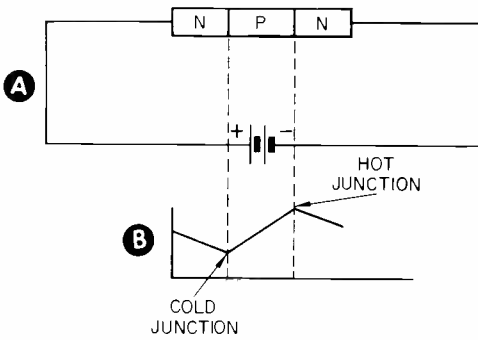


FIG. 2. Modern thermoelectric device.

of the P-type region. This gaining of energy results in cooling of the second junction. This shift about in energy levels is illustrated in Fig. 2B.

For optimum results the thermoelectric material should have high Seebeck Effect, high electrical conductivity, and low thermal conductivity. All of these properties are determined by the number of free electrons or charge carriers which they contain. A substance with a large number of charge carriers is a good conductor of both electricity and heat. These of course are characteristic of a metal. On the other hand, large Seebeck Effects are exhibited primarily by insulators. Thus, it would appear, and in fact is the case, that a suitable semiconductor material would offer the best compromise for use as a thermoelectric cooler.

The physical construction of a typical thermoelectric cooler is shown in Fig. 3. Notice that instead of common junction between the N and P-type semiconductor materials as in a conventional diode, the N and P type are tied together by a copper strap. This copper strap serves as the thermoelectric generator's "cold" junction.

It should be noted that the "hot" and "cold" junctions pictured in Fig. 3 may be reversed by simply reversing the direction of current flow through the device. Thus, a thermoelec-

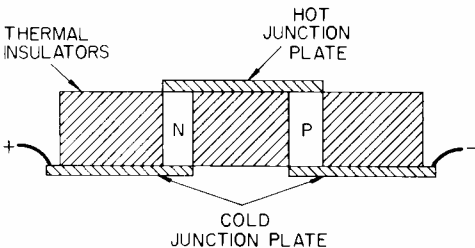


FIG. 3. Typical thermoelectric cooler.

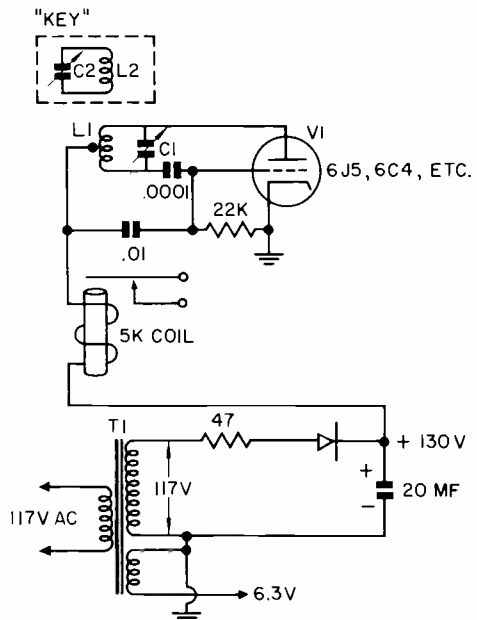
tric device of the type shown in Fig. 3 may be used to both heat and cool. A practical application of this was demonstrated recently ... a serving tray which would either warm or cool foods and beverages merely by flicking a switch.

One point that must be kept in mind about thermoelectric devices is that they are essentially "heat pumps" ... absorbing heat in one locality and giving it up in an adjacent locality. In order to efficiently "dump" the heat which they absorb during cooling, thermoelectric devices are generally fitted with cooling radiators or heat sinks.

Thermoelectric devices have a direct current power source of low voltage and high current and relatively low ripple content. For this reason, multiple "cell" thermoelectric cooler assemblies are usually connected in series as it is generally more economical to design a DC power supply with a higher voltage medium current output than one with a very low voltage, high current output.

NOVEL CIRCUITS

Here's a rather unusual project that will serve as both quite a conversation piece and toy to delight the kids as well as teach something about basic resonant circuit theory.



T1-STANCOR PS-8415 OR EQUIVALENT
L1-C1 L2-C2 TUNABLE TO SAME FREQUENCY

FIG. 4. Oscillator operated relay.

As shown in Fig. 4 the gadget is basically a simple series-fed Hartly Oscillator and associated power supply. A relay is connected in the oscillator's plate circuit. In operation, L1, C1 are tuned to the same resonant frequency as the external resonant circuit consisting of L2, C2. Now, when the external resonant circuit is brought close to the oscillator's tank circuit, L1, C1, the oscillator will be "loaded" due to the absorption of rf energy by the nearly external resonant circuit. This will cause the oscillator's plate current to increase, energizing the relay. This operation is, of course, basically similar to that of a grid-dip meter.

Now, here's the novel part of the circuit. The unit is displayed as an "electronic lock" ... the key being the external resonant circuit, L2, C2, while the oscillator circuit and relay form the "lock." The "key" is fashioned into a flat circular shape as shown in Fig. 5 and the oscillator "works" are packaged in a small enclosure with the oscillator tank circuit, L1, C1, spaced close to one end along one side of the enclosure.

When it is desired to actuate the "lock" the "key" is brought close to, and parallel with, the oscillator tank circuit. If the key is tuned

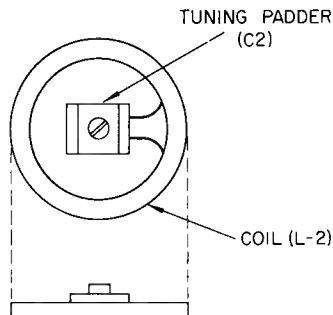


FIG. 5. Details of the "key" shown in Fig. 4.

to the same frequency as the oscillator tank circuit it will absorb rf energy from the tank.

This in turn will cause the oscillator's plate current to increase, actuating the relay. If the "key" is tuned to any frequency other than that of the oscillator tank circuit, it will not absorb energy and the relay will not be energized.

The relay contacts can be connected in series with a battery and light bulb to more readily indicate relay action.

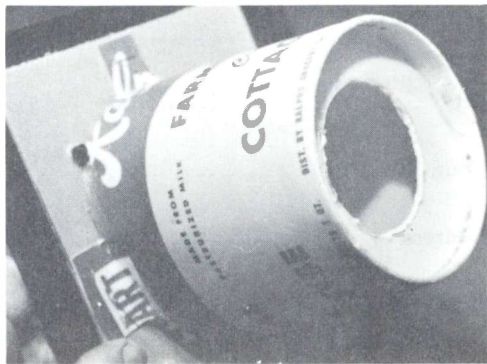
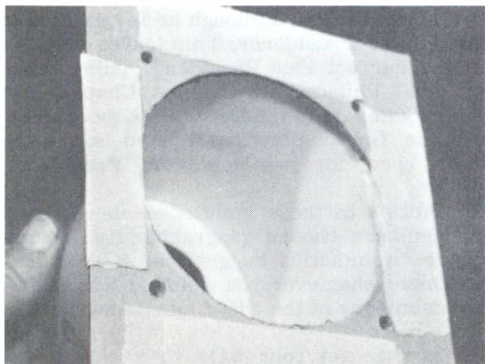
SOUND CHAMBER FOR SMALL SPEAKERS

An efficient sound chamber which will protect and improve the tweeter type loudspeaker can be quickly devised from a quart or pint size soft food container. This type of cardboard container is most often used for cottage cheese and it accommodates any small speaker up to 5 inches in diameter. Clean the container is most often used for cottage cheese such a way as to provide at least four attaching tabs as shown in the photo. By means of these tabs the container is stapled (or by

other means) to a corrugated cardboard grill piece. The staples and tabs are then covered with strips of masking tape and four holes are punched in the cardboard to match the holes in the speaker. A hole is next cut in the bottom of the container and the speaker installed.

This simple, no-cost, sound chamber is not only suitable for regular or custom installation, it can also be used to protect the cone on test speakers and will more nearly reproduce life-like sound. The containers can, of course, be painted if desired.

G.F.S.



A cottage cheese container used as a sound chamber for a tweeter type loudspeaker.

Nomination Ballot

T. E. ROSE
Executive Secretary
NRI Alumni Association,
3939 Wisconsin Ave.,
Washington, D. C. 20016

I am submitting this Nomination Ballot for my choice of candidates for the coming election. The men below are those whom I would like to see elected officers for the next year.

(Polls close July 25)

MY CHOICE FOR PRESIDENT IS

.....

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MY CHOICE FOR FOUR
VICE-PRESIDENTS IS

1.

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2.

City State

3.

City State

4.

City State

Your Signature

Address

City State

Student Number

ELECTION OF NRIAA OFFICERS

Politics is very much in the forefront of public interest these days. Soon we will be devoting much thought to choosing the men to run our country for the next four years.

Your NRI Alumni Association is in step with the spirit of the times. We're having our election for the National Officers for 1965. Five officers will be elected, a President and four Vice Presidents. The two members who receive the most votes for the Presidency will become the nominees for President. The eight who receive the most votes for a Vice Presidency will be the nominees for that office.

The deadline for nominations to reach NRI is July 25. The votes will be tallied by National Headquarters and the names winning nomination will be listed in the September-October issue of the Journal. The membership will be asked to vote for the President and Vice Presidents.

The current President, J. Arthur Ragsdale, will turn over the office to the new President on January 1, 1965.

For the past few years, in addition to other members elected, there were two who were particularly conspicuous: David Spitzer of the New York City Chapter and Howard Tate of the Pittsburgh Chapter. Both are strong men. They will be hard to beat but they will probably also find it hard to beat each other.

Neither Spitzer nor Tate is eligible to run as candidate for Vice President; both recently served two consecutive terms in that office. Eugene DeCaussin of the Los Angeles Chapter is ineligible for a Vice Presidency for the same reason, although he is qualified to run for the Presidency. This leaves only two of the current Vice Presidents, Jules Cohen of the Philadelphia-Camden Chapter and Frank Zimmer of the New York City Chapter, eligible for re-election. It also leaves the door open for two new Vice Presidents.

In addition to those mentioned above, a list of members chosen geographically appears under "Nomination Suggestions." You may nominate whomever you wish, so long as they are members of the NRI Alumni Association.

Be sure to get your ballot to Washington by July 25 or as much earlier as you wish.

**NOMINATION SUGGESTIONS
FOR ALUMNI
ASSOCIATION ELECTION**

Charles E. McLain, Montgomery, Ala.
 George F. Duck, Phenix City, Ala.
 Oscar C. Cota, Phoenix, Ariz.
 Charles A. Kudrie, Tucson, Ariz.
 Stuart A. Moore, Hot Springs, Ark.
 Charles R. Ledbetter, Fayetteville, Ark.
 Arnold Hopkins, El Cerrito, Calif.
 Arthur J. Ragsdale, San Francisco, Calif.
 Anderson Royal, San Francisco, Calif.
 Joseph Stocker, Los Angeles, Calif.
 Eugene De Caussin, Hollywood, Calif.
 Fred Tevis, Los Angeles, Calif.
 Carl W. Gerberich, Colorado Springs, Colo.
 Howard O'Brate, Pueblo, Colo.
 Emilio J. Branciforte, Cromwell, Conn.
 Edward Sarath, Ridgefield, Conn.
 Oliver A. Short, Wilmington, Del.
 Albert J. Kent, Claymont, Del.
 Charles E. Brack, Washington, D. C.
 Robert M. Rickover, Washington, D. C.
 James H. Adams, Tampa, Fla.
 R. C. Strickland, St. Augustine, Fla.
 A. W. Butler, Decatur, Ga.
 Martin L. Fussell, Augusta, Ga.
 Jack R. Dickerson, Pocatello, Idaho
 Edward W. Dorsey, Boise, Idaho
 Jas. R. Collier, Cahokia, Ill.
 Perry Trueblood, Charleston, Ill.

J. W. Sawyer, Springfield, Ill.
 Jos. Grinus, E. St. Louis, Ill.
 Albert F. Sklenka, Springfield, Ill.
 Chas. O. Jimerson, Madison, Ill.
 Samuel C. Holmes, Ft. Wayne, Ind.
 Albert Novak, Hammond, Ind.
 Clare L. Edsill, Waterloo, Iowa
 Merle M. Lewis, Davenport, Iowa
 J.J. Drake, Wichita, Kans.
 Clarence Sutton, Coffeyville, Kans.
 Joseph B. Beckley, Louisville, Ky.
 John B. Davis, Madisonville, Ky.
 Willie J. Triche, Westwego, La.
 Iry G. Carlin, Plaquemine, La.
 Edward Goodin, Bangor, Maine
 Louis J. Vincen, Lewiston, Maine
 John L. Carter, Kingsville, Md.
 Louis J. Heitman, Baltimore, Md.
 Arnold Wilder, Agawam, Mass.
 John T. Park, Ware, Mass.
 Rolland Kirchner, Rosemount, Minn.
 Billy Friedland, Cambridge, Minn.
 Earl Oliver, E. Detroit, Mich.
 Clyde Morissette, Flint, Mich.
 Paul Crippen, Millington, Mich.
 Frank Rizzi, Detroit, Mich.
 Quintus Jones, Jackson, Miss.
 Donald E. Barnes, Vicksburg, Miss.
 Leo W. Mason, Kirkwood, Mo.
 Bernard Bosse, Overland, Mo.
 Harry E. Risley, Great Falls, Mont.
 Ted E. Grove, Plentywood, Mont.
 Henry F. Briggs, Columbus, Nebr.

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Note: Easy payment contracts cannot be accepted from persons under 21 years of age. If you are under 21, have this sheet filled in by a person of legal age and regularly employed.

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 of 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? _____

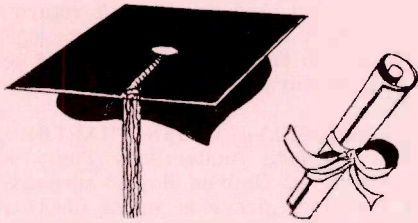
If in business for self, what business? _____ How Long? _____

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

J. Arthur Ragsdale	President
Howard Tate	Vice President
Frank Zimmer	Vice President
Eugene DeCaussin	Vice President
Jules Cohen	Vice President
Theodore E. Rose	Executive Sect.

CHAPTER CHATTER

DETROIT CHAPTER was as pleased to welcome Secretary Andrew Jobbagy and Treasurer Clyde Morrissette of the Flint Chapter as guests as these two gentlemen were to attend the meeting. The Detroit Chapter members agreed with the visitors that much could be gained by the exchange of ideas between the two chapters, particularly with regard to programs.

At a previous meeting a drive was put on to provide the chapter with tools for use during various demonstrations. Each member donated something. The chapter wound up with a soldering gun, two extension cords, a lot of jumper cables, longnose pliers, cutters, a tool box, and various other tools. The chapter now feels that it is among the best equipped chapters.

FLINT (SAGINAW VALLEY CHAPTER) strongly encourages each of its members to share any special knowledge or experience he may have with the other members. Here is how one meeting went: Leslie Carley showed how to make a three-way light by utilizing a silicon rectifier and three-way switch; Paul Crippen changed a pen-light soldering gun into a printed circuit tracer by using a Sylvania 7C7 bulb; Leroy Cockrell made a power supply and a buzzer tester for a transistor radio; Donald Darbee proved that when jumper cables are being used and a car transistor radio is on, it will put the transistor out of commission every time. This is more frequent especially when you are using an alternator.

Earnest Hubbard showed 101 different ideas that can be carried out with an NE 2 neon bulb. One idea was a diagram for the dashboard to indicate the operation of the spark plugs. Another was that of a blinker light for Christmas trees; Andrew Jobbagy demonstrated how to change an NRI Model 290 transistor radio to a signal tracer and the functions of a solar radio; Gilbert Harris explained how to use a tuner cleaner appliance like an electric clock and fan; Clyde Morrissette hooked an output meter to a small

transistor radio by using a tube type output transformer; George Martin showed how to make an inexpensive two or three set coupler by the capacity type or old-fashioned rf coil type. The latter can be made at home out of spare wire and a ferrite loopstick.

Wayne Todd checked a spark plug with an NE2 neon bulb by using a high rf current on a distributor cap; Robert Newell told about a TV advertisement on changing black and white sets to color sets; Robert Poli demonstrated his solar energy conversion kit that he purchased from NRI; Charles Wotring loosened some rusty nuts with a drop of hydrogen peroxide; and Jim Windom demonstrated reversing the polarity of a meter while working on a TV set.

Andrew Jobbagy and Clyde Morrissette, as good-will ambassadors of the Flint Chapter, received a warm and hospitable welcome when they visited the Detroit Chapter. The two chapters arrived at the understanding that in the future they would share any plans or improvements concerning educational programs and the Detroit Chapter promised to return the visit in the near future.

HACKENSACK CHAPTER has had to find new quarters; space is no longer available for rental in the YMCA building where the Chapter used to meet. The meetings are now held at St. Francis Hall, corner of Lodi and Holt Streets, Hackensack. The members are well satisfied with the new meeting place.

The Chapter enjoyed another of the taped and illustrated lectures furnished by Howard Sams Company. It was about transistors and was in two parts. The first thirty-five-minute reel was devoted to the theory of the transistor. The second reel, of equal length, was on the subject of transistor circuits.

Chapter members find these lectures very helpful in reviewing various electronic subjects and in keeping informed on the constant stream of new products and methods. The Chapter wishes to express its appreciation to the Howard Sams Company for making these programs available to the members.

The Chapter has been very pleased to admit

three new members to membership. They are Anthony Poschini, Hackensack, Joseph Wachala, Bloomfield, and Peter Corallo Newark. Congratulations to these gentlemen!

LOS ANGELES CHAPTER is still reactivating old members who have dropped by the way-side. The latest to return to the fold is Harry Matsukane, who had not attended a meeting for some four years. Welcome back home, Harry!

The latest new member to join is Graham Boyd. Our congratulations, Graham!

At one meeting an interesting hour or more was spent having each member give an account of his past activities in Radio-TV-Electronics.

Joe Stocker gave an interesting demonstration on aligning a television receiver with a sweep generator and a scope. Eugene De Caussin explained how he constructed a hi-fi from an old TV set. The result was so satisfactory that he indicated he planned to do another one.

NEW YORK CITY CHAPTER welcomed its newest member, Charles Williams, who turns out to be interested in ham radio, and a returning old member, Frank DeNunzio.

The Chapter heard from several members, Ralph Pincus, Mack Carter, and Ontie Crowe, about difficulties with particular sets that they had run into, getting helpful tips on problems anyone might encounter in service work.

Chairman Dave Spitzer continued his detective operations in the sound system of the



Guests from New York City Chapter: Mr. and Mrs. Al Bimstein, Mr. and Mrs. Dave Spitzer, Jim Eaddy, Sam Artman.

Chapter's set. And Jim Eaddy's return to the fold brought the membership once again in contact with troubles in the AVC i-f section of a transistor portable Radio.

PHILADELPHIA-CAMDEN CHAPTER did it again. Its 30th Anniversary Party at the Southwark AC Club on May 16 surpassed all the chapter's previous social functions. In addition to the Chapter members themselves, there were guests from two other chapters, from the National Radio Institute, and representatives of manufacturers and local distributors. All told there were 126 present at the banquet.



Chairman John Perrung presenting plaque to Jules Cohen.

A highlight of the evening was the presentation of a plaque to Secretary Jules Cohen, which was inscribed as follows:

Presented To

JULES COHEN

Secretary

Philadelphia-Camden Chapter

In Recognition of His Devotion, Loyalty,
And Initiative Readiness To
The Philadelphia-Camden Chapter
And For His Efforts In Keeping
The Ideals And Ethics
Of the Alumni Association,
Ever Seeking to Foster Its Aims And
Ambitions For A Bigger And Better Chapter
Where Good Fellowship And Knowledge
Of the Electronics Industry
Can Be Gained

Presented By

The Officers And Members

May 16, 1964



Guests from Pittsburgh Chapter: Mr. and Mrs. Frank Skolnik, George Mc Elwain, Howard Tate, Jim Wheeler.

Twenty-two door prizes were donated, almost all by local distributors, and there were also many table favors. The speeches were the shortest in the history of the Chapter, which was highly desirable.

The delicious prime rib of beef dinner was followed by dancing and an excellent two-hour entertainment program. Everything went off according to schedule and worked out perfectly. The Chapter is to be congratulated not only on its 30th anniversary but also on the magnificent manner in which it was celebrated.

PITTSBURGH CHAPTER enjoyed a program conducted by guest speaker Mr. J. W. Kuntz, a representative of the B and K Manufacturing Company. He demonstrated the use of the B and K model 1074 Analyst on both a black and white and a color television receiver. He also demonstrated the B and K Model 850 Color Generator, after which he conducted a question and answer period. Many searching questions were asked and were answered by Mr. Kuntz.

In demonstrating the Model 850 he dismantled part of the TV receiver, particularly everything on the neck of the picture tube, to show that after they were replaced most of the adjustments could be made from the front end by the use of the Model 850 and adapters.

Anthony P. Jox and John Duchi have recently joined the Chapter. We are glad to number you among the membership, gentlemen!

SAN ANTONIO (ALAMO) CHAPTER Chairman Sam Dentler demonstrated TV alignment. At a previous meeting he led a discussion on this subject. At this meeting he set up a sweep and marker generator on a TV set and aligned it thoroughly, explaining every action. At the end of the meeting several members were heard to say that it was the most instructive program the chapter had ever had and that there is no doubt about it, Sam knows his business.

The Chapter was so much interested in TV alignment that it scheduled a continuation of it for the following month. Instruments and a TV set were to be set up for alignment; the Chapter members were to align it under Sam's instructions.

Ronald Smith is the newest member to join the Chapter. Congratulations, Ronald!

SAN FRANCISCO CHAPTER'S Art Ragsdale delivered another one of his fine talks, this time on stacked B+ power supply in TV, his subject being based on an article appearing in the March issue of PF Reporter.

There was a discussion on getting instruments to keep at the meeting-place. VTVM and scope kits were decided on. A committee was appointed to plan a tour of station KFRC AM-FM broadcasting station.

Arnold Hopkins conducted an excellent demonstration on waveforms. In the course of this, he gave the members ten questions each to answer. This added considerable interest to the program.

Ed Persau promised to illustrate and demonstrate the use of photo cells and magnetic switches at the next meeting.

SOUTHEASTERN MASSACHUSETTS CHAPTER'S John Alves and Frank Sarro showed how to troubleshoot the high voltage section of a TV receiver by the use of a high voltage probe. They then employed an oscilloscope, a CRT tester and a VTVM to find the cause of no raster in the receiver under test.

The members present at this meeting agreed on the need for the Chapter to own a color TV set for troubleshooting and to give the average member confidence in servicing color TV. The Chapter expects to make this a reality very soon.

SPRINGFIELD (MASS.) CHAPTER held its May meeting on the twenty-third instead of the twenty-ninth because of the holiday. The feature of this meeting was a talk and demonstration on Industrial Electronics by Arnold

Wilde, who also explained the circuiting. This was a fine talk and demonstration.

The newest member to be accepted into the chapter is Jorge Mino. Welcome aboard, Jorge.

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, Mic., VI-1-4972.

FLINT (SAGINAW VALLEY) CHAPTER meets 8:00 P. M., 2nd Wednesday of each month at Andrew Jobbagy's Shop, G-5507 S. Saginaw Rd., Flint. Chairman: Henry Hubbard, 5497 E. Hill Rd., Grand Blanc, Mich., 694-4535.

HACKENSACK CHAPTER meets 8:00 P. M., last Friday of each month, St. Francis Hall, Cor. Lodi and Holt 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, 4912 DeCausin, 5870 Franklin Ave., Apt. 203, Hollywood, Calif., NO 4-3455.

MINNEAPOLIS-ST PAUL (TWIN CITIES) CHAPTER meets 8:00 P. M., 2nd Thursday of each month, at the homes of its members. 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.

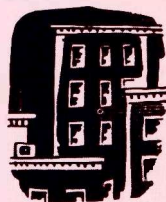
PITTSBURGH CHAPTER meets 8:00 P. M., 1st Thursday of each month, 436 Forbes Ave., Pittsburgh. Chairman: James L. Wheeler, 1436 Riverview Dr., Verona, Pa. 793-1298.

SAN ANTONIO ALAMO CHAPTER meets 7:30 P. M., 3rd Wednesday of each month, Beethoven Hall, 422 Pereida, San Antonio, Chairman: Sam O. Dentler, 329 Southcross, San Antonio, Texas. WA 2-8682.

SAN FRANCISCO CHAPTER meets 8:00 P.M., 1st Wednesday of each month, 147 Albion St., San Francisco. Chairman: Peter Salvotti, 2543 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.



ANSWER TO LUCKY'S PROBLEM

Knowing that this particular RF Generator was being used for ordinary receiver alignment purposes and not experimental or visual observation work, where exact waveforms and phasing are important, Lucky instructed the younger technician to install a .1 mfd 600-volt paper capacitor, in series with the output hot lead, inside of the instrument, for DC isolation. By having the capacitor inside of the generator it was virtually impossible to forget using one and thus saved time and expense.

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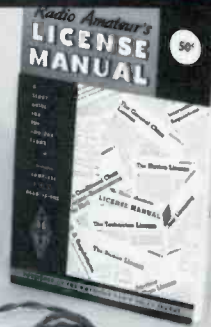
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MODEL 400
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The Model 400 25-watt Transmitter

Inside this attractive 10" x 7½" x 6½" dark blue cabinet is a remarkable powerhouse. Yet, it's so simple to build, so easy to tune, even an inexperienced kit builder can be on the air in one evening. Covers the popular Novice bands—80, 40 and 15 meters. 3" square panel meter for fast "tuning up." Special variable-impedance current-limiter assures purest signal on any band, protects your valuable crystals (crystals not included). Other features: Pi-network output; transformer power supply with dual silicon rectifier to produce ripple-free DC for plate power; bleeder resistor to regulate and discharge high-voltage capacitors when gear is turned off; co-ax output.

KIT PRICE: \$32.50
(Stock #400UK)
Assembled: \$46.50
(Stock #400WT)

Shipping wt. 10 lbs., parcel post insured

The Model 500 3 Band Receiver

Identical in size and color to the Transmitter. Offers features of receivers priced much higher. Superhet circuit has TWO stages of i-f amplification to "dig down" for weak signals. Antenna trimmer lets you adjust front end for peak reception on each of the three bands. Bands cover stretches over nearly full travel of large tuning dial. Separate, stable bfo for clear reception of CW and SSB signals. Variable i-f gain. Following the detector are two stages of audio amplification to drive either the built-in speaker or headphones. Transformer operated with semiconductor rectifier to supply power for various circuits. Receives AM, CW and SSB. So easy to build, so easy to use, so easy to own. Order yours today.

KIT PRICE: \$37.50
(Stock #500UK)
Assembled: \$56.50
(Stock #500WT)

Shipping wt. 10 lbs., parcel post insured

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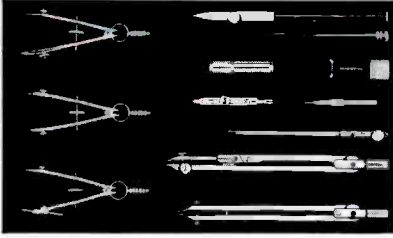
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