journal

may/june
1971

Harold Turner discusses Stereo/Hi-Fi Servicing

FREE GIFTS *With Conar Test Equipment*

One (or more) premium gifts is yours free of extra cost when you purchase any of the CONAR instruments or merchandise advertised in this issue.

PLAY THE NUMBERS GAME

SEE THE CENTER ADVERTISING PAGES FOR DETAILS.

CONAR 5" Wide Band Oscilloscope

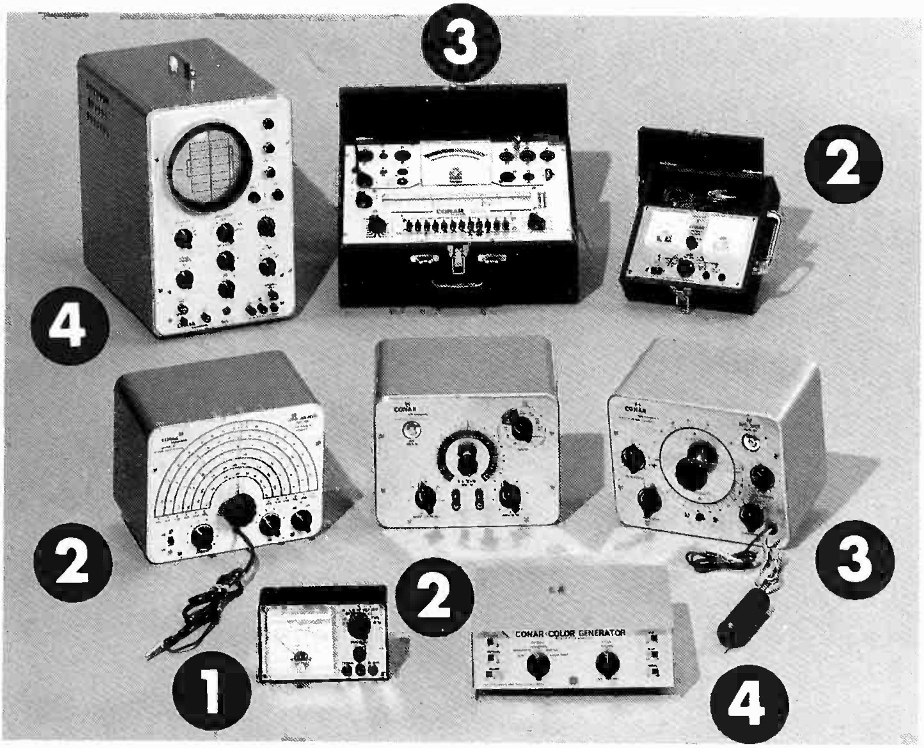
Kit	NRI Student & Alumni Price	Catalog Price
250UK	82.90	99.90
Wired 250WT	129.75	139.50

CONAR 223 Tube Tester

Kit	NRI Student & Alumni Price	Catalog Price
223UK	44.80	49.95
Wired 223WT	68.25	75.95

CONAR 200 Appliance Tester

Kit	NRI Student & Alumni Price	Catalog Price
200UK	25.40	31.95
Wired 200WT	30.90	39.95



CONAR 280 Signal Generator

Kit	NRI Student & Alumni Price	Catalog Price
280UK	26.35	29.95
Wired 280WT	39.55	43.95

CONAR 311 Resistor-Capacitor Tester

Kit	NRI Student & Alumni Price	Catalog Price
311UK	24.40	29.95
Wired 311WT	33.85	42.50

CONAR 230 Signal Tracer

Kit	NRI Student & Alumni Price	Price Catalog
230UK	39.80	49.95
Wired 230WT	56.70	69.95

CONAR 240 Volt-Ohmmeter Kit

240UK 19.95

Credit Terms available
Low monthly payments

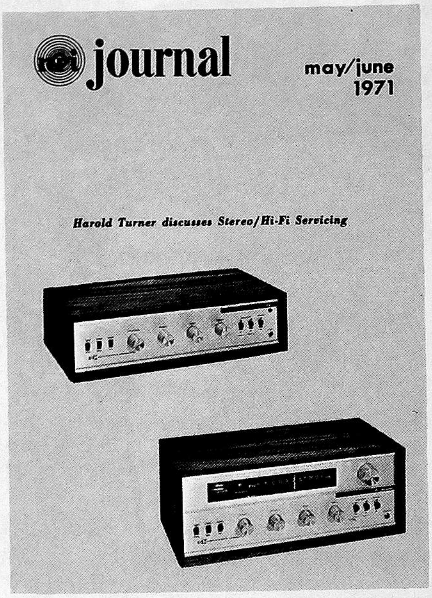
See your CONAR catalog for technical description of equipment.

BE SURE TO USE "FREE GIFTS" ORDER BLANK

CONAR 681WT Color-Bar Generator

Kit	NRI Student & Alumni Price	Catalog Price
681UK	79.50	89.50
Wired 681WT	109.00	121.50

Cover Photographs Courtesy
Audio Dynamics Corporation



MAY/JUNE 1971

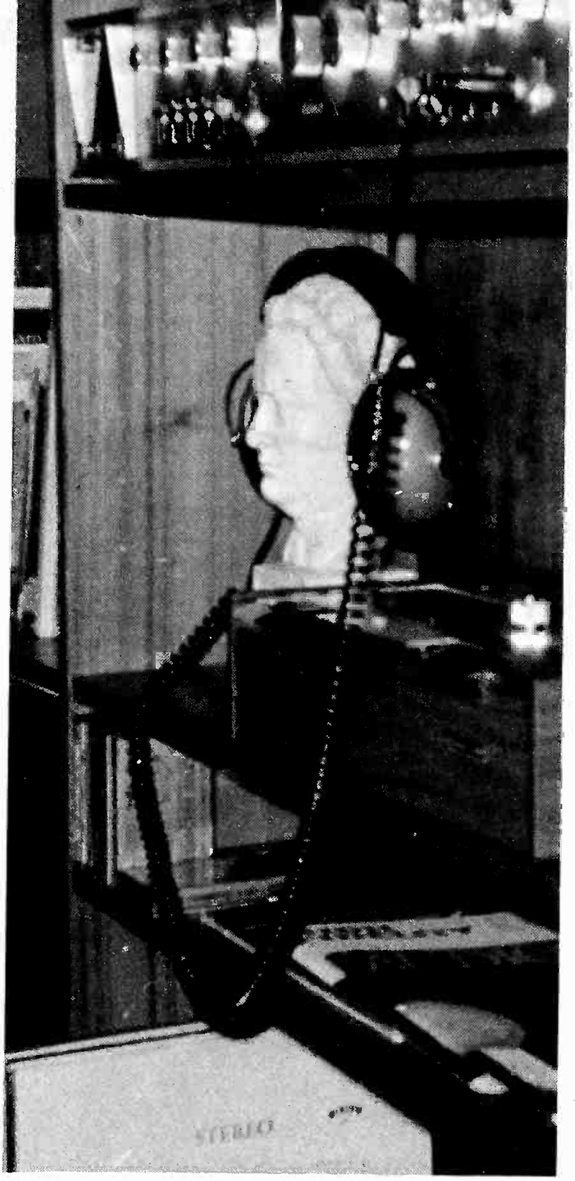
VOLUME 28 NO. 3

CONTENTS

• • •

the NRI Journal is published
bimonthly by National Radio Institute
3939 Wisconsin Avenue
Washington, D.C. 20016
subscription price is 2 dollars yearly
or 35 cents per single copy
second-class postage paid at
Washington, D.C.

EDITOR AND PUBLISHER
william f. dunn
MANAGING EDITOR
allene magann
ASSOCIATE EDITORS
j.f. thompson
h.b. bennett
TECHNICAL EDITOR
e.b. beach
ASSISTANT EDITORS
judy rhodes
kathy kibsey
shirley m. hildebrand
kathy dowling
STAFF ARTISTS
art susser
ernie blaine



by HAROLD J. TURNER, JR.

stereo/hi-fi servicing

As recently as ten years ago, the stereo/hi-fi business was relatively small. Only those who were knowledgeable in electronics, highly interested in music, rather wealthy, or some combination of these, ever owned a good music system. Today, of course, the market has been turned upside down. This is partly a result of improved technology (stereo instead of single-channel sound, transistors instead of tubes, cassettes instead of reel-to-reel tape, etc.).

The biggest difference, however, is probably in the market itself. Ten years ago the average hi-fi owner was a middle-aged man whose musical interests leaned toward Beethoven or perhaps Henry Mancini. Today, the young largely control the hi-fi market. In case you haven't noticed, music is an integral part of our "youth culture." And the young have a way of settling down, getting married, and furnishing a home. This is where the audio business enters the picture. Practically every newlywed couple's most prized possessions are their color TV and their stereo – and not necessarily in that order.

What does this mean to you as a technician? Well, for one thing, you could make your living servicing audio equipment. No TV's, two-way radios, or intercoms – just hi-fi equipment. In many localities there will be more than enough business to keep you busy full-time.

WHAT DO I NEED TO SPECIALIZE IN AUDIO SERVICING?

To specialize in audio servicing, or in any other area of electronics for that matter, you must be knowledgeable and skilled in the general field of electronics. Your NRI training will provide you with this basic qualification. But it is up to you to keep abreast of the latest developments in electronics in general, as well as in your particular field. The best way to keep up with the field of electronics is to read regularly at least two or three of the best trade magazines (*Electronics World*, *Radio-Electronics*, and *Electronic Servicing* are some).

If you are already a hi-fi buff, or if you are at least keenly interested in the field, you are several steps ahead of others who might be considering the business opportunities in this area of electronics. If your knowledge of audio is very limited, don't be too concerned about it. As long as you have a good, solid electronics background, you can pick up the details as you work. But the best way to learn is to read, read, read. Check the list at the end of this article for some good reference material. Probably the best single reference in the entire field is the huge *Audio Cyclopedia*. Although this book is very expensive, it will certainly be a good investment if you decide to make audio your business.

As you begin to learn something of the field, you will begin to see that perhaps the biggest difference between audio servicing and other types of consumer electronic servicing is the type of customer you are likely to encounter. The audio customer will probably be more demanding of your talents while being willing to pay well. Much of the work will be in tracking down relatively minor complaints, troubles which other people might never notice, or would certainly never complain about. This means that you must develop a very keen ear for good sound equipment.

WHAT TEST EQUIPMENT DO I NEED?

If you are doing radio-TV service work, you probably already have the equipment you need to do 90% of all audio servicing jobs. As in any electronic specialty, the basic test instruments are the vtvm (or high-impedance transistorized voltmeter) and oscilloscope. Some jobs, however, will require the use of specialized test equipment such as a sine-square wave generator, a distortion analyzer, an audio voltmeter, an FM stereo generator, and an FM sweep generator.

HOW DO I GO ABOUT SETTING UP AN AUDIO SERVICE BENCH?

First of all, you must realize that much of the equipment you will be servicing will be individual components rather than complete systems. In general, a component audio system consists of one or more program sources (record player, tape player, FM tuner, etc.), an amplifier, and a set of speakers. In order to service such individual components efficiently, you must have a test bench that provides the missing pieces to make up a complete system while the service work is in progress.

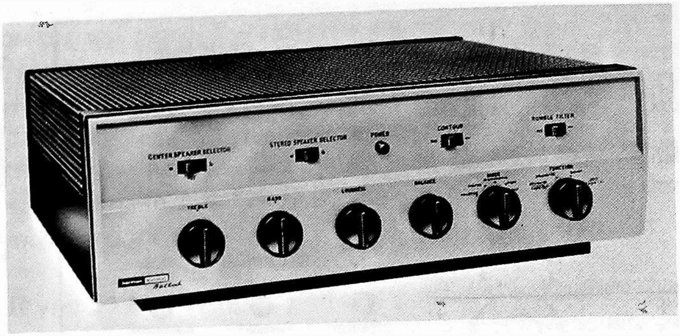
The best way to go about setting up such a service bench is to purchase a stereo FM tuner, stereo amplifier, and a pair of speakers and make available all input and output connections to these pieces of equipment on a jack panel mounted in a convenient place on the service bench. Since any piece of equipment you service will be roughly equal in function to one of the pieces of equipment permanently mounted on the bench, you simply substitute the piece of equipment under test for one of your bench units. Together they will form a complete system.

Since the performance of the entire system can be no better than the performance of any one component, you can use the sound that comes out of the speakers as a gauge for telling just how well your service work is progressing. Suppose you were servicing an amplifier. You would connect the output of the FM tuner into the amplifier input and connect the amplifier output to the bench speakers.

The equipment you use for your bench setup need not be new. The tuner can be practically any stereo FM tuner capable of furnishing a signal of about 1 volt rms into a high impedance load. This is a "high level" signal, which is more or less a standard audio signal level. Most components are designed to accept a signal of roughly this strength. The quality of the unit is not especially important, as long as the tuner is reliable and can pick up at least one FM stereo station without noticeable background noise.

Ideally, the amplifier should consist of two separate pieces: a PREAMPLIFIER, which includes the early stages of the amplifier and all necessary controls and switches, and a separate POWER AMPLIFIER, which includes the driver and audio power output stages. It is best that these units be separate so that you can test separate preamplifiers and power amplifiers. However, if you can't find separate units, an integrated amplifier (combined preamplifier and power amplifier) will do nearly as well.

I recommend that you get a tube type amplifier; some transistor designs are prone to



An integrated amplifier: *a 2-channel stereo preamplifier and two power amplifiers on one chassis.*

Courtesy Harman Kardon

failure as a result of shorted outputs, excessive input signals, etc. Since you will be making a lot of connections to the outputs of the amplifier, the chances of an eventual error are quite high. Tube amplifiers are more or less immune to this type of trouble. The power rating should be on the order of 10 to 15 watts of audio output per channel.

It is very important that the amplifier have an input for a magnetic phonograph cartridge; you will need this input whenever you test a phonograph equipped with such a cartridge. This type of cartridge has a very low output level (about 10 millivolts) and requires a special equalization circuit to cancel out the frequency compensation introduced in the recording process. Since you will often be testing the magnetic phono inputs on amplifiers, you must have available a test signal for feeding to this type of input. For this you can use the 1-volt rms output of your FM tuner, attenuated as shown in Fig. 1. The capacitor is used to approximate the way the phonograph recording would be altered in the recording process, just the opposite of what happens in the magnetic phono preamp. The two effects cancel out to produce an overall uniform frequency response.

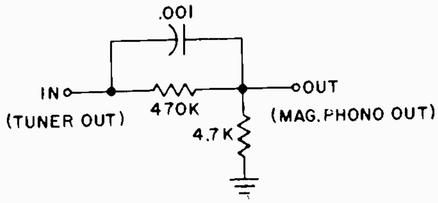
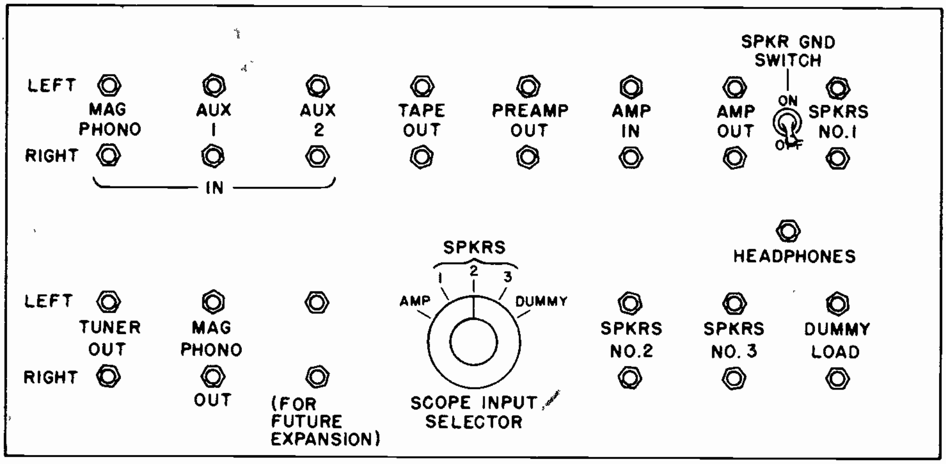


Fig. 1. *How to obtain a signal for testing magnetic phono inputs. Two of these circuits are needed for stereo.*

Fig. 2 shows how your test panel can be set up. I prefer standard 1/4-inch phone plugs and jacks; they are fairly inexpensive and almost indestructible connectors. In addition, they make more reliable connections than phono plugs do. All amplifier inputs and outputs, tuner outputs, and speaker connections are brought to jacks on this panel.

The detail in Fig. 2 shows how each of the normally closed jacks works. The "sleeve" is connected to ground in most cases. Since the sleeve makes electrical contact with the panel, the panel should be made of some kind of insulating material such as masonite. A metal panel would connect all the sleeves together at all times, and some of them must be



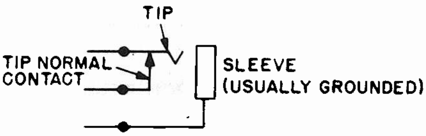


Fig. 2. *Test panel layout.*

isolated for certain special tests. The sleeve of the jack makes contact with the main part of the phone plug. The tip of the phone plug, which is the signal-carrying conductor, makes contact with a spring in the jack. This spring connector is normally called the "tip." These two elements make up a complete open-circuit jack. Closed-circuit jacks, such as the ones used on the test panel, incorporate a third connection, called the "tip normal." It is normally connected to the tip whenever a plug is not inserted. Inserting a plug breaks the connection between the tip and tip normal contacts. This feature is very useful in providing automatic switching of inputs and outputs.

You will need a good assortment of patch cords to use with the test panel. Since all the jacks are the standard 1/4-inch phone jacks, all your patch cords must be equipped with a 1/4-inch phone plug on at least one end. It would be a good idea to have at least four cords with this type of plug on both ends so that you can provide connections between two jacks mounted to the panel. You will also need several cords with a 1/4-inch phone plug on one end and a phono plug on the other end. You can make these cords yourself or you can buy them already assembled. Preassembled cords are more expensive but provide more reliable connections, especially in the case of phono plugs.

Since many of the circuits you'll be working on handle fairly low signal levels at fairly high impedances, all patch cords should be made of shielded cable. It's best to standardize on shielded cable for all your patch cords so you will automatically have shielding when you need it.

All the jacks used are the standard open-circuit type, except the eight closed-circuit jacks and the single stereo headphone jack. Closed-circuit jacks are used normally in two places on the test panel. Both circuits are shown in Fig. 3. You will need the "preamp out" and "amplifier in" shown in Fig. 3A only if you use a separate preamplifier and power amplifier.

If you have a single-chassis integrated amplifier, this connection will be made inside the equipment. In that case you won't be able to bring the outputs to the jack panel without modifying the circuit.

If you do have separate units, you will normally want them to be connected; the normal jacks do this for you automatically, without using any patch cords. If you want to use either amplifier separately, the normal connection will be broken as soon as you insert the plug.

The speaker outputs shown in Fig. 3B are wired in much the same way, but an extra switch has been added to isolate the speakers from the amplifier ground circuit. Also a stereo headphone jack is wired in parallel with the amplifier output. You can turn off the speakers by opening the double-pole switch when you wish to listen only to the headphones. This leaves the amplifier connected without much of a load, so don't turn the volume up too high. Without any load connected, some amplifiers will develop trouble. To avoid this possibility, connect a 33-ohm, 2-watt resistor across each amplifier output. This will provide at least a light load at all times.

There are a couple of special features incorporated on the jack panel. Perhaps most important is the speaker switching arrangement, shown in Fig. 3. Normally closed jacks are used so that, when no patch cords are inserted into any of the jacks, the two bench speakers are connected directly to the outputs of the bench amplifier.

Notice that there is also a double-pole switch in the ground circuits. This switch must be opened to isolate the ground circuits when you are working on certain amplifiers.

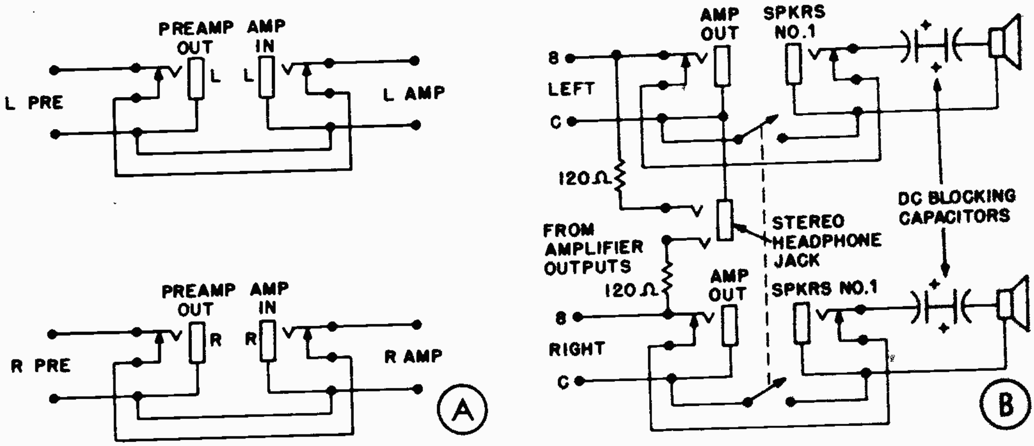


Fig. 3. *Normally closed jacks for the amplifier input (A) and output (B).*

Fortunately, on most amplifiers the right and left channel speaker ground terminals can be connected together. But this is not always true. Be sure to check the schematic diagram to see if the ground terminals can be connected together safely.

Another handy feature is a pair of 8-ohm, 60-watt dummy load resistors. They can help you make high level checks of power amplifiers without losing your speakers or your mind. Since 8-ohm, 60-watt resistors are rather hard to find, use a combination of higher resistances connected in parallel to get the correct resistance. Two sets of five 40-ohm, 12-watt resistors would to the job nicely. Whatever value you use, make sure that they are noninductively wound.

Another very useful feature is the built-in oscilloscope switching circuit. I recommend that you use a second oscilloscope, in addition to the scope that you use for ordinary troubleshooting, to be connected to the test panel at all times. A selector switch allows you to monitor continuously any of several sets of jacks to see what signals are present.

Notice that three pairs of speaker connections are shown in Fig. 2 instead of just one. The main pair of speakers is used for most servicing work, while the others are used for "test-playing" units that have already been repaired. As shown in Fig. 4, the oscilloscope selector switch can be used to monitor the signals fed to any pair of speakers, the dummy load, or the output of the bench amplifier.

As mentioned earlier, you won't always be able to "common" (connect together) the ground leads from the left and right channel of the amplifier you are servicing. Since the

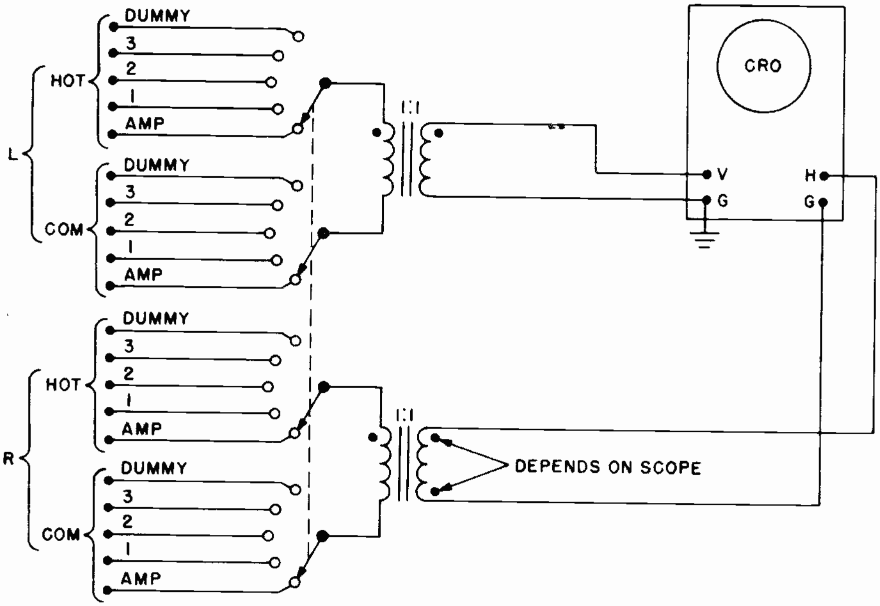


Fig. 4. *Oscilloscope switching setup.*

oscilloscope vertical and horizontal inputs do have a common ground, you must isolate each of these inputs with a small transformer to prevent damage to the amplifier under test. The transformer you use should have about a unity turns ratio (1:1) and fairly high input and output impedance (about 10k ohms). Of course, they should be fairly high quality transformers so as not to distort the audio signal. If you don't have anything closer in the junk box, a UTC SO-2 interstage coupling transformer would work nicely. These are available at industrial parts suppliers for about $7 each.

Although most tube type amplifiers have output connections for 4, 8 and 16-ohm speakers, all connections are made to the 8-ohm taps on the test amplifier. This is a compromise to avoid having to change the amplifier impedance taps. Most of the speakers you will be testing will be rated at 8 ohms impedance, so a slight mismatch won't hurt very much.

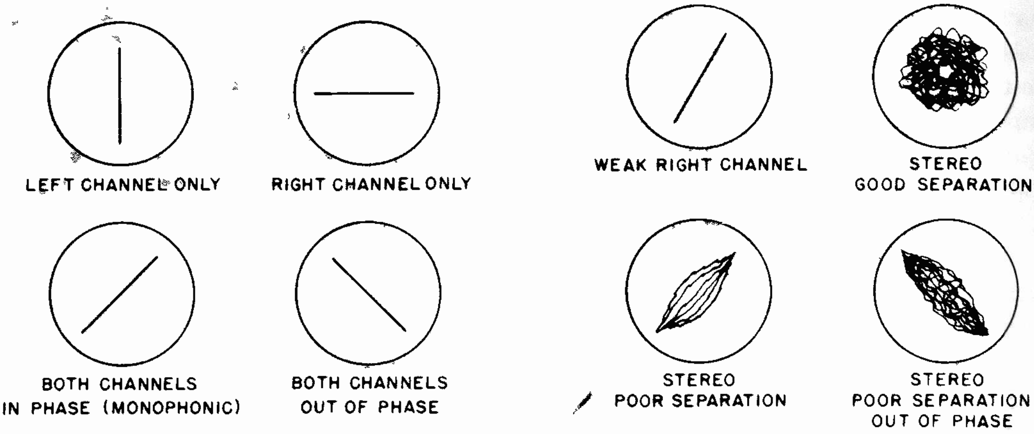
As far as the speakers themselves are concerned, the main speakers should be fairly high quality units: at least 8-inch speakers, each mounted in a substantial wooden box. You might consider purchasing a pair of complete bookshelf speaker systems. You should expect to spend between $20 and $60 per speaker. The extra test speakers can be inexpensive replacement speakers mounted in small boxes. But even here 8-inch speakers are preferred.

Normally, no dc is ever passed through a speaker. This would overheat the voice coil and perhaps burn it out. Unfortunately, sooner or later you will connect a defective amplifier to your test panel only to find that perhaps 30 to 40 volts dc is present at the speaker terminals. This could be disastrous.

But the danger can be avoided by permanently connecting a large-value capacitor in series with each of your test speakers. Since you need nonpolarized capacitors, you can connect two ordinary polarized electrolytics back-to-back as shown in Fig. 3B. If you use capacitors of equal value, the capacitance will be half each individual capacitor; the voltage rating will be equal to the voltage rating of either capacitor alone. (Remember, a reverse-connected electrolytic acts as a virtual short circuit while the other capacitor is charged to the full applied voltage.) You can purchase 5000-mfd, 25-volt capacitors for less than $3.

The oscilloscope you use on the test bench doesn't have to be a very expensive one. For audio work all you need is 200 kHz frequency response; the vertical and horizontal amplifiers should be more or less the same for best results. The Heathkit Model IO-21 is ideal for this purpose. Most of your testing with this scope will be done with the left stereo channel connected to the vertical input of the scope, and the right channel connected to the horizontal input. Fig. 5 shows the display you can expect from different signals. This type of display is most useful in determining the amount of separation present in a stereo signal, especially for FM stereo alignment work.

Speaking of FM stereo, another important thing which must be available on your test


LEFT CHANNEL ONLY

RIGHT CHANNEL ONLY

WEAK RIGHT CHANNEL

STEREO
GOOD SEPARATION

BOTH CHANNELS
IN PHASE (MONOPHONIC)

BOTH CHANNELS
OUT OF PHASE

STEREO
POOR SEPARATION

STEREO
POOR SEPARATION
OUT OF PHASE

Fig. 5. *Typical waveforms.*

bench is an FM antenna connection. This can be tied to your television master antenna system or it can be a separate system. In either case, be sure to provide two or three antenna connections on the test bench.

Not all your work will involve amplifiers, preamplifiers, and speakers. Much of your time will be spent servicing turntables, record changers, and tape recorders (including reel-to-reel, 8-track cartridge, and cassette machines). This is almost a separate field in itself, since most of the problems are mechanical. Unfortunately, the average audiophile doesn't realize this. Since you are his hi-fi man, he will turn to you for help when his record player or tape recorder is sick. Don't let this disturb you; there is much profit to be made in servicing such equipment. However, as usual, it's best to read up on the subject so that you will be at least basically familiar with the various problems to be expected. These machines are just briefly discussed in many books on audio, so it's best to read one or two books on these specific types of equipment as well.

HOW DO I GET AUDIO SERVICE CUSTOMERS?

The answer to this question depends upon what size business you are planning. If this will be strictly a part-time operation, you will probably be limited to word-of-mouth and business card advertising. You might also consider placing newspaper classified ads or posting notices on public bulletin boards.

A larger-scale operation would call for more advertising. A listing in the yellow pages of the telephone book usually pays off many times over. The next best type of advertising is probably the local daily newspaper. Since many of your potential customers are FM radio listeners, you might consider advertising on an FM broadcast station.

WHERE DO I GET SERVICE INFORMATION?

If you have been in the radio-TV service business for long, you know that Sams Photofacts provides coverage of most radio and TV receivers. Unfortunately, Sams covers

(continued on Page 24)

Dr. Farnsworth, TV's 'Father', Was A Star NRI Student At 15

"*. . . The evil that men do lives after them;*
The good is oft interred with their bones. . ."

Not so for Dr. Philo T. Farnsworth, whose invention of the first complete electronic television system made him known to the world as the "Father of Television". Dr. Farnsworth's first patented invention was also a first of its kind for the world, a complete television system, for which he also designed a sort of cathode ray tube to meet his own specifications. In following years, he acquired more than 200 U.S. and foreign patents in the field of electronics, primarily in perfections of his original idea.

That's a legacy of infinite, unburiable good.

But for 90-year old J. E. Smith, NRI's founder, the recent death of Dr. Farnsworth, 64, holds a poignancy and a memory in a different vein: that of the precocious NRI student in 1921 from Beaver, Utah, who even at 15 had a dream of "pictures in the air".

By the time Dr. Farnsworth dropped out of Brigham Young University in Provo, Utah, at the age of 18 (his father's death made it financially impossible), he was an NRI graduate and well on the way to making his dream a reality. The tubes he visualized as part of his camera-tube system didn't exist, so he invented – and built -- those, too. He filed his first application for a patent on the TV system in 1924.

By 1924 Farnsworth had set up a lab in San Francisco for television transmission; in August 1931 an article in the National Radio News cited the "vast importance" of his invention and aid to "enthusiast" engineers by further perfections, such as elimination of the clumsy scanning disc in favor of scanning with "an elaborate form of photo-electric cell." In 1934 Farnsworth was granted the first television Broadcast license in the world, followed up in 1935 by the first public transmission, generating his fame beyond engineers to a larger portion of the world.

He then founded the Farnsworth Radio and Television Company, which later became the Cape-Farnsworth Radio and Television Company, which later became the Cape-Farnsworth Electronics Company, part of the ITT system. While its vice-president and director of research in the rapidly burgeoning field, he found time to serve as an unpaid consultant on what was then the NRI advisory board. . .because he believed in the training to help further the careers of other ambitious young men.

Obviously, he too had a long memory.

digital counters

the final article in a series on digital techniques

by louis e. frenzel, jr.

Courtesy Hewlett Packard

In this last article of the series on digital techniques, we are going to cover perhaps the most widely used of all digital circuits, the counter. A counter is a digital circuit made up of flip-flops. The flip-flops are cascaded in such a way that if one changes state, all the others will be affected. The input to the counter is a series of pulses. The counter counts these pulses and then stores in the flip-flops a binary number that represents the number of input pulses received. There is a wide variety of counters and they have numerous applications in digital equipment. Let's discuss some of the most important counters and show some interesting uses.

BINARY COUNTERS

Fig. 1 shows a diagram of a four-stage binary counter. Notice that it is made up of JK flip-flops. The J and K inputs are not used. Instead, the flip-flops are used in their toggle or complementing mode only. Each time that a flip-flop receives an input pulse, the flip-flop will toggle or change state. Connecting the normal (Q) output of one flip-flop to the toggle (T) input of the next in the series produces a binary counting effect. What this means is that as the input pulses are applied, the binary number stored in the four flip-flops will increase one step at a time for each input pulse. At any given time you can look at the flip-flop outputs A, B, C, and D and observe a binary number that, when converted to decimal notation, indicates the number of pulses that have occurred.

Table I shows the count sequence for the binary counter. This table indicates the condition of each flip-flop in the counter after each input pulse occurs.

Let's assume that the counter is initially cleared or reset to the 0000 state by

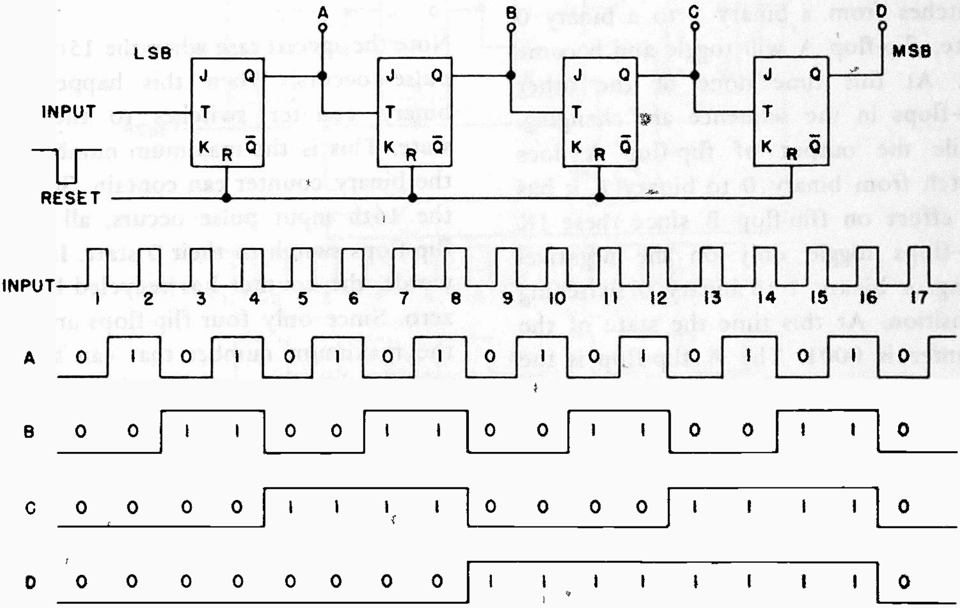


Fig. 1. A 4-bit binary counter and input/output waveforms.

	DCBA
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
10	1010
11	1011
12	1100
13	1101
14	1110
15	1111

Table I. Count sequence for the 4-bit binary counter.

applying a negative-going pulse to the direct reset inputs on the JK flip-flops. If we now apply an input pulse that switches from a binary 1 to a binary 0 state, flip-flop A will toggle and become set. At this time none of the other flip-flops in the sequence are changing. While the output of flip-flop A does switch from binary 0 to binary 1, it has no effect on flip-flop B since these JK flip-flops toggle only on the negative-going or binary 1 to binary 0 switching transition. At this time the state of the counter is 0001. The A flip-flop is the least significant bit (LSB) position while the D flip-flop is the most significant bit (MSB) position.

When the next input pulse occurs, the A flip-flop again toggles. It switches to the binary 0 state. In doing this, its normal output switches from binary 1 to binary 0; this, in turn, toggles or sets flip-flop B. The state of the counter is now 0010, corresponding to a decimal 2.

Fig. 1 also shows the waveforms of the input signal and each of the flip-flop outputs. You can see that the flip-flops are toggling on the trailing edge of their input. You can also see the binary number stored in the counter for each state. The binary 1 and binary 0 conditions for each flip-flop are noted in the diagram. Reading these from bottom to top (D through A) you can see how these states correspond to the count sequence shown in Table I. Note that the starting state on the far left is the reset or 0000 condition. When input pulse number one occurs, the state of the A flip-flop changes so that the number is now 0001. The counter retains this state until the trailing edge of the second input pulse occurs. At this time the counter changes to the 0010 state. As you can see, the number of input pulses corresponds to the binary number contained within the counter.

Note the special case when the 15th input pulse occurs. When this happens the binary counter switches to the 1111 state. This is the maximum number that the binary counter can contain. So when the 16th input pulse occurs, all of the flip-flops switch to their 0 state. In other words, the counter has recycled back to zero. Since only four flip-flops are used, the maximum number that can be contained within the counter is 1111 or a decimal 15.

The maximum count capability of a binary counter is determined by the number of flip-flops in the counter. The maximum number that can be stored is determined by the simple formula:

$$2^n - 1$$

In our 4-bit counter, the maximum count capability is 15.

$$2^4 - 1 = (16 - 1) = 15$$

An 8-bit binary counter can count to a maximum of:

$$2^8 - 1 = (256 - 1) = 255$$

Such a counter can be used to count quantities up to and including 255.

BCD COUNTERS

Another widely used type of counter is the BCD or binary coded decimal counter shown in Fig. 2. Like the 4-bit binary counter just discussed, it uses four JK flip-flops. However, it also uses some logic gates and some unusual wiring connections that were not present in the pure binary counter of Fig. 1. The extra wiring and additional logic circuitry permit this 4-bit counter to count decimally. That is, it can represent in binary code any one of the ten decimal numbers zero through nine. Such counters are used in digital equipment that requires frequent output interpretation. Since we all use the decimal system, we are better off when we can use this type of number system. The BCD system, while still a binary system, permits the output states to be more easily recognized.

The BCD counter in Fig. 2 is similar in operation to the simple 4-bit binary counter in Fig. 1. As you can see by the count sequence in Table II, it corresponds almost directly with that of the count sequence in Table I. Notice, however, that only the states 0 through 9 are used. After the ninth state the counter recycles

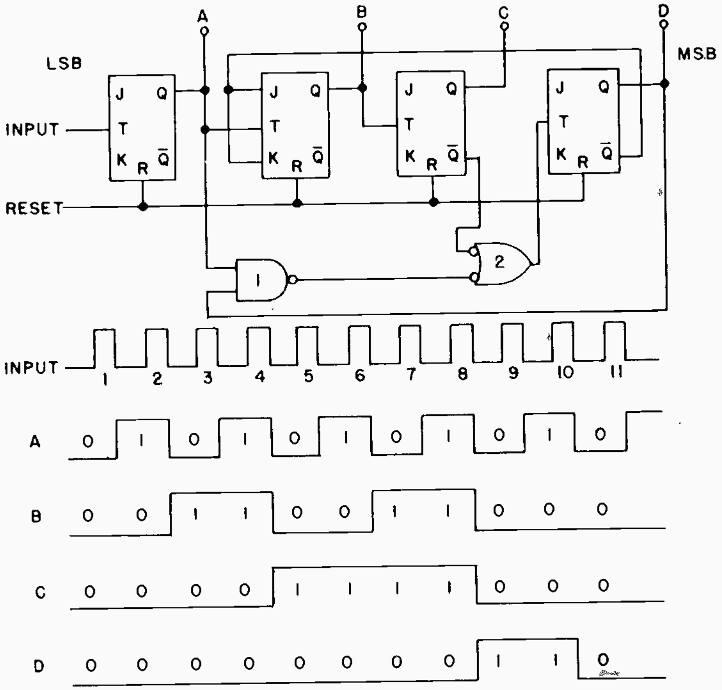


Fig. 2. A BCD counter and its input/output waveforms.

	DCBA
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001

Table II. Count sequence for the BCD counter.

back to its zero condition. Otherwise, the ten states of the BCD counter are identical to the first ten states of the binary counter. The extra gate circuitry shown in Fig. 2 is used to force the flip-flops to count only the zero through nine states.

Refer to the input/output waveforms shown in Fig. 2. Note that the flip-flops still toggle on the negative-going transition at their T input. Except for the last stage, the flip-flops are cascaded in much the same way as the binary counter. As the input pulses are applied, the A, B, and C flip-flops toggle as before. When the output of LSB flip-flop A switches from binary 1 to binary 0, the B flip-flop toggles. When the output of the B flip-flop switches from binary 1 to binary 0, the C flip-flop toggles. The $\overline{Q}$ or complement output of the D flip-flop is fed back to the J and K inputs of the B flip-flop. As long as the J and K inputs are at a binary 1 condition, the flip-flop will toggle normally. When the J and K inputs are held to a binary 0 condition, however, the flip-flop will not toggle. During most of the count sequence the complement output of the D flip-flop will be a binary binary 1. This condition permits the B flip-flop to be toggled by the A flip-flop.

The waveforms in Fig. 2 show that the count sequence for the BCD counter is similar to that of the binary counter up through the 0111 state. Gates 1 and 2 cause the D flip-flop to toggle and the counter to change from the 0111 state to the 1000 state. In the 0111 state, the complement output of the C flip-flop is at a binary 0 condition, holding the output of gate 2 high. When the next input pulse occurs, the A flip-flop toggles from 1 to 0, thereby toggling the B flip-flop which in turn toggles the C flip-flop. The complement output of the C flip-flop switches from a binary 0 to a binary 1 condition. This causes the output of gate 2 to switch from a binary 1 to a binary 0 condition, thereby setting the D flip-flop. The next input pulse (the 9th input pulse) toggles the A flip-flop, producing the correct code 1001. The output of the D flip-flop, now a binary 1, causes gate 1 to be enabled. When the 10th input pulse occurs, the output of the A flip-flop switches from a binary 1 to a binary 0. The output of gate 1 switches from binary 0 to binary 1. The output of gate 2 then switches from binary 1 to binary 0, thereby toggling the D flip-flop and resetting it to zero as the A flip-flop is toggled and reset to zero. Notice that the output signal from the complement side of the D flip-flop is fed back to the J and K inputs to the B flip-flop. With the D flip-flop set, its complement output is a binary 0, thereby holding the J and K inputs to the B flip-flop at a binary 0. This prevents the B flip-flop from toggling when the 10th input pulse occurs and the A flip-flop output switches from a binary 1 to a binary 0. The overall result is that from the 1001 state the counter returns to the 0000 state.

FREE PREMIUM GIFTS WITH YOUR PURCHASE IN CONAR'S SPRINGTIME SHOPPING SALE

PLAY THE NUMBER'S GAME!

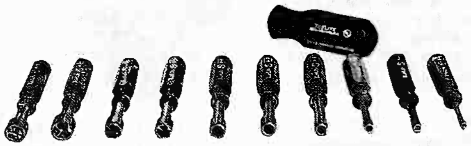
HERE'S HOW . . . One (or more) of the premium gifts shown on this page is yours free of extra cost when you purchase any of the CONAR instruments or merchandise featured in this issue.

Each premium gift below is numbered. Each item for sale features a number in a circle. Simply match the numbers to see which gift you receive free with your purchase. The higher the number, the more valuable the gift.

When you order your merchandise, be sure to cut out and enclose the appropriate coupon (or coupons) below so that you will receive your free gift.

This special offer ends at midnight on June 30, 1971, so don't delay. Send in your order right away.

④ PREMIUM GIFT COUPON



ECELITE NUTDRIVER SET

Ten color-coded, pocket size drivers, plus a "torque amplifier handle" that fits over driver handles. Packed in sturdy, see-through plastic case. A $8.25 value.

③ PREMIUM GIFT COUPON

FOUR TOOLS IN ONE:

Slip-joint Plier • Wire Cutter
Screwdriver • Adjustable Wrench

Countless uses with handymen, sportsmen, hobbyists, and housewives. Forged of special alloy steel. A $5.00 value.

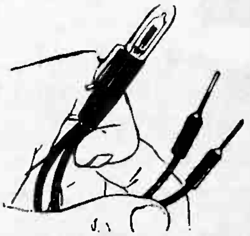
② PREMIUM GIFT COUPON

MINI WIRE STRIPPER

Multi-purpose handy pocket tool. Pocket clip opens to cut wire. Strips insulation without nicking. Handy insulated small screwdriver. Only 5½" long. A $2.50 value.

① PREMIUM GIFT COUPON

CLIP-ON NEON TESTER



Test voltage in any circuit. Indicator shows when circuit is hot. AC or DC 90 to 500 volts. Clip on shirt or coat pocket.

BE SURE TO USE "FREE GIFTS" ORDER BLANK

Save $30
Get Free Gift Too

④

THE FAMOUS GTX HUNTMASTER

Jetco Metal And Mineral Detector
DESIGNED FOR THE PROFESSIONAL AND AMATEUR ALIKE!

- ★ 14 Transistors of Power
- ★ Lightweight and Balanced
- ★ Waterproof Search Coils
- ★ Detects Through Wood, Dirt, Rock, Sand, Mud and Water
- ★ 3 Year Guarantee
- ★ Precision Pin-Point Tuning
- ★ Comes With 2 Search Coils

THE GTX HUNTMASTER WILL DETECT: A PENNY . . . AT 5 TO 7 INCHES • A SILVER DOLLAR . . . 8 TO 12 INCHES • A BAG OR JAR OF COINS . . . 18 TO 30 INCHES • LARGER OBJECTS DEEPER . . .

DETECTS ALL DETECTABLE METALS AND MINERALS

The GTX Huntmaster is the perfect companion for exploring old homesites, ghost towns, caves and beaches. Its durable corrosion resistant construction makes it excellent for use near salt water. Detects gold, silver, copper, iron and all other metals and detectable minerals. The amazing GTX HUNTMASTER features maximum penetrating power combined with small coin sensitivity that cannot be surpassed, regardless of cost.

The GTX Huntmaster has view-meter which increases its efficiency by detecting objects on the fringe of the normal detecting area. View-meter allows the GTX to be used silently.

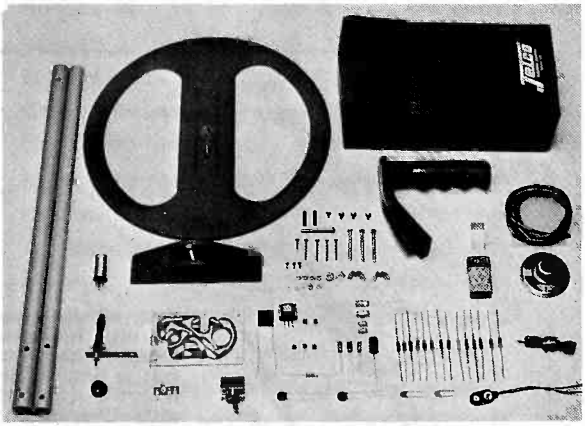
The GTX Huntmaster comes complete — ready to use with both 6" and 12" waterproof coils. You will not find a better detector at a comparable price.

COMPLETE ONLY
~~$129.50~~
Stock #1 Wt. 6 lbs. Parcel Post Ins.

NEW LOW PRICE
ONLY $99.50

THE JETCO GTS

THE NEW KIT MODEL DETECTOR



Pictured above are the components of the GTS Kit Model Detector. A printed circuit board (not shown) is included. There is nothing else to buy. In about four hours you will have built a power packed detector worth nearly twice the price. You save because you build it yourself.

Assembles in about four hours—no knowledge of Electronics required for easy assembly.

$59.95
6" Coil #8UK
12" Coil #9UK
5 lbs. Par. Post. Ins.

Dual Search Coils
Model #10UK $69.95
6 lbs. Par. Post Ins.

- **Power Packed, Highly Sensitive Detector**
- **Fully Transistorized**
- **Easy Fine Tuning**
- **Cleartone Loud Speaker Control**
- **Your Choice of 6" or 12" Waterproof Search Coils**
- **Lightweight — 3 Pounds**
- **All Parts Guaranteed 3 Years**
- **Detects All Metals & Detectable Minerals**
- **Works Through Mud, Rock, Concrete, Soil, Wood and Water**

③

BE SURE TO USE "FREE GIFTS" ORDER BLANK

FREE GIFTS

CONAR

ORDER BLANK

DIVISION OF NATIONAL RADIO INSTITUTE
3939 WISCONSIN AVENUE • WASHINGTON, D.C. 20016

CHECK ONE:
☐ Cash Order
☐ C.O.D. (20% deposit required)
☐ Select-A-Plan Order

CHECK ONE:
☐ New CONAR Account
☐ Add-on CONAR Account
☐ Re-open CONAR Account

PLEASE PRINT

NRI Student or Graduate No.

Name

Address

City State Zip Code

Moved since last order?

Previous Address City State

Ship to another address? Give Directions here

Name

Address

City State Zip Code

1. NAME OF ITEM	2. STOCK #	3. HOW MANY?	4. PRICE EACH	5. TOTAL	WEIGHT

IMPORTANT

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

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

Please include postage for weight shown and insurance on Parcel Post orders.

Express Orders should not include shipping charges.

A 20% deposit is required on C.O.D. orders. SELECT-A-PLAN ORDERS: Please complete and sign reverse side.

Thank you for your order.

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

6. **Total Cash Price For Merchandise**		
(Do not remit for items shipped Express Collect) 7. **Parcel Post and Insurance**		
8. **10% Cash Down Payment and Parcel Post Costs Required on New CONAR Accounts**		
9. **Unpaid Balance of Cash Price** (Items 6 & 7 less item 8)		
10. **Sales Tax** (Washington, D.C. Residents Only)		
11. **Unpaid Balance** (Amount to be financed) (Item 9 plus item 10)		
12. **Finance Charge** (See schedule on back)		
13. **Total of Payments** (Item 11 plus item 12)		
14. **Deferred Payment Price** (Items 6, 10 and 12)		

Please do not write in this space

RETAIL INSTALLMENT CONTRACT & SECURITY AGREEMENT

CONAR SELECT-A-PLAN

SELECT YOUR TERMS TO FIT YOUR BUDGET

CONAR FINANCIAL RATES:

STANDARD PLAN—The ANNUAL PERCENTAGE RATE is 17.75%

EXTENDED PLAN—The ANNUAL PERCENTAGE RATE is 15.50%

SELECT-A-PLAN SCHEDULE

PLEASE CHECK ONE: ☐ STANDARD PLAN
☐ EXTENDED PLAN

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

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

TO SPEED SHIPMENT

1. Complete other side of this sheet.
2. Use Select-A-Plan Schedule on the right to find your Finance Charge and your Monthly Payment.
3. Insert amount of down payment (at least 10% of total order) and other information in Payment Agreement below.
4. Sign Payment Agreement and fill in Credit Application.

IMPORTANT: When you have made three monthly payments, you can "add-on" purchases with no down payment. If you are under 21, please have the Payment Agreement and credit application filled out and signed by a person over 21. He can make the purchase for you and will be responsible for payment. If you have a CONAR account open or recently paid-in-full, just sign the Payment Agreement.

NOTICE TO THE BUYER: (1.) Do not sign this agreement before you read it or if it contains any blank space. (2.) You are entitled to a copy of this signed agreement. (3.) The Finance Charge will be waived if the unpaid balance is paid within 30 days. If paid within 60 days, the Finance Charge will be reduced by 2/3; if paid within 90 days, the Finance Charge will be reduced by 1/3. Accounts extending beyond 30 days will pay up to $3 in Credit Service Charges before the above reductions are made.

HOW TO DETERMINE THE NUMBER AND AMOUNT OF MONTHLY PAYMENTS TO REPAY THE "TOTAL OF PAYMENTS"

Use the Select-A-Plan Schedule to find out what your monthly payment is. Then divide your monthly payment into your "Total of Payments" to find out how many monthly payments you must make. The amount which is left over is your final payment. FOR EXAMPLE, if your unpaid balance is $95, then your monthly payment is $8.75 (using the Standard Plan). If your "Total of Payments" is $104, then your monthly payment of $8.75 divides into that number 11 times with $7.75 left over. This means you make 11 payments of $8.75 each, plus a final payment of $7.75.

PAYMENT AGREEMENT

Enclosed is a down payment of $.................... on the merchandise I have listed on the reverse side. Beginning 30 days from date of shipment, I will pay CONAR $.................... each month for .... months, plus a final monthly payment of $.................... Title to and right of possession of the merchandise shall remain in you until all payments have been made. If I do not make the payments as agreed, you may declare the entire balance immediately due and payable. In satisfaction of the balance, you may at your option, take back the merchandise, which I agree to return at your request. I understand that a 1% accounting charge will be added to my unpaid balance if my payments become 60 days or more in arrears. I agree that the above conditions shall apply to any add-on purchases to my Select-A-Plan account. The statements below are true and are made for the purpose of receiving credit.

DATE .... BUYER SIGN HERE ....

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

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

CONFIDENTIAL

A → WHERE DO YOU LIVE?

PRINT FULL NAME .... Age ....
HOME ADDRESS .... CITY .... STATE .... ZIP CODE ....
HOME PHONE .... HOW LONG AT THIS ADDRESS ....
( ) OWN HOME ( ) RENT RENT OR MORTGAGE PAYMENTS $.................... PER. MO.
WIFE'S NAME .... MARITAL STATUS ( ) MARRIED ( ) SINGLE
NUMBER OF DEPENDENT CHILDREN ....
PREVIOUS ADDRESS .... HOW LONG? ....

B → WHERE DO YOU WORK?

YOUR EMPLOYER .... POSITION .... MONTHLY INCOME $....................
EMPLOYER'S ADDRESS .... Street .... City .... State HOW MANY YEARS ON PRESENT JOB? ....
PREVIOUS EMPLOYER .... Name .... Address HOW LONG? ....
WIFE'S EMPLOYER .... Name .... Address MONTHLY INCOME $....................

C → WHERE DO YOU TRADE?

BANK ACCOUNT WITH .... Street .... City .... State ( ) CHECKING ( ) SAVINGS ( ) LOAN
CREDIT ACCOUNT WITH .... Street .... City .... State
CREDIT ACCOUNT WITH .... Street .... City .... State TOTAL OF ALL MONTHLY PAYMENTS INCLUDING CAR $....................

In the pure binary counter it is only necessary to add additional flip-flops to count to a higher number. When using BCD counters, however, a slightly different technique must be used. Additional flip-flops are added, but not in the same way.

Since each BCD counter counts from zero through nine, these counters can be cascaded to count to any decimal number. Fig. 3 shows an example. Here four BCD counters are cascaded. Just as in the decimal number system, each counter represents one digit. The left-most counter, which represents the least significant digit (LSD), is the units counter. The next one is the tens counter; the next is the hundreds counter; and the right-most is the thousands counter. This last counter is designated the most significant digit (MSD). As you might expect, this 4-digit BCD counter is capable of counting to a maximum of 9999. Fig. 3 shows the output states that exist when the counter stores the number 7928.

The input pulses are applied to the LSD counter. Each time this counter counts ten pulses, its D output changes from binary 1 to binary 0, thereby triggering the tens counter. After every tenth input pulse, the tens counter is toggled. Likewise, after one hundred input pulses, the hundreds counter is toggled. When the tens counter contains the number 1001 (decimal 9) and ten additional input pulses are applied, the tens counter will toggle and its D output will change from binary 1 to binary 0, thereby stepping the one hundreds counter. Any number of BCD counters can be cascaded to handle any size number.

FREQUENCY DIVISION

Any counter is also a frequency divider. If you refer back to the waveforms for the 4-bit binary counter shown in Fig. 1, you will see that the frequency of the output signal gets lower as it passes through each of the flip-flops in the chain. Each flip-flop produces frequency division by two. For that reason, the frequency of the signal at the output of the flip-flop is always one-half the frequency of its input. For example, in Fig. 1 if the input waveform is a 100 kHz signal, the output of the A flip-flop will be one-half of this or 50 kHz. The output of the B flip-flop will again be one-half of this or 25 kHz. The C flip-flop again divides this by two to produce 12.5 kHz. The output of the D flip-flop will then be 6.25 kHz. Continuing to add flip-flops to this circuit would cause the output frequency to drop even lower by a factor of two for each flip-flop added.

The total amount of frequency division produced by a chain of flip-flops can be determined with the simple relationship 2^n, where n represents the number of flip-flops in the chain. Applying this to our example, we can see that the total frequency division produced is equal to

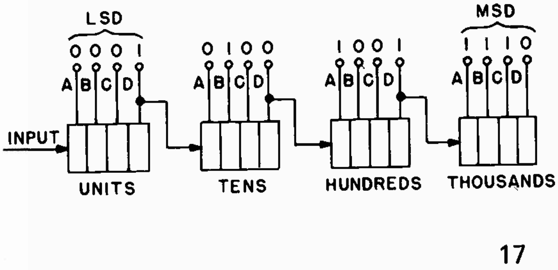


Fig. 3. A 4-stage BCD counter storing the number 7928.

$2^4 = 16$. With an input signal of 100 kHz and a total frequency division of 16, the output of the last flip-flop will be:

$$\frac{100\text{ kHz}}{16} = 6.25\text{ kHz}$$

This is the figure we arrived at earlier. The figure 16 simply indicates that the counter can exist in 16 different states (0 through 15). These were listed in binary and decimal form in Table I.

The BCD counter can contain a maximum of ten different states, 0 through 9. For that reason the BCD counter is a divide-by-ten circuit. The BCD counter is often called a decade counter or decade divider. The output frequency of the BCD counter will be one-tenth the frequency of the input. With a 100 kHz input signal, the output will be 10 kHz.

While straight binary and BCD counters handle most frequency division problems, it is sometimes necessary to produce frequency division by another number. For example, you might want to produce frequency division by 6, 12, or 24. In such cases, special counter/frequency dividers can be constructed. They are similar to the BCD counter circuit in that they consist of JK flip-flops connected in cascade, but they have special logic gate arrangements that force the counters to count in the desired sequence.

COUNTER APPLICATIONS

There are hundreds of applications for counters in digital and electronic equipment. Let's take a look at some of the most commonly used applications for counters.

Fig. 4 shows the diagram of a time interval measuring instrument whose principle element is the BCD counter. The purpose of this device is to measure the time duration of an input pulse occurring at the input. To do this we will use a 4-digit BCD counter to count pulses occurring at a fixed, accurate time interval. BCD counters 1, 2, 3, and 4 will count these accurate pulses. The 100 kHz crystal oscillator and BCD counters 5

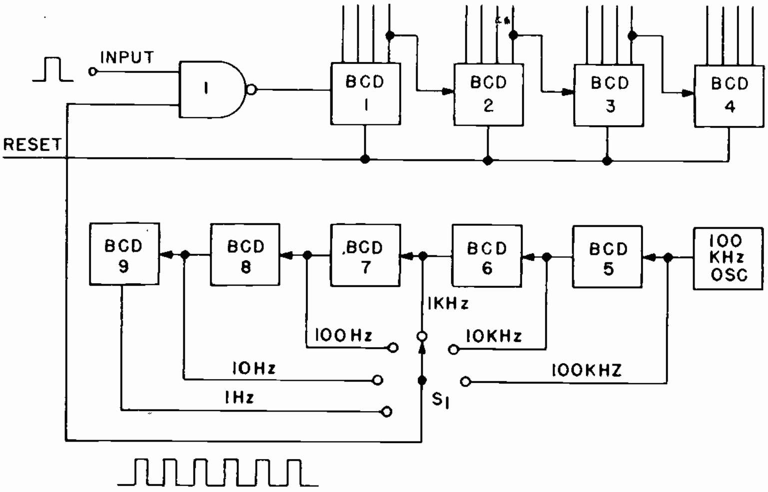


Fig. 4. Time interval measurement.

through 9 are used to generate the accurate time interval pulses. Switch S_1 is used to select which pulse interval is desired. Since the switch is shown in the 1 kHz position, the pulses appearing at the arm of the switch will occur every 1 millisecond.

$$t = 1/f = 1/1 \text{ kHz} = 1/1000 = .001 \text{ second} = 1 \text{ millisecond}$$

Assume that the input pulse is initially setting at a binary 0 level. The counter circuit is first cleared by applying a momentary negative-going pulse to the reset line. When the input pulse starts, it switches from a binary 0 to a binary 1 level, thereby enabling NAND gate 1. This permits the 1 millisecond pulses to pass through gate 1 to the BCD counter. Each time that a pulse occurs, it steps the BCD counter chain. If the input pulse duration is 1.5 seconds, then 1500 pulses will be passed through gate 1 to the BCD counter before the input pulse switches off and inhibits gate 1. The contents of the BCD counter tells you that 1500 pulses, each 1 millisecond in length, have been counted. This means that a total of 1500 milliseconds has elapsed. The duration of the input pulse then is 1500 milliseconds or 1.5 seconds.

Switch S_1 permits you to select the resolution with which the input pulse is measured. For example, if only a rough indication of the input pulse is desired and it is relatively long, then the 1 Hz output can be used. The output from this BCD divider occurs once a second. On the other hand, if greater resolution is required, then the output of the 100 kHz oscillator can be selected to step the counter. This means that each output pulse will occur every ten microseconds. This permits very accurate measurement of the input pulse duration.

Fig. 5 shows a frequency measuring circuit. The principle of operation of this circuit is simply that the BCD counter chain will count input pulses at an unknown signal frequency for a known time period. Knowing the time duration over which a given number of input pulses occur, we can determine the number of input pulses that occur in 1 second; that is, we can determine the frequency of the input signal. BCD counters 1 through 4 count the unknown input frequency. The unknown frequency pulses are passed to this counter through gate 1. Gate 1, however, is controlled by flip-flop FF1 which is, in turn, toggled by a signal whose time duration is known. For this

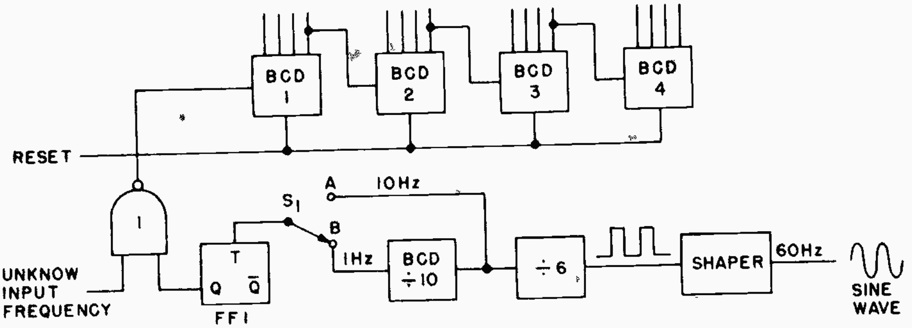


Fig. 5. Frequency measuring circuit.

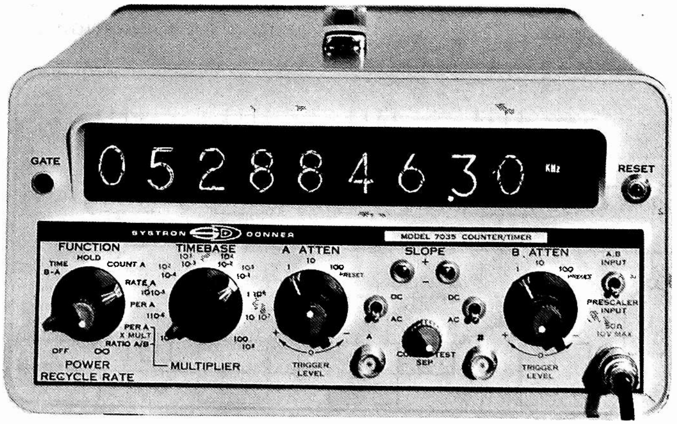
circuit we take the standard 60 Hz power line sine wave signal and shape it into a square wave. We then divide it by 6 with a three flip-flop frequency divider. This produces an output frequency of 10 Hz.

We divide this by 10 to produce a signal of 1 Hz. A BCD decade divider is used for this purpose. Switch S_1 then permits us to select either the 1 Hz or 10 Hz signal to toggle flip-flop FF1. In Fig. 5 the B position of S_1 is selected so that a 1 Hz signal will toggle FF1. It will alternately switch between its set and reset states and be in each state for a 1 second duration. During the set state, its normal output will be high, enabling gate 1. During this 1 second period of time the unknown input frequency pulses will pass through gate 1 to the counter. The output of the counter then tells us how many pulses occur in one second. From this we can determine the frequency of the counter. For example, if a total of 732 pulses occur during a one second interval, then we know that the frequency of the input signal is 732 Hz.

If position A of switch 1 had been selected, then FF1 would toggle every tenth of a second. The output of FF1 would be set for a period of one-tenth of a second or 100 milliseconds. If 300 pulses occur during this one-tenth of a second period, then we know that the frequency of the input signal must be 300 X 10 = 3000 Hz or 3 kHz.

For this frequency measuring circuit we could have used the 100 kHz crystal oscillator and the decade divider chain shown in Fig. 4 to produce the time intervals necessary to toggle FF1 in Fig. 5. The crystal oscillator provides high accuracy in timing. However, for less expensive frequency measuring circuits, the 60 Hz power line signal provides satisfactory accuracy. While crystal oscillators can provide .001% frequency tolerance, the 60 Hz power line is accurate to within .1%. This is accurate enough for many applications, and it eliminates the need for an expensive crystal oscillator.

Both the time interval and frequency measuring instruments shown in Figs. 4 and 5 are available as a single commercial unit like that shown in Fig. 6. The outputs of the BCD counters are decoded and used to drive decimal read-out tubes



Courtesy Systron Donner

Fig. 6. A typical time interval counter.

so that the operator using the instrument can tell at a glance the value of the frequency or the time interval being measured. Such an instrument has many useful applications in the design, troubleshooting, and servicing of electronic equipment.

CONCLUSION

This concludes our series on digital techniques. While we have only hit the high points, the fundamentals of digital techniques have been thoroughly covered. We hope that this series has given you some idea as to the importance of digital techniques in electronic equipment today. Be prepared to see a continued and increased use of digital techniques in all phases of electronics.

As an electronics technician, you are sure to encounter digital techniques sooner or later in your work. We encourage you to study this subject further to ensure yourself success in electronics. Knowing digital techniques is good insurance against technical obsolescence.

NRI's new Computer Electronics Course is one way to greatly expand your knowledge of digital techniques. The Computer Course emphasizes digital techniques and digital computers. In NRI's new digital and computer lessons, you study every phase and detail of digital techniques; and in the training kits you actually build, test, and demonstrate all of the most popular digital circuits. You use modern dual in-line SSI and MSI TTL integrated circuits for this purpose. You build a complete working digital computer that contains virtually every type of digital circuit. You learn computer organization, operation, and programming. The knowledge gained from NRI's Computer Electronics course can train you for profitable positions in the computer electronics field or in any field in which digital techniques are used. Write to NRI for more information.

● ● ●

WANTED

A speaker for an Atwater Kent Model 55C, 7-tube receiver. Anyone who has one for sale or has any information as to where one might be purchased, please contact:

MR. JOSEPH SMOLKOVICH
Suburban Mobile Park #263
13th St., Niles, Ohio, 44446

NRI honors program awards

During the months of January and February, the following NRI graduates received, in addition to their NRI electronics diplomas, CERTIFICATES OF DISTINCTION under the NRI Honors Program for outstanding grades throughout their NRI training. This distinction is made part of their permanent NRI records and appears on all transcripts of records requested. NRI's worldwide leadership in electronics training is represented by these outstanding graduates from almost every area of the United States, from Mexico and Canada, and from other foreign countries.

HIGHEST HONORS

Anthony J. Bara, Amsterdam N. Y.
Orville W. Beck, Dover, Del.
Robert D. Culbertson, Altus AFB, Okla.
Hugh S. Davis, Huntersville, N. C.
Leroy J. Davis, Burlington, Mass.
Billy E. Dawson, Cortland, Ohio
Fred H. Eldred, Bonsall, Calif.
Richard N. Gottbreht, Santa Maria, Calif.
Earl G. Mackey, Belvidere, Ill.
Shirlee I. Maddren, East Norwalk, Conn.
William R. Merchant, Sandwich, Ill.
Manuel Hinojosa Montanez, Mexico
Earl B. Polen, La Plata, Md.

HIGH HONORS

Robert Arndt, Chicago, Ill.
Billy S. Barrett, Tulsa, Okla.
Richard J. Bisson, China Lake, Calif.
William H. Boyd, Nashville, Tenn.
Thomas J. Bray, Muscatine, Iowa
Bennie J. Butchee, Vandenberg AFB, Calif.
Lucius T. Chapin, Richmond, Va.
John E. Cirota, Clarksville, Pa.
Kenneth W. Clark, Yakima, Wash.
Henry Crocco, Toronto, Ont., Canada
James L. Daugherty, Lancaster, Ohio
Richard S. Dease, Warner Robins, Ga.
Mr. Bronislav Dubovsky, Lincoln, Neb.
Cecil M. Duncan, St. Charles, Mo.
David A. Emerich, FPO New York
Charles H. Evans, Jr., Napoleonville, La.
John Wallace Farrar, Dallas, Tex.
Julius W. Fitzpatrick, Saratoga, Calif.
Ralph James Folkner, South Bend, Ind.
Howard K. Fuller, Richmond, Calif.
Joseph Galli, Berkeley, Ill.
Robert M. Gant, Jr., Carlisle, S.C.
Jose A. Falcon Garza, Monclova Coahuila, Mex.
Joseph D. Gatto, Severna Park, Md.
James R. Gross, Portsmouth, Va.
Donald H. Hall, Warwick, R. I.
Kenneth L. Hansen, Lancaster, Calif.
James A. Herrick, Richford, N.Y.
Samuel M. Hopkins, Carteret, N. J.
Allen R. Hulsey, Owensboro, Ky.
Joseph J. Johnen, Jr., Milpitas, Calif.
Irving Kannatt, Brooklyn, N. Y.
James T. Kennedy, Austin, Tex.
Kenneth A. Koch, Rockford, Ill.
Richard H. Koenig, Northridge, Calif.
Murray J. Lalone, Closter, N. J.
Barry McKinley, Boothwyn, Pa.
Ronald J. Milsom, Corpus Christi, Tex.
Charles WM. Morgan, Jr., Estill Springs, Tenn.
Edward J. Nelson, Cape Canaveral, Fla.
Robert A. Nelson, Narragansett, R. I.
Lawrence G. Nibler, Albany, Oreg.
Robert O'Brien, Denver, Colo.
Sam Oliveto, Clinton, Md.
Walter S. Orzel, Scranton, Pa.
Donald E. Padrnos, Brownton, Minn.
James W. Pruett, Johnson City, Tenn.
Everett H. Pugh, Silver Spring, Md.
Lymon W. Rains, St. Charles, Mo.
Sydney V. Reid, Kingston, Jamaica, W. I.
Lawrence E. Rheinhardt, Richmond, Ind.
Gerald R. Rinko, Kent, Wash.
Marco Rogosich, Kirtland AFB, N. Mex.
Rodolfo B. Ruiz, FPO San Francisco
Richard E. Sanders, Chaffee, Mo.
Bernard Schultz, Leavenworth, Kansas
Norman E. Seal, Opolis, Kansas
Henry Sellars, Clovis, N. Mex.
Anthony Shangler, Pleasant Hill, Mo.
Edward G. Smith, FPO New York
Robert E. Smith, San Jose, Calif.
Dana L. Staker, Peoria, Ill.
Paul Stanton, Phoenix, Ariz.
Daniel M. Sternberg, Lansdowne, Pa.
C. W. Steward, Needles, Calif.
Philip B. Thompson, Huntington Beach, Calif.

Donald G. Treder, Spokane, Wash.
Martin Trumps, Daingerfield, Tex.
Donald F. Veihmeyer, Orinda, Calif.
Robert J. Watson, Jr., Richmond Hill, N. Y.
Paul White, Mountain Rest, S. C.
William R. Whitlock, Front Royal, Va.
Andrew Yankanich, Wheaton, Md.

HONORS

H. J. Aarts, Boulder, Colo.
Dennis Ahr, Midland, Mich.
Donald E. Anderson, St. James, Minn.
Ray L. Argyle, Marion, Ala.
Ermel Arias, Canton, Pa.
Eugene N. Badger, Kalamazoo, Mich.
Ray W. Baker, Joplin, Mo.
Richard L. Beck, Rockwall, Tex.
Stanley E. Bethune, East Hampstead, N. H.
Daniel Boone, Santa Maria, Calif.
Michael Brolich, Blaine, Wash.
Lawrence Bucholtz, Pembroke, Ont., Canada
Ray R. L. Burchardt, Wausau, Wis.
Roger E. Campbell, Seattle, Wash.
Gordon L. Carkin, APO New York
Leung Cheung Chi, Kowloon Hong Kong
Benny V. Colecchi, Kent, Ohio
Roland K. Conklin, Springfield, Va.
Howard L. Crabtree, Catlettsburg, Ky.
Robert L. Criger, Baltimore, Md.
R. R. Crouch, Paris, Tex.
Edward V. Cullen, Jersey City, N. J.
Richard J. E. Davison, Tintah, Minn.
Roland M. Drake, Jackson, Mich.
Melvin S. Duggins, Newport News, Va.
MSGT. Allen J. R. Dunlap, Minot AFB, N. Dak.
Hugh L. Faulk, II, Jonesboro, Ga,
Marvin C. Fortune, Richmond, Va.
Harry S. Fowlkes, Danville, Va.
John Fox, Massau, Bahamas
Basil E. Frank, Colorado Springs, Colo.
John G. Frank, Royal Oak, Mich.
Michael D. Givens, Loring AFB, Maine
Patrick B. Gormley, Redwood City, Calif.
Stanley C. Guyer, Clinton, N. Y.
Harold Haar, Lincoln, Neb.
Leroy M. Hardy, Youngstown, N. Y.
Daniel C. Harley, Apple Valley, Calif.
Henry N. Heckert, Carthage, Mo.
Robert C. Hoagland, Beaver Dams, N. Y.
Cecil Wright Hobbs, Jr., Raleigh, N. C.
Charles C. Hood, Jr., Knoxville, Tenn.
W. A. Hopkins, Chatham, N. J.
Arthur F. Hotz, Woodhaven, N. Y.
Duane E. Huse, Bedford, Ind.
Harold E Inman, Key West, Fla.
Stanley Jacobson, Brooklyn, N. Y.
Johnnie Mack Jones, Norlina, N. C.
Richard L. Kihn, Anahuac, Tex.
William O. Kubitz, APO San Francisco
Betty Kujaneck, Englewood, Fla.
William P. Lane, N. Weymouth, Mass.
Merle W. Lawton, Sr., Council Bluffs, Iowa
Earl W. LeCroy, Tuscaloosa, Ala.
Norman H. Mahle, Rochester, N. Y.
Wayne P. Martin, Fort Covington, N. Y
Walter J. Maurey, Brazil, Ind.
Lorenzo P. Maya, Jr., Culver City, Calif.
Wynn E. McGhee, Valdosta, Ga.
Edward E. McGrath, New Castle, Del.
Kenneth L. Merkel, Greenwood, Ind.
John L. Metcalf, Lexington Park, Md.
William P. Miller, Jr., Arlington, Tenn.
James C. Mitchell, San Francisco, Calif.
Calvin R. Morgan, Baltimore, Md.
Harold Oduber, Aruba, N. A.
Manuel Pena, Tacoma, Wash.
Phillip M. Ploof, St. Albans, Vt.
Oren F. Potito, Ocala, Fla.
Richard H. Reuling, Sr., Newark, Del.
Teodoro Reyes, Compton, Calif.
Bobby G. Rhea, Blytheville, AFB, Ark
Thurman A. Rives, Opa-Locka, Fla.
Edward J. Ross, Cleveland, Ohio
Fred G. Russell, Cleveland, Ohio
Marjorie R. Sanner, Sparks, Md.
Alfred A. Schleif, Jr., Phoenix, Ariz.
Paul J. Schmidt, Effingham, Ill.
Verlin F. Schuler, Ness City, Kansas
Jan Sobkowiak, Jamesburg, N. J.
Edward A. Standridge, Fairfax, Va.
William H. Stewart, Marysville, Calif.
Robert L. Stillwell, Ozona, Tex.
Ralph I. Stinson, Clinton, Miss.
Orison Stolz, Bryant, Ind.
Franklin M. Stone, FPO New York
Larry P. Szczesny, Somerset, Mass.
Jules J. Szentirmai, Oakland, N. J.
Jimmy Lee Taylor, Covington, Va.
John E. Thompson, Jr., Rosedale, Md.
Kenneth E. Toal, Hamilton, Ont., Canada
Ernest A. Uibel, Gloucester City, N. J.
Wallace N. Vanderwerf, Imperial Beach, Calif.
Lawrence Van DeSteene, Houston, Tex.
Darrel D. Vogt, Colorado Springs, Colo.
Terry W. Ward, Chicago Heights, Ill.
Lawrence T. Wehner, Jr., Angola, La.
Arthur K. Weissinger, Fort Huachuca, Ariz.
Leo H. Westley, Angola, N. Y.

STEREO HI-FI SERVICING *(cont. from Page 10)*

(cont. from Page 10)

only fairly popular models (and their definition of popularity is how many pieces of a given model are sold). Since the hi-fi market is nowhere near the size of the color TV market, you won't be able to get a Sams Photofact for every piece of hi-fi equipment. In many cases you will have to write directly to the manufacturer for the information you need.

Today much hi-fi equipment is of Japanese origin. You can get a free list of the names and addresses of importers of Japanese electronic equipment by writing to:

Electronics Division
Japan Light Machinery Information Center
437 Fifth Avenue
New York, NY 10016

Ask for "Importers and Distributors of Japanese Consumer Electronics Products."

IN CONCLUSION

This article is intended merely to make you aware of the many opportunities in audio servicing. Before you actually begin any work of this type, brush up on the electronics you will need by reviewing your NRI lessons. Read at least some of the books and subscribe to at least two of the magazines listed. Remember, the more you know about this fascinating field, the better equipped you will be.

BOOKS

Audio Cyclopedia, Sams 20675, $29.95
Hi-Fi Stereo Handbook, Sams 20565, $5.50
Measuring Hi-Fi Amplifiers, Sams 20561, $3.95
Troubleshooting Audio Equipment, Sams 20525, $3.95
Know your Square-Wave and Pulse Generators, Sams 20593, $3.25
101 Ways to Use Your Oscilloscope (2nd edition), Sams 20416, $3.50
101 Ways to Use Your Square-Wave and Pulse Generators, Sams 20562, $3.50
Tape Recorder Servicing Guide, Sams 20748, $3.95
Record Changer Servicing Guide, Sams 20730, $3.95
1 - 2 - 3 -4 Servicing Automobile Stereo, Sams 20737, $3.95

Sams books are available from your local Sams Photofacts dealer or by mail from Howard W. Sams & Co., Inc., 4300 W. 62nd St., Indianapolis, IN 46268.

Radiotron Designer's Handbook, RCA, $7.00. This book is rather old (published in 1953), but contains several chapters on basic concepts of high-fidelity sound. Highly recommended. Order from: RCA Commercial Engineering, Harrison, NJ 07029.

MAGAZINES

Audio, 134 N. 13th St., Philadelphia, PA 19107, $5.00 per year (12 issues)
Stereo Review, P.O. Box 1099, Flushing, NY 11352, $7.00 per year (12 issues)
High Fidelity, 2160 Patterson St., Cincinnati, OH 45214, $7.00 per year (12 issues)
The Audio Amateur, 307 Dickinson Ave., Swarthmore, PA 19081, $5.00 per year (4 issues)

job-ops

We are looking for a:

QUALIFIED COLOR TV TECHNICIAN

If you feel that you might fill the bill, contact:

Mr. H. R. Buswell
ACE Electronics
627 First Avenue, SW
Cedar Rapids, Iowa 52404

MONTGOMERY WARD
has openings for TV technicians or grads of electronics schools. Openings available in Wash., Md., and Va. areas. Applicants will be required to have a personal interview for employment consideration.

FOR APPOINTMENT CONTACT:

Pat F. Cosentini, Service Manager
7100 Old Landover Rd.
Landover, Md. 20785
301-322-3344

John Shaffer, of SHAFFER'S APPLIANCE CENTER, needs a successor to his radio, appliance and TV business.

His two-man shop now grosses over $50,000 per year. For the details about this professional opportunity, contact John.

SHAFFER'S APPLIANCE CENTER
233 Maple Avenue East
Vienna, Virginia 22180

phone: (703) 938-6577

Television Service Technician needed.
Contact Mr. Robinson at:

THUMB RADIO AND TV
1020 N. Van Dyke
Bad Axe, Michigan 48413

phone: (517) 269-6420

SEARS
has many career opportunities for experienced TV technicians or recent graduates of electronics schools. Top benefits, locations throughout the U.S.

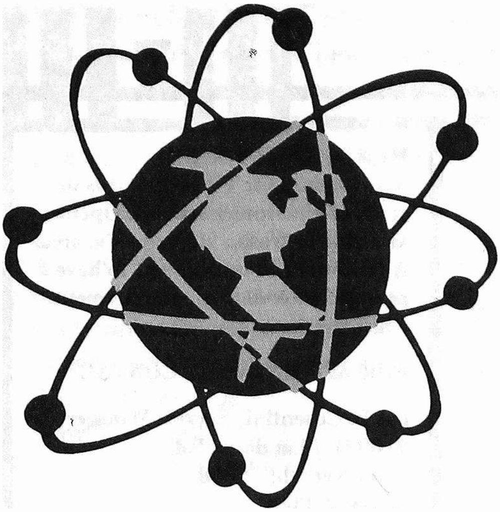
CONTACT:

The Service Manager
of your nearest
SEARS SERVICE CENTER
or the Personnel Manager
of your nearest
SEARS retail store.

W. T. Grant Company
Service Depot #9406
8 Hixon Place
Maplewood, New Jersey 07040

Radio and TV technicians (and apprentices)
Appliance technicians (and apprentices)

minimum qualifications:
1. NRI graduate or:
2. Present enrollee who has completed 2/3 of the course and maintained at least a B average.



Ham News

BY TED BEACH, K4MKX

Here's a thought. Do you know how many active amateurs there are in the United States alone? A lot. How many of these hams are really technically competent? Surprisingly enough there are a lot of "appliance operators" running loose who learned enough electronics (and code) to satisfy the FCC; then out to the nearest dealer to buy a Sooper KW transceiver, beam, tower and rotator. These people I feel sorry for because they are missing a great deal of what it is to be an amateur.

They light off the rig and sit down to chew the rag for hours on end, but wouldn't know a soldering iron from a pair of diagonal cutters. What a waste. But these are usually very nice people, and, to us who happen to have **learned** something about electronics, from our NRI courses, they could represent an added source of income.

How? Well, what happens when the Sooper KW XCVR becomes a Sooper Pooper and fails to light up? Back to the dealer (or factory) for a nice long downtime and a lot of bucks — bucks which could go into **your** pocket if you work it right. Communications equipment is really not difficult to service, and it doesn't take a lot of equipment. If you built or work on your own rig you should be well prepared to tackle anybody's rig. Think about it. All you need to do is let it be known at a club meeting, on the air, on the bulletin board at school, or at the wholesaler that you are capable and available to repair Ham equipment. (Don't try to take on CB or other commercial gear unless you have a First or Second Radiotelephone license.)

Most people with a dead rig would rather have work done on it locally than ship it off to the factory. If they bought the equipment new, in all likelihood they have the owner's manual with its detailed circuit description, schematic and alignment information. If it's an old rig or a secondhand rig, you may have to write the manufacturer for a manual. Failing this, it is possible that the NRI Diagram Service can be of some help. We have quite a few in our files.

If you really get into this kind of work, it is possible that you might even work some sort of a deal with local dealers and service shops to handle their communications repair work. Surprisingly enough, most radio-TV shops won't even look at a short-wave receiver. To them it is time-consuming, low paying work that keeps them from their higher paying jobs. They would probably welcome subcontracting work out to you.

Now, let's see who in the NRI Course for Amateur Licenses we have heard from:

George	**WN1NZW**	**N**	**E. Sandwich, MA**
Charles	**K1UAM**	**G**	**Coventry, RI**
John	**WN3PDM**	**N**	**Chambersburg, PA**
W. G.	**WN4TNY**	**N**	**Memphis, TN**
Charles	**WN4TYJ**	**N**	**Newport News, VA**
Howard	**WN5BLQ**	**N**	**Warren, TX**
Bill	**WN5DCY**	**N**	**Long Beach, MS**
Gail	**WN6GMU**	**N**	**Grass Valley, CA**
Mark	**WN6PCP**	**N**	**San Lorenzo, CA**
Donald	**WN7NEN**	**N**	**State Line, NV**
Edgar	**WN8IQR**	**N**	**Cincinnati, OH**
Vytas	**WN9GJM**	**N**	**Chicago, IL**
Bruce	*****	**-**	**Columbus, OH**

*** Passed Novice 2/4/71 - waiting!**

Not too many this time, but I sure do like to see all those brand new Novice calls up there. Again, all of the calls listed came to us via our grading section so there are very few interesting comments to pass along to you about the people behind the calls and what they are doing.

WN1NZW, however, seems to have the age-old problem of the Code Plateau. George says he is "frozen" at 5 WPM copying. I can say that, once he's on the air, his speed will probably increase rapidly to 10 or 11 WPM and freeze once more. At that plateau, 12 WPM will seem like 30 WPM! Then the General test will be passed and, if you don't drop cw, there will be another plateau at about 15 or 16 WPM. I know, because that's where I am now. 20 WPM sounds like RTTY to me, but one of these days . . .

K1UAM doesn't seem to have this problem. Charles, the only General listed, reports an astounding 25 WPM capability. Wow!

Although W. G. is listed as WN4TNY, he says that he has passed his General and is just waiting. His Novice call was issued January 8, 1971, and by chance he took his General exam one day earlier, on the 7th. Be patient, W.G., and we'll look forward to listing you as an "upgrade" real soon.

WN5DCY follows what I consider to be the best possible plan for upping the code speed. Bill regularly copies W1AW and can read their "10 WPM +" sessions. Keep with it, Bill.

Edgar, WN8IQR, says he is sure of only one thing — his speed is over 5 WPM since he has his Novice ticket. Guess we can't dispute that.

Here are the other NRI students and graduates we have heard from:

Ronie	**WB4HSR**	**G**	**Supply, NC**
Gerald	**WB4PVC**	**A**	**Owensboro, KY**
Bill	**WA5NHI**	**G**	**Denton, TX**
Paul	**W5SOE**	**-**	**Fort Hood, TX**
Bud	**WA7IXG**	**G**	**Maple Valley, WA**
David	**WB8GOY***	**G**	**Mt. Clemens, MI**
Jim	**WN8IBT**	**N**	**Kerens, WV**
Ernest	**WA8RSY**	**A**	**West Logan, WV**
Dan	**WA8WDX**	**G**	**Morocco/Navy**
Don	**VE3AAW**	**-**	**Ottawa, ON**

*** Just upgraded - congratulations!**

WB4HSR looks like the ideal type to take on the work mentioned at the beginning of this column. Ronie is a graduate of our Communications course, a student of our Servicing course, has built a home-brew linear for his TR4 and works in radio-TV repair. What a combination for getting into Ham servicing.

WB4PVC writes the kind of note we like to hear. Gerald just got his Advanced license and says, "Couldn't have done it without training I received from NRI." Thanks, Gerald, that makes it all worthwhile.

WA7IXG reports he has had his ticket for three years and is just now getting around to letting us know. Cryptically, Bud says he is known as the "Double Header on 7.295." Just what that means, I don't know. What gives, Bud?

WB8GOY's General class license arrived in the same mail as the NRI Journal which listed his Novice call. How about that? Anyway, Dave is another of those avid (aren't they all avid?) QRP types and would like very much to contact other NRI people with the idea of forming a QRP club. The emphasis would be on low power, low cost, and development of new QRP circuits and techniques. This sounds real interesting. Anyone interested can write Dave at:

20121 Webster
Mt. Clemens
MI, 48043

You might also see the last Journal for more QRP news.

WA8WDX is presently QRT at his Morocco QTH and says we statesiders should appreciate our operating privileges; there's no reciprocal licensing in Morocco.

Now – here are our first HAM-ADS:

HAM-ADS

SALE – Collins 75A1 $125, Hallicrafters HT37 $175 or trade for transceiver. WA5NHI Glenn Brazzel. Rt 4, Box 426, Denton, TX 76201

SALE – Heath AT1 transmitter $18, 15-watt power. Contact S. Couch, RR1, Ottawa, KS 66067

How about some more, fellas? All it takes is a card or QSL – no charge at all.

That's about it for this time. See you in a couple of months.

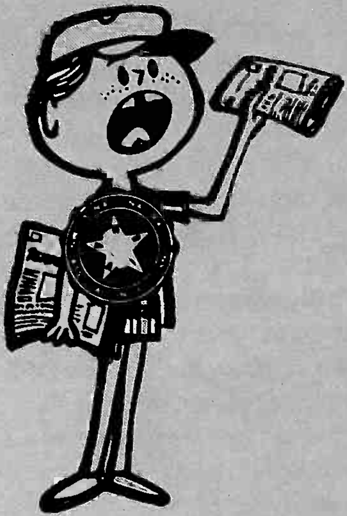
VY 73
Ted – K4MKX

FREE - A large box of small appliance parts to give to any student. Call:

(703) 494-4562

any evening after six. Or write:

Fred L. Sanders
14100 Randall Drive
Woodbridge, Va. 22191



Alumni News

James Wheeler	President
Robert Bonge	Vice-Pres.
Graham Boyd	Vice-Pres.
Br. Bernard Frey	Vice-Pres.
Thomas Schnader	Vice-Pres.
T.F. Nolan, Jr.	Exec. Sec.

DETROIT Chapter studies solid state

The bad weather for the last couple of meetings has not kept the members away. The Chapter has been having a program on silicon controlled rectifiers, as it is something new and all new circuits should be studied in order to keep up with the field. Mr. Kelly used a pegboard to show the layout of the parts and he marked the locations where the scope should be connected.

One of the members had purchased an SCR motor controller, to be used with one of his appliances. When trouble developed, he brought it to the meeting. Because of the lectures and the pegboard, he was able to immediately troubleshoot the unit and repair it.

The Chapter has very good lectures. Students are always welcome, as they are sure to learn something that will help them with their studies.

FLINT-SAGINAW Chapter sends good will ambassador

Andrew Jobbagy, chairman of the Flint-Saginaw Chapter, visited San Francisco as a good will ambassador from Michigan.

This was a meeting of two old-timers, Arthur Ragsdale, 82 years young, and Andy Jobbagy, 62 years old. The two grew up with radio and TV. Andy delivered a short talk with good wishes from the North. After the meeting, Mr. Ragsdale showed western hospitality by serving green Hungarian wine. Mr. Jobbagy pointed out a few ways the San Francisco Chapter could obtain speakers for the coming season, and the two old-timers vowed to meet again next year.

Arthur Ragsdale, left, and Andrew Jobbagy, both radio and TV veterans, met in January.

DIRECTORY OF CHAPTERS

CHAMBERSBURG (CUMBERLAND VALLEY) CHAPTER meets 8 p.m. 2nd Tuesday of each month at Bob Erford's Radio-TV Service Shop, Chambersburg, Pa. Chairman: Gerald Strite, RR1, Chambersburg, Pa.

DETROIT CHAPTER meets 8 p.m., 2nd Friday of each month at St. Andrews Hall, 431 E. Congress St., Detroit. Chairman: James Kelley, 1140 Livernois; Detroit, Mich. 841-4972.

FLINT (SAGINAW VALLEY) CHAPTER meets 7:30 p.m., 2nd Wednesday of each month at Chairman Andrew Jobbagy's shop, G-5507 S. Saginaw Rd., Flint, Mich.

LOS ANGELES CHAPTER meets 8 p.m., third Friday of each month at Graham D. Boyd's TV Shop, 1223 N. Vermont Ave., Los Angeles, Calif., 662-3759.

NEW ORLEANS CHAPTER meets 8 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 Tuesday of each month at 264 E. 10th St., New York City. Chairman: Samuel Antman, 1669 45th St., Brooklyn, N.Y.

NORTH JERSEY CHAPTER meets 8 p.m., last Friday of each month at The Players Club, Washington Square. Chairman: George Stoll, 10 Jefferson Avenue, Kearney, N.J.

PHILADELPHIA-CAMDEN CHAPTER meets 8 p.m., 4th Monday of each month at K of C Hall, Tulip and Tyson Sts., Philadelphia. Chairman: John Pirrung, 2923 Longshore, Philadelphia, Pa.

PITTSBURGH CHAPTER meets 8 p.m., 1st Thursday of each month in the basement of the U.P. Church of Verona, Pa., corner of South Ave. & 2nd St. Chairman: Tom Schnader, RFD 3, Irwin, Pa.

SAN ANTONIO (ALAMO) CHAPTER meets 7 p.m., 4th Friday of each month at Alamo Heights Christian Church Scout House, 350 Primrose St., 6500 block of N. New Braunfels St. (3 blocks north of Austin Hwy.), San Antonio. Chairman: Joe R. Garcia, 8026 Cinch, San Antonio, Tex., 694-3461.

SAN FRANCISCO CHAPTER meets 8 p.m., 2nd Wednesday of each month at the home of J. Arthur Ragsdale, 1526 27th Ave., San Francisco. Chairman: Isaiah Randolph, 60 Santa Fe Ave., San Francisco, Calif.

SOUTHEASTERN MASSACHUSETTS CHAPTER meets 8 p.m., last Wednesday of each month at the home of Chairman John Alves, 57 Allen Boulevard, Swansea, Massachusetts.

SPRINGFIELD (MASS.) CHAPTER meets 7 p.m., 2nd Saturday of each month at the shop of Norman Charest, 74 Redfern Dr., Springfield; and 4th Saturday at the shop of Chairman Al Dorman, 6 Forest Lane, Simsbury, Conn.

FREE GIFTS

WITH YOUR PURCHASE IN CONAR'S SPRINGTIME SHOPPING SALE

One (or more) premium gifts is yours free of extra cost when you purchase any of the CONAR instruments or merchandise advertised in this issue.

PLAY THE NUMBERS GAME

SEE THE CENTER ADVERTISING PAGES FOR DETAILS.

3

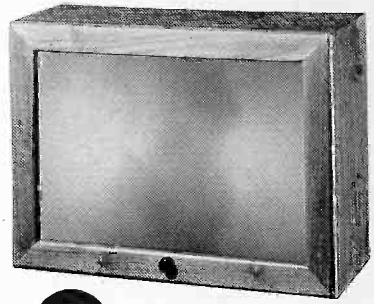
ATR Model 610
6V-12V Battery Eliminator

$55.00 Stock #610WT
22 lbs., express collect

1

TRANSISTOR POWER SUPPLY
Factory Assembled

$18.50 Stock #510WT
2 lbs., Par. Post



3

CONAR'S Original Audio Color
An Exciting New Concept in Music

	NRI Student & Alumni Price	Catalog Price
Kit 103UK	39.85	44.95
Wired 103WT	49.45	54.95

NO MONEY DOWN ON ESTABLISHED ACCOUNTS

SOLDERING TOOLS AND AIDS

The Revolutionary New

ENDECO

Desoldering Resoldering Tool

One-hand operation

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

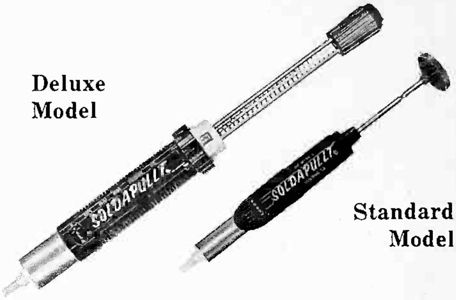
1

Stock #1300TO
Wt. 11 oz.
Parcel Post

$11.45

SOLDAPULLT

Deluxe Model



Standard Model

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

1

$5.95
Stock #14TO
Standard
8 oz. Parcel Post

$9.95
Stock #13TO
Deluxe
10 oz. Parcel Post

Refer to your Conar catalog for full descriptions of items advertised.
BE SURE TO USE YOUR FREE GIFTS ORDER BLANK.

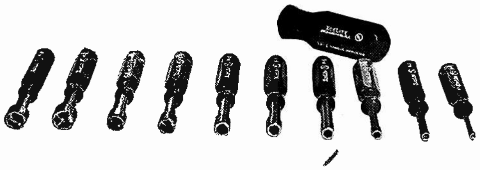
FREE GIFTS

WITH YOUR PURCHASE IN
CONAR'S SPRINGTIME SHOPPING SALE

One (or more) of these premium gifts is yours free of extra cost when you purchase any of the CONAR instruments or merchandise advertised in this issue.

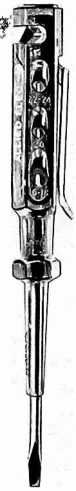
PLAY THE NUMBERS GAME

SEE THE CENTER ADVERTISING PAGES FOR DETAILS.



4

Xcelite
Nutdriver
Set

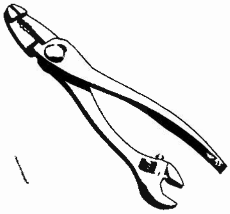


2

Mini
Wire
Stripper

1

Clip-on
Neon
Tester



3

Handy-
Boy
Tool

(SPECIAL OFFER ENDS JUNE 30, 1971

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

Second-class
postage paid
at Washington, D. C.

Mr. Virgil Hicks E196-R956 GIG
425 New York St.
Huntington W Va 25704 * 12/22/49