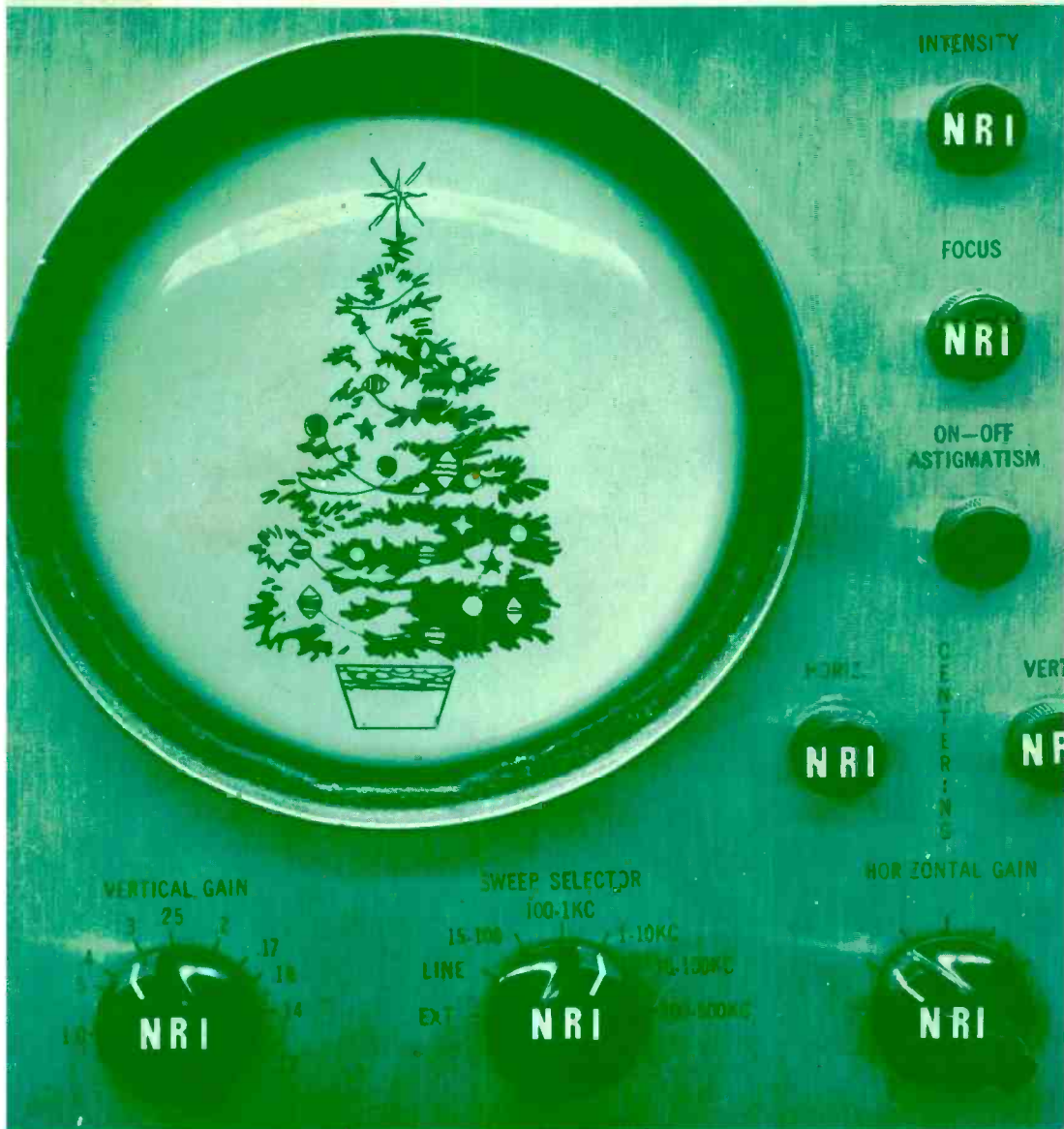


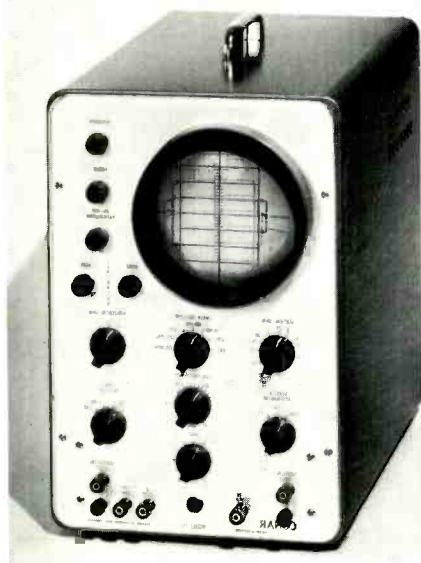


journal



November/December, 1968

35 Cents



CONAR 5" Wide Band Oscilloscope

KIT	CATALOG PRICE	NRI STUDENT AND ALUMNI PRICE
250UK	\$99.90	\$82.90
		\$5 PER MONTH
WIRED		
250WT	\$139.50	\$129.75
		\$7 PER MONTH

Shipped Express Collect

OPTIONAL ACCESSORY

Set of four heavy duty probes designed specifically for use with Model 250. Set includes: Signal Tracing Low Capacity; Resistor Isolated; and Direct Testing Probes; Roll-up Carrying Case. Complete instructions in Model 250 manual.

Stock #250PB. 2 lbs. Parcel Post **\$17.70**

ADVANCED DESIGN · NEWEST CIRCUITRY · EXCLUSIVE FEATURES

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

- Note these CONAR Model 250 features:
- Uses 2400 volts on the cathode ray tube—50% more than most scopes. Trace remains clear, distinct, bright, with increase in sweep frequency or vertical-horizontal expansion. Forget about darkening room to observe traces on your Model 250 screen!
 - Vertical gain control is calibrated for direct reading of peak-to-peak voltages. Simply multiply vertical gain control setting by attenuator setting by trace height for quick, accurate peak-to-peak readings. No need to remember special formulas or "feed-in" calibrating signals.
 - New improved scope circuitry gives excellent linearity at low frequencies without limiting the production of frequency sweep signals.
 - Two stage retrace blanking amplifier gives 100% retrace blanking at all frequencies produced by the scope sweep generator. Retrace lines will not confuse the display at high sweep frequencies.

- Accurately measures ripple output of power supplies; checks auto radio vibrators dynamically.
- Intensity and focus controls use special insulated high voltage potentiometers to eliminate leakage and shock hazards.
- Has push-pull outputs balanced by separate phase splitter tubes in both horizontal and vertical amplifiers.
- Built-in flyback checker gives rapid, in-circuit testing of flybacks, transformers, yokes, coils, loopsticks. Eliminates need for a separate flyback tester costing from \$40 to \$70.
- Sweep range—10 cps to 500 kc—five times the range of most other scopes, using special linearity circuit.

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

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

SPECIFICATIONS

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

CONVENT ORDER BLANK ON PAGE 25



journal

Nov/Dec 1968
Vol. 25 No. 6

Published every other month by the National Radio Institute, 3939 Wisconsin Avenue, N.W., Washington, D.C. 20016. Subscription \$2.00 a year. Litho in U.S.A. Second class postage paid at Washington, D.C.

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The Cathode Ray Oscilloscope As A Training Aid :II

by J.B. Straughn

NOTE: J. B. Straughn, NRI's long-time Chief of Consultation until his recent retirement, and engineer of much of the company's servicing equipment, mentioned casually in a late Journal article that he would amplify his subject further "if there is sufficient interest". The impressive number of favorable replies on the article, "The Cathode Ray Oscilloscope As A Training Aid" prompted the ensuing article in this issue. This one covers primarily uses of the scope in the study of power supplies. In the following issue, Mr. Straughn will go into power-supply experiments.

In the July/August issue we talked about how the "scope" can be used to get more thorough understanding of the basic principles studied in the kits which are a part of NRI Servicing, Communications, Industrial Electronics, and Color TV courses.

In this article we will specifically work with the type of experiments found in the Servicing Course kits, but the material is applicable to any of the other courses.

All you need for these practical applications are the Servicing Course kits through 4WW (or whatever equivalent material is available), a few parts, a service-type scope (preferably the CONAR Model 250), and a vtvm (such as the CONAR Model 211).

If you are just getting started in electronics in any phase, right now is the time to get the Model 250 in kit form and

assemble it yourself. You will need the scope for service work, and assembling the kit will give you some valuable practical experience. It is no more difficult to construct than the vtvm you build in your second kit - there's just more of it. If you don't have the eight to 15 hours you'll need to invest in the scope's construction, preassembled Model 250 scopes are available (at NRI, of course).

While the experiments in this article are roughly based on the material in Kit 4WW, we will not cover exactly the same circuits. We will even throw in some "goodies" you haven't heard about! There will be no pictorials; now is as good a time as any for you to learn to work from schematics, as you must; also it's possible you may use parts having a different physical appearance from those in the kits. Tiresome step-by-step instructions are omitted here as well.

If you have a scope, its manual shows you how to connect the leads and adjust the controls to get the desired pattern, etc. However, instructions on adjustments will appear here when they seem needful. Let's start our experiments with a deviation from the norm and have the scope trace out the B-H curve of an iron-core transformer.

OBTAINING A B-H CURVE

A B-H curve indicates the number of lines of magnetic flux produced by magnetizing forces of varying strengths acting in an iron core. The curve is generally

S-shaped, with the top and bottom loops indicating magnetic saturation of the core material. If the core has magnetic hysteresis, the S-shaped curve will widen, with the area between the two sides representing magnetic loss.

To obtain a B-H curve on your scope screen, it is necessary to secure a horizontal deflection signal proportional to the magnetizing force applied to the transformer, and a vertical deflection signal proportional to the number of lines of magnetic flux.

The circuit arrangement shown in Fig. 1A will give you a B-H curve for your power transformer. Note that only the 120-volt primary winding and the 6.3-volt tap of the 12.6-volt winding are used. Do not connect the other winding of the power transformer.

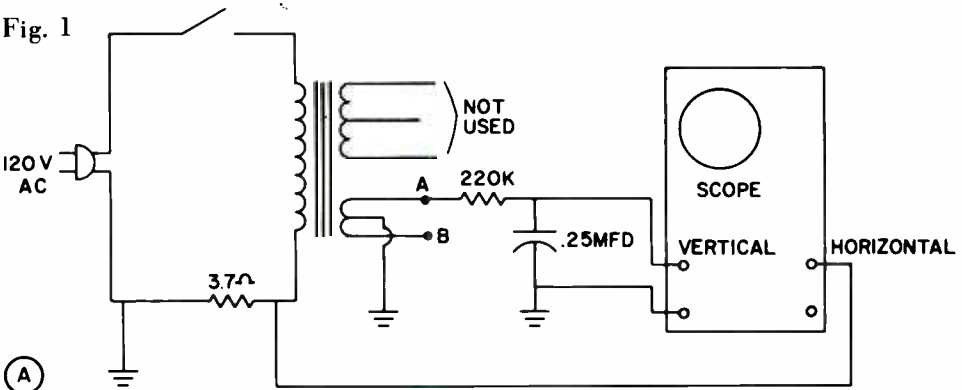
Ground connections go to the chassis on which the power transformer is mounted. Since you connect one side of the power line to the chassis, check the polarity of the line plug to make sure that it's the grounded side that is connected. This is to avoid a shock if you touch an actual ground (a concrete floor, for example) and the chassis.

You can check the plug polarity by wiring up the unit as shown, inserting the plug in the wall socket, and turning on the equipment. Use an ac voltmeter to measure for voltage between the chassis and an earth ground, such as a water pipe, radiator, or the screw holding the wall socket plate in place. Dig your probe tip in well enough to penetrate any paint on the grounded object. If you measure line voltage between the chassis and ground, reverse the line plug at the wall outlet to produce zero ac voltage.

A lack of ac voltage is the desired condition; it proves the chassis and earth ground are at the same potential. Mark your plug in some way so you can always insert it properly in this particular outlet. A dab of nail polish on the plug and wall outlet will do nicely.

With the circuit shown in Fig. 1A, we can obtain a voltage to apply to the scope's horizontal input proportional to the magnetizing force applied to the transformer core, by using the voltage drop across a resistor in series with the primary winding. The primary current flows through this resistor and acts as the magnetizing force. A low value of resistor was purposely chosen, so that its effect on the

Fig. 1



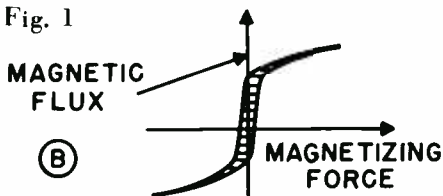
primary current can be disregarded. My first thought was to use a 5-ohm, .5-watt resistor, but my junk box came up with a 3.7-ohm, 5-watt resistor that worked just as well.

Across the secondary winding (in this case half of the 12.6-volt winding) we have a voltage proportional to the turns-ratio, the number of lines of flux produced, and the rate of change of the lines of flux. By using the resistor-capacitor integrating network shown in Fig. 1A, we can obtain a voltage proportional only to the number of lines of flux and the turns-ratio between the primary and secondary windings (as well as the primary voltage).

Since the turns-ratio is constant, we can assume that the voltage we apply to the vertical input of the scope is proportional to the number of lines of flux. The values of the resistor and the capacitor are not critical. With the values chosen, the vertical and horizontal attenuators of the scope, when adjusted for maximum deflection, give a pattern that just fills the face of the crt. With the scope connection shown in Fig. 1A, the Sweep Selector should be set to its External position. If necessary, adjust the vertical and horizontal gain or attenuator controls to give the typical S-shaped curve shown in Fig. 1B below.

If your curve faces to the left instead of the right, disconnect the 220K-ohm resis-

Fig. 1



tor from A and attach it to B. This will reverse the curve. (Try it, anyway, and see what happens!)

To see how losses are increased when a load is placed on the secondary, wire in the 6-volt tube filament tube from transformer secondary lead A or B to the chassis. I used the handiest tube, a 6X4. Observe that the general shape of the B-H curve remains the same, but the area indicating loss becomes much greater. This is due to increased saturation of the core, as will be explained. Now remove the tube.

Now that you have seen the B-H or hysteresis curve of your power transformer, you will find it worthwhile to examine the current and voltage waveshapes applied to the primary of the power transformer. Completely remove the lead to the horizontal input of the scope, as the scope's internal sweep will be used here. Connect the vertical lead to the ungrounded end of the 3.7-ohm resistor in Fig. 1A.

Set the Sweep Selector to "15-100 cycles" and the Sync Selector to "Line". Adjust the Fine Frequency and Sync controls to obtain about two stable cycles. Adjust the Vertical Attenuator and Horizontal Gain controls to produce a display like that in Fig. 2A. This is the primary current waveshape. Note that it is not a true sine wave, but is considerably distorted.

This odd waveshape is due to the effect of saturation on the peaks of the applied voltage. As the core of the transformer is saturated, the rate of change of the lines of magnetic flux is reduced and the instantaneous reactance of the transformer primary drops. When this

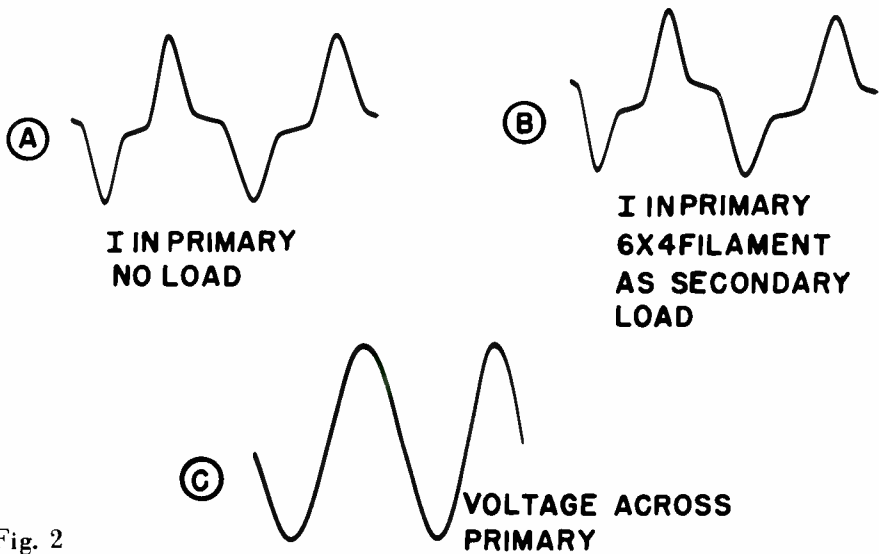


Fig. 2

happens, more current flows in the primary on the instantaneous peaks, and a more sharply peaked current results (Fig. 2A).

Fig. 2A represents the no-load or idling current of the power transformer. To see the effect of a load, insert your 6-volt tube to connect its filament across the filament winding, and again look at the primary current wavelshape. Fig. 2B shows the current display when the tube filament is connected from A to the chassis in Fig. 1A. Note that saturation occurs more rapidly when the secondary is loaded.

The voltage applied to the primary of the power transformer is a true sine wave. Observe it by transferring the vertical scope lead to the other side of the power transformer primary (switch side). Turn the Vertical Attenuator to 100X; otherwise a distorted display (due to overloading) will result. The display should be similar to that shown in Fig. 2C.

Before we go on to further experiments, remove the R-C network and the 3.7-ohm resistor; also the ac line connection to the chassis, so that when the plug is inserted in the wall outlet the line voltage is applied only to the transformer primary.

STUDYING RECTIFIER OPERATION

By using an ordinary power transformer, rectifiers, and a suitable load resistor, we can demonstrate and observe the operation of half-wave and full-wave rectifiers. Use the circuit in Fig. 3A. The internal sweep of the scope is used, set to the 15 to 100 cycle position, and the signal across the load resistor, which is to be displayed, is connected to the vertical input terminals of the scope. Since these signals will be at the line frequency (or multiple thereof), the Sync Selector switch can be placed in the Line position. This reduces readjustment of the Sync control as there are changes in amplitude of the observed signal.

Fig. 3A is arranged for easy observation of the rectifier action of either a vacuum tube or a solid-state rectifier in both full-wave and half-wave action. With the scope Vertical Input lead connected to S, we see the output of the solid-state rectifier (in this case D_1 and D_2 are 120V selenium rectifiers such as NRI SR10) while the tube rectifier may be viewed at T. By touching lead X of the power transformer to pin 6 of the 6-volt tube socket, we can change either circuit from half-wave to full-wave rectification.

Now let's see just what we are going to rectify. First temporarily solder lead X of the power transformer to pin 6 of the tube socket. As you have learned in your NRI course, the ac voltages obtained at opposite ends of a transformer winding are 180° out-of-phase with each other when compared to the center tap of the winding. To demonstrate this, leave the ground lead of the scope connected to

the experimental chassis. It is therefore connected to the grounded center tap of the high-voltage winding.

Now connect the vertical lead of the scope to pin 6 of the tube socket and sync in a display of two cycles, with the Sync Selector in the line position. The display may look like either Fig. 3B or Fig. 3C.

Notice what happens when you transfer the scope vertical lead to pin 1 of the tube socket. You will see that the starting point of the trace has shifted. As shown in Fig. 3B and Fig. 3C, one signal starts at the peak of the positive cycle and the other at the peak of the negative cycle. Thus you have proof that the voltages are 180° out-of-phase at opposite ends of the transformer windings. In the case of a full-wave rectifier, one plate of one diode is always receiving or is just about to receive a positive signal.

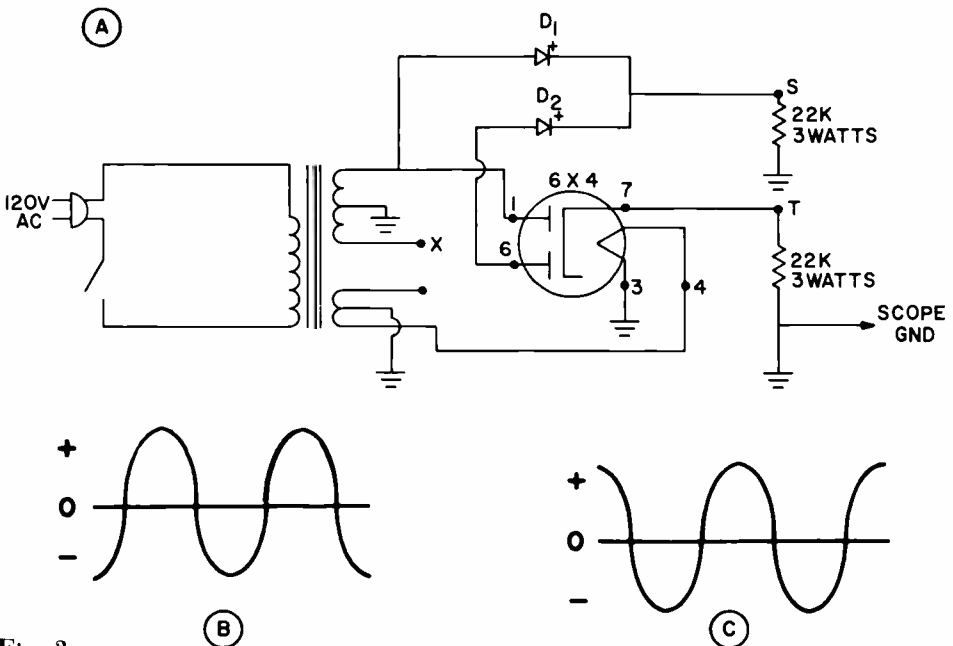


Fig. 3

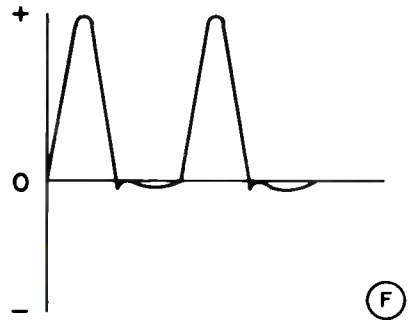
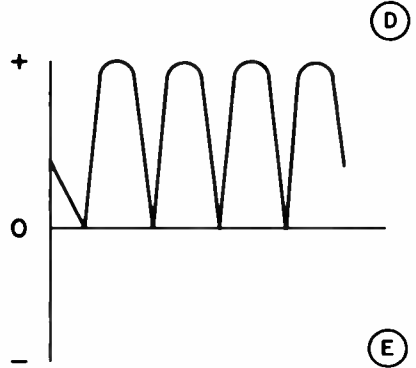
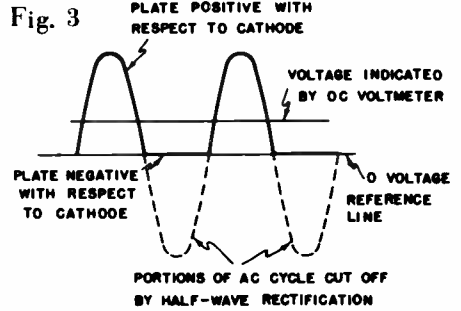
Now remove lead X from socket pin 6, and let's see how these pulses appear across the load after rectification. Set the scope Vertical Attenuator and the Vertical Gain control to 10X to produce a display about 2" high. The output will look like Fig. 3D, while the full-wave connection produces the waveshape shown in Fig. 3E.

Next, switch the Vertical Input lead over to S to view the output of the half-wave solid-state rectifier, which will appear as shown in Fig. 3F. Note the slight curve at the bottom where the tube rectifier (Fig. 3D) cuts off completely, because the selenium rectifier passes a slight current in the opposite direction, but this is not visible when we change to full-wave rectification in Fig. 3E. This is accomplished by touching transformer lead X to pin 6 of the tube socket.

Incidentally, if you think the lead could slip from pin 6, take time out to turn off the supply and solder the connection in place. You can avoid trouble and perhaps the further delay of damage in your experiments by spending the few extra minutes it will take.

From the comparisons we have made, we see that either solid-state or tube rectifiers can produce about the same results when used within these voltage ratings. Unbalanced rectifier operation can be demonstrated by connecting a 6.8K-ohm, 1/2-watt resistor between transformer lead X and pin 6 of the tube socket. Again observe the signal between the chassis and point S or T. The pattern will resemble that in Fig. 4.

Half of this rectified signal has a higher amplitude than the other half. This super-



In Fig. D the heavy line indicates the shape of the voltage across the load of the half wave rectifier circuit.

imposes a 60-cycle variation on the 120-cycle ripple frequency obtained with full-wave rectification. Such a condition may occur due to a defective rectifier, with one-half of the tube, or a single solid-state rectifier not operating as well as the other, due to a partially shorted

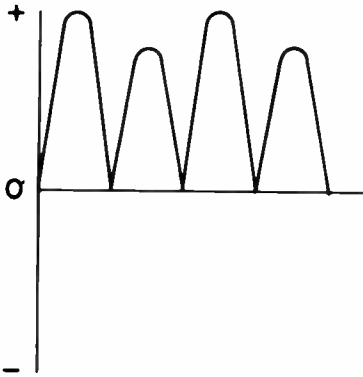


Fig. 4. Rectified full wave signal resulting from unbalanced rectification.

winding on one-half of the high-voltage secondary of the power transformer, a rosin joint in one of the rectifier anode connections, or similar causes.

Such a defect will superimpose a 60-cycle ripple normally obtained from a full-wave power supply. In many amplifiers, radios, and TV sets the power supply is not designed to effectively remove a 60-cycle ripple. Because of this a severe 60-cycle hum condition may be found, even though the filter parts are in good condi-

tion. In practice, such a condition can be spotted by observing the waveshape of the hum signal in the B supply line and determining if it is 60 cycles or 120 cycles. Then the ac voltage supplied by each half of the power transformer high-voltage winding can be checked. These voltages should be about equal. A severe variation in the measured voltages will result in the condition demonstrated.

The rectifier tube can be checked in an ordinary emission-type tube tester. A lower emission indication for one-half of the tube than for the other shows that the imbalance is in the tube itself. The best check on a selenium or silicon diode is temporary substitution of a known good unit. Rosin joints can be cleared with a hot soldering iron. If vapor rises from the heated joint, excess rosin was present. Additional solder should not be necessary.

What happens if we reverse the connections to a rectifier? This can be done by switching the diode connections, as shown in Fig. 5. Note that the connections to D_1 and D_2 have been reversed. The anodes are now connected together

Fig. 5

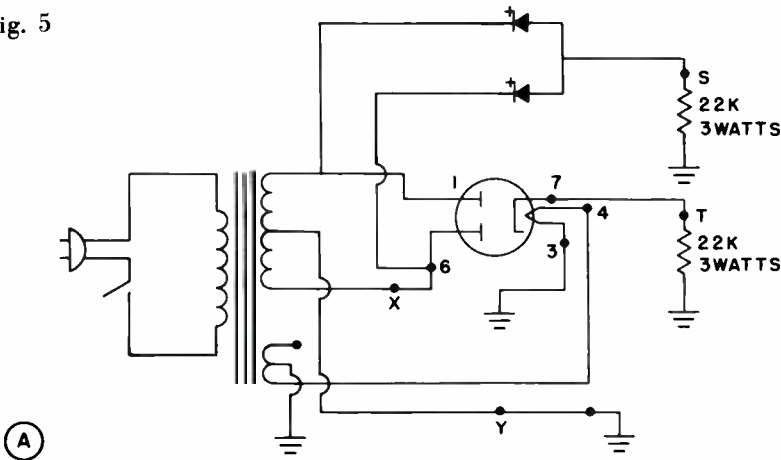
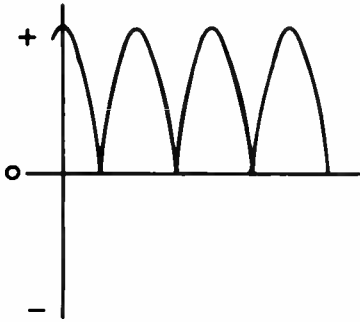


Fig. 5



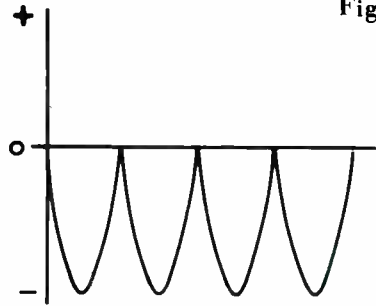
(B)

rather than the cathodes (see Fig. 3A), and the ac voltage is applied to the cathodes.

Make this change: putting in wire jumpers at X and Y, as shown in Fig. 5.

The waveshape between the chassis and point T will remain as it was in Fig. 3E. Verify this to make sure everything is properly wired. This gives the shape shown in Fig. 5B. Check the signal waveshape at terminal S and the chassis. The resulting waveshape (see Fig. 5C) is 180° out-of-phase with that in Fig. 5B, because now we are utilizing the negative halves of the ac voltage source, due to the reversal of the connections of D₁ and D₂.

An ac service-type scope will show both Fig. 5B and Fig. 5C in the same relative position on the screen. Verify the dc



(C)

polarity of the rectified pulses by measuring between the chassis and points T and S with a dc voltmeter. You should measure between 50 and 60 volts dc in either case. However, you will find point T positive with respect to the chassis, while point S is negative.

I measured +56 volts between T and the chassis, and +52 volts between S and the chassis. If you get a similar variation, reverse the position of the two 22K-ohm resistors and see if this variation is due to a difference in the values of the load resistors. If the variation remains the same, you can figure the tube rectifier to be slightly more efficient than the selenium diodes.

Next issue: Power-supply experiments and modifications using a service-type oscilloscope.

Christmas Seals fight tuberculosis, emphysema, air pollution.

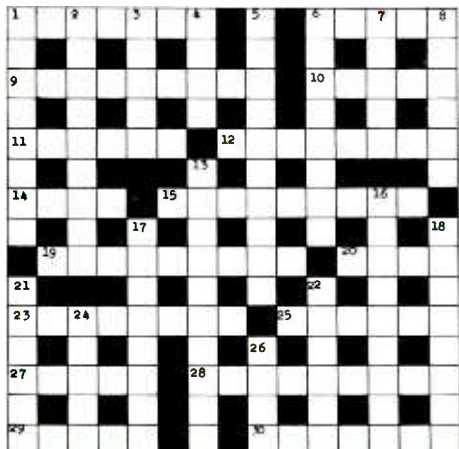


This space contributed by the publisher as a public service

ELECTRONICS CROSSWORD PUZZLE

by Michael Kresila

(Solution on page 28)



DOWN

1. An amplifying station used to boost the volume on long telephone lines.
2. A tungsten vacuum tube filament to which an element is added to improve emission.
3. A tube small in size and shape.
4. Level.
5. An instrument for measuring voltages, current, and resistance.
6. A coupling unit for two transmitters to operate into the same antenna.
7. To assign or give.
8. A stylus.
13. A method of communication requiring two frequencies.
16. The process of emitting waves from an antenna.
17. What a radio wave did if it just carried intelligence of any form.
18. Waves suitable for modulating.

21. Enlargement in a spot size in a cathode ray tube resulting from abnormal brilliancy.
22. A slang term for a small radio tube.
24. Any of a class of substances which are good conductors of electricity.
26. Against.

ACROSS

1. Return to a spot in a picture tube after sweeping across the screen.
6. A term used to indicate that current is being taken from a voltage source.
9. A barrier-layer cell.
10. A surge of voltage or current.
11. Term for negative ions that move
12. A 14 pin tube base that is used for cathode-ray tubes.
14. Corrodes.
15. Transmitting data over great distances via radio.
19. Two colors that combine to form a third.
20. A thought.
23. Shining; emitting light; full of light, as a room.
25. To mend.
27. A tube socket with openings for eight pins.
28. Disturbing electrical impulses in a transmission line. (two words)
29. A conductor which is not divided into strands.
30. Means to.

dah-di-dah-dit dah-dah-di-dah

dah-di-dah-dit dah-dah-di-dah

CQ from W3WNJ and the group

With the number of licensed radio amateurs in the United States approaching 300,000, it seems likely that there are a number of hams among our current and former students. We know from letters we receive that some of you have licenses, but until now we have made no effort to find out how many of you share our interest in this hobby.

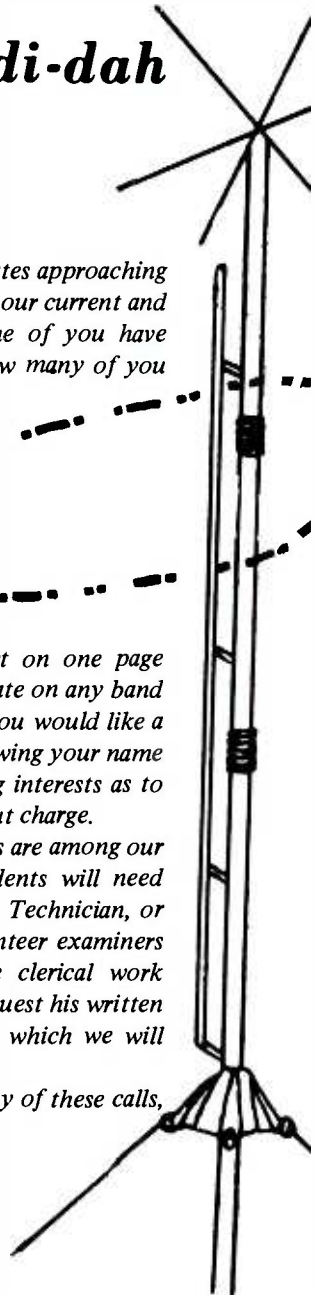
As you may know, NRI is initiating courses in amateur radio to make it easy for newcomers to acquire the knowledge of code, theory, and regulations needed to get started in ham radio. We think the courses will be particularly useful to current Citizens Band operators who want to expand the range of stations they can work.

In preparing the ham courses, we developed a handy chart on one page showing the class of license required on the various dates to operate on any band or band segment under the FCC's incentive licensing order. If you would like a copy, just send us a postcard (your QSL card will do nicely) showing your name and address, call letters, class of license, and principal operating interests as to modes and bands. We'll send you the chart by return mail, without charge.

We have a particular reason for wanting to know who the hams are among our readers. We anticipate that some of our amateur course students will need volunteer examiners to give them the FCC tests for the Novice, Technician, or Conditional class licenses. Most hams who have served as volunteer examiners have found it an interesting and satisfying experience. The clerical work necessary to certify the student's code speed to the FCC and request his written examination is largely taken care of by the preprinted form which we will furnish the student.

Who are we – the hams at NRI Headquarters? If you hear any of these calls, give us a shout:

W3WNJ	Bill Dunn, Director of Education
K4MKX	Ted Beach, Chief Technical Editor
WN4JSO	Harry Taylor, Technical Editor
W3FSP	Russ Kidwell, Technical Editor.



Electronic Time Measurement

by Louis R. Frenzel, Jr.

If someone approached you and asked you to give them a good definition of time, what would you say? If you are like most of us, you probably never really gave it much thought before. But now stop and think a moment. Just what is time?

Having considered a definition now, you are sure to realize that time is a very vague and relative thing, and it is pretty difficult to define. It is something that we cannot see, feel or hear, and we never seem to have enough of it. But we can measure it, and without this ability our lives would be quite confusing and unorganized. In addition, science and technology would not be what they are today.

Time is one of the most important factors in our lives, since it controls virtually everything that we do. It determines when we go to work in the morning, and it tells us when to watch our favorite TV program at night. Keeping track of time puts us on schedule and brings general order into our lives.

Time is generally defined as the interval that elapses between the occurrence of two events. Time, as we know, is based upon the occurrence of such events as the rotation of the earth around the sun and the rotation of the earth upon its own axis. These two events determine specifically the length of our year and our day. Since we are generally interested in intervals smaller than a day, the hour, minute and second are used.

Our ability to make the best use of the time available to us depends upon our ability to measure or keep track of it. Time measurement is also very important in scientific and engineering activities. It allows us to observe when an event occurs with respect to a standard, and it enables us to determine the duration of a given event.

The science of time measurement is called chronometry. It has taken many years for this science to develop into today's system. We see this system in the form of our present day calendars and units of time length. Many different instruments for measuring time have been devised, from crude sun dials and sand glasses to today's ultra-precise atomic clock.

Of all the physical quantities with which we normally deal, time can be measured with the greatest accuracy, and electronics has played a major role in allowing us to measure time with such accuracy.

Time Measurement. Time measurement is generally performed by mechanical or electromechanical devices known as clock and watches. A clock (or a watch) contains a constant speed motor that drives a set of gears, which in turn operate an hour hand, a minute hand and in some cases, a second hand. The hands displayed against the clock face or dial indicate the time.

The accuracy of a clock or watch like this is a function of the motor speed. To be accurate, the clock must have a motor whose speed is very constant. In a fully mechanical watch, a spring motor is used and a mechanical regulating system, using an escapement and a balance wheel assembly, controls the speed. Battery-operated, electromechanical clocks and watches are also available. The battery operates a magnetic escapement type motor to develop a constant speed source to drive the gears which turn the hands.

Another form of watch or clock, commercially known as the ACCUTRON, uses a tuning fork in conjunction with an electronic circuit to form an accurate oscillator. The vibrating tuning fork makes a good, constant speed motor. The tuning fork, long recognized as the precision frequency standard, vibrates at a frequency of 360 cps. A mechanical linkage couples the vibrating energy from one of the fork tines to a gear train that turns the hands. An ACCUTRON clock or watch is very accurate, much more so than an ordinary mechanical or electromechanical escapement type watch. Fig. 1 shows an ACCUTRON wristwatch.



Figure 1

In an ordinary electric clock, a synchronous ac motor is used. The 60 cps ac power-line frequency determines the speed of this motor. Most electric clock motors turn at 3600 rpm and are geared down to drive the hour, minute, and second hands. The accuracy of the power line frequency is quite good, so most electric clocks are accurate timekeepers.

For general time-keeping applications, such as the routine scheduling of our lives, mechanical and electromechanical clocks or watches have sufficient accuracy. But for the more accurate timing involved in scientific and engineering measurements, they fall far short of the precision desired or required. Special electronic time measuring devices have been developed and these are used for such critical applications.

For time-interval measurements, a stop watch is used. This is a mechanical device that is reset, stopped and started manually. A stop watch can measure time intervals quite accurately, but most of the error introduced into measurements with these devices is caused by human error in starting or stopping them.

The first step that we might take toward making a more accurate timepiece for scientific measurements could be to improve upon the common electric motor clock. First we

might produce a more accurate dial. We should also reduce the parallax between the hands and dial.

Next we would want to use a motor that would maintain a constant and accurate speed. The speed of a synchronous motor depends solely upon the frequency of the ac driving it, so we can use this if an accurate source of ac is available. The common electric clock uses this kind of motor, and we must depend upon the frequency of the 60 cps power line to be accurate. This varies too much for really critical applications, so we might generate a stable and accurate frequency with a crystal or tuning fork oscillator, amplify it, and use it to drive the clock motor.

Even with these improvements, the precision of our clock is limited. Changes in temperature will cause the crystal or fork frequency to vary slightly, and the necessity for interpolation between the marks on the clock dial will induce errors. This latter difficulty is one of the troubles inherent in analog measurement devices. Clocks are analog devices, since they give us a continuous indication of time rather than a discrete step-by-step indication as a digital device would do. A common voltmeter is an analog device like the clock, and to read it accurately we must guess at fractions of a dial marking since the dial size limits the number of small divisions that can be used. Parallax and pointer size also limit the accuracy of a reading.

But consider the digital voltmeter. Here is a device that gives a direct number readout of a measured voltage to a given number of decimal places. Such a device eliminates the human error in reading a measuring instrument and makes the measurement dependent entirely upon the accuracy of the electronic circuitry in the device. Such digital techniques are also applicable to time measuring instruments. In fact, digital clocks and time interval counters give us the most accurate way to measure time.

Time Interval Measurement. Fig. 2 shows a block diagram of a digital time-interval counter that is used to measure the time interval between the occurrence of two events.

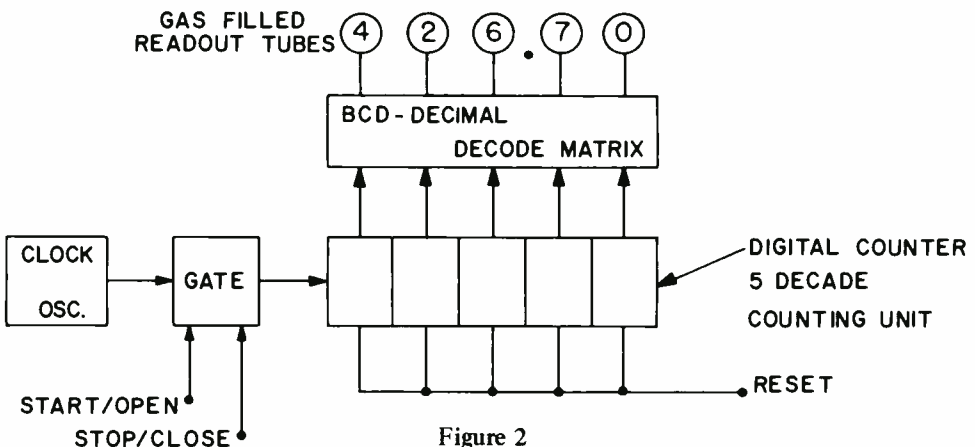


Figure 2

Essentially it is a sophisticated electronic version of a stop watch. It consists of a digital counter, a gate, a clock and a readout. The clock is a very stable and highly accurate oscillator that produces output pulses to drive the counter. The clock frequency determines the smallest interval of time that we can measure. For example, if we want to measure the time in milliseconds, a 1000 cps clock will be used ($f=1/t=1/.001=1000$ cps).

The clock oscillator is usually crystal-controlled and in most cases is followed by a frequency divider to produce the desired output frequency. Tuning fork oscillators make excellent clocks for the low frequencies (50 cps to about 10 kc), and usually eliminate the need for frequency dividers that are required to produce a low-frequency signal from a high-frequency crystal.

The heart of this instrument is the decade counter units. Each decade counter is a 10:1 frequency divider, which means that it produces one output pulse for every ten input pulses. If input pulses occur every one second, output pulses will occur every ten seconds. The decade counter is made up by cascading four flip flops or binary multivibrators. Each flip flop divides by two, so the four together will normally produce division by 16. But in this case, feedback between flip flop stages is used to cause the circuit to divide by ten. Five of these decade counter units are used in the circuit of Fig. 2 to make up a counter that divides by 10^5 or 100,000 input pulses before it "overflows" and starts all over. This type of counter is called a binary coded decimal (BCD) counter since it counts decimally by units, tens, hundred, etc. just as we do.

Accompanying the five stage counter is a BCD to decimal decode matrix. Essentially, this is a large group of diode AND gates that monitor the output states of the flip flops in the decade counter units. The AND gate outputs feed light driver circuits that operate a readout display. This can be a gas tube, containing the numbers 0 through 9 that light one at a time when energized individually. As a decade counter counts through its ten possible states, 0 through 9, the numbers in the readout tube light sequentially. Each decade counter has a readout tube.

Between the clock and the counter is a gate. This is a circuit or device that passes or inhibits clock pulses to the counter upon command. It has two inputs, a start input that opens the gate and allows clock pulses to trigger the counter, and a stop input that closes the gate. A typical gate might be a shunt or series transistor switch, a flip flop or a controlled AND gate.

To see how this circuit measures a time interval, let's assume that we have a 1 mc clock frequency. This means that the time interval displayed on the readout tubes will be in microseconds. The first decade counts in microseconds, the second in tens of microseconds, the third in hundreds of microseconds, the fourth in thousands of microseconds or milliseconds, and the fifth in tens of milliseconds. The counter will measure up to a total of 99.999 milliseconds before it overflows, resets and starts over.

Now let's assume that we want to measure relay delay time, the interval between the initial application of power to a relay coil and the exact instant of contact closure. This is

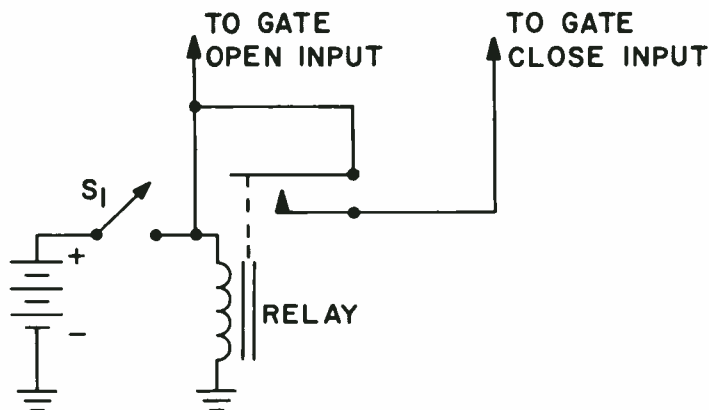


Figure 3

easily done with our time-interval circuit of Fig. 2. The exact setup may appear as shown in Fig. 3. When S_1 is closed, the battery voltage will be applied to the relay coil. Due to the inductance of the coil, the current does not follow the applied voltage. There is a time lag between the initial application of coil voltage and the time where current increases to the point where the coil pulls the relay contacts closed.

Closing S_1 will energize the relay and will also generate the start signal for the timer gate. When the relay contacts close, the battery voltage will then be applied to the timer gate stop input. To make the measurement, we first reset all the decade counters so that they will start counting from zero. At this time the gate is closed.

When S_1 is closed the relay coil is energized and the gate is opened. Clock pulses then begin to feed the decade counters. When the relay contacts close, the battery voltage is applied to the stop input of the gate. The clock pulses no longer reach the counters, and the readout display shows the time delay. The display may read 07.624 as shown in Fig. 2. This means that the delay is seven milliseconds and six hundred and twenty-four microseconds.



Figure 4

CONAR CHRISTMAS SHOPPING GUIDE



For NRI Students and their Wives . . . CHRISTMAS Gift-Giving Suggestions . . . from CONAR

HERS

Sure, he'd appreciate new shirts, or a sports coat, or an electric razor, or . . . well, you know, the *usual* Christmas gifts. But if you want to make him doubly happy, give him a gift he really wants. Chances are, he really wants one of the CONAR test instruments described in this issue of the Journal. You know how men are . . . they can get as excited about a set of tools or an electronics test device as you get about a new dress or purse.

But how do you figure out which equipment to get for him? We think we've found a way to make that easy. Just read the rest of the page and you'll see what we mean.



HIS

Your wife is wondering what to get you for Christmas. Whatever she decides, you'll be pleased. Of course. But wouldn't you be even happier if she got you that CONAR instrument you've been wanting? Truth is, she'd be happier too, because she wants to please you. Why not help her out by marking in this issue of the Journal the item you want, and then have her read this page. Better yet, mark several items and let her make the selection so she can still surprise you.

(For you wives who are still reading, remember: two can play this game. Why not circle some of the items YOU like and give the Journal back to him.)

See the CONAR Catalog for Other Gift Ideas

CONAR CHRISTMAS SHOPPING GUIDE

CONAR Cathode Conductance Tube Tester



Catalog Price **\$49.95**

NRI Student and Alumni Price

KIT 223 UK **\$44.80**

\$5 DOWN, \$5 PER MONTH

Catalog Price **\$75.95**

NRI Student and Alumni Price

WIRED 223 WT **\$68.25**

\$7 DOWN, \$7 PER MONTH

Express Collect

Completely new, modestly-priced Tube Tester Kit, designed by men with **unequaled** experience in training technicians -- understanding their equipment needs and servicing problems. No unnecessary frills added to the Model 223's specs. Only those features most essential to a technician's work are built in.

Every technician -- full or part time -- needs the Model 223 for his bench. Helps you make better job estimates and pays for itself quickly in extra profits. Perfect for experimenters and hobbyists, too.

Tests all series string and up-to-date tubes as well as the standard base types -- 4, 5, 6, 7-pin large octal, local, 7, 9 and 10-pin miniatures, 5 pin nuvistor, novar and Compactron. Checks 17 individual filament voltages from .75 to 110 volts. Tests multi-section tubes, gas rectifiers and remote control gaseous types. Has open-close "eye" tests for cathode ray indicator tubes, and visible filament continuity check to show up on filaments regardless of pin position.

12 level element selector-distribution system enables you to select the individual elements of the tube you're checking and simplifies cathode leakage tests and inter-element short tests. Most important this feature provides you with flexibility AND gives you insurance against obsolescence as new tubes reach the market.

Designed around the approved Electronic Industry Association's Emission Circuit, the Model

223 uses a precise, accurate, double-jeweled meter movement. It's balanced and factory calibrated within 2% accuracy. Large, easy to read -- with clear plastic case and two 2-color scales.

Test sequence set up to reveal quickly open filaments and shorts. The time-saving feature rejects an "open" or "shorted" tube and lets you proceed with more detailed checks right away. For maximum safety to you and the instrument, the test circuit transformer is isolated from the power line. Triple-window, high-speed, gear-operated roll chart is illuminated, easy to read, even in darkened areas. Lists over 2,000 tube types.

Durable, black, leather-fabric case makes the Model 223 attractive as well as functional. Hinged lid is removable. When the lid is on, a snap lock holds it securely.

Level switches and other controls conveniently grouped to eliminate wasted motion. This minor but thoughtful feature is typical of the care put into the Model 223.

The instruction manual for the Model 223 is written with the same high standard that went into the circuit design -- with HUGE picture diagrams to guide you every step of the way.

Building the Model 223 is easy. Using it is even easier. The operating simplicity makes it a pleasure to use. Just 10 lbs. -- it's a pleasure to tote along on service calls, too.

PICTURE TUBE ADAPTORS: 70°-90°, Stock 3AD; 110°, Stock 5AD -- \$3 Each

See the CONAR Catalog for Other Gift Ideas

CONAR CHRISTMAS SHOPPING GUIDE

CONAR Model 280 Signal Generator



**NRI Student and
Alumni Price \$26.35**
KIT 280 UK
Catalog Price \$29.95

**NRI Student and
Alumni Price \$39.55**
WIRED 280 WT
Catalog Price \$43.95

9 lbs., P.P. Ins.

Widely acclaimed as most accurate signal generator near the price.

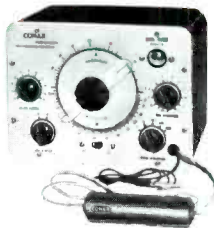
Uses Hartley type oscillator circuit with six separate coils and capacitors to give accuracy within 1% after easy calibration. All coils are carefully pre-aligned, double-checked before shipment.

High output of the Model 280 simplifies signal injection for rapid alignment and trouble-shooting of transistor and tube receivers. Covers 170 kc to 60 mc in six ranges with harmonic frequency coverage over 120 mc. Ideally suited as marker generator for TV alignment.

Tuning dial features planetary drive with 6:1 ratio for greater accuracy and elimination of backlash. Scale is full 9" wide with transparent hairline pointer for readings at a glance. Has a single cable for all outputs, no need to change leads when switching from 400 cycle audio to modulated or unmodulated RF.

SPECIFICATIONS
CONTROLS: High-Low Output Selector, Main-Tuning Dial, Band Selector—A thru F, Output Selector—Mod. RF, Audio, Attenuator/On-Off switch
TUBES: 6BE6, 12AU7
CIRCUIT: Slug adjusted RF coils with mica trimmers on low bands, Ceramic trimmers on high bands
CABINET: Steel, baked-on blue finish; satin finish panel with red lettering
DIMENSIONS: 9 7/8" x 7 1/2" x 6 1/2"
POWER SUPPLY: Solid state 110-120 V, 60 cycle AC

CONAR Tuned SIGNAL TRACER



**NRI Student and
Alumni Price \$39.85**
KIT 230 UK
Catalog Price \$49.95

**NRI Student and
Alumni Price \$56.70**
WIRED 230 WT
Catalog Price \$69.95

11 lbs., P.P. Ins.

Makes servicing of transistor, vacuum tube and hybrid receivers easy. Can be used to locate a dead stage, to find hum, noise and distortion as well as intermittents. Will pay for itself over and over again.

The CONAR Model 230 tuned signal tracer is not to be confused with low cost untuned signal tracers which contain only a diode detector and an audio amplifier. Untuned signal tracers are of very limited value in service work.

There are more than 12 pages on uses of the Model 230 in the Instruction Manual. Here is an instrument that will be invaluable to beginners and cut servicing time in half for the experienced technician on many sets.

SPECIFICATIONS
FREQUENCY: 170 kc to 1500 kc (2 bands)
TUNING: Planetary Drive, 3:1 ratio
RF TRANSFORMERS: Permeability tuned
ATTENUATORS: Calibrated RF and AF
TUBES: (2) 6GM6, (1) 6AV6, (1) 6AQ5, (1) 6E5, (1) 6X4, (1) 6AB4
CONTROLS: Volume, Band Selector, Main Tuning, Fine Attenuator On-Off, Coarse Attenuator, RF-AF switch
CABINET: Steel, blue finish with satin finish panel, red lettering
DIMENSIONS: 9 7/8" x 7 1/2" x 6 1/2"
POWER SOURCE: 110-120, 60 cycle

CONAR Model 311 R-C TESTER



**NRI Student and
Alumni Price \$24.40**
KIT 311 UK
Catalog Price \$29.95

**NRI Student and
Alumni Price \$33.85**
WIRED 311 WT
Catalog Price \$42.50

9 lbs., P.P. Ins.

The Model 311 gives fast, accurate, reliable test on all resistors and capacitors. Measures capacity of mica, ceramic, paper, oil-filled and electrolytics from 10 mmfd. to 1500 mfd, 0-450 volts. Checks for leakage, measures power factor and useful life. Shows exact value of resistors from 1 ohm to 150 meg-ohms. Clearly indicates opens and shorts.

Has "floating chassis" design to greatly reduce shock hazards. The Model 311 will also apply actual DC working voltage to capacitors to reveal break-down under normal circuit conditions, a feature far superior to many R-C testers which give low voltage "continuity" tests.

Can be used for in-circuit tests in many applications and circuits. Has 1% precision resistors in range circuit. A basic test instrument that won't become obsolete!

SPECIFICATIONS
RESISTANCE RANGES: 0-500 ohms, 100-50K, 10K-5M, 1.8M-150M (extended range)
CAPACITY RANGES: 0.1-50 mfd, .001-5 mfd, .00001-0.05 mfd, 18-1500 mfd (extended range)
CONTROLS: Range Selector, Leakage Test Voltage (0-450V), Power Factor (0-60%)
TUBES: 6E5 "eye" indicator 6X4
BINDING POSTS: Special 5-way type
CABINET: Steel, smooth blue
DIMENSIONS: 9 7/8" x 7 1/2" x 6 1/2"
POWER SUPPLY: 110-120 V, 60 cycle AC

See the CONAR Catalog for Other Gift Ideas

CONAR CHRISTMAS SHOPPING GUIDE

CONAR "300" Stereo System



- Power Amplifier Kit
- 2 Speakers in Enclosures
- Garrard Turntable
- Stereo Cartridge
- All Cable, Wire, Jacks

Shipped Express Collect

KIT
300 UK
Catalog Price
\$121.00

NRI Student and Alumni Price

\$108.00

\$11 Down - \$5 Monthly

WIRED
1300 WT
Catalog Price
\$135.00

NRI Student and Alumni Price

\$119.95

\$12 Down - \$6 Monthly

The shock of common sense in STEREO—you *must* hear it to believe it!

The "300" Stereo System is designed for those who consider their ears as the best judge of true stereo reproduction. It is not for people who insist on spending \$400 or more for stereo or people who thrive on long lists of specifications, technically accurate or not.

Here is quality stereo to compliment your tastes for good listening and fit any budget. A precision engineered system with carefully matched components; yet ruggedly built as a home entertainment center for the entire family.

Whether it's violin, piano solo or bass drum—Beethoven, Belafonte or Brubeck—the "300" urges and invites your comparison with stereo systems costing considerably more. We repeat, let your EARS judge the living sound, superb channel separation, the startling realism that only good component stereo can bring.

FREE STEREO CARTRIDGE

**ELECTRO-VOICE 126A, \$10 VALUE
DIAMOND-SAPPHIRE NEEDLE**

CONAR Audio Color

An Exciting New Concept in Music

For music lovers and electronics enthusiasts alike, this transistorized marvel attaches quickly to hi-fi sets, stereos, tape recorders and *even most* radios. Simply connect alligator-clip leads to your speaker terminals, and you're ready to enjoy a color spectacle.

While you listen to your favorite melody, beautiful hues of red, orange, yellow, blue, green and violet move across the Audio Color screen in a breathtaking variety of patterns. A frosted screen eliminates glare without filtering the colors.

But Audio Color *does more* than paint the music. It also reproduces the tempo. With each *torrid* beat of the bongos . . . with each *clash* of the cymbals, the colors grow brighter. If the tempo mounts slowly, the colors brighten gradually. A *sharp rise* in volume is matched by a *sudden flash* of colors, bass on the right—treble on the left.

Order the Audio Color in kit form and build it yourself in a few short hours. For those who can't wait to see it, we have a few already assembled.



\$39.85 For NRI Students and Alumni

KIT 103UK

Catalog Price **\$44.95**

\$49.45 For NRI Students and Alumni

WIRED 103WT

Catalog Price **\$54.95**

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CONAR CHRISTMAS SHOPPING GUIDE

FROM CONAR...

Adventures In Electronics Kit

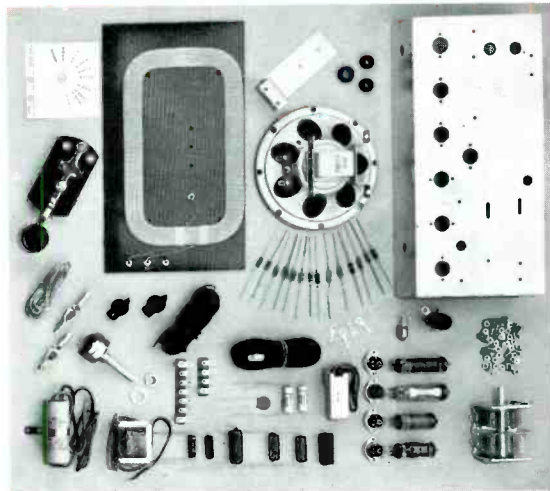
*The Perfect Gift
For Some Lucky
Boy (or His Dad)!*

★ More Than 100 Parts

★ A Dozen Experiments

\$18⁹⁵

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Ten *fascinating* and *safe* educational projects. This kit is used by teachers in many school classrooms to introduce students to electronics—help them toward satisfying and profitable careers. Here's proof positive of its sound educational value and thorough training.

Kit contains over 100 top-quality parts—name brands you'll recognize. This is not the "plastic-cardboard-battery" type experimenter's kit usually found on store shelves. IF PURCHASED SEPARATELY, THE PARTS USED IN THE ADVENTURES IN ELECTRONICS KIT WOULD RUN WELL OVER \$30.00.

You learn about electronics and *have fun* doing it. Each project graphically demonstrates a number of electronics principles. You're shown "why" and "how" these principles work. You need *no previous electronic training or experience*. Just follow the simple, concise instructions and large diagrams in the 46-page project manual. The manual includes a glossary of common electronics terms for quick and easy reference.

The projects cover a *seemingly endless variety* of activities:

- You build a Radio Receiver which performs exact-

ly like a manufactured set—picks up local broadcasts and distant stations.

- You learn about Testing Radio Sets. In this project you build a signal tracer and use it to find the exact point in a circuit where the signal stops. The signal tracer is a test instrument used by professional electronics technicians.

- Then you become a Radio Announcer. You set up a broadcast station, and with the speaker as your "mike," transmit your voice through your radio or a neighbor's set.

- Now you assemble a "Secret Listener." The speaker becomes a concealed microphone. Put it in one room and hear any conversations through a receiver without being present. Use it as an electronic "baby sitter." Mother can place the "Listener" near baby's crib and hear cries while she's in another room.

- You'll experiment with sound. In one project you build an Audio Oscillator and produce a wide range of sounds. Another experiment teaches how sound is magnified. After putting together an Audio Amplifier, you amplify sounds from a phonograph pick-up.

ALL THE TOOLS YOU NEED
ARE INCLUDED **FREE**

SOLDERING IRON • SCREWDRIVER • PLIERS

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CONAR CHRISTMAS SHOPPING GUIDE

WELTRON CASSETTE TAPE RECORDER



Now, the Portable Cassette Tape Recorder that couldn't be easier to use! All Push Button! No tapes to thread! Simply snap in a tape cassette, press a button and record. Press a button to rewind or to move the tape ahead. Inexpensive cassettes can be used as "talking letters" to friends and relatives. Even children can insert or remove cassettes and record and play. Included with the recorder is a carrying strap, an earphone and a microphone with its own case.

SPECIFICATIONS

TRACK SYSTEM: 2 track monaural. **POWER SOURCE:** 5 standard "C" cells. **TAPE SPEED:** 1 1/4 IPS. **BATTERY LIFE:** 10 hours in continuous use. **RECORDING TIME:** 1 Hr. **FREQUENCY RESPONSE:** 200-6,000 c/s ± 3 db. **WOW AND FLUTTER:** Less than .4%. **SIZE:** 5" x 9 3/4" x 3 1/2".

Stock #1000EN
4 lbs. P.P. Inc.

\$39⁹⁵

Arvin Cassette Tape Recorder with AM-FM Radio



Lets you record and play back monaural AM or FM broadcasts, or record live with the slim-style microphone which features a remote control switch that starts and stops tape automatically. Uses tape cassettes so there is no tape threading. Powerful 13 transistor — 16 diode chassis. Push-button controls. Auxiliary input. Battery or AC operation. AM ferrite rod antenna and telescoping FM antenna. Uses 4 "C" cell batteries. Comes with earphone, microphone with stand and AC line cord. Measures 13 1/4" x 9 1/4" x 5 1/4".

\$79⁹⁵ Stock #19EN
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Cassette Tape Player



Beautiful green and gold portable cassette tape player provides instant musical fun wherever you go. Operates on 4 low-cost "C" cell batteries. Uses easy-to-load tape cassettes that play up to one full hour of musical selections at 1 1/4 ips. Powerful 6-transistor chassis and velvet voice speaker deliver crisp, clear sound. Measures 9 1/4" x 5 1/8" x 2 1/4".

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\$69⁹⁵ AR Stereo Tape Player

Stock
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Express
Collect

Gidget
\$5.98
#4300EN

From Automatic Radio—A compact stereo cartridge tape player engineered to play all 8-track cartridges and any 4-track cartridge with "Gidget." Install in your car or boat . . . operates on 12-volt negative ground electrical system. Fully transistorized. Features volume, tone and balance controls.

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CONAR CHRISTMAS SHOPPING GUIDE

Outstanding Values In Portable Radios



Stock #279RT
2 lbs. P.P. Inc.

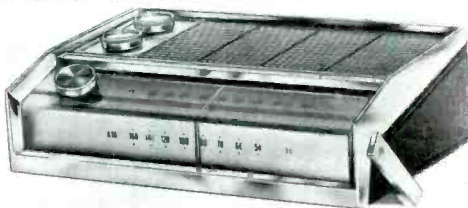
\$56⁹⁵

Arvin 15-Transistor 4-Band Portable Radio

This deluxe Arvin portable radio is a powerhouse of listening pleasure. Enjoy AM broadcasts; static-free FM; plus "Ham" radio broadcasts, police calls, marine weather and ships-at-sea on the two short wave bands. The handsome case is covered with genuine top-grain cowhide with a wood-grain carrying handle. A 4" velvet voice speaker gives clear, sparkling sound. Slide rule dial with push button dial light. Fine tuning control lets you pinpoint short wave stations. AFC (switchable). Full range tone control. Ferrite rod AM antenna. Telescoping swivel whip FM-Shortwave antenna. Uses 4 low cost "C" flashlight batteries. Earphone and batteries included. Measures 10" x 6½" x 3".

AC-DC Convertible Portable

This remarkable AM portable leads a double life. Upright it's a portable—horizontally (as in photo) it's a modernistic low-profile table radio. Two slide-rule tuning dials for station finding in either position. Operates on 4 "D" cells (included) or with built-in line cord. 10 transistors, 2 diodes, 1 thermistor, 1 selenium rectifier. Full range 4" dynamic speaker. Built-in ferrite antenna. On-off, volume and tone controls. Padded black vinyl cabinet with vinyl-clad die-cast handle. Earphone included. Measures 16½" x 8¾" x 3".



\$26⁹⁰

Stock #187T



Lloyd's "Valencia" FM-AM Portable

This good looking FM-AM portable features Lloyd's exclusive *nitemate* electronic timer which allows 10 to 90 minutes of play, with last 5 minutes fading out to automatic shut off. All solid state, etched circuitry. Five IF transformers on FM and four on AM. Large 3¾" permanent magnet speaker. AFC for FM and AGC for AM. Built-in ferrite AM antenna and telescoping FM antenna. Operates on either 4 standard "C" cell batteries (included), or through built-in line cord. Unique cylinder dial tuning. Earphone included. Handsome padded vinyl cabinet. Color: Tan.

Measures 8¾" x 5¾" x 2¾".

\$29⁹⁵

Stock #241RT
7 lbs. P.P. Inc.

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CONAR CHRISTMAS SHOPPING GUIDE

LOOKING FOR SOME REALLY DIFFERENT TRANSISTOR RADIOS?

"YORICK"



A most unusual free-form ball top AM radio.

- Ferrite antenna inside ball rotates for best reception.
- Powerful 2 $\frac{3}{4}$ " speaker housed in ball
- Solid state etched circuitry
- 3 IF transformers
- Operates on 4 penlight batteries (included)
- Color: Rosewood grain base/black ball
- Size: 6 $\frac{3}{4}$ " x 4 $\frac{1}{4}$ " x 4 $\frac{1}{4}$ "

\$11⁹⁵

Stock #839RT



A uniquely styled portable AM desk radio.

- All solid state circuitry
- Three IF transformers
- Ferrite antenna built-in
- High efficiency 2 $\frac{1}{4}$ " speaker
- Cylindrical cabinet can be rotated on base
- Operates on 4 standard "C" batteries (included)
- Cabinet is wood grain on silver base
- Size: 6 $\frac{1}{4}$ " x 6 $\frac{1}{2}$ " x 2 $\frac{1}{2}$ "

\$11⁹⁵

Stock #837RT

"SNAPPER"

Solid state pocket AM radio

- Sturdy cabinet accented with chrome die case front panel
- Etched circuitry
- Push-pull audio circuit with 3 IF transformers
- Built in ferrite antenna
- Powerful permanent magnet speaker
- Uses one standard 9 V battery (included)
- Colors: Black and Grey
- Size: 4-1/2" X 2-3/4" X 1-1/8"



\$9⁹⁵

Stock #941RT

Transistor Radio Sunglasses



- Precision-made miniaturized transistor radio receives stations with amazing clarity and tone.
- Equipped with on-off switch, volume control, tuning dial and built-in invisible antenna.
- Easy operation, dependable performance.
- Miniature energy cell (battery) operates 80 to 160 hours. Replacement battery available at most camera stores and hearing aid centers.
- High quality ground lenses in well-made sturdy frame. Can be fitted with prescription lenses by any optometrist or oculist.
- Handsome protective plastic carrying case.

Stock 625EN, Shipping Wt. 7 oz.
Shipped: Parcel Post Insured

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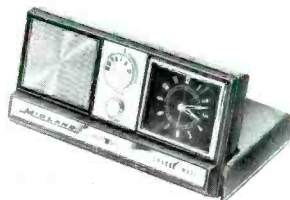
Stock #29RT
2 lbs. P.P. Ins.

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Eight transistor miniature AM portable radio comes gift-boxed with battery, earphone, wrist strap and polishing cloth.

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Fig. 4 shows a commercial time-interval measurement instrument made by CMC. Connectors A and B on the lower left are for the gate start and stop signal inputs. The trigger level controls above the connectors allow adjustment of triggering level. Gate triggering signals may come from a variety of sources such as photocells, microswitches, or other transducers. The time base-multiplier control on the far right sets the clock frequency feeding the counter. Such a control allows a wide range of time interval measurements to be made. Intervals between one microsecond and 10^7 seconds (approximately 2777 hours) can be measured with this instrument. If this switch was set so that we counted in microseconds, the display as shown in Fig. 4 would be reading 124,704 microseconds, or 124.704 milliseconds.

The Digital Clock. Another useful digital timekeeping device is the digital clock. A commercial unit is shown in Fig. 5. This device keeps time just like an ordinary clock, except that instead of presenting the time in a continuous analog way, this unit displays the exact hour, minute and second in large easy-to-read digits. Based on the 24-hour timekeeping system, this clock is indicating 13 minutes and 43 seconds after seven in the evening. If the clock indicated zero hours, minutes and seconds, the time would be 12 midnight.

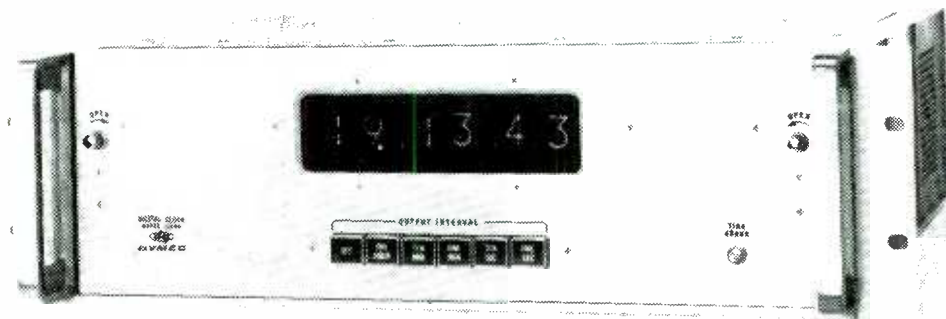


Figure 5

The operation of the digital clock is quite similar to that of the time-interval counter just discussed. Fig. 6 is a simplified block diagram of a digital clock. An oscillator, used as a precision frequency standard, is the basis for the generation of an accurate time base. Most commercial digital clocks use a quartz crystal oscillator, but a tuning fork oscillator could also be used.

The oscillator generates a high frequency signal, 100 kc for example, and frequency dividers are used to reduce the frequency of one pps. The one pulse-per-second signal is then used to trigger a BCD counter that acts in effect as a frequency divider. The BCD counter accumulates the seconds, minutes and hours in the form of a binary bit pattern in the counter. The bit pattern is continuously monitored and decoded to display the time. The frequency dividers and BCD counter stages are generally conventional flip flops connected to provide the desired division or counting.

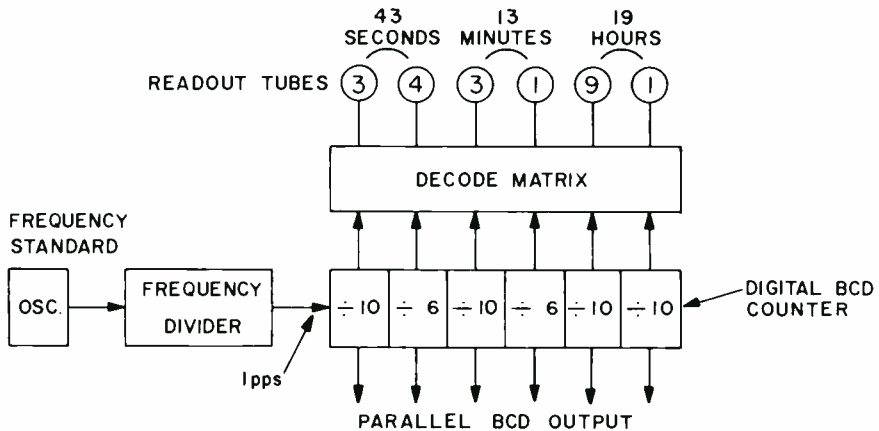


Figure 6

The BCD bit pattern is also made available in parallel externally, so that the digital binary code representing time can be recorded or stored for reference later or used for control purposes. Most digital clocks are set to local standard time or GMT, but alternately they can be used to simply accumulate time starting from zero to record the total duration of an event, such as the duration of a space flight.

Time and Frequency Standards. As you probably noticed, in both the time interval counter and the digital clock, an accurate frequency source is the time standard. Since frequency is specified in terms of so many cycles per unit of time, the generation of an accurate frequency is directly related to the development of an exact time interval ($t = 1/f$). So any accurate frequency source can be used as a time base in electronic timing instruments. As mentioned earlier, the 60 cps ac power line makes a good frequency standard.

Most power companies maintain a relatively accurate frequency, and for many noncritical timing applications it's a good source. It is certainly economical and convenient! For more critical timing applications, quartz crystal and tuning fork oscillators can be used. For even greater precision and stability, an atomic oscillator can be used. An atomic oscillator is the ultimate frequency standard, and its accuracy is several orders of magnitude better than that of a quartz crystal oscillator.

When a gas such as ammonia or cesium is radiated with a microwave signal of a certain frequency, the atoms of the gas will undergo transitions from one energy level to another. In other words, they will begin to oscillate at a specific frequency, 23,870 mc in the case of ammonia (NH_3), and 9,192, 631,770 mc in the case of cesium 133. The oscillating atoms are then detected by a hot wire ionizer and an electron multiplier and the output derived is used to synchronize a quartz crystal oscillator, and to control the frequency of the microwave signal radiating the gas to eliminate frequency error. The output of the synchronized crystal oscillator is then used as the standard frequency.

The accuracy of a clock or watch like this is a function of the motor speed. To be accurate, the clock must have a motor whose speed is very constant. In a fully mechanical watch, a spring motor is used and a mechanical regulating system, using an escapement and a balance wheel assembly, controls the speed. Battery-operated, electromechanical clocks and watches are also available. The battery operates a magnetic escapement type motor to develop a constant speed source to drive the gears which turn the hands.

Another form of watch or clock, commercially known as the ACCUTRON, uses a tuning fork in conjunction with an electronic circuit to form an accurate oscillator. The vibrating tuning fork makes a good, constant speed motor. The tuning fork, long recognized as the precision frequency standard, vibrates at a frequency of 360 cps. A mechanical linkage couples the vibrating energy from one of the fork tines to a gear train that turns the hands. An ACCUTRON clock or watch is very accurate, much more so than an ordinary mechanical or electromechanical escapement type watch. Fig. 1 shows an ACCUTRON wristwatch.



Figure 1

In an ordinary electric clock, a synchronous ac motor is used. The 60 cps ac power-line frequency determines the speed of this motor. Most electric clock motors turn at 3600 rpm and are geared down to drive the hour, minute, and second hands. The accuracy of the power line frequency is quite good, so most electric clocks are accurate timekeepers.

For general time-keeping applications, such as the routine scheduling of our lives, mechanical and electromechanical clocks or watches have sufficient accuracy. But for the more accurate timing involved in scientific and engineering measurements, they fall far short of the precision desired or required. Special electronic time measuring devices have been developed and these are used for such critical applications.

For time-interval measurements, a stop watch is used. This is a mechanical device that is reset, stopped and started manually. A stop watch can measure time intervals quite accurately, but most of the error introduced into measurements with these devices is caused by human error in starting or stopping them.

The first step that we might take toward making a more accurate timepiece for scientific measurements could be to improve upon the common electric motor clock. First we

might produce a more accurate dial. We should also reduce the parallax between the hands and dial.

Next we would want to use a motor that would maintain a constant and accurate speed. The speed of a synchronous motor depends solely upon the frequency of the ac driving it, so we can use this if an accurate source of ac is available. The common electric clock uses this kind of motor, and we must depend upon the frequency of the 60 cps power line to be accurate. This varies too much for really critical applications, so we might generate a stable and accurate frequency with a crystal or tuning fork oscillator, amplify it, and use it to drive the clock motor.

Even with these improvements, the precision of our clock is limited. Changes in temperature will cause the crystal or fork frequency to vary slightly, and the necessity for interpolation between the marks on the clock dial will induce errors. This latter difficulty is one of the troubles inherent in analog measurement devices. Clocks are analog devices, since they give us a continuous indication of time rather than a discrete step-by-step indication as a digital device would do. A common voltmeter is an analog device like the clock, and to read it accurately we must guess at fractions of a dial marking since the dial size limits the number of small divisions that can be used. Parallax and pointer size also limit the accuracy of a reading.

But consider the digital voltmeter. Here is a device that gives a direct number readout of a measured voltage to a given number of decimal places. Such a device eliminates the human error in reading a measuring instrument and makes the measurement dependent entirely upon the accuracy of the electronic circuitry in the device. Such digital techniques are also applicable to time measuring instruments. In fact, digital clocks and time interval counters give us the most accurate way to measure time.

Time Interval Measurement. Fig. 2 shows a block diagram of a digital time-interval counter that is used to measure the time interval between the occurrence of two events.

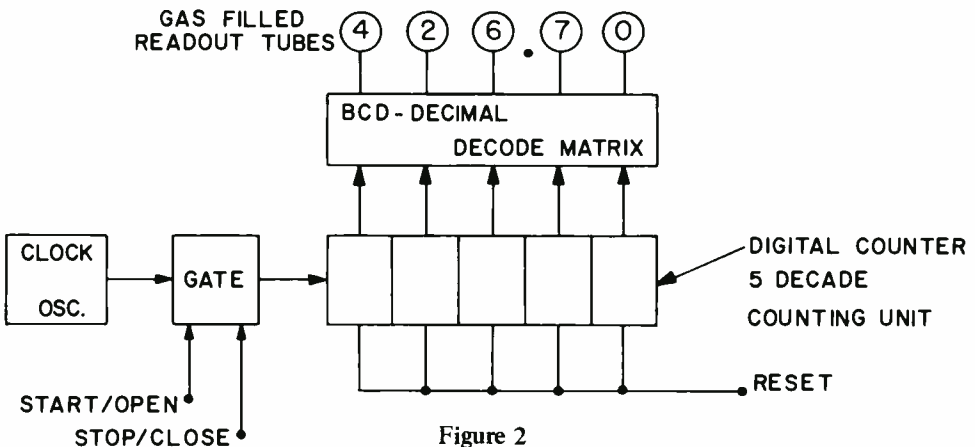


Figure 2

The accuracy and stability of an atomic oscillator is unsurpassed. In fact, the cesium 133 oscillator is so superior that it has been adopted as the international standard of time-interval measurement. The international second is now defined as 9,192,631,770 cycles of energy transitions of the cesium 133 atom.

Before the discovery of atomic oscillators and the adoption of the cesium 133 oscillator as the international standard, frequency standards were derived and calibrated by astronomical observations. Observatories throughout the world continuously measure the rotational time of the earth around the sun, the time of rotation of the earth upon its own axis, and other pertinent astronomical phenomena. These time measurements are made available for the calibration of instruments by radio time signal transmissions. The U.S. Naval Observatory broadcasts time signals through the facilities of the U.S. Naval Radio Service. The National Bureau of Standards' station WWV also transmits Naval Observatory time signals, while Station CHU in Canada broadcasts time signals provided to it by the Dominion Observatory. Time signals based on the international atomic time standard are transmitted by National Bureau of Standards station WWVB.

Applications of Time Measuring Instruments. The time measuring instruments just described here have many useful applications. Let's take a look at some of them.

Digital clocks are used quite frequently in data acquisition or data logging systems. These systems are used to gather data in whatever form it may occur. The data may then be analyzed or used for control purposes. For example, the ground station equipment associated with a missile shot or a satellite is a data acquisition system. It consists of the telemetry receiving equipment that picks up the data (temperature, speed, etc.) sent to it by the missile or satellite; the magnetic tape, strip chart and other recorders that store or display the data; and in some cases a computer for data storage, analysis or perhaps control.

The digital clock in such a system may perform several functions. It may be used, for example, to record the total elapsed time of a flight say from lift-off to touchdown. The clock would initially be set to zero and would accumulate the time in hours, minutes, and seconds. Or the clock could be synchronized with local time or GMT so that the data gathered could be related to a specific time. Since time may be an important factor with relation to the data collected, the digital binary code developed by the clock is also recorded simultaneously with the data so that in analysis later a specific event may be related to its time or occurrence or so that the duration of a measurement could be determined.

The digital clock could also be used to initiate the recording of data at a predetermined time. The clock in the system would be accumulating time, and when a preset time was reached, the clock would turn on the data logging system so that it would start recording data. In many clocks, provision is made for repetitive output trigger pulses at intervals of one minute, one hour, 8 hours, etc. to be used to initiate a data gathering operation.

Assume that a clock is used in a data logging system that measures air pollution in a big

city. Such a system might measure temperature, humidity, barometric pressure, and light level. Other sensors would measure the quality and type of air pollution existing. It would be wasteful to run the system continuously, so the digital clock is programmed to turn the system off and on at specific times to take measurements. The time of the measurement would also be recorded along with the data. Later, in analysis, the system might tell us that air pollution increased substantially after the 8 a.m. and 5 p.m. traffic rushes due to the exhaust fumes at these heavy traffic times, and is at a minimum in the early morning hours when traffic is light.

Time-interval measuring instruments have even wider application. For laboratory testing and measuring this type of instrument can perform many measurements similar to the relay time delay measurement described earlier. Suppose that we wanted to measure the length of time that a camera shutter remains open. We could use the time counter instrument to do this. A strong light source could be placed on one side of the shutter and a photocell on the other side. When the shutter is triggered, it will open for a brief period, then close. During the time it is open, the photocell will generate an output voltage that can be amplified and differentiated. The pulses derived from the leading and trailing edges of the photocell signal by differentiation could be used to operate the start and stop inputs to the time-interval counter. The width of the photocell signal would determine the length of time that the shutter is open.

The time interval counter can also be used to measure the speed of an object over a known distance. It is commonly known that the distance travelled by an object is equal to its speed multiplied by the travel time. If we know the distance travelled, we can find the average speed over this distance by measuring the elapsed time. Using this principle in the laboratory, we could perform such experiments as measuring the speed of a bullet as it is fired from a gun or measuring the velocity of sound in a particular type of material. Outside of the lab we could make a good speed trap for cars. By marking off an accurately measured distance on the highway and using light beams and photocells at the beginning and end of the "trap", we could measure the elapsed time through the trap and calculate the car's speed.

Some of the most recent and interesting applications of time-interval measurement have been in sports -- particularly auto racing and swimming. Drag racing is a very big sport today. This is a race between stock cars, hot rods or dragsters. The cars race from a dead stop for a quarter mile. The car that crosses the finish line first or the car with the shortest elapsed time is the winner. In many races, the results are so close that human determination of the winner is sometimes difficult if not impossible. To be completely fair and to record an accurate elapsed time for national or regional race records, electronic time interval instruments are used to determine the winner.

When the two cars that are to race are given the go signal, they will cross the starting line and in doing so break a light beam. A photocell recognizes the light break and generates a signal to trigger the start input to a time-interval counter. As the winning car crosses the finish line, it breaks another light beam. This generates a signal to stop the counter. The

read-out tubes will display the elapsed time, usually to the nearest millisecond. Some standard stock sedans turn quarter mile in times down to 12 seconds.

Even though the shortest elapsed time determines the winner, the speed at the end of the quarter mile is also measured. A speed trap 132 feet long and centered on the finish line is used as the basis for speed measurement. The time it takes to cover this known distance is a direct indication of the average speed over this distance. Another time-interval counter is used to measure the trap time which is used in calculating the trap speed. Photocells and light beams 66 feet before and after the quarter-mile finish line generate the signals to start and stop the counter. Dragsters have recorded trap speeds up to 230 mph in the quarter mile.

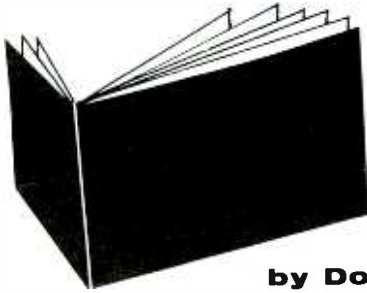
When the cars cross the starting line, the elapsed time clocks start. The first photocell they come to starts the speed timer. Sixty-six feet later, the cars cross the finish line stopping the elapsed time clock. Then in another 66 feet the speed timer is stopped when the last light beam is broken. In simple timing setups, only the time and speed of the fastest car is recorded. However, at the more modern drag strips, dual lane timers measure speed and elapsed time on both cars.

Electronic timers are also used where land speed records by cars in various classes are made and broken on the salt flats near Bonneville, Utah, each year. Here elapsed times are measured over known distances to determine speed. Timing systems are also used to time other car races such as the Indianapolis 500.

Swimming races are also timed by electronic timers with good success. Today many swimming races are timed with stop watches. In some instances where the competition is stiff and the races are close, the manual dexterity of the timekeeper could decide who wins the race more than the ability of the swimmer. While it has been shown that an expert with a stop watch can match the accuracy of an electronic counter to the nearest tenth of a second, races today are being won by just thousandths of a second and a human operator just cannot resolve intervals this short.

Electronic timers eliminate this problem, of course. In a typical system, a common 1 kc clock feeds a counter for each swimmer in the contest. As each swimmer leaves the starting block, a switch is operated to open the gate in his counter. When the contestant swims the length of the pool and returns, he touches a pad that operates a switch to shut the gate and stop the clock. The clocks display elapsed time to the nearest millisecond. Many races are won by just a few milliseconds, which makes one wonder just how many races have been won by the timekeeper and not by the swimmer before the use of electronic timers!

Electronic timers can also be used in other sporting events to improve accuracy and precision of time measurements and to eliminate human error introduced by stop watch timing. Electronic equipment for elapsed time and speed measurements finds application in boat races, auto rallies, track meets and in many other events.



NEW BOOKS

by **Donald A. Smith**
NRI BOOK EDITOR

101 Questions and Answers about CATV and MATV, by Robert E. Baum and Theodore B. Baum. Howard W. Sams & Co., Indianapolis, Ind. 96 pages, \$2.50.

This book delivers just what it says it does, namely, 101 questions and answers on community antenna television and master antenna television systems. The book is divided into six sections: 1. The CATV and MATV System; 2. The Head End; 3. The Main Trunk Line; 4. Distribution System; 5. Subscriber Equipment and Services; 6. The Future of CATV.

The book nicely covers the reasons for these systems and why they are even found in some cities which have good television signal strengths. Various types of equipment are pictured, with sample systems shown in block diagram form. Many types of special coaxial distribution cable are shown, with the losses shown in graphs.

For someone who would like to know something about cable television services and how they are being used, as well as some technical information about them, this book would be a good introduction. Though it is not a complete text on the subject, it will provide many answers about these antenna systems. As a matter of fact, exactly 101 of them.

Modern TV Waveform Analysis, by Stan Prentiss. Tab Books, Blue Ridge Summit, Pa. 17214. 256 pages, \$4.95 paperbound and \$7.95 hardbound.

This is a new book that I am very enthusiastic about! Not just another book on oscilloscope waveforms, but a thorough, practical book on how to analyze oscilloscope waveforms when servicing television, primarily color sets, both tube and transistor types. It is not a book for beginners, but rather a book for those who know something about television and how to use a scope. For those who want to

learn to diagnose TV circuit troubles efficiently.

Chapter One deals with expected waveforms found in regular tube-type, black-and-white television sets, and how the waveforms may be analyzed. Each section of the set is included, even the power supply. In addition, this chapter has a wealth of information on servicing of the TV set, and how to find the defective stage. Even a technician with some experience will not only find this chapter interesting, but helpful as well.

The following chapters deal with separate sections of a television set, both black-and-white and color sets, with heavy emphasis on the color sets. For example, Chapter Two deals with RF-I-F circuits, while Chapter Four deals with Noise, Sync and AGC. Chroma circuits are excellently covered in Chapter Nine. In each of these chapters, transistorized equipment is covered as well as tube-type sets. Chapter Ten is devoted to the location of defective parts and troubleshooting procedures which can be used on transistorized equipment. The technician experienced on tube-type television sets, who is having a bit of trouble with the new transistorized sets, will find this chapter very, very, helpful.

I recommend this book very emphatically to anyone who is servicing, hopes to service, or is interested in the servicing of tele-

vision sets through the use of a good oscilloscope. In my opinion, there is NO other way!

101 Questions and Answers About Color TV, by Leo G. Sands, Howard W. Sams and Co., Indianapolis, Ind. 64 pages, \$1.75

As Mr. Sands states in his preface, "This book does not attempt to cover the subject from A to Z." I have to agree. Though Mr. Sands is well known for his technical books, written primarily for the technician, this book is more for the beginner, student, or those just "interested" in color television.

When reading this book, I found that at times questions were answered which a television viewer might ask, and further on down the page, it answered questions which an electronics student might ask. Both types of questions will be found in this book. Over half of them are of a technical nature. As usual, Mr. Sands has done a good job of clearly stating technical answers.

Those without much knowledge of color television, or those who are not advanced students, will find this book both interesting and informative. I hope some of the 101 questions will be those which you would like to ask an expert like Leo G. Sands.

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Howard L. Gibbons of Chase, British Columbia, NRI graduate 18-YR07 and 58-M436, with Helen Thomas.

an interesting visit with him; and it was a most satisfying experience, while on furlough from NRI, to find such tangible evidence of the school's far-reaching influence.

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Mr. Gibbons is a long-time member of the Alumni Association and an enthusiastic advocate of NRI training. We had

Helen Thomas
Administrative Services Division

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City & State _____ How long at this address? _____

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Robert J. Abernethy, Babylon, N.Y.
Norman E. Adkins, Richmond, Va.
Earl M. Allen, Evanston, Ill.
A.E. Antonelli, Ft. Leavenworth, Kans.
Carl C. Baca, Lovington, N. Mex.
Robert S. Barrett, Rochester, N.Y.
James R. Baur, Lowry, Colo.
W.R. Baxter, Wichita Falls, Texas
William C. Bergmann, Sedalia, Mo.
Ronald H. Bobo, St. Louis, Mo.
Oliver P. Boyke, Brooklyn, N.Y.
H.C. Brand, Dallas, Texas
S.F. Bulecza, Jr., Ludlow, Mass.
J.E. Busdiecker, Castleton-on-Hudson, N.Y.
Billy W. Campbell, Baltimore, Md.
Franklin Cook, Silver Spring, Md.
Michael Dale, Texarkana, Texas
Lawrence J. Dreyfus, Baltimore, Md.
Robert E. Eidel, Elmhurst, Ill.
Alvaro Fernandez, Del Rio, Texas
Dalton W. Fickes, Tyndall AFB, Fla.
George Franceschiello, Groton, Conn.
Thomas L. French, St. Cloud, Fla.
Amos L. Funk, Worthington, Ohio
Vernon E. Glover, Owensboro, Ky.
Michael S. Gordon, Austin, Texas
Robert Gorsuch, Johnstown, Ohio
Frederick Heim, APO San Francisco
Wayne E. Hodge, Silver Spring, Md.
Lowell Hunke, Mandan, N. Dak.
Alexander Johnson, Saudi Arabia
George W. Jones, Aurora, Ill.
Leo M. Karl, Mill Valley, Calif.
Clifford Kruse, Fort Myers, Fla.
Donald A. Kuhn, Wichita, Kans.
Trygve L. Larsen, Brooklyn, N.Y.
W.P. Mahoney, Hackensack, N.J.
Walter A. McMullen, Dewitt, N.Y.
Charles E. Michael, Baltimore, Md.
Clifford F. Mink, Spokane, Wash.
D.H. Montoya, Jr., Tularosa, N. Mex.
Robert L. Morrow, Florissant, Mo.
Ronald A. Neff, Ashfield, Pa.
Walter C. Neu, Copeland, Idaho
Frank Neumann, B.C., Canada

Harvey O'Brien, San Francisco, Calif.
David R. Oliastro, Ellwood City, Pa.
Carlos Rivera Ortiz, Puerto Rico
Henry M. Park, Crescent City, Calif.
Ronald F. Peterson, Belleville, Ill.
C. Sinclair Porth, Morgan City, La.
George E. Rambo, Claymont, Del.
Stanley R. Raupach, Duncansville, Pa.
James Robinson, Franklin, Ohio
Manly S. Rooks, Lumberton, N.C.
Gerald W. Schmich, Longmont, Colo.
Jimmy C. Simpson, Mobile, Ala.
Steven L. Smith, Rossville, Ga.
Leonard A. Spencer, Salinas, Calif.
William R. Storm, Griffiss AFB, N.Y.
George V. Thompson, Toms River, N.J.
Edward Tramer, Hyattsville, Md.
Alvin D. Urie, Aurora, Colo.
Reynold F. Valdez, Key West, Fla.
William B. Vokac, Mansfield, Ill.
Lawrence W. Watts, Long Beach, Calif.
Virgil D. Watts, Bowling Green, Md.
Paul L. Way, Harrisville, Miss.
Robert G. Zelenak, Aliquippa, Pa.

Solution To Crossword Puzzle





Alumni News

John Pirrung President
Franklin Lucas Vice-Pres.
James J. Kelley Vice-Pres.
Arthur Howard Vice-Pres.
E. J. Meyer Vice-Pres.
T. F. Nolan, Jr. Exec. Sec.

WALTER ADAMIEC IS NEW ALUMNI PRESIDENT

From the results of the primary it was almost a foregone conclusion that Walter Adamiec would come out way ahead in this election -- and he did! -- because he is so much better known than his opponent, Robert F. Smith. Mr. Smith of Burlington, Vt., has no chapter affiliations and is therefore comparatively unknown.

Three of the incumbent Vice-Presidents, Franklin Lucas, James Kelley, and E. J. Meyer, were re-elected. This is a second consecutive term for all of them so they will be ineligible for a Vice-Presidency again until after the passage of three years. The other winner of a Vice-Presidency is Reynolds Nickless, Norwalk, Conn., who is not affiliated with the local chapter.

Our congratulations to all the winning candidates!

President-Elect Adamiec was born in 1917 in New Bedford, Mass. In high school he was a member of a radio club. Since then his interest in radio has never left him.

Graduating in 1948 from his NRI Servicing course, he re-enrolled with NRI in 1952 for Advanced Television Practice

training, from which he graduated in 1952. After a period of several years, to update himself in electronics, he took a resident course with the Massachusetts Radio and Telegraph School in Boston. Graduating from this course in 1961, he again turned to NRI for further studies. He graduated from this course in May, 1963, and then obtained his FCC Commercial License.



This is Walter Adamiec of the Southeastern Massachusetts Chapter, who is President-Elect of the NRI Alumni Association for 1969.

In the meantime, Walter had proposed and taken the lead in establishing the Southeastern Massachusetts Chapter of the NRI Alumni Association. Since then he has held the chairmanship of the Chapter for more years than any other member, and has also served as its Secretary. One of Walter's great satisfactions, he says, has been in seeing other members go on to achieve success in electronics,

and that they look back to their membership in the Southeastern Massachusetts Chapter as one of the stepping stones toward their achievements.

From his work with the Chapter and the help he has given individual members, Walter Adamiec is fully deserving of the honor and recognition of his election as President of the NRI Alumni Association.

Season Openers Lively

LOS ANGELES SEES SERVICING DEMONSTRATIONS

LOS ANGELES CHAPTER'S Chairman Eugene DeCaussin demonstrated the various instruments used in Radio-TV Servicing. This was the result of a suggestion made by one of the members about having demonstrations on the different test instruments.

NEW YORK CHAPTER WELCOMES NEW MEMBERS

NEW YORK CITY CHAPTER welcomed three new members at the very first meeting after the summer vacation. They are Graduate Robert White, Student Eddy Leconte, and Graduate Clarence Holder. Acting Secretary Joe Bradley offered the comment that this could augur a good, active season.

The main business of this meeting was to get the Chapter's TV set in shape. It has plagued the members with sound troubles. Real progress was made in this direction. After many suggestions and much disagreement and participation from the floor, the work was of benefit and interest.

The Chapter was pleased to welcome Wiener Dimanche, a graduate of last spring, as a guest again.

P-C CHAPTER STARTS OFF SEASON WITH VIGOR

PHILADELPHIA-CAMDEN CHAPTER has begun reporting new members again. Graduate Stanley Feuerman of Philadelphia is the latest new member. Our congratulations, Stanley!

This year was the first time the Chapter suspended meetings in July and August. Heretofore one meeting instead of two was held in July and August, but attendance was small, so the Chapter decided to eliminate the meetings altogether in July and August. The nice turnout for the first September meeting proved that the suspension of meetings in July and August did the Chapter no harm.

Bill Davis, a chapter member, gave a refresher course on how to set up a Color TV in the customer's house. It was well accepted by the members.

Plans have been made to visit the Westinghouse Corporation at Metuchen, N. J. Secretary Jules Cohen is also negotiating a deal with the Channel Master Antenna Company for one of its field men to give the Chapter a talk on antennas.

TRANSISTORS COLOR LECTURE FOR PITTSBURGH

PITTSBURGH CHAPTER thoroughly enjoyed a lecture conducted by guest speaker John Orbitz, TV field man for Westinghouse. His subjects were "Transistors In Color TV Sets" and "Tuning Bar Alignment".

Mr. Orbitz discussed transistors and used a slide projector to show the differences in NPN and PNP construction and their uses in a circuit. He had a board made up to show how a flip-flop circuit works and at what rate you can make it work. Mr. Orbitz, an able speaker, made his lecture not only instructive but also entertaining.

SAN FRANCISCO CHECKS DIODES, SEES LISSAJOUS PATTERNS

SAN FRANCISCO CHAPTER'S newest member is Mr. Wilhelm Mortensen. Congratulations Wilhelm!

Pete Salvotti gave a talk on assembling an in-or-out of a circuit diode checker. With Mr. Jenkin's assistance, Pete demon-

strated the checker on the oscilloscope, showing the different waveforms.

At the next meeting Art Ragsdale demonstrated Lissajous patterns on a scope, with the use of a signal generator. One of a 60-cycle circle, one of 120-cycles of a figure eight lying on the side, and one of a 60-cycle figure eight in a vertical position, etc.

DIRECTORY OF ALUMNI CHAPTERS

DETROIT CHAPTER meets 8:00 P.M., 2nd and 4th Friday of each month, St. Andrews Hall, 431 E. Congress St., Detroit. Chairman: James Kelley, 1140 Livernois, Detroit, Mich., V11-4972.

FLINT (SAGINAW VALLEY) CHAPTER meets 7:30 P.M., 2nd Wednesday of each month at Andrew Jobbagy's Shop, G-5507 S. Saginaw Rd., Flint. Chairman: Arthur Clapp, 705 Bradley Ave., Flint, Mich. 234-7923.

HAGERSTOWN (CUMBERLAND VALLEY) CHAPTER meets 7:30 P.M., 2nd Thursday of each month at George Fulk's Radio-TV Service Shop, Boonsboro, Md. Chairman: Robert McHenry, RR2, Kearneysville, W. Va.

LOS ANGELES CHAPTER meets 8:00 P.M., 2nd and last Saturday of each month, at Chairman Eugene DeCausin's Radio-TV Shop 4912 Fountain Ave., L.A., Calif., NO4-3455.

NEW ORLEANS CHAPTER meets 8:00 P.M., 2nd Tuesday of each month at Galjor'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: Samuel Antman, 1669 45th St., Brooklyn, N. Y.

NORTH JERSEY CHAPTER meets 8:00 P.M., last Friday of each month, Players Club, Washington Square (1/2 block west of Wash-

ington and Kearney Avenues), Kearney, N. J. Chairman: William Colton, 191 Prospect Ave., North Arlington, N. J.

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 Wheeler, 1436 Riverview Drive, Verona, Pa.

SAN ANTONIO (ALAMO) CHAPTER meets 7:00 P.M., 4th Friday of each month, Alamo Heights Christian Church Scout House, 350 Primrose St., 6500 Block of North New Braunsfels St. (3 blocks north of Austin Hwy.) San Antonio. Chairman: C. W. A. Hoffman, 4215 Shelton Dr., San Antonio, Texas.

SAN FRANCISCO CHAPTER meets 8:00 P.M., 2nd Wednesday of each month, at the home of J. Arthur Ragsdale, 1526 27th Ave., San Francisco. Chairman: Isaiah Randolph, 523 Ivy St.,

SOUTHEASTERN MASSACHUSETTS CHAPTER meets 8:00 P.M., last Wednesday of each month at the home of John Alves, 57 Allen Blvd., Swansea, Mass. Chairman: Oliva J. Laprise, 55 Tecumseh St., Fall River, Mass.

SPRINGFIELD (MASS.) CHAPTER meets 7:00 P.M., last Saturday of each month at the shop of Norman Charest, 74 Redfern Dr., Springfield, Mass. Chairman: Br. Bernard Frey, 254 Bridge St., Springfield, Mass.

A Great CHRISTMAS GIFT For Any Radio-TV Technician

Completely
New from
CONAR

MODEL 680

**INTEGRATED
CIRCUIT**

COLOR GENERATOR



KIT 680UK	CATALOG PRICE \$89.50	NRI STUDENT AND ALUMNI PRICE \$79.45
WIRED 680WT	\$121.50	\$109.00

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Only the 680 Has All These Features At Any Price!

- EXCLUSIVE Digital Integrated Circuits
- EXCLUSIVE 4 Crystal Controlled Oscillators
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- Completely Solid State
- Color Amplitude Control
- Color Phase Adjustment
- Regulated Power Supply
- Stability Control
- TV Station Sync and Blanking Pulses
- Nine Patterns
- Red, Blue and Green Gun Killers
- Compact, Lightweight, Portable

SPECIFICATIONS

OUTPUT:

R. F. only—low impedance
Approximately 50,000 microvolts into 300 ohm tuner

100% modulated carrier—composite video

Crystal controlled oscillators:

189 kc timing oscillator

3,563.795 kc offset color subcarrier oscillator

4,500 kc sound carrier oscillator

55.25 mc or 61.25 mc rf carrier oscillator

MODULATION:

Single dot

Single cross

Single vertical line

Single horizontal line

Full dot pattern

Full crosshatch pattern

Full vertical line pattern

Full horizontal line pattern

Keyed rainbow color pattern

POWER REQUIREMENTS

120 vac—1.0 watt or:

4 "D" cells—6.0 vdc at 130 ma.

REGULATED POWER SUPPLY:

Silicon diode bridge rectifier

Zener diode stabilized transistor regulator

SEMICONDUCTOR COMPLEMENT:

16 type 914 integrated circuits

3 type 2N2369 NPN silicon transistors

1 type 2N355 PNP power transistor

1 type 1N736A Zener diode

4 silicon rectifier diodes

1 modulator diode

GUN KILLER SWITCHES:

Permanently wired cable

Separate red, blue and green switches

Colored switches for rapid location

CONSTRUCTION:

Aluminum cabinet, chassis and panel for light weight

Printed circuit board, 6" x 9"

SIZE:

10" x 3" x 9" (WxHxD)

WEIGHT:

Less than 5 pounds with batteries

Less than 4 pounds without batteries

Tomorrow's Engineering Today

You can pay much more, but you can't buy more exclusive and up-to-date features than CONAR engineers have built into the new Model 680 Color Generator. CONAR is first with digital integrated circuits, 4 crystal-controlled oscillators and AC and battery operation built in (even the batteries are supplied). Compact and portable, the 680 weighs less than 5 lbs. Peak accuracy and stability are assured by cool all solid state circuitry, regulated power supply and stability control. The 680 incorporates a wide range of test patterns, including single and multiple vertical bar, horizontal bar and crosshatch patterns—all with horizontal lines only one raster line thick, as well as a standard 10-bar color pattern. The most modern and versatile color generator on the market, the 680 incorporates 26 semi-conductors: 16 type 914 integrated circuits, 3 2N2369 transistors, 1 2N355 transistor, 5 silicon diodes and 1 zener diode. Oscillators include 189kc. timing generator, 3.56 mc. offset color subcarrier, 4.5 mc. sound carrier and 55.25 mc. or 61.25 mc rf carrier (channel 2 or 3 as ordered). Until now, no commercially available color generator has offered so many quality features in a single instrument. The 680 features nine video patterns to speed convergence adjustments, simple timing circuit alignment, all printed circuit construction, plus your choice of kit or wired models, and represents the finest in operating quality. You get TV station quality composite video signals, including "back porch" color burst. All this, plus CONAR's low prices, make the 680 the absolute tops in dollar-for-dollar value.

Please Specify Channel 2 or 3

CONVENIENT ORDER BLANK ON PAGE 25



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