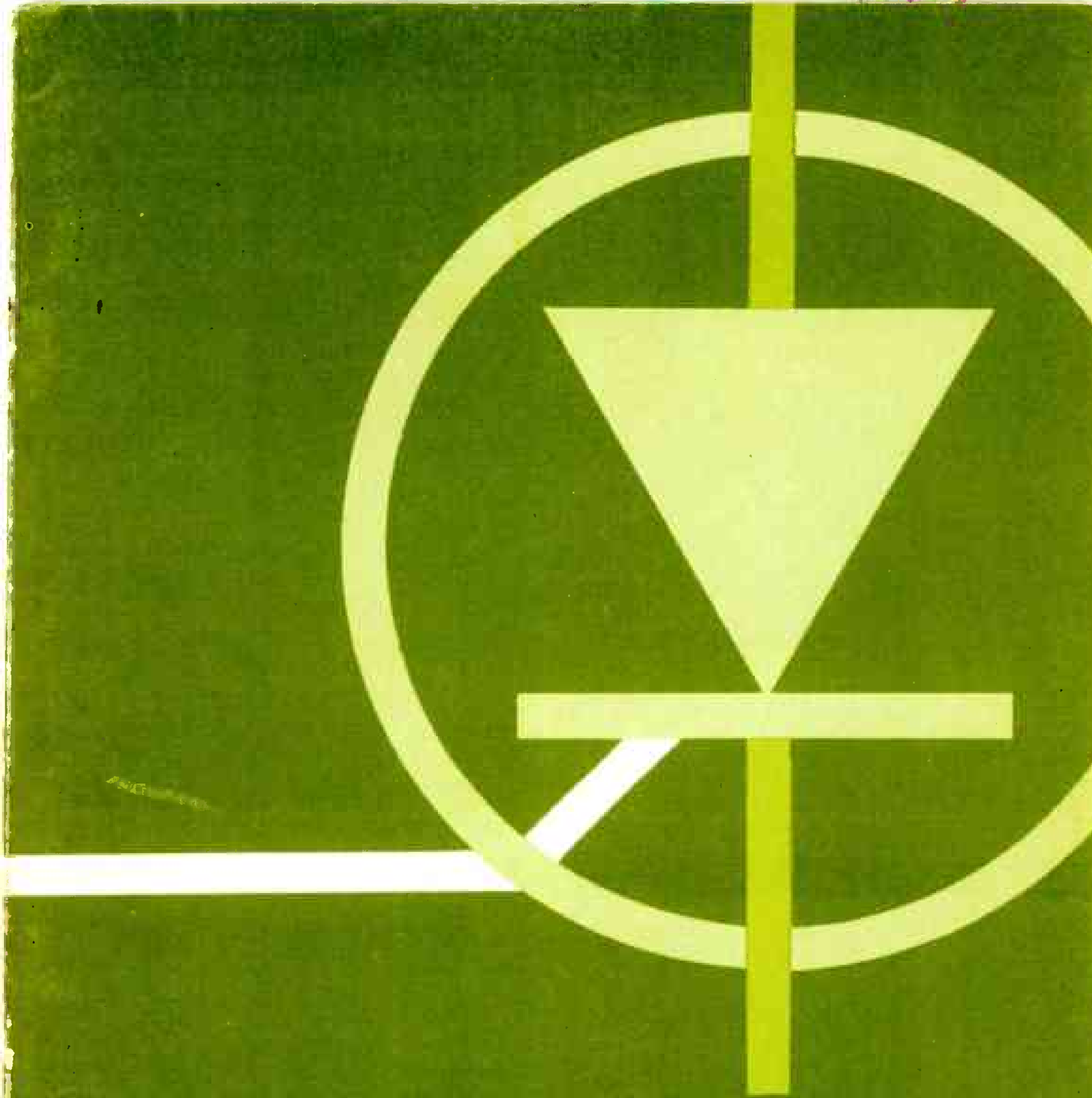

- SCR's in Horizontal Sweep Circuits
- Eliminating Those Troublesome Callbacks

nri journal

March/April 1976

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March/April 1976
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In this issue.
Journal Editor and Publisher Bill Dunn explains the operation of silicon controlled rectifiers in modern color television receivers. Also, Elmer Blush, NRI's first Computer Course graduate, gives us some timely hints for avoiding that most frustrating of TV servicing afflictions, the callback.

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SCR's in horizontal sweep circuits

by Bill Dunn

The silicon controlled rectifier (abbreviated SCR) is a solid-state device designed to replace the thyratron tube. The SCR has been widely used in industry, but has been of no importance to the radio-TV service man because it has not been used in radio and television receiving equipment. However, most RCA color television sets contain two SCR's and two silicon diodes in the horizontal sweep circuit. Therefore, the time has come when the TV service man must learn about silicon controlled rectifiers.

Basically the SCR is a switch. It is able to control and rectify ac. It can also be used to control dc. The switch is a form of latching switch; that is, once it is turned to the on position, it remains in the on position until the power is removed from the circuit.

In the silicon-controlled rectifier there are four semiconductor regions arranged as shown in Figure 1. At the N end of the rectifier is the cathode, and at the P end is the anode. Connected to the second region is an additional connection called a gate. You can see from Figure 1 that we have three junctions in the rectifier. Both the center N and P sections act as base regions.

In operation from a dc source, a positive voltage is applied to the anode and a negative voltage to the cathode. With this polarity applied to the rectifier, we have a forward bias across the first junction, labeled J1, and a forward bias across a third junction labeled J3. We have a reverse bias across the second junction, J2. If the voltage between the anode and cathode is made high enough, the second junction, J2, will break down. Once this happens, we will have a high current flow through the rectifier. Current will continue to flow until the voltage between the anode and cathode is reduced to a low value. Then the current will drop to a certain minimum value after which the flow of current stops completely.

The rectifier can also be made to conduct by use of the gate. With a positive voltage applied to the anode and a negative voltage to the cathode, assuming the voltage is not high enough to break down the second junction, we can cause current to flow by applying a positive voltage to the gate. This causes a current to flow from the cathode to the gate. Once it reaches a certain level, the rectifier switches to the on state, and a high current can flow through it from the cathode to the anode. The resistance of the rectifier becomes so low that the current flow through the rectifier is limited almost entirely by external resistance in the circuit.

Once we have turned the rectifier to the on state by means of a positive voltage or a positive pulse fed to the gate, the gate loses control of the rectifier. In other words,

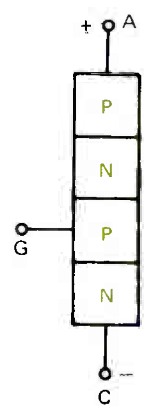


FIGURE 1. THE SCR HAS FOUR SEMICONDUCTOR REGIONS AND THREE JUNCTIONS.

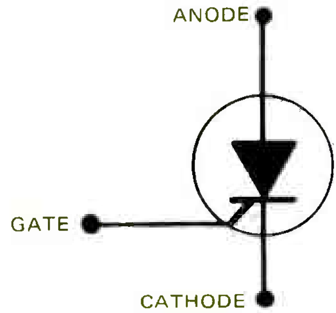


FIGURE 2. SCHEMATIC SYMBOL OF SILICON CONTROLLED RECTIFIER.

simply removing the gate voltage or pulse will not cause the rectifier to stop conducting. Current will continue to flow through the rectifier until the current reaches a certain minimum value. It may reach this minimum value because the anode-to-cathode voltage drops below a certain value or something may happen to the resistance in the external circuit to reduce the current below the holding value. Once the current flow through the rectifier stops, the gate once again gains control and can be used to turn the rectifier back on.

In some applications where the rectifier is used in an ac circuit, the portion of the cycle over which it conducts can be controlled by the phasing of the signal fed to the gate. For example, if the voltage applied between the anode and cathode is kept low enough so the breakdown does not occur, we might arrange the gate pulse so that when the anode becomes positive with respect to the cathode, a quarter of a cycle passes before a positive pulse is fed to the gate. Once the positive pulse is fed to the gate, the rectifier will begin conducting and will conduct for the remainder of the half-cycle during which the anode is positive. When the polarity of the voltage applied to the rectifier reverses, current flow through the rectifier will stop and once again we can turn the rectifier back on at the appropriate time at the positive half-cycle.

The schematic symbol used to represent the SCR is shown in Figure 2. Notice that the symbol is very much like the symbol used for a diode; we simply added the external gate connection to the diode symbol. Now let's go ahead and learn how the SCR is used in a horizontal sweep system.

THE BASIC SYSTEM

A simplified schematic diagram of the basic circuit used in the horizontal sweep output stage of the RCA solid-state color television chassis is shown in Figure 3. Notice that there are two SCR's and two diodes used. In the most recent series of color chassis, the diodes are combined into the same three-lead packages with their associated SCR's. SCR2 and D2 control the sweep of the electron beam from the left side of the picture tube across the face of the tube to the right side of the picture tube. SCR1 and D1 control the retrace as the beam flies rapidly from the

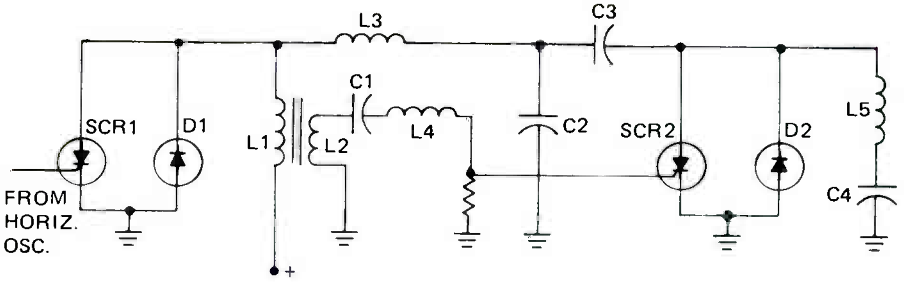


FIGURE 3. SIMPLIFIED SCHEMATIC OF HORIZONTAL SWEEP.

right side back to the left to start the next line. L5 is the deflection yoke; L3, C2 and C3 are used in the circuit to aid in the rapid retrace of the electron beam from the right side back to the left side during the horizontal blanking interval.

THE HORIZONTAL CYCLE

In Figure 4 we have shown graphically the horizontal trace and retrace current cycle. We have labeled the current we are discussing I_1 and we will discuss I_2, also shown on the graph, later. When the electron beam is at the extreme left side of the tube, we have a maximum current flow through the deflection coil in one direction. This is indicated by T1 in Figure 4. As the beam moves at an even rate from the left side to the center of the tube, the current through the deflection coil decreases in a linear fashion until at point T2, the electron beam is in the exact center of the screen and at this time the current through the deflection coil is zero.

Now as the beam is moved from the center of the tube to the right side, the current through the deflection coil must increase in a linear fashion from zero at point T2 to its maximum value in the opposite direction at point T5. At point T5, the

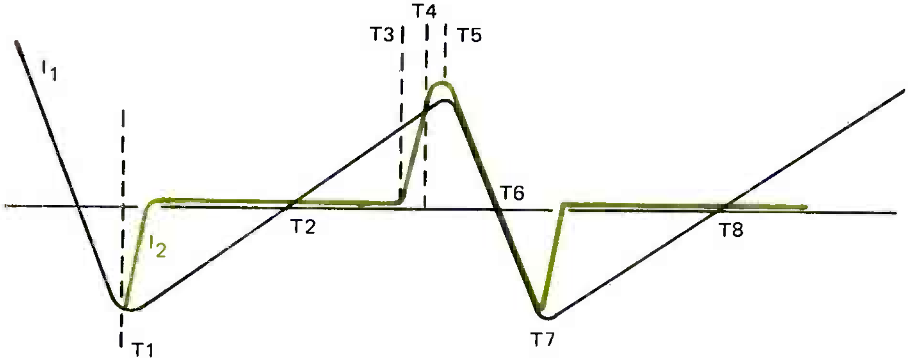


FIGURE 4. THE HORIZONTAL TRACE AND RETRACE CYCLE.

electron beam is at the extreme right of the tube and the retrace cycle begins. The deflection coil current must drop rapidly to zero at T6 and build up to its maximum amplitude with the opposite polarity at point T7. The cycle then repeats itself as the beam is swept back and forth across the face of the picture tube.

For our analysis of the operation of the circuit, let's consider that the beam is at the extreme left of the picture tube at point T1. In other words, we have maximum current flowing through the deflection coil L5. At this point, all of the energy in the deflection circuit is stored in the field about L5. Capacitors C3 and C4 will be discharged at this time. There will be no current flow through L1 and hence no voltage drop across it; this will place a reverse bias across D1 so it cannot conduct. SCR1 cannot conduct because it has been turned off, and there is no positive pulse applied to the gate to turn it on to the conduction state. Similarly, SCR2 cannot conduct because the polarity of the voltage applied across it will be such that the anode will be negative and the cathode positive.

The current flow in the circuit will be as shown in Figure 5. The yoke current will place the correct polarity across D2 so it will conduct, and current will flow through the yoke as indicated by the arrows and labeled I_1. This current will begin to charge capacitor C4, so that the grounded end will become negative and the other end positive. At the same time, part of the yoke current will flow into one side of C3 and out of the other side. This current through L3 and L1 will begin to charge this capacitor. The energy needed to charge C3 is supplied by the power supply and thus any energy lost during the sweep cycle is replaced. This action continues, as the current through L5 drops to zero at time T2.

The charging of C3 causes a current to flow through L1. L1 is inductively coupled to L2 and induces a voltage in it. By means of the phasing network consisting of C1, L4 and R1, a positive pulse has been produced and is applied to the gate of SCR2. The rectifier does not conduct, however, while the current is flowing as shown in Figure 5, because the polarity of the voltage applied to the anode and cathode is incorrect.

When the yoke current drops to zero at time T2 and reverses as shown in Figure 6, the polarity of the voltage across D2 changes and it stops conducting. SCR2,

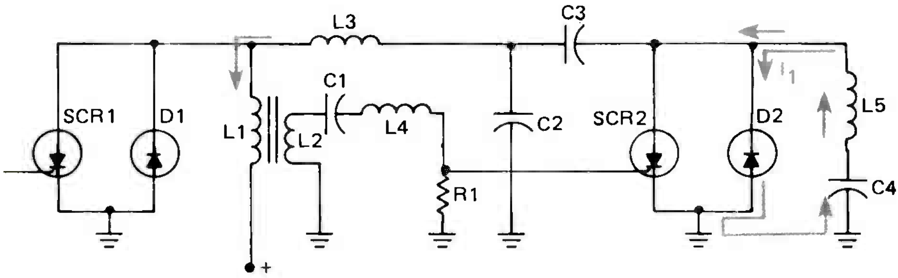


FIGURE 5. CURRENT FLOW THROUGH YOKE AND D2 AT T1.

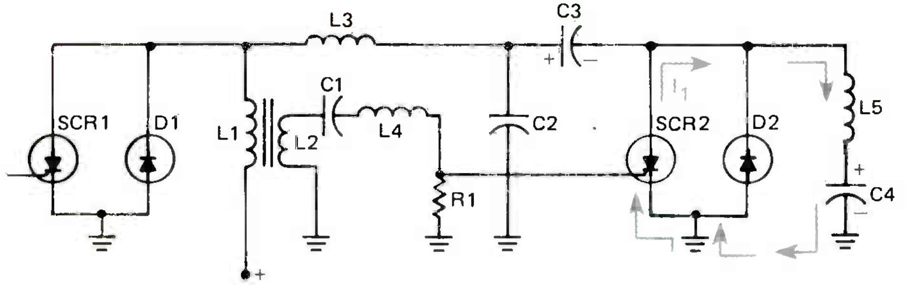


FIGURE 6. CURRENT FLOW AT THE START OF THE SECOND HALF OF THE TRACE CYCLE, JUST AFTER T2.

however, goes into conduction immediately because it has the correct polarity applied between the anode and cathode, and also we have applied a positive voltage to the gate. Meanwhile, capacitor C4, which has charged during the interval T1 to T2, will have the polarity shown in Figure 6. It is this capacitor discharging that causes the current to flow through SCR2 and the yoke L5 during the second half of the trace cycle. We have labeled this current I_1. If C3 is not fully charged, it continues charging through SCR2, L3 and L1.

The current through L5 continues to build up from T2 to T3 as shown in Figure 4. At this instant a positive pulse is fed from the horizontal oscillator to the gate of SCR1. At time T3 capacitor C3 will be fully charged so there will be no voltage drop across L1. This means that the full B-supply voltage will be applied to the anode of SCR1, so that the rectifier begins conducting immediately.

The current through SCR1 is represented by I_2 in Figure 4 and also is labeled I_2 in Figure 7. Notice that electrons flow from ground through SCR1, through L3 and into the positive plate of C3. Electrons begin leaving the negative plate of C3 and flow through L5 and into the positive plate of C4. Electrons will leave the negative plate of C4 and flow back to ground. Meanwhile the current I_1 continues to flow through SCR2.

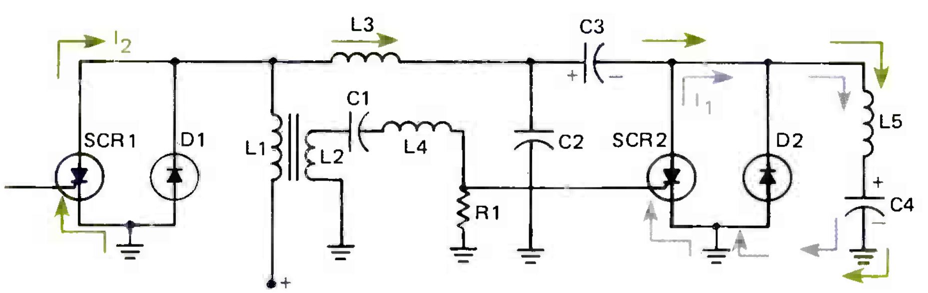


FIGURE 7. CURRENT FLOW DURING THE INTERVAL T3 TO T4 WHEN BOTH SCR'S ARE CONDUCTING.

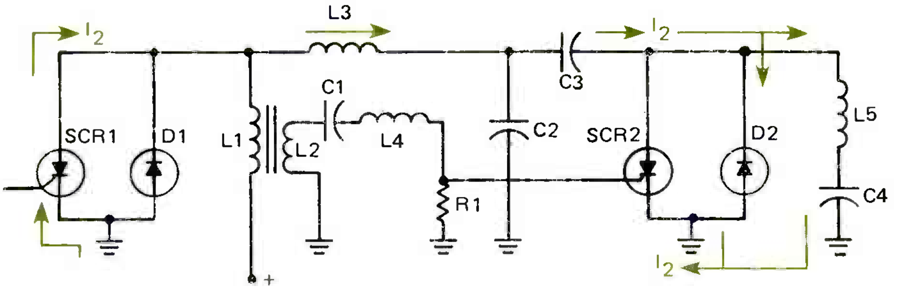


FIGURE 8. CURRENT FLOW DURING THE INTERVAL T4 TO T5 WHEN SCR1 AND D2 ARE CONDUCTING.

The significance of the current I_2 is that it now begins to supply part of the yoke current, so that the current flow through SCR2 begins to go down. The current I_2 builds up very rapidly during the interval T3 to T4 as you can see in Figure 4. This is due to the short time constant of L3 and C3 in series with L5. Thus at point T4 the current I_2 equals the current I_1 and then almost immediately exceeds this value. Now the current through SCR2 drops to zero and the rectifier is shut off and will not start conducting again until time T8, when we will once again have a positive voltage on the anode, a negative voltage on the cathode, and a positive pulse on the gate.

During the interval T4 to T5 when the current I_2 exceeds the yoke current, the polarity of the voltage across D2 reverses and part of I_2 flows through D2. The remainder flows through the deflection yoke, bringing the beam over to point T5 where retrace starts. Remember that at point T5 we have maximum current through the deflection yoke flowing in the direction shown in Figure 8. At the same instant D2, which has been conducting during the interval T4 to T5, stops conducting. Capacitors C4 and C3 will be discharged and all the energy in the circuit will be stored in L3 and L5.

At the interval T5, D2 stops conducting. Now the circuit consisting of L3, C3 and L5 begins ringing. C4 is so large that it has no effect on the resonant frequency of

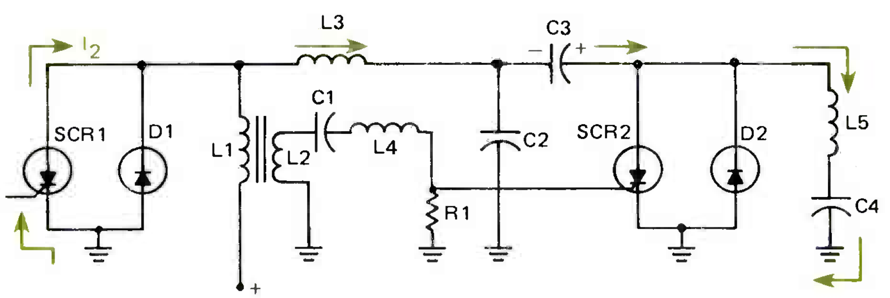


FIGURE 9. CURRENT FLOW DURING THE INTERVAL T5 TO T6. NOW ONLY SCR1 IS CONDUCTING.

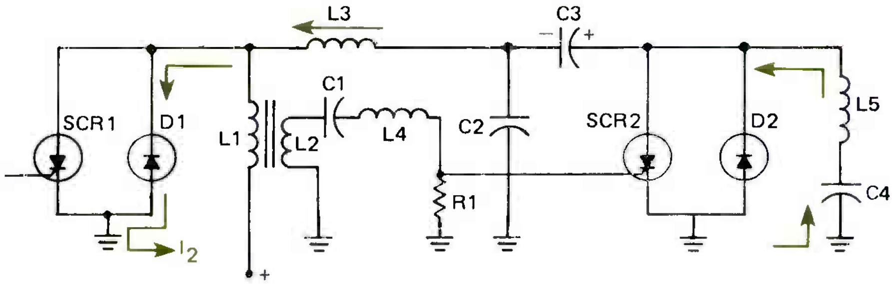


FIGURE 10. CURRENT FLOW DURING THE INTERVAL T6 TO T7 WHEN D1 IS CONDUCTING.

this circuit. It is controlled primarily by the inductance of the two coils and the capacitance of C3. The circuit goes through the next half-cycle from T5 to T6 rapidly with the current I_2 flowing through SCR1 as shown in Figure 9. At the same time, the capacitor C3 is charged with the polarity shown, but little or no charge is built up across C4 because of its large size.

At time T6, the current through L5 will have dropped to zero and will begin to change direction. When the current reaches this point, the current through SCR1 reaches such a low value that conduction through this rectifier stops, and it will remain turned off until it gets the next positive pulse from the horizontal oscillator circuit as it did at time T3.

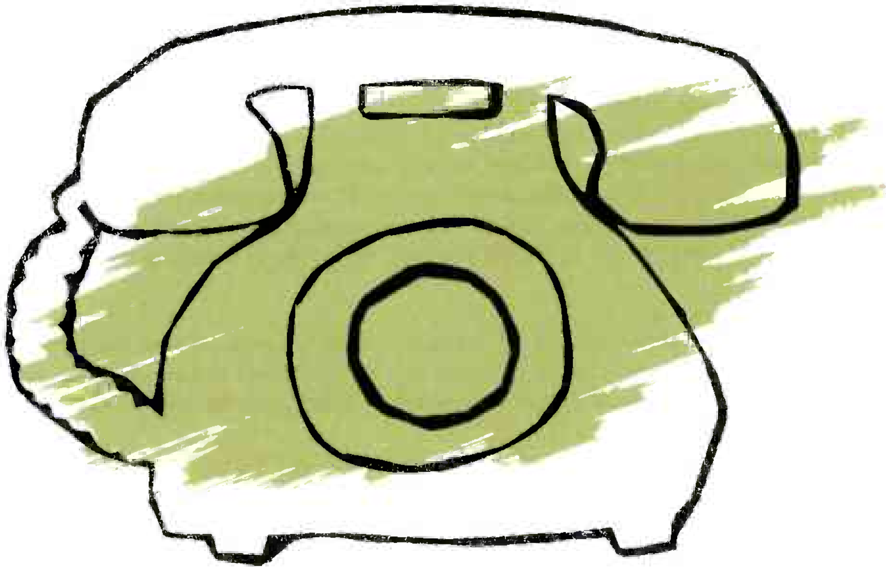
At the time T6, shown in Figure 4, the current through L5 begins flowing in the opposite direction as shown in Figure 10. The current begins discharging C3. Electrons leave the negative plate of C3 and flow through L3 and through the diode D1 as shown in Figure 10. Once again, there is little or no charge built up on C4 because of its large size. Current continues to build up during the interval from T6 to T7.

The values of L3 and C3 are selected along with the value of L5, so that the total time required for one cycle at the resonant frequency will be twice the retrace interval. Thus we can have one half-cycle during the retrace interval which is sufficient to move the beam from T5 to T7. When the electron beam reaches point T7, we'll have maximum current flow through the yoke in the direction shown in Figure 10 and current will begin to decrease. At the interval T7, C3 will be discharged and therefore the voltage across D1 will disappear and this diode will stop conducting. However, D2 begins conducting as the electron beam starts moving from point T7 to T8 to initiate the first half of the trace. Capacitor C3 and C4 begin charging and the cycle repeats itself.

SUMMARY

The operation of the horizontal sweep using the two silicon-controlled rectifiers is not particularly simple and you have to go over it several times to get the entire sequence of events. However, to summarize briefly, here is what happens. As the electron beam starts moving from the left side of the screen to the center, current flow is through the yoke and through D2. As the beam moves slowly from the center to the right side of the screen, current flows through the yoke and SCR2 until the electron beam is almost to the extreme right side of the screen. Near the right side of the screen SCR2 begins supplying the yoke current.

During the retrace interval as the beam moves rapidly from the right edge to the center of the screen, the deflection field current collapses through SCR1 and then as the field current builds up with the opposite polarity the current builds up through the yoke and D1. Timing pulses are generated in the transformer made up of L1 and L2 to have SCR2 gated positive so that current will begin to flow through it at time T2. A timing pulse is fed into the gate of SCR1 from the horizontal oscillator to turn it on at the appropriate time to start the sequence of events that initiate the retrace.



eliminating those troublesome CALLBACKS

Elmer H. Blush, Jr.
C.E.T.

One of the problems encountered in servicing radio and TV receivers is that of the callback. In the majority of cases the callback is a different trouble that either has developed since the original repair was made or is a problem that was overlooked by the technician when the set was repaired. The callback is a nuisance to the customer as well as to the technician. It does not help the technician's reputation and it is costly in time and money. It is to the serviceman's advantage to eliminate the callback.

While we cannot eliminate the redo's 100 percent, we can cut them to a very small percentage if we follow good servicing procedures. How do we do this? One, by performing a thorough check of the set's operation, whether it is a complicated color TV receiver or a simple radio. Two, we must perform preventive maintenance on each set. Three, the set must be test-played for at least one hour, and preferably longer, after the completion of repairs. The importance of performing a thorough check of the operation of a radio or TV cannot be overemphasized, as you will see from the case histories that are related later in this article. In many cases the customer does not inform the serviceman of all the problems the set has. This may be unintentional or it may not. It is up to you, the technician, to uncover these hidden problems before giving an estimate or before completing the repair of the set.

An operational check should be made after every repair. If you follow the same pattern of operational checks on every receiver, whether the set is a radio or a TV, you will acquire a mental checklist which you will automatically follow on every receiver.

OPERATIONAL CHECK

The sequence that I follow is listed next and can be used as a general guide for most sets. The first three checks listed apply to both radio and television receivers.

1. Check the ac power cord for bad insulation and intermittent connections. Flex the wire back and forth at the ac plug and at the interlock or point where it enters the set. These two spots are the most troublesome and are often overlooked. On battery-operated sets, check the condition of the batteries. This can be done by using a battery checker or by measuring the battery voltage while the set is in operation. Also check the battery holder and contacts for corrosion and for frayed leads.

2. Check the on-off switch next. Turn it on and off several times to see that it works every time. In the majority of cases the volume control is part of the on-off switch. If the volume control is noisy when turned, very often this can be cured by spraying with a tuner cleaner and lubricant. After spraying, operate the control back and forth a few times. In stubborn cases the control may have to be replaced.

3. Check the tone control if one is used. Use the same procedure used with the volume control.

4. On radios and stereo receivers, check the operation of balance, bass and treble controls. Check the operation of all switches—the function switch, AFC, tape monitor, speaker switches, and so on. The number and type of controls vary from unit to unit—the important point here is that all must be checked. As with the volume control, if any control or switch is noisy or intermittent, more often than not it can be fixed by spraying with a tuner cleaner and lubricant, and operating it back and forth a few times.

5. Operate the tuning dial of radios and tuners from one end to the other a couple of times. Be sure it moves smoothly without binding or slipping. If the receiver is a multiband unit, check the operation on each band. Some of the older foreign makes used a clutch mechanism to engage one dial mechanism for am and another for fm. Be sure both work properly.

6. On TV receivers, the tuners should be checked for proper operation. If the vhf tuner is intermittent or noisy, spray it first with a tuner degreaser and then a tuner lubricant. I do not recommend spraying the uhf tuner. If there is a defect in it, replacement is in order.

7. Check the vertical and horizontal hold controls on TV receivers. Make sure the controls lock-in the picture in the center of their range. See that they provide positive locking of the picture over a portion of their range. If the lock-in is critical, look for trouble in the sync circuits and correct the defect.

8. Check the brightness and contrast controls for erratic or noisy operation and for lack of control over the brightness and contrast of the picture. Correct any problems found in these circuits.

9. On a color TV set, check the color intensity and tint controls. Also at this time check the color afc control if one is used. Here again, correct any defects.

10. In addition to the customer-operated controls, you should check some of the technician-operated controls that are usually located on the back of the set. Begin with the vertical height and vertical linearity controls. Check for smoothness of operation, making sure there are no bad spots in the range of the control. Check the agc control for proper agc action. On a color set, check the operation of the screen controls and the background controls. Also, check the brightness limiter control if one is used. Check the operation of the color killer control. The service switch should be checked because it has been known to give trouble.

11. On color TV receivers it is imperative that the high voltage be checked when the set is serviced. If the high voltage is allowed to run too high, there is the danger of X-ray radiation, and the life of the high-voltage transformer will be shortened. On a color receiver, it takes about four minutes to check the high voltage and the operation of the tuners and controls mentioned. It is time well spent.

PREVENTIVE MAINTENANCE

Preventive maintenance should become a routine that is performed on every set repaired in your shop. This includes spraying the vhf tuner with a degreaser and tuner lubricant. Also spray all controls and switches with a tuner lubricant. These measures apply even if the tuner and controls passed the operational checks outlined above. Preventive maintenance means correcting any defects found in the receiver that the customer has not mentioned or is not aware of. On tube-type sets I recommend testing all tubes even though the set appears to be operating properly. Sometimes a very weak or partially shorted tube may still perform satisfactorily in the set, but the chances are that it will give trouble shortly. It's best to replace it now.

TEST-PLAYING

When you have completed the repair of the radio or TV set, set it aside and let it play for at least one hour and preferably longer. The purpose of this procedure is to uncover any malfunctions that occur after the set has heated up and to check for intermittent problems. Tube-type sets are more prone to heat-up problems than transistor sets. For instance, the sound may become distorted after warmup due to defective tubes or leaky coupling capacitors. In TV sets the vertical size may vary, or the picture may start to roll after the set has been on for a while. Also, the horizontal size might shrink, or the horizontal frequency might change. Oscillator problems in the vhf tuner might cause the loss of the higher vhf channels or all vhf stations while the uhf tuner still operates. There are many problems that can occur after a set has been on for a while, so it is important to test-play a radio or TV receiver after making repairs.

CASE HISTORIES

The following case histories are some examples of what happened to me because I did not perform the operational check, preventive maintenance, or the test-play.

Defective On-Off Switch

This one was a black-and-white portable TV. The complaint was that the set had no sound; the picture was okay. I put the set on the bench and connected the power cord to confirm the complaint. The switch was already turned on, so I just advanced the volume. Sure enough, there was no sound but a good picture was present. Instead of turning the set off with the switch, I unplugged the power cord and removed the back. I cured the sound problem by replacing one of the audio tubes. Very simple. I reinstalled the back on the TV and put it aside to test-play. I was thinking it would be nice if all repair jobs were this simple as I was making out the bill. Keep in mind that the set still had not been turned off with the switch, and the customer had said nothing about it.

The day after the customer picked up the set he returned with it, complaining that I had not done a very good job because he could not turn the set off. The switch was broken in the on position. If I had performed the operational check, I would have discovered this. As it turned out, I performed two repair jobs for the price of one as the customer paid only for the switch the second time. If I had replaced the switch the first time, the labor bill would have been higher. The result—money lost.

Volume Control

This black-and-white portable had no brightness. I quickly opened up the set and replaced the high-voltage rectifier tube. This restored the brightness and everything seemed fine, including the sound. Another quick and simple repair job thought I. I buttoned up the set and put it aside to test-play. I didn't want to listen to the sound, so I turned down the volume control before the set had warmed up. After a couple of hours, I notified the owner to come and get his set. When he arrived, he wanted to see it work. The picture looked great, but oh that noise as he turned up the volume control! He had not informed me of the noisy volume control, and I had failed to perform the operational check and the preventive maintenance. I lost valuable time having to remove the back of the set and spray the volume control.

Open Contrast Control

This one was another black-and-white portable TV. The complaint on this set was no sound but it had a good picture. The cure for this problem was a little more complicated than just replacing tubes. The trouble turned out to be an open plate resistor in the audio detector tube, a common problem. Here again the set was buttoned up and test-played for several hours. Everything appeared okay. The customer picked up his set and everything seemed fine.

A few days later he returned with the set. The complaint was no picture. Upon turning on the TV I found that it had brightness but no video. I turned the contrast control up and the picture reappeared just as good as ever. The customer said that he didn't know what the contrast control was for and had never touched it. Who had turned it down? It had worked okay for several days. The man recalled that they had had visitors the night before the set had lost its picture. The visitors' children had apparently played with the set and had turned the contrast control down. The control was open. When it was turned down there was no picture. When it was about two-thirds of the way up, the video reappeared. I had not adjusted the contrast when the TV was in the shop for the sound problem, and thus the open control went unnoticed. Here again, I didn't perform the operational test or preventive maintenance. Either one would have prevented a callback.

Defective UHF Tuner

I have had several callbacks on uhf tuners. The sets had been brought in for various problems, all of which had been repaired. Not one of the customers mentioned the fact that the uhf tuner was not working. Upon questioning the customers who returned with the no-uhf complaint, the majority admitted that they had not used the uhf for some time and thought it was still working okay. Most of my customers do not know what the uhf tuner is or how to operate it, so it is easy to fall into the habit of not checking the uhf when repairing a set. Had I made the operational check, I would have discovered the defective uhf tuners. I might add that I recently moved to an area where many people are on cable TV and the uhf is not used, but I still check the uhf tuners when working on a TV set.

Defective Picture Tube

This one occasionally happens to the outside serviceman. It usually happens that he gets a service call to repair a console model TV that is dead—nothing works. Exhausting all the normal service procedures with no results, he decides that the set must go to the shop for repair. The trouble is in the chassis, so he pulls the tuner and the chassis, and returns to the shop, leaving the cabinet and picture tube in the customer's home. The bench technician determines the cause of the trouble and gives the owner an estimate on the cost of repair. The customer okays the repair, and the outside serviceman returns the chassis to the cabinet. When he turns the set on, he discovers that the picture tube is defective. If he is lucky, he can rejuvenate it with a picture-tube rejuvenator. If he isn't lucky, he has a problem. If he had checked the picture tube *before* pulling the chassis, this unfortunate situation could have been avoided.

Defective Alarm on Clock Radio

TV sets are not the only items that can trap the unsuspecting service technician. Clock radios can do it, too. A nice middle-aged woman called one day to inquire if I would repair her digital clock radio. She was so thankful to find that I would, since she had been all over town and no other shop would even look at it. You won't find any service literature on the clock mechanism in any of the usual service manuals, hence the reason no one else would take the radio in for repair.

This radio worked okay, but the complaint was that the hour and minute numbers on the clock didn't move. The seconds numbers were still turning. This is a common trouble with this particular type of clock mechanism. The seconds numbers are on a small drum. The drum has a little projection on it that advances the minute numbers one number for each revolution of the seconds drum. This projection was broken off. The cure was to drill a tiny hole through the drum and insert a screw through it to take the place of the projection. This is not an easy repair since the clock mechanism has to be disassembled and the parts are small.

When the lady arrived to pick up her clock radio, her only concern was whether the alarm worked. I thought, why shouldn't it? I moved the on-off-alarm lever to the alarm position and turned the alarm set knob until the alarm went off. Satisfied, she took her radio and departed, only to return later saying the alarm didn't work at all. She had set it for eight o'clock and it wouldn't go off. She was right. It went off at eleven when set for eight. The alarm was off by three hours.

Now the point of this episode is that when I repaired the original problem, it had nothing to do with the alarm setting. A different mechanism on the other end of the clock assembly controls this. The alarm had been off by three hours before the projection had broken off the seconds drum, causing the clock to stop operating. The customer had not informed me of this and was indignant because it wasn't corrected. I had to disassemble the clock mechanism again and adjust the alarm. Again I did two repair jobs for the price of one. Had I performed a complete operational check of the clock after the repairs were made, I would have discovered that the alarm did not go off at the proper time, and I could have adjusted the charges for the repair to cover this.

So far the case histories seem to paint a picture of gloom and doom for the unsuspecting service technician, but thankfully they are in the minority. Let's see how well a couple of jobs turned out in the next case histories.

Sears Model 81641

The first set was a Sears color TV Model 81641. The complaint was that the screen had a wide horizontal line across it. This was all the lady of the house could tell me over the phone, except that her husband had removed all the tubes and had had someone test them. They were sure the set would have to go to the shop. When I arrived at the customer's home, the TV had been reassembled. I turned it on to verify the complaint, and it did just as the lady had said. Since the customer had been into the set, I decided to take it in.

The first thing I did when I returned to the shop was to check the vertical output tube (21LU8). It checked dead. On examining the pins of the tube I discovered that pin 10 was bent over and was not going into the socket. The pin apparently was bent when the customer tried to reinsert the tube in its socket. Pin 10 is the grid of the vertical multivibrator; thus the grid was open and the tube inoperative. Straightening the pin and replacing the tube in its socket restored the vertical sweep.

Since the vertical trouble was apparently put into the set by the customer and I didn't know what the original problem was, I decided the set needed a thorough check of its operation. I connected my B&K TV Analyst to the antenna terminals and checked the vhf tuner channels. The Analyst puts out a signal on channels 2, 3, 4, 6, 7, 8, 12, and 13. These channels provide a good indication of the tuner operation. The tuner was working on all channels but required an abnormal amount of signal to eliminate snow in the picture. This indicated that the tuner had poor sensitivity. This condition is difficult to detect when operating the set from an antenna with a relatively strong signal. It would more than likely go unnoticed. Even though the customer had said the tubes had been tested, I decided the tuner and video i-f tubes needed checking again. Both tuner tubes were weak (6HA5 and 6GS7). In addition, the 6GS7 was shorted. I noted that the dust on the tuner tubes had not been disturbed so I was sure they had not been checked by the customer. The i-f tubes were okay. Installing new tuner tubes cleared up the snow problem.

Checking the sensitivity with the TV Analyst probably saved a possible callback because the tuner tubes were on the verge of complete failure. Also, if the customer happened to be in a weak signal area, he probably would have had snow in the picture with the weak tuner tubes.

Now that the vhf tuner was operating properly, the Analyst signal was switched over to the uhf tuner. The Analyst puts out a continuously variable signal from channel 14 to 83. This provides an excellent check of the uhf tuner. This set passed the uhf test.

Now in the process of checking out the tuner and i-f tubes, the set had been turned off. When I turned it back on with new tubes I noted that the picture was coming on long after the sound. The picture gradually increased in brightness for about three minutes and then was stable. It seemed to me that a tube in the video circuits was slow in warming up, so I decided to test all the remaining tubes on the tube checker. All tubes passed the test except the chroma amplifier and video amplifier, both in the same envelope (8JV8). The video section was very weak. Replacing this with a new tube corrected this defect. While the set would have worked with the old 8JV8, I might have had a callback.

The set was now operating pretty well. A check of the high voltage with the brightness turned down showed the voltage to be within the manufacturer's specifications. Always be sure the brightness is turned down when checking the high voltage, as the voltage is highest at minimum brightness. Since the high-voltage setting varies from one set to another, you should always check the service information for the particular set you are working on to get the proper voltage setting.

Next, I made an operational check of all the controls mentioned previously. After spraying the tuner and controls, I buttoned up the TV and set it aside to test-play for several hours. The set was delivered to the customer and I might add that I did not get a callback on this set.

GE Model 21T1541

On this occasion I was called to the customer's home to repair a black-and-white GE Model 21T1541. The complaint was that the stations above channel 6 didn't come in. Also the vhf tuner shaft was broken. Since the tuner shaft was broken and obviously could not be repaired in the home, I didn't bother to check the set there. I was pretty sure a 17-year-old set just had to have other troubles.

With the set in the shop, I found that even though the tuner shaft was broken and could be pulled completely out of the front of the set, it could still be turned in one direction. As the customer had said, the stations above channel 6 could not be tuned in. The fine tuning was working but could not be tuned far enough to bring in the stations.

Normally my first impulse would be to readjust the tuner oscillator slugs in order to tune in the higher channels. In this case, considering the age of the set, I thought I should first find out the condition of the tuner tubes. My tube tester showed that both the rf amplifier (6BZ7) and oscillator (6U8) had practically no emission. Since these were in such poor condition, I decided to check the i-f tubes at the same time. The first i-f tube (6CF6) was extremely weak, the others checked okay.

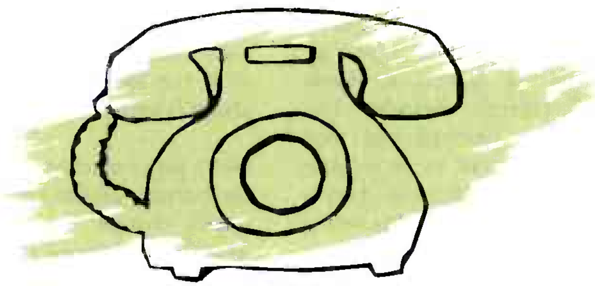
Replacing the tuner tubes and the one i-f tube with new ones brought the higher channels back in, but the fine tuning had to be turned all the way to one end of its range to accomplish this. At this point I sprayed the tuner with a tuner cleaner and lubricant and adjusted the oscillator slugs. The tuner was working fine except for the broken shaft, which I had to order from GE.

Since it would take a week or so to get the new shaft, I continued checking out the set. The next thing I noticed was that the sound was slightly distorted--not really bad. It had been unnoticed by the customer. I found that the 6T8 audio stage was almost dead but still working. Replacing it with a new one cleared up the sound distortion. A slight distortion in the sound can, and very often is, caused by a misaligned quadrature coil or ratio detector. My first thought is usually to "touch up" the alignment slugs first, but as seen in the example of this set, it is best to be sure the tubes are in good condition first.

Now that the set appeared to be operating well, I sprayed all operating controls mentioned earlier with a tuner lubricant and checked for proper operation. The height and vertical linearity needed readjustment as they had been moved during the operational check, and the picture needed centering. All repairs were now complete except for the tuner shaft.

When the tuner shaft arrived I installed it and test-played the chassis for a couple of hours. Another repair job was successfully completed. There was no callback on this set.

As you can see from these case histories, it does take more time and trouble to do the job right, but it is worth the extra effort. By eliminating the callback, the end result is that the job is done in less time and your profits are higher. The repairs on all of the case histories described were performed in the shop. It is more difficult to eliminate the callback when the service is performed in the home. You can perform the operational check in the home and the preventive maintenance to a certain extent, but the test-play cannot be done. In this situation you have to take your chances.

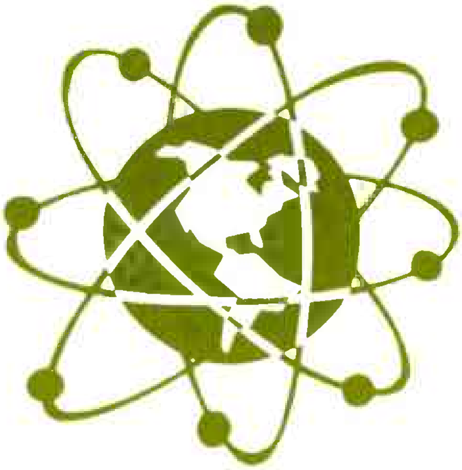


Helpful Hints 5

If you've had trouble installing or removing screws from hard-to-reach places, you'll appreciate what a piece of electrical tape or a dab of ordinary beeswax will do. Place a small amount of beeswax inside the socket of a nutdriver or on the blade of a screwdriver and you'll be able to install or remove screws without dropping them. Beeswax can be bought at most good hardware stores.

Electrical tape, a more common item in a technician's toolbox, is limited to being used with only the nutdriver. In those hard-to-reach places when you are plagued by the screw repeatedly falling out of the nutdriver socket, try this: Place a piece of electrical tape over the hex head of the screw. Then insert the taped screw head into the nutdriver socket. The tape will hold the screw in place for installation.

—*James Crudup*



HAM NEWS

By Ted Beach K4MKX

Just so that we don't have any more "negative feedback" this time like we had in the last issue, let me say that I got no fewer than four letters (two from non-hams) on an item which was printed in the last column. There was a real typo in the report on George, K2IVG, as having gotten a Heath keyer on his "sixteenth" birthday. The hotshot detectives pointed out that George would have had to be mighty young when he got his K2 call if he is just now sixteen. Actually, his letter said that he treated himself to the new keyer on his *sixtieth* birthday, not his sixteenth.

Oh, well, it sure is nice to know that someone out there is reading all this stuff. Actually I'm surprised that more such goofs do not appear in these pages since usually the Journal is "put to bed" in rather a rush to meet printing and mailing deadlines that creep up on us. Anyway, please bear with us and we shall try to do better in the future.

Now that I am the proud owner of two pieces of two-meter gear (both mobile), I have found a continuing need for a power supply to run the fool things off the ac lines inside the shack. The Genave takes a healthy 7 amps at 13.5 volts while the Wilson is very happy on its nicads. However, if I want to drive the 25-watt amplifier with the Wilson, I need 13.5 volts at about 5 amps for this combination.

Until just recently I had been using a car battery which I kept floating on a trickle charger in the shack. Unfortunately, the battery died recently (having originally been removed from service in the VW so it wasn't too good to begin with) and I certainly didn't want to buy a new battery. Besides, I never could get the thing to take a real charge with only a trickle charger so I usually had only about 11.8 volts to work with.

My next thought was to see if I could build an ac supply for the shack. Unfortunately, power transformers for such a supply are not easy to find and are quite expensive. I figured I should have at least an 8-amp supply which I could adjust over a voltage range of about 11 to 14 volts. Good regulation wouldn't hurt either. I saw a few kits advertised in some of the magazines, but unfortunately they want *money* for these things, and money is one thing I have very little of these days.

Then one day I saw an ad in the local paper that said I could get a 6-ampere battery charger for $14, so I said to myself, "Let's try to give the old battery a good charge and put it back into service." $14 I *think* I can afford. Besides, I can use it to juice up the car batteries when they get low.

Lo and behold, the old VW battery took a fine charge, and with the new charger floating across its terminals does an excellent job of supplying the mobile rigs in the shack. Still, I have no idea how long the battery will last—I am sure it is on borrowed time right now, so I decided to open up the unit and see just what was inside.

As I had suspected, there is a huge transformer, two single-plate selenium (I think) rectifiers, an ammeter, and a thermal overload breaker, with lots of wide open spaces surrounding it all. In fact, there is plenty of room to install a good size filter capacitor and a voltage regulator, so that is the course I am going to follow just as soon as I have a few spare minutes. I will also put in a switch to disable the regulator so that I can use the charger as it was originally intended as well. I figure the parts I will need to convert it into a regulated supply will run about $4 since I have a pretty well stocked junk

Jim	WA2YSK	G	Poughkeepsie NY
Dave	WN3AKI	N	Bethel PA
Gene	WN3AWS	N	Columbia MD
Jim	WN4BCJ	N	Charlotte NC
Leon	WN4BZU	N	Macon GA
Bill	WN4CUY	N	Norfolk VA
Tom	WN4UEI	N	Dobson NC
David	WN4LIO	N	Rocky Mount NC
Doc	WB4WVG	A*	Lake Park FL
H.B.	WB5QPI	G*	Midwest City OK
Walt	WN5QXZ	N	Galveston TX
Bill	WB5QZM	T	Garland TX
Hubert	WN6EAD	N	Pasadena CA
Ron	WN6JFZ	N	San Carlos CA
Hal	W7AYN	—	Pocatello ID
Greg	WN8UTC	N	Vandalia OH
Donald	WN9SGM	N	East Chicago IN
Ralph	WBØQOO	G	Belton MO
Stan	WN3ALQ	N	Johnstown PA
Emory	WN8WKM	N	Lowell OH
George	WB5HKY	E	Midland TX
Don	K5CKQ	G	Lawton OK
Ralph	WN7CMR	N	Emmett ID
Fred	VE3AWO	—	Cornwall ON, Can

* Just upgraded – congratulations!

box. All I need is an adjustable regulator (723 type), a pass transistor and heat sink (2N3055 is nice and cheap), a couple of resistors and a pot, and a filter capacitor. When I get the thing put together I'll take a couple of photos of it and print them in the column for you along with the actual schematic I end up with. I think this promises to be a real nifty project. How else could you get a nice well-regulated 6-ampere supply for $18? More later.

Now, let's see who we have heard from since last time.

The first eighteen calls in the list are students and graduates of the Amateur courses, while the last six are from the ranks of other NRI courses.

Unfortunately, most of the names and calls came to me from our lesson grading section and did not have a lot of real news in attendance, so as a result the report section will not be very long this time.

When WN3AKI got his call recently he got all wrapped up in operating on 40 and 80 and says that he will "get back to those lessons later." I know the exact feeling, Dave. Whenever I get something interesting to work on, all else goes by the board for quite a while. Dave is really working at the General License, spending lots of time with the code records and listening to W1AW as well. As he says, it takes practice, practice, practice.

During the time between Christmas and New Years, my family (and several thousand other people!) drove down to Florida to spend a few days, and had I known that WB4WVG lived in Lake Park I certainly would have looked him up as I was in West Palm Beach, my home town. Anyway, our very best congratulations to Doc on getting his Advanced license—a very good hedge against Docket 20282 (if it ever gets acted upon).

If I were a new Novice I would certainly hate to get the call that Walt recently got: WN5QXZ. Try that one out on cw some time! It's bad enough on phone. Walt is cranking out the call at present on a Heath HW16 and is waiting to finish building the Conar transmitter which is part of his course to go along with his Model 500 receiver. Best of luck, Walt.

W7AYN sent us a fine photo of himself sitting in his shack which, unfortunately, we cannot run here because it is a color print. Hal is 65 years young and appears to run a Yaesu FT101 from his QTH. Thanks for the photo, Hal, and we're only sorry that we can't print it here for everyone to see. Black-and-white pictures will work fine.

WN8UTC wrote a nice letter on the subject of CB radio that I had mentioned in a previous column. Greg had had experiences similar to mine about all the clutter and heterodynes, etc., and he solved the problem quite nicely. Where he lives (intersection of I-70 and I-75 and very close to Dayton) 11 meters is saturated and he wished to maintain contact with his wife, who is not interested in ham radio. Single sideband proved to be the answer. Now his wife likes the new gear and Greg says she gives him very little QRM when it comes to getting new equipment (ham or CB!). Sounds like you have it all wrapped up, Greg.

WN8WKM appears to be a very busy person. In addition to winding up the complete communications course, Emory is currently enrolled in an EE course at a community college and recently sat for his commercial ticket. So anyway, he is now working for the General and finding time to operate his HW101 (after doing some trouble-shooting). Whew! Best of luck, Emory. I hope you can hold up.

George, WB5HKY, appears to be a cw addict. He mainly works 15 and 80 using a DX60, Swan 240, and a MJF QRP rig. Using the latter, George has worked 21 states on 40 with a whopping 4 watts input. How about that one? I'm impressed.

K5CKQ got his old call back after being without it for 15 years. After letting it lapse, Don got a Novice (WN5OCN) and then General (WB5OCN) after studying the NRI course for three months. Fine business, Don, and I have passed on your request to the proper people.

WN7CMR got his ticket in October and says he has made several enjoyable contacts using a Heath DX100 and a Realistic DX160 receiver into a dipole. Fine, Ralph, and we'll be looking forward to hearing from you again real soon.

VE3AWO sent us four—count them, four—QSL cards with his note. All four of the cards appear to be in use at the present. One is a Centennial call card, one is an Olympic special call card, and the other two are plain old cards. Me, I don't even have a card! One of these days I'll have to make some up. Anyway, Fred writes that he also operates CB, primarily for his wife's benefit, and everything works out fine since they don't have the same problems we have down here. Thanks, Fred, and we have added your cards to our collection.

That about wraps it up for this time. Be sure to write and let us know what you are doing out there.

Very 73,

Ted – K4MKX

Job Ops

NEEDED: Avionics and A&P technicians, qualified and experienced. Must have First or Second Class FCC with Radar Endorsement, 18 months experience in avionics, eligible for FAA repairman certificate, and able and willing to work night shift. Largest fixed base operator in West Virginia. Single, twin-engine Cessna dealer, Allegheny Commuter operator with full maintenance facilities. Adequate wages and benefits. Full explanation given to applicants. Contact Aeromech, Inc., PO Box 2550, Clarksburg, West Virginia 26301. Telephone (304) 842-5403. Ronald K. Shull, Vice President.

A Reminder

Always be sure to include your student number whenever you contact NRI. This will help to ensure that we can serve you promptly and efficiently.

NRI HONORS PROGRAM AWARDS

In the tradition of NRI's pursuit of excellence in training, the following graduates who earned NRI electronics diplomas in November/December also earned unusual recognition under the NRI Honors Program. On the basis of their grades, these graduates distinguished themselves by earning the right to honors listed below and to the appropriate Certificate of Distinction in addition to their regular NRI Diploma. This distinction is made part of their permanent NRI records.

WITH HIGHEST HONORS

Ralph E. Covington, Sr., Las Vegas, NV
William M. Glanton, APO San Francisco
John J. Glover, Phoenix, AZ
Lana L. Heckman, Grandview, MO
Therso R. Lyons, San Antonio, TX
Gerald D. Norton, Los Altos, CA
John F. Politz, Baton Rouge, LA

WITH HIGH HONORS

Edgar A. Baldock, Los Gatos, CA
Leon L. Barnes, Medley, FL
Michael J. Bradley, FPO New York
Shirley T. Carter, Anchorage, AK
Norman J. Coletti, Portville, NY
Walter Dahlberg, Superior, WI
Ricky Drenkhahn, Apache Junction, AZ
Lindsay R. Eades, Bellevue, WA
J. Wayne Faulkenbury, Jacksonville Beach, FL
Frederick W. Gerleve, Chicago, IL
John W. Goetzcke, Golden, CO
Lemuel R. Goodwin, Jr., Columbus, GA
Gary N. Gourley, Springfield, MO
Christopher S. Gray, Lodi, NJ
James H. Krueger, Cincinnati, OH
Leo Landry, Bellville, ON, Canada
Duane M. Lietha, Marquette, MI
Walter L. Marquardt, Oak Lawn, IL
Lawrence P. McGahey, Charleston, IL
Joe R. McGlothan, Carson, CA
Ronald B. Moore, San Diego, CA
Dwight Edwin Pittman, FPO San Francisco
Normand Richard, Gaithersburg, MD
James L. Richards, Teaneck, NJ
Lee D. Robbins, Williamsburg, VA
Silvero R. Rodriquez, Sugarland, TX
James H. Salyerds, Jr., Daytona Beach FL
Leroy Sheppard, Thonotosassa, FL
Kenneth H. Stone, Seattle, WA
Eric L. Thurston, Jr., Baton Rouge, LA
Harold W. Tucker, Maysville, KY
Harry E. Whittle, Orwland, PA
Robert C. Wohr, Colorado Springs, CO

WITH HONORS

Thomas J. Benthall, Roanoke Rapids, NC
Edward P. Brady, Albany, NY
Jed Brandes, Milwaukee, WI
Robert Brandt, Saugerties, NY
Thomas J. Bundros, Errington, BC IVO
Calvin M.Byrd, Essex Junction, VT
Jack G. Cannon, Jacksonville, FL
W. D. Cardwell, Andler, IN
Thomas E. Carlton, Burlingame, CA
George M. Cousens, Patrick AFB, FL
Kenneth Derstine, Quakertown, PA
Jack S. Dowell, Charlotte, NC
Eugene C. Eastway, South Milwaukee, WI
David A. Felber, Belton, MO
Dennis J. Frank, Denver, CO
Robert J. Freund, Alexandria, VA
Frank R. Gabriele, Whitman, MA
Wayne D. Gall, FPO New York
Roscoe S. Galleher, Tucson, AZ
Lowell D. Gehman, East Earl, PA
Joseph E. Givens, San Francisco, CA
Ronald C. Good, Toledo, OH
Joseph L. Hatfield, Bethesda, MD
Melvin R. Hebert, Virginia Beach, VA
Joseph Kassanchuk, Sequim, WA
Charles Kavan, Jr., Redford, MI
William A. Kelly, Port Austin, MI
James C. Kessey, Jr., Sioux City, IA
Joseph N. Klages, St. Louis, MO
Philip Krupa, Elmhurst, NY
Paul A. Lavoie, Nashua, NH
Frank T. Lemon, Ijamsville, MD
Michael P. Levis, West Lafayette, IN
Frederick D. Lockley, Durham, NC

Terry Mazzocco, Akron, OH
Thomas L. McQueary, Fort Worth, TX
Richard M. Mettler, Oildale, CA
Steven C. Michal, New Hope, PA
Jorge Rodiquez, Laurel, MD
Richard Rosenfeld, New Orleans, LA
Dale E. Sanders, APO New York
Tim G. Sexton, Lakeside, CA
Jerry L. Shears, Wabash, IN
Harry C. Shilling, Philadelphia, PA
Robert E. Sink, Jr., Tampa, FL
Gary H. Smith, Melbourne, FL
Gerald P. Smith, Dagsboro, DE
George M. St. Clair, San Diego, CA
Barbara P. Sterling, Syosset, NY
Orest Storoshchuk, Oshawa ON
Larry E. Venezia, Murphysboro, IL
Robert O. Zupp, Smithtown, NY

DIRECTORY OF ALUMNI CHAPTERS

DETROIT CHAPTER meets at 8 p.m. on the second Friday of each month at St. Andrews Hall, 431 E. Congress St., Detroit. Chairman: James Kelley, 1140 Livernois, Detroit, Michigan. 841-4972.

FLINT (SAGINAW VALLEY) CHAPTER meets 7:30 p.m. the second Wednesday of each month at Andy's Radio and TV Shop, G-5507 S. Saginaw Rd., Flint, Michigan. Chairman: Larry McMaster, (517) 463-5059.

NEW YORK CITY CHAPTER meets at 8:30 p.m., first and third Thursday of each month, at 199 Lefferts Avenue, Brooklyn, New York. Chairman: Samuel Antman, 1669 45th St., Brooklyn, New York.

NORTH JERSEY CHAPTER meets at 8 p.m. on the second Friday of each month at the Players Club, located on Washington Square in Kearny, New Jersey. Chairman: Al Mould. Telephone 991-9299 or 384-8112.

PHILADELPHIA-CAMDEN CHAPTER meets on the fourth Monday of each month at 8 p.m. at the home of Chairman Boyd A. Bingaman, 426 Crotzer Avenue, Folcroft, Penna. Telephone LU 3-7165.

PITTSBURGH CHAPTER meets at 8 p.m. on the first Thursday of each month in the basement of the U.P. Church of Verona, Pa., corner of South Ave. and Second Street. Chairman: James Wheeler.

SAN ANTONIO (ALAMO) CHAPTER meets at 7 p.m., fourth Thursday of each month, at the Alamo Heights Christian Church Scout House, 350 Primrose St., 6500 block of N. New Braunfels St. (three blocks north of Austin Hwy.), San Antonio. Chairman: Robert Bonge, 222 Amador Lane, San Antonio. All San Antonio area NRI students are always welcome. A free annual chapter membership will be given to all NRI graduates attending within three months of their graduation.

SOUTHEASTERN MASSACHUSETTS CHAPTER meets at 8 p.m. on the last Wednesday of each month at the home of Chairman Daniel DeJesus, 12 Brookview St., Fairhaven, Mass. 02719.

SPRINGFIELD (MASS.) CHAPTER meets at 7:30 p.m. on the second Saturday of each month at the shop of Norman Charest, 74 Redfern Drive, Springfield, Mass. 01109. Telephone (413) 734-2609. Chairman: Preston Atwood.

TORONTO CHAPTER meets at McGraw-Hill CEC, 330 Progress Avenue, Scarborough, Ontario, Canada. Chairman: Branko Lebar. For information contact Stewart J. Kenmuir, (416) 293-1911.

DETROIT CHAPTER INCREASES MEMBERSHIP

At the December meeting, Mr. John Zalman was welcomed to membership. At the January meeting Mr. Tom Tishler was also made a member.

In December Mr. Bruce Rittenhouse checked diodes for Mr. Charles Cope which were used in a Wurlitzer organ. One diode was found to be defective, and when replaced this put the organ into operation. The members then checked on a multiband radio which was found to have distortion. This was a radio used to receive weather reports and could not be repaired at the December meeting because of unavailability of parts.

Also, at the December meeting the Chapter made arrangements for a seminar to be given by the Sencore Products Corporation. The seminar will be on the use of an oscilloscope and will last approximately three hours, but all the members attending should know more about oscilloscopes when the meeting is over.

At the January meeting Mr. Kelly recommended that a monthly project

NRI AA OFFICERS	
Ray Berus	President
Earle B. Allen, Jr.	Vice President
J. S. Bartlett	Vice President
Homer Chaney	Vice President
Branko Lebar	Vice President
Tom Nolan	Executive Secretary

Alumni News

list be prepared by the chairman with backup projects in case the first project fails. Also, a cross reference list should be made of all magazines that members receive. The members can then exchange or reference any electronic magazine to show all the membership what articles are available.

Mr. Nagy compared and also repaired two Heathkit Audio Analyzers. One belonged to himself and the other to Richard Kapalski.

PITTSBURGH CHAPTER HOLDS ANNUAL CHRISTMAS PARTY

At the December meeting, the Chapter had their annual Christmas party and also elected officers.

The new officers are: Chairman, James L. Wheeler; Vice-Chairman, John L. Benoit; Treasurer, Gerald F. Genellie; Secretary, Joseph L. Burnelis; Directors, George McElwain and David Benes.

The Chapter is looking forward to programs by Motorola, Zenith, GE, and RCA during the coming year. They are also looking forward to Tom Nolan's visit during the summer.

SPRINGFIELD CHAPTER HOLDS MEETING IN SPITE OF WEATHER

At the January meeting, ten members showed up even though the weather was in the zero-degree range.

Mr. Preston Atwood, Chapter Chairman and owner of his own repair shop, presented a discussion on high voltage. He cited a case in which arcing in the high-voltage cage finally caused a pinhole in the rectifier tube and destroyed the tube and high voltage.

The chapter is looking forward to a good year with expanded programs.

FLINT/SAGINAW VALLEY CHAPTER HELPS STUDENTS

At the December meeting Mr. Dale Keys brought in one of his training kits used in his course, and we were able to help him find a wrong connection.

Mr. Fred Malick gave a demonstration on how to connect 75-ohm shielded cable so that it will work properly without shorting out.

Mr. Andrew Jobbagy gave an explanation of the XL100 RCA CTC38 vertical module. This discussion should help in future servicing of these units.

The meeting closed with the ending of the year 1975 and the Chapter wished everybody a Merry Christmas and a Happy New Year.

NORTH JERSEY CHAPTER ELECTS NEW OFFICERS

At the meeting of the North Jersey Chapter on December 12, the following officers were elected: Albert Mould, Chairman; Harry Alla, Vice-Chairman; Leroy Frienschner, Treasurer; and Richard Wagstaff, Secretary.

It was suggested at the meeting that the names and addresses of students and graduates in the New Jersey area be obtained from NRI. Unfortunately, NRI is not computerized so a list like this is not possible. Therefore, all students and graduates living in the New Jersey area are urged to contact the North Jersey Chapter of NRIAA and are cordially invited to attend their meetings. Their meeting place is listed in the Chapter index in this issue.

NRIAA Officers 1976

The new President of NRIAA is Ray Berus of Detroit, Michigan.

Ray was born in Bridgeport, Ohio in 1912. He grew up in Ohio and was employed in the Ohio Glass plant before moving to Detroit in 1936.

From 1936 until 1975 Ray worked for the Fisher Body Division of General Motors in Detroit, recently retiring from this position last year.

Ray began his first course in TV Servicing with NRI in January, 1966, and received his diploma in May, 1968. He says that one of the reasons he started his course with NRI was the information he received through the Detroit Better Business Bureau.

While two other schools claimed to guarantee a job upon completion of their courses, NRI made no such claim. NRI told him that an individual taking their course would get out of it only what he put into it, and that meant study and hard work.

Ray, now retired, will devote his time to a small shop repairing television receivers and radios for his friends and customers, and also using his knowledge for his hobbies.

NRIAA's new Vice Presidents are John Bartlett of Washington, D.C., Homer Chaney of Branson, Missouri, Branko Lebar of Ontario, Canada, and Earle B. Allen, Jr., of Corona California.

NRI wishes the Alumni Association's new officers the best of luck during their 1976 terms.

CONAR presents the

Litronix 2260

ONLY $39.95

Plus $1 for shipping
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Stock No.EN226

The Litronix 2260 has ●automatic scientific notation override from eight-digit floating-point decimal display ●a memory system that performs natural parenthetical entry of complete algebraic expressions ●accumulating memory and store-recall memory ●advanced square/square root system ●does square and square root of sums, sums of squares and square roots without reentering intermediate results ●constant pi ●plus the exclusive Litronix on-off keys, automatic shutoff system, and "Error" signal.

Three penlight AA batteries provide up to eight hours of use and alkaline batteries will give you 16 hours. An optional AC adapter, which bypasses the batteries, is available for use from normal house current.

If your hound gnaws it to bits . . . or even if you flatten it under a steamroller . . . your Litronix calculator is still unconditionally guaranteed for one whole year. Just return it prepaid to the factory and a replacement will be sent. No questions asked.

- One-year unconditional guarantee
- Adds, subtracts, multiplies, divides
- Automatic squaring
- Automatic square root
- Displays pi to eight significant figures for use in electronics calculations
- Straightforward algebraic logic with parentheses
- Scientific notation
- Automatic constant
- Performs even the most involved electronics calculations with speed and ease. Example: determine the capacitive reactance at 60 Hz of a 0.05-μf capacitor. Exact keystroke sequence follows: 1 ÷ (.05 EXP +/– 6 x 2 x π x 60) = 53051.647 (answer in ohms)
- Battery-saving flasher*
- Automatic power-off after 15 minutes of non-use. No more dead batteries due to leaving calculator on by accident.*
- Flashing "Error" signal for improper operations. Retains data.*

*Litronix exclusives

Optional Cal-Converter

Holds calculator at proper angle for desk work

$3.95 Stock No. EN101

Optional AC Adapter

$5.95 Stock No. EN1

IMPORTANT: With so many calculators on the market, it's pretty hard for a student in electronics or a technician to pick the one best suited to his needs. After an exhaustive study of available machines, H. J. (Joe) Turner, Jr., NRI development engineer, prolific NRI Journal author, and avowed calculator nut, has found the Litronix 2260 to be by far the best calculator buy for use in electronics.

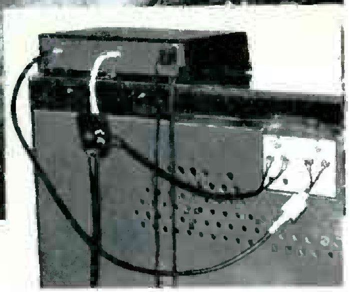
CONAR ANNOUNCES AN INDUSTRY FIRST...

JERROLD Universal TV Remote Control

Suggested List $99.95

$74.50

Shipping Weight 10½ Pounds
Shipped Parcel Post or UPS



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- **INCLUDES VARACTOR DIODE CONVERTER PLUS BUILT-IN SIGNAL AMPLIFIER**
- **CAN IMPROVE PICTURE QUALITY AND ELIMINATE DIRECT PICKUP GHOSTS**
- **SAVES WEAR & TEAR ON TV TUNER**

For easy connection to any TV set, order Model TRC-300K hookup kit which includes all necessary cables, signal splitters and matching transformers.

Only $7.45 Stock No. AC300
1 lb. P.P. Ins.

The Jerrold Universal TV Remote Control is completely solid state. The only moving parts are the pushbuttons used to change channels, the on-off switch and the fine tuning control. All incoming channels are converted either to Channel 2 or Channel 3 (whichever is not received off-the-air in your area).*

Tuning is accomplished by means of a varactor diode oscillator. Varactor diode oscillators are unique because their frequency can be varied simply by changing the bias voltage. Each channel push-button selects a voltage divider which determines the precise voltage to be sent to the varactor diode.

The Jerrold TV Remote Control is rugged enough to outlast several TV sets. It can pay for itself by eliminating tuner repairs and cleaning.

Built-in amplification helps to clean up "snow" in many cases. The conversion process eliminates direct pickup which can cause ghosts on sets connected to MATV systems.

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

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NOTICE TO THE BUYER: (1.) Do not sign this agreement before you read it or if it contains any blank space. (2.) You are entitled to a copy of this signed agreement. (3.) The Finance Charge will be waived if the unpaid balance is paid within 30 days. If paid within 60 days, the Finance Charge will be reduced by ⅔; if paid within 90 days, the Finance Charge will be reduced by ⅓. Accounts extending beyond 30 days will pay up to $3 in Credit Service Charges before the above reductions are made.

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25.01- 30.00	1.50	4,00		
30.01- 35 00	2.05	4.50		
35.01- 40.00	2.65	4 75		
40.01- 50.00	3.00	5 00		
50.01- 60.00	4.15	5.50		
60.01- 70.00	5.50	6.00	6.40	4.50
70.01- 80.00	7.00	6.50	8.00	5 00
80.01- 90.00	8.00	7 75	10.10	5.00
90.01-100.00	9.00	8.75	12.60	5.25
100.01-110.00	10.00	9.75	14.80	5,50
110 01-120.00	11 00	10.75	16 20	6.00
120.01-130:00	12 00	11.75	17.60	6.50
130.01-140.00	13.00	12.75	19.40	7.00
140.01-150 00	14 00	13.75	21.60	7.50
150.01-160.00	15.00	14.75	23 20	8.00
160.01-170.00	16.00	15.75	24.80	8 50
170.01-180.00	17.00	16.75	26.20	9.00
180.01-200.00	18.00	17 00	27.90	10.00
200.01-220.00	20.00	18 50	29.80	11.00
220.01-240.00	22.00	20.00	32.40	12.00
240 01-260 00	24.00	22.00	35.20	13.00
260.01-280.00	26.00	24.00	38.20	14.50
280.01-300 00	30 00	24.50	41.20	15.50
300.01-320 00	32 00	25.50	44 20	17.00
320.01-340.00	35 00	27 00	47.80	18.00
340.01-370 00	38.00	28.00	52.40	18.50
370.01-400 00	42 00	29.50	57.20	20.00
400.01-430.00	46 00	31.50	62.20	21 00
430.01-460 00	49.50	34 00	69.00	22.00

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

A → WHERE DO YOU LIVE?

PRINT FULL NAME .... Age ....

HOME ADDRESS .... CITY .... STATE .... ZIP CODE ....

HOME PHONE .... HOW LONG AT THIS ADDRESS ....

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

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

NUMBER OF DEPENDENT CHILDREN ....

PREVIOUS ADDRESS .... HOW LONG? ....

B → WHERE DO YOU WORK?

YOUR EMPLOYER .... POSITION .... MONTHLY INCOME $ ....

EMPLOYER'S ADDRESS .... Street .... City .... State .... HOW MANY YEARS ON PRESENT JOB? ....

PREVIOUS EMPLOYER .... Name .... Address .... HOW LONG? ....

WIFE'S EMPLOYER .... Name .... Address .... MONTHLY INCOME $ ....

C → WHERE DO YOU TRADE?

BANK ACCOUNT WITH .... Street .... City .... State .... ( ) CHECKING ( ) SAVINGS ( ) LOAN

CREDIT ACCOUNT WITH .... Street .... City .... State ....

CREDIT ACCOUNT WITH .... Street .... City .... State .... TOTAL OF ALL MONTHLY PAYMENTS INCLUDING CAR $ ....

Portable Multimeter

From CONAR and B&K . . .

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The Model 280 is a true digital multimeter—with 22 scales that range as high as 1000 volts dc or ac, 1000 ma and 10 megohms. All ranges are overload-protected, with automatic polarity indication. Decimal point position and out-of-range indication are also automatic. The Model 280 even has a built-in battery check. Its case is impact-resistant Cycolac. The Model 280 includes two test leads. Uses ordinary C cells or rechargeables. An optional ac adapter/charger is available for bench use.

- **Low Price**
- **Reliable—fully overload-protected**
- **Easy to read**
- **Large three-digit LED readout**
- **1 mv, 1 microampere, 0.1 ohm readout**
- **Completely portable—use it anywhere!**
- **Battery-operated for convenience**
- **10-megohm input, industry standard**
- **Automatic polarity**
- **High-low power ohms for in-circuit accuracy**

ACCURACY. **Note:** For all ranges add ∓1 least significant digit to accuracy indicated below. **DC volts:** ∓0.5 percent of reading, ∓0.5 percent of full scale, three lowest ranges; ∓1.0 percent of reading, ∓0.5 percent of full range, 1000 volt range. **AC volts, dc current, ac current:** ∓1.0 percent of reading, ∓1.0 percent of full scale, three lowest ranges; ∓2.0 percent of reading, ∓1.0 percent of full scale, highest range. **Resistance:** ∓1.0 percent of reading, ∓1.0 percent of full scale, five lowest ranges; ∓1.5 percent of reading, ∓1.0 percent of full scale, 10 megohm range. **Specification temperature:** 25°C, ∓1°C. **Temperature coefficient:** +15° to 35°C: Voltage, ∓0.025 percent/°C; current and resistance, ∓0.05 percent/°C.

ACCURACY. **Readout:** Three LED digits. **Power source:** Four C-size batteries, Nicad, alkaline, or carbon-zinc, with provision for ac adapter charger (batteries and ac adapter/charger not supplied). **Battery life:** Better than 50 hours of continuous use with alkaline batteries. **Over-range indication:** Display flashes when input exceeds value of range selected. **Polarity indication (dc volts and dc current):** Automatic; minus sign shown with plus sign implied. **Operating temperature range:** 0°C to +50°C. **Setting time:** Typically 0.5 second. Includes two test leads. **Size (WDH):** 4.38 x 2 x 6.38". **Net weight:** 2 pounds.

Complete specifications available upon request

Model LC-28 Carrying Case — **$6.00**
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Model MS-28 Wire Tilt Stand — **$3.00**
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- **Low Price**
- **Reliable—fully overload-protected**
- **Easy to read**
- **Large three-digit LED readout**
- **1 mv, 1 microampere, 0.1 ohm readout**
- **Completely portable—use it anywhere!**
- **Battery-operated for convenience**
- **10-megohm input, industry standard**
- **Automatic polarity**
- **High-low power ohms for in-circuit accuracy**

ACCURACY. Note: For all ranges add ∓1 least significant digit to accuracy indicated below. **DC volts:** ∓0.5 percent of reading, ∓0.5 percent of full scale, three lowest ranges; ∓1.0 percent of reading, ∓0.5 percent of full range, 1000 volt range. **AC volts, dc current, ac current:** ∓1.0 percent of reading, ∓1.0 percent of full scale, three lowest ranges; ∓2.0 percent of reading, ∓1.0 percent of full scale, highest range. **Resistance:** ∓1.0 percent of reading, ∓1.0 percent of full scale, five lowest ranges; ∓1.5 percent of reading, ∓1.0 percent of full scale, 10-megohm range. **Specification temperature:** 25°C, ∓1°C. **Temperature coefficient:** +15° to 35°C: Voltage, ∓0.025 percent/°C; current and resistance, ∓0.05 percent/°C.

ACCURACY. Readout: Three LED digits. **Power source:** Four C-size batteries, Nicad, alkaline, or carbon-zinc, with provision for ac adapter charger (batteries and ac adapter/charger not supplied). **Battery life:** Better than 50 hours of continuous use with alkaline batteries. **Over-range indication:** Display flashes when input exceeds value of range selected. **Polarity indication (dc volts and dc current):** Automatic; minus sign shown with plus sign implied. **Operating temperature range:** 0°C to +50°C. **Setting time:** Typically 0.5 second. Includes two test leads. **Size (WDH):** 4.38 x 2 x 6.38". **Net weight:** 2 pounds.

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