QUADRAPHONICS

- Quadraphonics: Newfangled name for newfangled sound
- Case histories compiled by a TV service technician

nri journal

July/August 1973

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You'll need:

- The Electro-Voice EVX-44 Universal Decoder
- Another amplifier
- Two more speakers

...and here's the heart of the conversion. (See Phil Deem's article in this issue for a detailed description of various four-channel systems.)

ELECTROVOICE
EVX-44 Universal Four-Channel Decoder

You don't have to worry about the method of four-channel reproduction with the EVX-44—it decodes both discrete and matrix. In addition, the subjective effect of ordinary stereo material can be improved through the use of the decoding circuitry. The decoding process takes place without affecting frequency response, distortion, signal-to-noise ratio, or other factors relating to audio quality.

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nri journal

July/August 1973
Volume 31, No. 4

This issue of the Journal features that newfangled concept of 4-channel sound: quadraphonics. This issue also re-introduces NRI's first computer course graduate as a professional TV service technician with a few years of experience behind him.

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

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quadraphonics: newfangled name for newfangled sound

Audio engineers have been constantly striving to allow us to reproduce in our own homes the great performances we have witnessed in person. They gave us all the clarity of sound they could push through that single speaker system of monophonic, high-fidelity days. An experienced listener could pick out the sound of each instrument. You could hear members of the choral taking a breath between passages. You could even listen to the faint rustling of the pages as the musicians turned their music sheets.

All the sounds were there—but the performers seemed to be more intimate than we remembered from attending live concerts. It was as though they had all gathered around a single microphone. Of course, many microphones were actually used to capture the original performance—but all these sound channels had to be mixed down into a single channel for reproduction at home.

Then came a giant stride forward in the unending quest for realism—stereophonic sound. Two separate and distinct channels of audio were available. Now we could hear not only the finest nuances of sound, but we could even tell approximately where they came from! We were able to produce a "wall" of sound, with the performers spread out across the "stage" in front of us, more nearly as we actually hear them at a live performance. But something was still missing.

The search for this elusive quality–believed by some to be the acoustical coloration of the performance by the hall in which it was held–has led to four-channel sound. The system was originally envisioned as being four separate and distinct channels of sound, which would be placed on four separate tracks of tape. The tape would be played on a special four-channel machine, and fed through four separate amplifiers to four-speaker systems, as shown in Figure 1. Although this system is still used, a great many new ideas have arisen since this original concept.

a brief history

The first commercially available four-channel programs were placed on tape in 1961 by the Nortronics Company, Inc. A company of apparent "far-thinkers," they were ahead of their time because the idea faded from the audio scene almost unnoticed.

In the summer of 1969, the idea reappeared. Acoustic Research conducted the first public demonstration of four-channel tapes produced by Vanguard. Columbia Records also produced some experimental four-channel tapes, again demonstrated by AR in New York and Cambridge.

In September of 1969, a real breakthrough was presented by Peter Scheiber. Mr. Scheiber came up with a means of producing four-channel sound from a stereo compatible disc. By suitably encoding or matrixing the four audio channels, they could all be placed in a single groove. The record could be played on a regular stereo machine without loss of information or deterioration. By attaching a suitable decoder, the listener could hear four-channel sound. Music from these discs could be broadcast in FM stereo and heard on existing receivers through the use of a simple add-on decoder and additional channels of amplification.

During the spring of 1970, Dynaco joined in with their "Dynaquad" system. It allowed the decoding of matrixed records and derived four-channel sound from existing stereo records. It used only two additional speakers without requiring extra amplifiers.

A little later, RCA Records announced discrete four-channel cartridge tapes and presented prototypes of home playback units. Motorola added strong backing, saying they would build auto tape players for them.

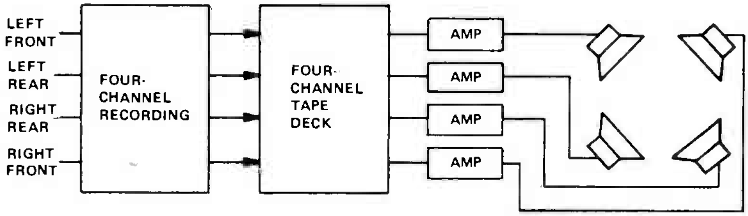


FIGURE 1. DISCRETE FOUR-CHANNEL TAPE SYSTEM.

In June of 1970, Sansui announced yet another system for matrixing and decoding four-channel discs. In September, JVC announced its CD-4 discrete four-channel disc system, the first of its kind. October brought Electro-Voice onto the scene with its matrix system for discs, tapes, and broadcasts.

What followed was a great deal of floundering around. Four-channel sound in almost any medium was not readily available, nor was the equipment for playing it. Everyone seemed to be waiting for a big company with a large following to take a step and perhaps get some standardization initiated.

Then along came Columbia Records--not with any standardization ideas in mind–but with yet another incompatible matrix system for discs, dubbed SQ for Stereo/Quadraphonic. The system was developed by its CBS Laboratories and co-sponsored by Sony Corp. Now the "big guns" are on the scene and cranking out records as fast as they can--at $1 premium over regular stereo discs!

where is four-channel today?

By now, four-channel has been tossed about for nearly four years. The air has begun to clear somewhat. Systems and four-channel program sources are now readily available. You can safely invest in four channel now without the worry that your expensive new system will become instantly obsolete.

Thanks to one manufacturer, even the incompatible matrix systems have turned out to be not so incompatible after all. The four-channel disc battle still rages, with RCA Records having joined forces with Victor Corporation of Japan (JVC) in developing a system similar to their CD-4 (Compatible Discrete 4-Channel).

the matrix systems

Matrixing is just a fancy engineering term. All it really means is mixing. During the production of a conventional stereo record, a good deal of audio mixing takes place. Special mikes are used for particular instruments, based upon the recording engineer's experience in working with them. The output from these mikes may be fed to as many as 16 separate channels in the recording studio. After the recording session, the engineers mix these tracks down into two.

The same thing happens during the production of a four-channel disc, with the exception that the four channels of the final master tape are mixed down into two channels according to a specific formula. There are only two variables in this process–amplitude and phase. Manipulating these two variables can result in almost infinite combinations. This is the major reason for so many encoding schemes. Each company feels that they have come up with the best channel mix.

Three major systems are currently in use in the United States. They are Columbia's "SQ," Sansui's "QS," and Electro-Voice's "Stereo-4." Dynaco's "Dynaquad" system is not considered among this group because it is a synthesis system, deriving four-channel sound from two-channel sources. More about that later. Let's take a look at what each company considered in designing their particular system.

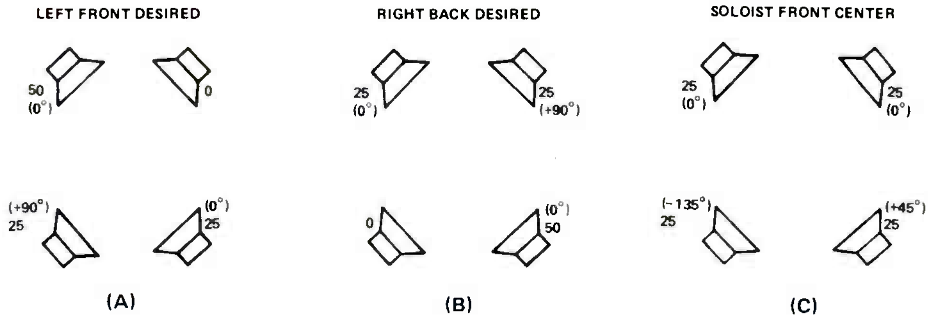


FIGURE 2. POWER AND PHASE DISTRIBUTION FOR THE COLUMBIA SQ SYSTEM.

columbia's SQ

Columbia felt that frontal stereo separation was of utmost importance, certainly more important than front-to-rear separation. When they designed their system, they chose mixing amplitudes that would result in maximum left/right separation at some cost to front-to-rear separation. They also shifted some of the signals 90° to favor frontal separation.

The overall result of the system produces the power distribution shown in Figure 2. In this figure, the numbers in parentheses represent the phase shift given the signal while the other numbers represent the percent power for each channel. At (A), sound would ideally be coming only from the left front speaker. As you can see, maximum frontal separation is achieved with 50% of the power in the left front speaker and no power at all in the right. A similar situation exists when only the right rear speaker should be producing all the sound, as shown at (B). Notice that although there is no power in the adjacent rear speaker, one-half of the power is in the other two.

Now see what happens when a soloist is placed at front center. The power coming from all four speakers is equal. Depending upon the listener's location in relation to the speakers, the solo may seem to be coming from behind or to the left or right. This effect is partially compensated for by the phase shifts introduced during the matrixing process, which tend to place the soloist at the front. The phase relationship between two adjacent channels will be 90° only when all the sound is in one channel. When more than one channel is driven, the phase relationship will be greater or less than 90°.

sansui's QS

Sansui decided that the degree of separation between any two adjacent speakers should be roughly the same all around. This seems a fairly logical approach, since they were trying to achieve an effect as close as possible to discrete four-channel sound. Sansui was the first company to employ the idea of introducing 90° phase shifts during the encoding process. They felt that this makes for better spatial definition, especially with regard to the rear channels.

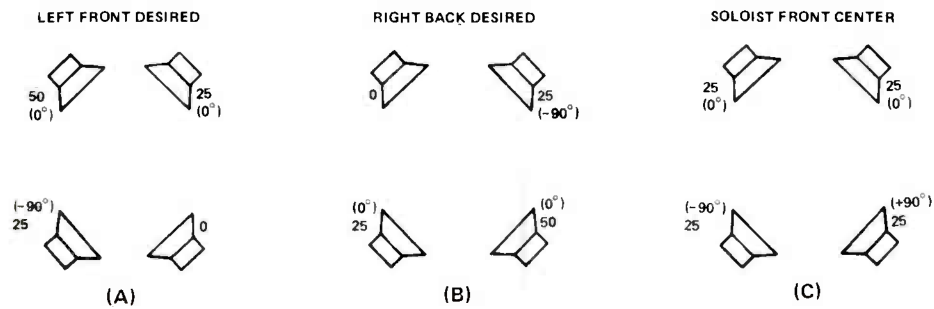


FIGURE 3. POWER AND PHASE DISTRIBUTION FOR THE SANSUI QS DECODER.

Otherwise, their design is very close to the original Scheiber proposal, which indicated that the channel diagonally opposite the desired one would have zero output. The power and phase distribution diagram for the Sansui matrix system is shown in Figure 3. The frontal separation is less than Columbia's SQ, but the front-to-rear separation is somewhat improved.

electro-voice's stereo-4

The engineers at Electro-Voice decided that it was not necessary to have maximum frontal stereo separation in order to produce a pleasing stereo effect. They considered a soloist placed at front stereo center should be firmly positioned there as reproduced from a matrixed disc and should not be allowed to wander toward the rear of the room. In order to achieve this end, the EV people chose some rather unusual amplitude ratios and also introduced phase shifts, but this time of 180°.

The power and phase distribution diagram is shown in Figure 4. Frontal separation is better than in the Sansui system, but poorer than Columbia's. Front-to-rear separation, when one of the front channels is desired, is reduced but still satisfactory. Notice what happens when one of the rear channels is desired. The power in the adjacent rear speaker is only slightly down from the desired one. This difficulty, however, is aided by the fact that the signals are out-of-phase.

The EV matrix system really shines when a soloist is at front center. Front-to-rear separation is nearly equal to that of a regular stereo record. It should be noted that

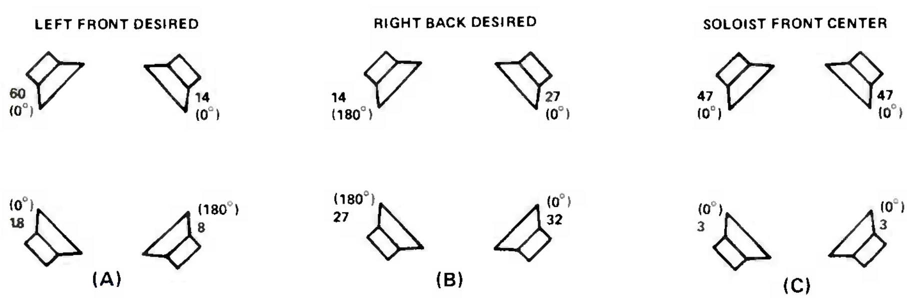


FIGURE 4. POWER AND PHASE DISTRIBUTION FOR THE "OLD" EV DECODER.

all of this data is for the "old" EV matrix system and not for the new one they have recently developed.

dynaco's dynaquad

Dynaco's system cannot really be considered a matrix system. It is the belief of this firm that there is a considerable amount of out-of-phase information in standard two-channel recordings on both disc and tape. Most of this information consists of sounds which were reflected from the walls and ceiling of the room or concert hall in which they were recorded. They are not heard through a regular stereo system because they cancel since they are out-of-phase.

The Dynaco people discovered that this information could be heard by adding two speakers to an existing stereo system connected as shown in Figure 5. This was an early approach. The speakers are connected in such a manner that a stereo difference signal is captured and reproduced by the front and rear speakers while maintaining the excellent separation of the regular stereo recording.

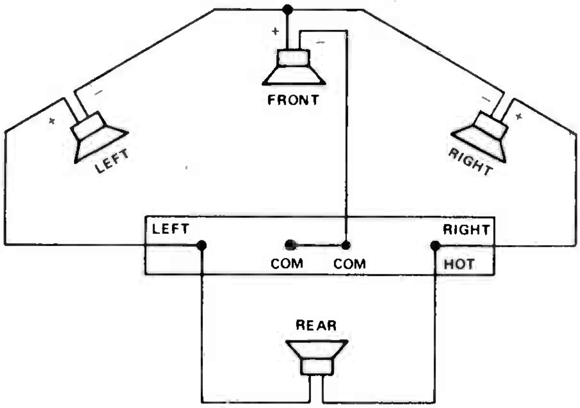


FIGURE 5. EARLY DYNACO APPROACH FOR REPRODUCING AMBIENT SOUND FROM REGULAR TWO-CHANNEL SOURCES.

Later they developed a four-channel synthesizer consisting of a number of passive components which altered the amplitude of the signals fed to the rear speakers. A more conventional four-channel speaker positioning was used–two front and two rear. Results depended upon the amount of surrounding sound (ambience) in the recording. Also, the system has the advantage that an additional stereo amplifier is not required. Only two additional speakers and the synthesizer are needed.

new EV system

Electro-Voice recently designed a decoder which is capable of properly decoding the QS and SQ in addition to the Stereo-4 records. They retained the original amplitude relationships of their first decoder, but added specific amounts of phase shift to some of the signals.

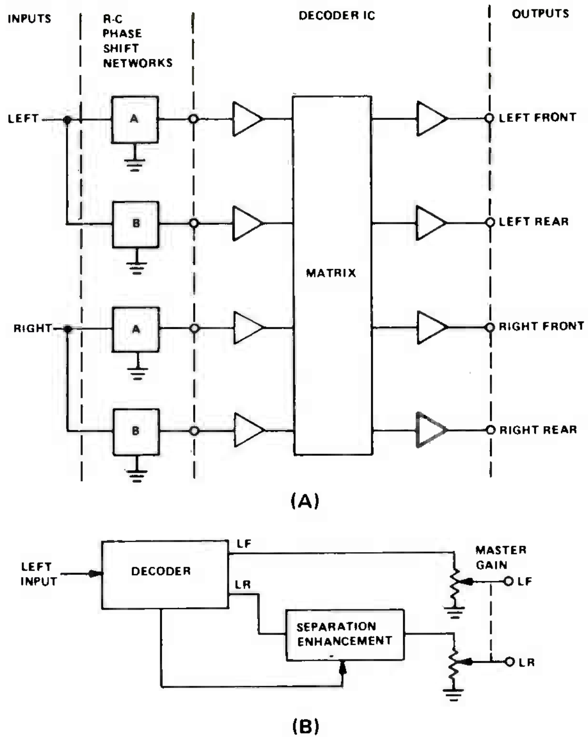


FIGURE 6. EVX-44 DECODER CONNECTIONS (A) AND FUNCTIONAL DIAGRAM (B).

The new decoder was developed through extensive computer analysis of the existing encoding systems. The result was a special integrated circuit plus several external components, as shown at (A) in Figure 6. The IC is proprietary, of course, but is being made available to all hi-fi equipment manufacturers and recording companies, as was the original decoder.

The decoder functional diagram of the left channels is shown in Figure 6(B). Notice the block marked "separation enhancement." This is a system of "gain riding" circuits which senses the presence of a dominant signal in one of the channels and increases its amplitude or reduces the amplitude of the other three to increase the apparent separation.

The overall performance of the EVX-44 decoder does not allow infinite separation, but the power in the undesired channels is only 2 to 6 percent. This allows the closest approach to discrete four-channel sound yet achieved in a matrix system.

discrete four-channel disc

The discrete four-channel disc under development by RCA and JVC has been plagued with many problems. Let's take a look at the system and discover why.

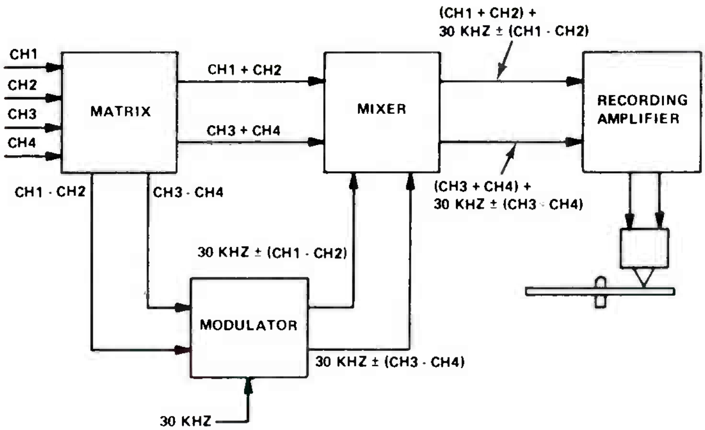


FIGURE 7. FOUR-CHANNEL DISC RECORDING PROCESS.

Figure 7 shows how the information gets from the master four-channel tape to the disc. The tape is fed into a matrix circuit which creates both a sum and a difference signal for channels 1 and 2 and channels 3 and 4. The sum signals are fed through the mixer and recorder amp and cut into the groove walls the same as a conventional stereo record. The difference signals are used to modulate a 30 kHz subcarrier in a manner similar to that used to broadcast stereo FM. The modulated subcarrier is then amplified and also cut into each side of the record groove.

The system for recovering this complex signal is shown in Figure 8. A special cartridge picks up the signals from the disc and feeds them to two separate circuits. The sum signals pass through an equalization circuit, a low-pass filter, an amplifier and separation adjustment circuit to the matrix. The difference signals are fed through a bandpass filter to a limiter/detector where they are separated from the 30 kHz subcarrier. Next, they go through a muting circuit and an expander to the matrix. The recovered four channels are then fed to separate amplifiers and speaker systems.

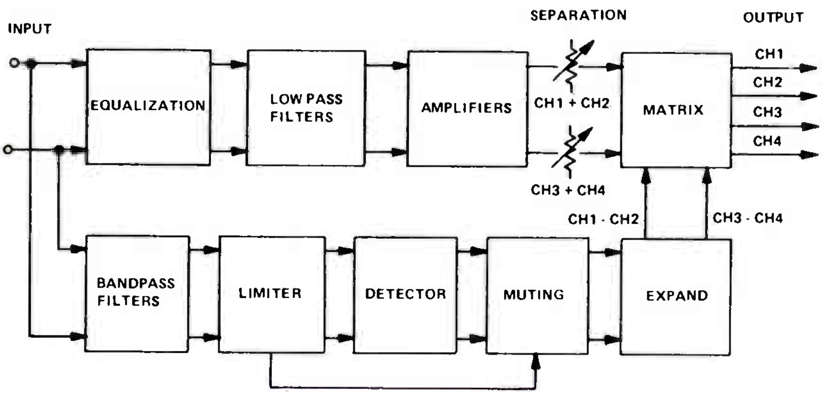


FIGURE 8. CIRCUITRY FOR RECOVERING FOUR CHANNELS FROM DISC.

Due to the way in which the disc is encoded, it can be played on a regular stereo machine. The standard stereo cartridge will not respond to the 30 kHz carrier signal. In fact, one of the problems of the discrete disc is that a cartridge capable of responding to 45 kHz must be used to recover the encoded information (30 kHz + 15 kHz sidebands). The record will last for only 100 plays due to deterioration of the record groove, which tends to wipe out the 30 kHz information. RCA is developing a new base material to help alleviate this problem.

Another problem area is that of broadcasting the discrete disc music. Several workable systems have been devised. Some add an additional subcarrier to the FM signal which would require FCC ruling and modification of station equipment in addition to adapters for home FM receivers. Another proposed system would supplant the present SCA subcarrier which is used to transmit special programs to those commercial establishments which pay for the service. If this method were chosen, it would mean a loss of revenue for the stations currently broadcasting SCA.

The advantages of the discrete disc may make the effort worthwhile. Each channel is completely independent. If sound is on only one channel in the master tape, that is the way it will be reproduced in the home. Overall separation will be at least as good as present stereo records.

why four-channel?

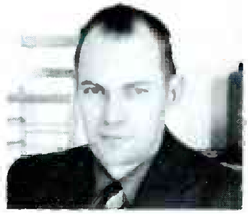
Four-channel sound is still a relatively new medium and like anything new, it is controversial–doubly so since even the manufacturers have had considerable trouble in settling on the best way to get it into our homes. Things have just begun to settle out with EV's introduction of the universal decoder. Many encoded discs are available and now you no longer have to worry whether or not you can play them through your four-channel system if you have the EVX-44 decoder.

The capabilities of four-channel sound have only begun to be explored and exploited as a recording medium. Audio engineers can engulf us in sound by placing us among the performers. They can move us from the back row of the music hall right up to the front. They can set us down in the center of Woodstock and make us believe we're there!

If you haven't heard four-channel sound yet--don't pass up an opportunity to do so. And, when you go, don't settle for a poor demonstration. There should be as few people as possible in the listening area and those remaining should be quiet. Don't expect the same acoustical effect that Carnegie Hall imparts to a performance, but listen for the spaciousness of the sound.

If the bug bites, I recommend your choice of two additional speakers and another stereo amplifier; but don't overlook the Electro-Voice model EVX-44 Universal Decoder. It is available through our CONAR division. See the ad elsewhere in this issue. ☐

If you think this man looks familiar, its because he is. In the last issue of the Journal, NRI introduced him as Elmer H. Blush, Jr., first graduate of the computer course. In this issue NRI introduces Mr. Blush as a professional TV service technician, something Blush admits he was known as long before his computer course fame. He was inspired to write this article because he believes that whether you are a full-time serviceman or whether you are just beginning and run a part-time business at home you can benefit from the experiences of a working TV technician with a few years of experience behind him. Blush's philosophy is simple. He maintains that you acquire a reputation by the type of work you do; and the technician who has the best reputation commands the highest pay.



case histories compiled by a tv service technician

You who are launching out into TV servicing will find that some of the troubles you will encounter can be solved quite simply. Others will require patience and perseverance and some ingenuity, but when the job is done, you will feel a real sense of accomplishment. Perhaps you may benefit from some of the experiences of a working TV technician with a few years service behind him. I will describe some of the problems I have run into and the procedures I have used to diagnose the various troubles.

one test checks all

The first one is an easy one, and I will describe step-by-step how I diagnosed the problem. This particular set was a Sony portable transistor TV, model 9-51UW. The customer's complaint was that there was no brightness but the sound was OK. Because I consider it a good policy to confirm the complaint before proceeding, I turned on the set to be sure that this was indeed what the set was doing. The complaint was confirmed, so I disconnected the power cord, removed the cabinet and connected two jumper cables to complete the interlock circuits between the cabinet back and front. Since the set had normal sound, it was safe to assume that the low-voltage power supply was OK and that the trouble was either in the horizontal circuits, the high-voltage circuit, the video circuits driving the picture tube, or in the picture tube itself. Now the problem was to decide the quickest way to isolate the trouble, because time is money.

In this case I first measured the high voltage at the picture tube anode connection, and found it was 12,000 volts. With 12,000 volts at this point, I could rule out trouble in the horizontal circuits, the horizontal output transformer, the yoke, and the high-voltage circuit. This meant that the trouble was either in the video circuits driving the picture tube or in the picture tube itself.

Since I was unable to see any filament light in the picture tube, which is normally dim and hard to see, I turned off the set by removing the power cord. Then I disconnected the picture tube socket and measured the resistance of the filament of the picture tube at pins 3 and 4. It read infinity. This meant that the picture tube filament was open and that the tube would have to be replaced. This customer did not have the set repaired because of the expense involved, but he paid the estimate charge and took the set with him.

I could have checked the picture tube filament first, but did not because past experience indicated that the cause of no brightness is seldom an open picture tube filament. Also it was a quick and simple matter to check the high voltage first. This one check tested for trouble in the horizontal circuits, the horizontal output transformer, the high-voltage circuits, and the yoke all at once. The idea here is to eliminate as many circuits as possible as the cause of the trouble with the minimum number of tests.

a temperamental channel selector

The next problem is quite common and simple to remedy. It was an RCA black-and-white portable TV, model AJ083E. The complaint was that the channel selector knob had to be wiggled frequently to get the stations to come in. Sometimes the picture would be snowy and sometimes it would disappear altogether. I turned on the set to check the complaint. The trouble appeared to be dirty channel selector contacts. I sprayed them with a tuner wash through the holes in the tuner cover. Consequently I did not have to remove the entire tuner in order to remove the cover. Then I rotated the selector several times in each direction. The stations held good and there was no snow. The final step was to spray the tuner contacts with a foam type cleaner-lubricant to insure that the trouble would not recur. I reassembled the set and the repair was complete.

I might mention here that I do not recommend bargain basement tuner cleaners, as some of them will actually detune the circuits and impair reception. I have run into cases where technicians who have serviced a piece of equipment before me loaded the tuner down with spray and could not get the stations tuned in. Some of them were still soaking wet several days after being sprayed. I suppose the thinking in those cases was that if a little spray is good, a lot is better. The cure was to give the tuner a good washing with a quality tuner wash, and then lubricate it with a foam type cleaner-lubricant, as I described in this case.

I'll never forget the time I was called upon to run a service call on my first day at a certain shop, and the complaint was the same . . . a tempermental channel selector. I did not know what I had in the shop's tool box, but I removed the back of the set and reached into the box for the tuner cleaner. You guessed it! All I could find in the tool box—or in the truck—was a can of bargain basement tuner cleaner. I knew there was nothing better back at the shop so I had no alternative but to use it. I had been getting three stations to start with, but after spraying the tuner I ended up with only one! Of course, I knew the other stations would return after the tuner had dried out because I had used the spray in moderation . . . but just try to collect money for your labor on that promise! Needless to say, it was an embarrassing situation that could have been avoided by using a quality cleaner. Incidentally, there was a discussion after I returned to the shop, and the shop owner was convinced that he should change brands.

pinpointing trouble with an ohmmeter reading

Another problem I encountered was in a Sylvania black-and-white TV, model MY82WS, which, according to the customer, had no picture. I turned on the set to confirm the complaint. It had sound but no raster. The brightness control was turned down, and turning it up produced no light on the screen. Then I turned up the contrast control, and at one point in its rotation the raster suddenly appeared on the screen. There was no video and the sound disappeared, indicating an open control. An ohmmeter check confirmed that the control was in fact defective.

The control had opened at the point indicated on the simplified schematic shown in Figure 1. When the wiper arm was below the break, the voltage on the picture tube cathode was high, cutting off the tube. When the wiper arm moved above the break, the cathode voltage dropped, turning on the picture tube. It was not necessary to know the voltages on the picture tube cathode or on the video output tube plate. It was only important to recognize that the control was open and that the raster appeared suddenly as the control was turned. The trouble was pinpointed with one ohmmeter reading. I replaced the control and the repair was complete.

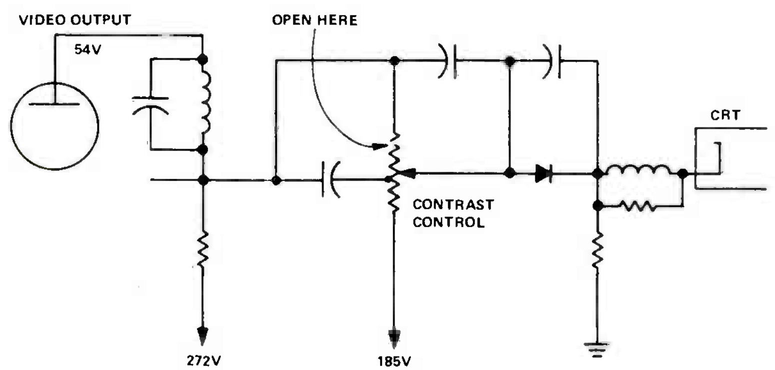


FIGURE 1. SIMPLIFIED SCHEMATIC SHOWING BREAK IN CONTRAST CONTROL.

no defect, but still a problem

Here is a problem that occurs quite often and is not due to any defect in the set. This set was a General Electric black-and-white TV, model M153SCH12. The complaint was that there was no picture. When I turned it on, it did have a picture, but it was stretched vertically and was rolling. I adjusted the height and linearity, and the vertical hold controls. The picture looked OK. I test-played the set for several hours and there was no further trouble. Evidently someone had turned the vertical controls on the back of the set. Quite often children will do this without their parents' knowledge, consequently the set is brought into the shop. I pronounced the set OK, and it was returned to the customer.

fuse blows, but why?

The next one was a Panasonic color TV, model CT-602D. The customer's complaint was that it smoked. Because of this condition I did not turn on the set, but instead removed the back for visual inspection. The only thing I could see was that the line fuse was blown. I had to figure out what had caused the fuse to blow.

This set has two power supplies, the main one is a 310-volt supply and the other is a 24-volt supply. My first step was to check the 310-volt supply shown in Figure 2 for a short. Since diodes D_1 and D_2 were not easily accessible, the most convenient place to check for shorts was from the 305-volt line on pin 9 of the damper tube to chassis ground. This reads 20,000 ohms, indicating no short on the 305-volt line or on the 310-volt line.

Next, I read the resistance from the positive lug of capacitor C804 to ground, with the meter ground lead connected to chassis ground. This read 20,000 ohms, proving that D_1 was not shorted. Next I read the resistance from the positive lug of C804 to pin 9 of the damper tube with the ground lead on the positive lug of C804 and the meter probe on pin 9 of the damper. This read 20,000 ohms, proving that D_2 was not shorted. These three ohmmeter readings indicated that the main power supply was OK.

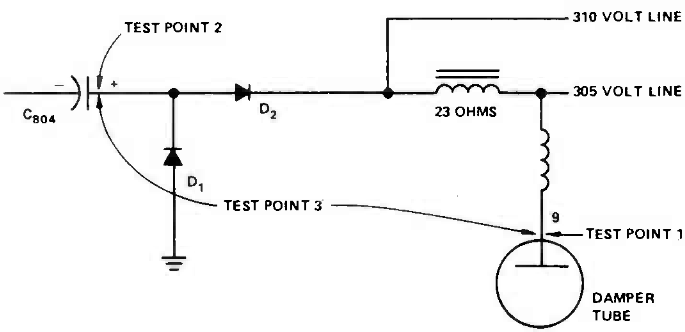


FIGURE 2. SIMPLIFIED SCHEMATIC SHOWING TEST POINTS.

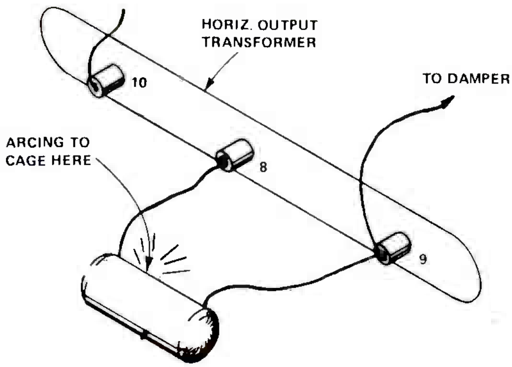


FIGURE 3. LOCATION OF COIL THAT WAS ARCING.

There could be trouble in the 24-volt power supply, but because of inaccessability I ignored this for the time being, replaced the blown line fuse, and turned on the set to see what would happen. The sound came on but as the high voltage came up there was arcing at the high-voltage transformer connections. These were covered with a sheet of plastic insulation, making it difficult to see exactly what was happening. It was necessary at this point to separate the main chassis from the picture tube and cabinet front assembly for a closer inspection of the high-voltage transformer connections. After doing this and removing the plastic insulation I discovered that a coil was too close to the high-voltage cage, and it was arcing to the cage, as shown in Figure 3. I installed a new coil, locating it well away from the cage, and the problem was cured. I reassembled the set and the repair was complete.

no picture, no sound, but brightness

Here is another problem, this time with a Zenith black-and-white TV, chassis 14Y33. The complaint was that there was no picture and no sound, but it did have raster. I confirmed the complaint, then removed the back of the set. As I turned the contrast control I noted that black horizontal streaks appeared on the screen. This indicated that noise was being fed to the picture tube.

I did not have a schematic for the set, so one at a time I pulled and reinserted the i-f tubes in their sockets to see if this would produce flashes on the screen and noise in the sound. Nothing happened. I turned the set on its side and removed the bottom cover to check for B+ on the i-f tubes, but only two of them were accessible, and there was B+ on the screens and plates of these two tubes. (A tube manual will tell you the pin connections of the tubes.)

At this instant, noise began blasting from the speaker and snow appeared on the picture tube screen. I connected the antenna and checked the stations. Channel 4 looked OK, channel 5 was fair, and channels 7 and 9 were snowy. These are our local vhf stations that are normally very good. The raster was "breathing" vertically (varying in height).

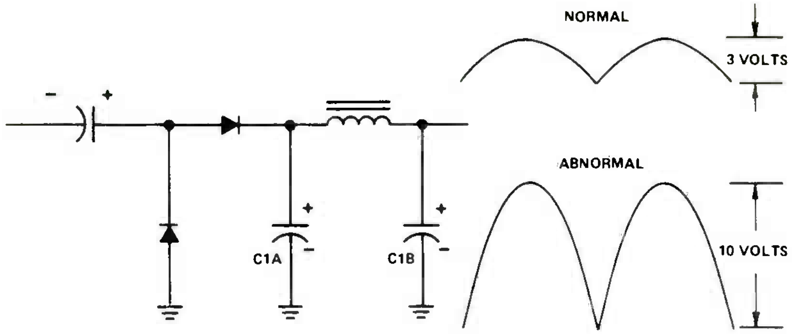


FIGURE 4. POWER SUPPLY OUTPUT WAVEFORMS.

The first problem to work on now was the snow on channels 7 and 9, ignoring the vertical breathing for the time being. The symptoms now led me to believe that the mixer-oscillator tube was defective. I checked this tube (6EA8) in the tube tester. Sure enough, it was defective, shorted and weak. Now I was making progress, or so I thought. I replaced the 6EA8 with a new one after checking it, and the set resumed its original trouble. At this point I decided to test the other tubes in the i-f strip, the agc tube, and the video amplifier. I checked the 6BA11 agc tube first. It was shorted. Replacing it produced no change. I next checked the first, second, and third i-f amplifiers. All three were shorted, showed grid emission, and were weak. The video amplifier and sound limiter, 10GN8, checked shorted and showed no emission. Replacing these tubes restored good video and sound on all channels.

The set, however, still had the vertical breathing problem. The vertical output tube checked OK, and the vertical oscillator, being one section of the 6BA11, had already been replaced. So I was sure the trouble had to be a filter capacitor.

An inspection of the two filter cans on the chassis revealed that the main power supply filter had been leaking electrolyte. This was a three-section filter. I used the oscilloscope to check the waveform on the filter. A simplified schematic of the power supply is shown in Figure 4, which I drew by tracing the circuit. The waveform on C1B, which is normally 3 volts or less, read 10 volts. You will remember that I did not have a schematic with voltage readings and waveforms given, but I knew that with this type of circuit, 3 volts ripple or less was normal, and 10 volts ripple was too much. To be positive this was going to cure the trouble, I turned off the set and bridged C1B with an 80 mfd, 450-volt paper filter.

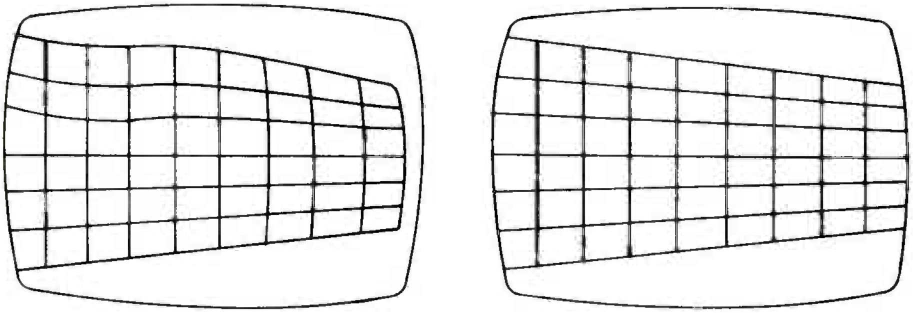
When I turned the set on again the vertical breathing had stopped, and the waveform on C1B was now 3 volts. I replaced the filter can, and to complete the repairs I sprayed the tuner with a cleaner-lubricant, and adjusted the height and vertical linearity controls. All other controls were checked for operation. I replaced the cabinet back and test-played the set for several hours. The repairs were complete.

bruised and banged GE portable

This next set had a problem that was very easily diagnosed, yet it was unusual. It was a GE black-and-white portable TV, chassis SE, that had been dropped by the customer. The cabinet front and the channel selector knobs were broken. I removed the back for visual inspection. Luckily the tuner was not damaged and there were no other signs of damage inside. When I turned the set on, the audio was OK, but the raster was "keystoned" and, in addition, was wavy on top and curved on the right side as shown in Figure 5(A). There was no doubt that the keystone raster was caused by a defective yoke, but what was causing the waviness at the top and the curve on the right side? Possibly the circuit board was broken somewhere, causing this weird symptom. The whole set, with the exception of the tuners, is made on one printed circuit board that slides into channels in the cabinet. I slid the circuit board out for visual inspection and found that it was undamaged.

Now I thought I had better have a real close look at the yoke. The windings looked OK, but I discovered a break in the ferrite core, partially hidden by the windings. The shock of the fall had broken the yoke core, producing both the keystoning and the waviness, and also the curve on the right side. Replacing the yoke cured the problem. Gluing the broken cabinet front and installing a new set of knobs completed the repairs.

I had seen many sets with defective yokes. All had either shorted windings or shorted capacitors across part of the windings. These defects will cause a keystoned raster but the horizontal and vertical lines will be straight. Figure 5(B) shows one type of "normal" keystoning. You will undoubtedly see a raster keystoned because of shorted windings or shorted capacitors, but you may never see one due to a broken core.



(A) (B)

FIGURE 5. KEYSTONING DUE TO A BROKEN CORE (A) AND DUE TO A SHORTED WINDING (B).

another channel selector complaint

This is another problem that occurs frequently in channel selectors. The set was a GE black-and-white portable TV, model M113AVY. The customer's complaint was that the channel selector was bad. When I checked the operation of the set, I found that some stations would come in OK, but not necessarily on the channel to which the set was tuned. For instance, when the channel selector was rotated back and forth several times, channel 4 might come in on channel 5 one time, channel 3 the next, and then on 4. It was not possible to predict on which channel it would show up next. The channel selector knob was not slipping on the shaft and the fine tuning was working.

This particular set was a wafer type tuner. I removed the tuner cover to inspect the wafers. As I thought, the oscillator wafer was not turning in step with the other wafers. The hole in the wafer through which the selector shaft passes was worn out, as shown in Figure 6(A). Thus the wafer was not being turned all the time, and this caused the stations to show up on the wrong channels. For instance, if the oscillator wafer was stuck on channel 4 and we switched to channel 5, channel 4 came in on channel 5.

Now the question was, what to do about this. There were three courses of action. (1) We could replace the tuner with a new one. This can be expensive. (2) We could remove the tuner and send it off to a company that specializes in TV tuner repairing. This would be moderately expensive, and the set would be out of action while we were waiting for the tuner to be returned. (3) We could repair it ourselves. This is the least expensive and the fastest course of action. Being a firm believer in doing it yourself, I chose number three, and repaired it myself.

do-it-yourself tuner repair

To repair this tuner, the first and most important thing to do is to line up the wafers in the proper relationship to each other. To do this properly you will need a diagram of the tuner wafers. Once the wafers are aligned, do not turn the selector

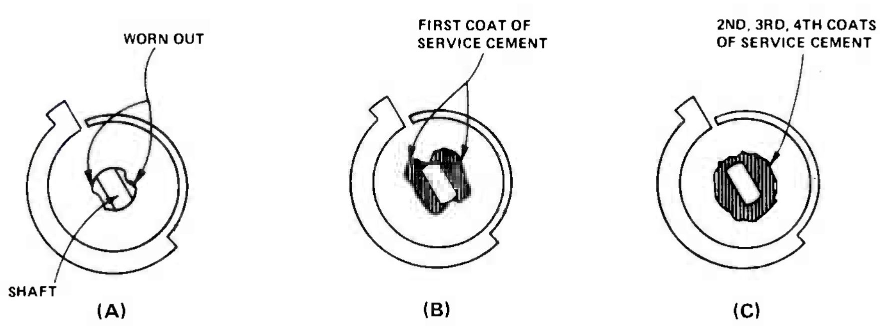


FIGURE 6. WAFER REPAIR.

shaft. Now, using a toothpick or small screwdriver, put some service cement in the worn wafer hole, as shown in Figure 6(B). A plastic compound can be used instead of service cement, if desired. Use only enough to fill the hole. Set the tuner aside to dry overnight. In the morning, apply a second coat of glue, this time being sure that the glue encircles the shaft, as shown in Figure 6(C). Do this on both sides of the wafer. It is best to use four coats, letting each coat dry thoroughly before applying the next one.

I have repaired quite a few tuners in this manner, and all repairs have been satisfactory. For a positive repair, this procedure should take three days. On the first day fill the holes, on the second day put on the second and third coats, and on the third day apply the fourth coat. Now the final step is to lubricate the tuner contacts with a foam type cleaner-lubricant.

a tough dog with a simple cure

This one is a simple trouble but it could be very difficult to pin down. This set was a Zenith color TV, chassis 25NC38, and the complaint was that there was no picture and no sound. After turning the set on to confirm the complaint, I found there was no sound, no video, and the raster was clean, no noise or snow. One at a time I pulled the i-f tubes and reinserted them in their sockets. The first one gave no indication of noise or flashing on the screen; the second and third ones gave only a very faint flashing and noise. Adjusting the agc made no difference. I figured this would be a good time to check the tubes in the i-f strip, the tuner, and the agc circuits. They all checked good.

Now it was time to check voltages so I pulled the schematic for this set. This being a console TV, I turned the cabinet on end and removed the bottom plate so I could get to the wiring. First I checked the plate and screen voltages of the i-f tubes, and everything seemed OK. Then I measured the agc voltage at the grid of the first i-f tube and at the same time adjusted the agc control. The voltage varied both negative and positive. The voltage is normally +20 volts, so I adjusted the control to give this reading. No problem here. So far I had eliminated tubes, agc circuit, and B+ voltages in the i-f strip as the source of the trouble. Or so I thought, as we shall see later.

At this point I put the B and K Analyst to work. First I inserted a video signal on the delay line and got an out-of-sync picture on the screen. This is normal. I worked back to the video detector diode, using the video signal. Everything was OK. Next I inserted an i-f signal into the third video i-f grid and got a very faint picture that was locked in sync. Next I moved to the second i-f grid and got the same thing. Going to the grid of the first i-f produced nothing on the screen.

It now appeared that the trouble was in the first i-f stage. But what? I had already determined that the tube was good, the plate and screen voltages OK, and the agc voltage on the grid all right. To be doubly sure, I tested the tube again in the tube tester, and it checked good. The tube voltages were rechecked, only this time the cathode voltage was checked on pin 3, which was not checked the first time. The schematic indicated 25 volts at this point and that's what I read. Now everything checked OK, but still no signal could be put through the first i-f stage.

After looking at the schematic and pondering what to do next, it was apparent that the cathode was connected internally to pins 1 and 3 of the tube. All of the circuit wiring connections were made to pin 1, and nothing to pin 3. When I measured the voltage on the cathode, I took the reading on pin 3 because it was most convenient. Now I was thinking, what about pin 1? What was the voltage here? Pin 1 measured 2 volts, and as before, pin 3 was still 25 volts. Now I had the solution!

I turned off the set, pulled the tube, and measured the resistance between pins 1 and 3. It read infinity, the internal connection between pins 1 and 3 was open. I was getting a false voltage reading on pin 3. I reinserted the tube into its socket, connected a jumper between pins 1 and 3, turned the set on, and readjusted the agc. Success! Now I could simply connect a jumper between pins 1 and 3 to put the set back into action.

But wait! Suppose at some later date someone removed the i-f tubes for testing, found them good, and when putting them back reversed the first and second i-f tubes. This could happen since they were both 6EH7's. Now they would end up with no video and no sound, because the cathode connections on both sockets were the same. This wouldn't do. It was better to replace the tube than try to save it, so into the trash can it went. Replacing the tube restored the set to operating condition.

All of this work was caused by a tube that tested good in the tube tester when it was actually defective. Had I substituted tubes in this set instead of testing them on a checker, the problem would have been solved much sooner. I have found, however, that problems of this type are far out-numbered by problems that can be solved using the tube tester. It is my policy to test tubes first before replacing them. Some technicians do not use tube testers at all, and indeed I have worked in shops where there were none. I personally prefer using the tube tester and find it indispensable in order to do top quality repair work.

I hope that my experience and case histories will give you some insight into what to expect in everyday servicing. The important thing to remember is to use a logical approach to the problem at hand. Once the problem is diagnosed, proceed with the repairs in a professional manner. You acquire your reputation by the type of work you do. The technician who has the best reputation commands the highest pay. This is true whether you are a full-time serviceman or run a part-time business at home. The opportunities for conscientious, competent technicians are everywhere. Take advantage of them. You can write your own ticket. ☐

HAM NEWS

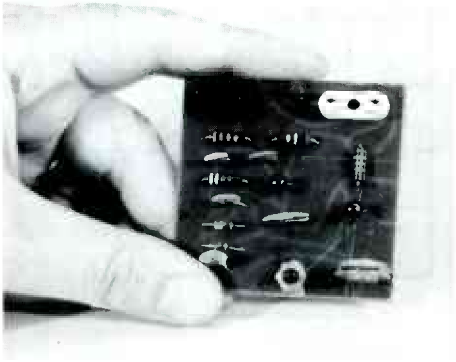
By Ted Beach K4MKX

The other day I discovered a box of crystals—transmit type, you know—that have been kicking around for several years after the demise of a Citizens Band project at the office. I guess there must be about thirty or thirty-five in that old box. Being the avid ham that I am (who else would keep a box of crystals around for six or seven years?), I decided that I would come up with a "project" to make good use of all those expensive rocks.

The project that came first to mind was a multi-pole crystal lattice filter for cw or sideband. Most of the crystals are marked as to transmit frequency and are, in general, third overtone types with a fundamental frequency in the 9.0 MHz range. Hmmm, could be useful. Add to all this the fact that many of the CB channels are spaced 10 kHz apart (this translates to about 3 kHz at the 9.0 MHz fundamental) and these rocks begin to look even more attractive for a 9.0 MHz filter.

The next problem was to see which, if any, of the crystals was good enough to try in a filter. Also, it would be very handy to have some way to find the series resonant frequency and measure the relative activity of the various crystals. Therein lies the meat of the subject of the column this time.

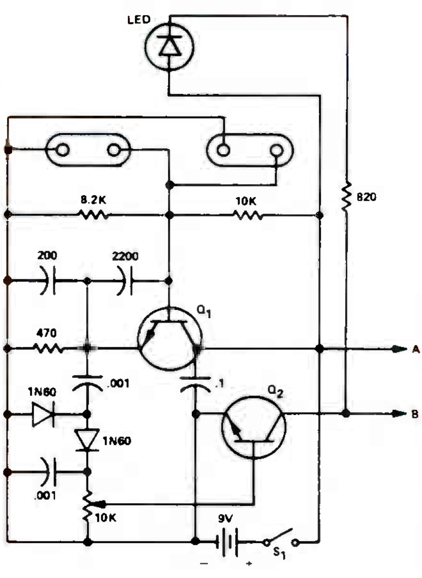
I decided that it would be a good idea to build up a small oscillator circuit and couple it to an output measuring circuit so that we could plug the crystals in, check the oscillating (series resonant) frequency and get an idea as to the liveliness of each crystal. The photo below shows the result.



CRYSTAL CHECKER BOARD LAYOUT

The oscillator circuit itself is very similar to one we designed a few years ago for the CONAR Color Generator. It is basically a common collector Colpitt's oscillator with the output being taken from the emitter. The output monitor consists of a voltage doubler rf detector driving a single transistor dc amplifier whose output is a light emitting diode (LED). The complete schematic is shown below. Q_1 and Q_2 can be any fairly high beta (100 to 400) high f_T (400 MHz) types. I used Fairchild SE2002's since I had them. The LED is a 50 cent type from one of the surplus dealing semiconductor houses—I've forgotten which right now.

The reason for the unusual layout shown in the schematic is that the parts are placed very nearly in the same places in the schematic as they are in the photograph, so you can almost "lay out" the circuit board from the schematic.



CRYSTAL CHECKER SCHEMATIC

I decided to put in two crystal sockets so that I could plug in either FT-243 or HC-6 type crystals. With the values shown in the schematic, the circuit should oscillate very nicely with crystals from about 1 MHz to 15 or 20 MHz fundamental frequencies. If you go outside of this range you will probably have to play with the values of the emitter resistor and the two capacitors in the base circuit of Q_1.

There are any number of ways you can slap the circuit together. I chose to use a circuit board because it makes a nice, neat job of it. For a one-time deal such as this there is no real justification in making an elaborate job of it. I just sort of transferred the circuit from the schematic to the board and then used one of those hand-held high speed hobby routers to isolate the foil paths and drill the mounting holes. My board measures just 2-1/2" X 2-1/2" and as you can see this is more than enough room—you could really make it much smaller. Another really simple method is to use the "perf" board that has holes on 0.1" centers and just bend the component leads over for the wiring connections. Using this method I'm sure you could have the circuit working in no more than 15 minutes!

To make it go, hook up a 9-volt transistor radio battery and push the button. You can tell if the crystal is oscillating by adjusting the 10k-ohm potentiometer and watching the LED. If the crystal is good, at some point in the rotation of the pot, the LED will light up. You can check relative activity of similar crystals by noting the brightness of the LED as you plug the crystals in (without adjusting the 10k-ohm pot). A much finer indication can be had by hooking a voltmeter (10-volt range) to the points marked A and B in the schematic. Connect the + lead to A.

Since putting this little gadget together I have found other uses for it. For instance, if you solder a short lead to the junction of two 1N60 diodes you'll have a Jim Dandy crystal-controlled signal generator. The lead makes like an antenna and the diode generates lots of harmonics so you could, for instance, plug in a 3.5 MHz rock and have a band-edge marker generator for all ham bands. The harmonics extend well into the vhf range. A 1 MHz crystal also makes a nice frequency spotting marker generator (100 kHz won't work, unfortunately). I'm quite sure you could think of plenty of uses for this gadget. Let me know if you come up with any real interesting ideas.

I have finally sorted out the various CB crystals as originally intended but have not yet started work on the lattice filter. That will come later and I'll be sure to tell you all about it then.

Now let's see who we've heard from since last time. The first 15 listed are in the course for amateur licenses and the last four are in various other NRI programs.

I have in front of me two letters from WN4EDQ. The first was written in March and the second in April (neither one in time to get into earlier Journals). Ralph was just finishing up his text work in the first letter and had passed the Novice test because he couldn't wait to get the code speed up to 13 wpm for General to get on the air. In his second letter he had received his ticket and was struggling valiantly with a stubborn vertical antenna, trying to get a reasonable vswr on 80 and 40 meters. The windy weather down there hasn't helped a bit.

WN7VND got his ticket back in February and made arrangements to take the Advanced test in April. That sure is moving

Harry	WN3UHV	N	Wilmington DE
Ralph	WN4DMV	N	Alexandria VA
Ralph	WN4EDQ	N	Miami FL
Frank	WN4WUY	N	Winston Salem NC
Edgar	WN5HAS	N	Philadelphia MS
Jerry	WN5JDY	N	Lufkin TX
E.J.	W5QIB	G	Bridge City TX
Jim	WN6UKY	N	San Bernardina CA
Bill	WB6UPP*	–	La Habra CA
Bob	WN7QZC	N	Vashon WA
Jim	WN7TYG	N	Duchesne UT
Warren	WN7VND	N	Seattle WA
David	WN8MQE	N	St. Louis MI
John	WN8PLI	N	Fraser MI
Lynn	WN9KTR	N	Ft. Wayne IN
*ex WA3RHK			
Jack	WA5RSI	A	Brazoria TX
Charlie	W8WAV	A	Ravenna OH
AL	W9HR	E	Kenosha WI
Angel	KP4AQS	A	San Juan PR

right along, Warren, and I hope that you were successful. Let us know.

A letter from WN8MQE brought to our attention a gross error in his call as listed in the March/April Journal. We had David listed as WN8NQE and put his QTH as St. Louis MO. This can't be anyone's fault but mine, because everybody knows that Missouri isn't in the 8th call district. Sorry about that OM (David is 15 years old I am told).

WN8PLI wrote us a very exuberant letter shortly after he received his ticket and got on the air. John was so excited when he made his first contact that all he could do was send QRS! He didn't get the name, QTH or signal report. Lucky for him he did at least copy down the call. John assures us that he has now settled down and his log is in much better shape.

We also got a note from graduate Tom Teraniski telling us that he had just passed his general test, thanks to our course. I guess that he had not gotten his ticket yet as he did not pass along his call. Tom would like very much to join a radio club, so if any of you fellows in California know of any in his area, drop him a line at: 8161 Sierra Bonita Ave., South San Gabriel, CA 91770.

W8WAV also caught a really bad boo-boo in the March/April Journal. Looks like that issue just had it in for me! On page 11 the caption of a vertical oscillator circuit in Blan Straughn's servicing article proudly proclaimed that it was a "Block diagram of the two-meter transceiver." Oh yeah? Charlie says he guesses that he just hasn't kept up with the improvements in the state-of-the-art if that's a two-meter rig.

He is staying with modern stuff, however, as he just finished building the little Heath HW-7 QRP rig. After replacing several defective parts Charlie says that it works FB. I seem to remember that the ARRL report of the kit also mentioned that they had found a number of defective parts in the one they built. Just goes to show you that NRI and CONAR aren't the only ones who have parts supply problems!

Jack, WA5RSI, operates mostly 75, 80 and 40 meters using a Heath HW-100 feeding an inverted vee antenna. He also has a first Radiotelephone license and operates Navy MARS occasionally.

W9HR was first licensed in 1939 as W9DTE and has had an Advanced Class license from that time until 1969 when he traded in the old call for the present one along with the upgrade to Extra. (A lot of you younger fellows probably think that the Advanced Class is a new license!) Al works mostly 15 and 20 cw, using a Drake T4XB and R4B along with a new tri-band beam sitting atop a 40′ tower. Al loves to chase DX and hangs out around the lower band edges as all DX hounds do.

As a final note, we have another request for help, this time from Florida. Richard O. Lott (no call given) is trying to get a list of amateurs and CBers in the Brevard County area so that he and others can organize a mobile disaster communications system with Civil Defense and Red Cross personnel. I'm not exactly sure just how they plan to go about doing this, but it sounds like a very worthwhile project. If any of you guys in the area have any interest along these lines or feel that you could help Richard out, please write him at: 212 Freddie Street, Indian Harbour Beach, FL 32937.

That's it — we'll see you next time.

Vy 73 — Ted — K4MKX

NRI HONORS PROGRAM AWARDS

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

WITH HIGHEST HONORS

Raymond R. Barca, Staten Island, NY
Ronald A. Beardslee, Rosemead, CA
Robert D. Bragdon, Baudette, MN
David W. Bunch, Whitehall, MI
Thomas C. Chambers, Sutersville, PA
Allen B. Clay, Southwest Harbor, ME
Pedro B. Conde, Miami, FL
Richard Coulter, Santa Clara, CA
Richard S. Dynes, Tucson, AZ
Noel Figueira, Montreal, PQ, Canada
Ray W. Ford, FPO San Francisco
V. F. Gallahan, Colonial Beach, VA
Carl E. George, Tahlequah, OK
John Gordon Hammer, Camarillo, CA
George E. Hann, Glassboro, NJ
John Alfred Harper, FPO San Francisco
Eric R. Hein, Hyattsville, MD
Daniel Paul Kidwell, Richmond, VA
Gerald L. Levins, Paragould, AR
Allan J. Lindsay, Providence, RI
Carl F. Meixsell, Horsham, PA
Alvin R. Norris, Fitchburg, MA
Ted Pace, Greenbelt, MD
David J. Paradise, Fitchburg, MA
Frank A. Rappl, Rochester, NY
Robert Ed Reeves, College Park, GA
C. W. Sullivan, Jackson, MS
Danny L. Summers, Marion, IL
Richard Theriault, Montreal, PQ, Canada

WITH HIGH HONORS

William L. Ackerman, Berryton, KS
Robert E. Albach, Des Moines, IA
David P. Andrews, Newmanstown, PA
Ralph F. Beckmeier, Freeport, ILL
James E. Blaylock, Eatontown, NJ
Bruce Blechman, Far Rockaway, NY
John A. Booth, Rochester, NY
Woolery Bowling, Jr., Manchester, KY
Terry G. Cady, Keohuk, IA
William H. Caldwell, Columbia, TN
Warren V. Carrigan, Jr., Newport, RI
C. J. Cowan, Jr. Sylva, NC
Bobby N. Dalton, Hurt, VA
Henry R. Darlington, Northridge, CA
Wendell C. Cavis, Arcadia, FL
Georges Dupuis, Val St. Michel, PQ, Canada
Glenn G. Evans, Rockville, MD
Claude T. Fariss, Bedford, VA
Lawrence E. Fetter, Hutchinson, KS
John B. Finch, Jr., Pennsgrove, NJ
John J. Flaherty, Park Forest, IL
Gilbert L. Foster, Lyons, MI
Maurice S. Gaston, Mary Esther, FL
Ralph P. Giardini, Jr., Quincy, MA
Ronald J. Goodman, Buffalo, NY
Lawrence Gray, San Dimas, CA
John L. Green, Tulsa, OK
Julius Greenfield, Mount Vernon, NY
Darrell Haberman, Hay Springs, NE
William E. Hanily, Union Beach, NJ
Joseph C. Haynes, Menomonie, WI
Lawrence M. Hays, Elko, NV
Choice R. Henson, Corpus Christi, TX
James C. Hester, Greenville, SC
Jetton Hodge III, Chicago, IL
James E. Horton, Dublin, VA
Calvin E. Houser, Harwood Mines, PA
Guido Ingegneri, Bridgeton, NJ
F. S. James, Renton, WA
Asgar Ali Jhinnu, APO San Francisco
Paul S. Johnson, Ogden, UT
Thomas J. Keenan, Jr., Stuebenville, OH
Richard C. King, Amherst, VA
Floyd L. Kissling, Beaver, KS
Edgar Kock, Schaumburg, IL
Ming C. Lai, Coronado, CA
Floyd D. Larkins, Sylvester, GA
Phillips B. Latta, Durham, NC
R. Eugene Lenherr, Greencastle, PA
Dale C. Lucand, FPO New York
Ronald S. Lutz, Kingsville, TX
Robert G. Mast, Phoenix, AZ
Ernest E. Mcombs, Houston, TX
Ted M. McCrory, Shreveport, LA
James A. McKinney, Chester, WV

Lawrence G. Meszaros, Chicago, IL
Gilbert M. Moore, Honolulu, HI
James D. Morris, Holloman AFB, NM
Floyd F. Munroe, Hamlin, ME
James H. Neeley, Duchesne, UT
Charles P. Onsgard, Green Bay, WI
Robert W. Osborn, Bringhurst, IN
Kenneth W. Owens, Anna, IL
Gilbert N. Peterson, Menomonee Falls, WI
Henry W. Petruskewic, Flushing, NY
John A. Phillipps, Lima, OH
John J. Polacek, Jr., Staten Island, NY
David Allen Putnam, Athens, OH
Robert J. Rakowski, Norristown, PA
Donald D. Reed, White Sulphur Springs, WV
Charles E. Rogers, Daly City, CA
Russell E. Rotz, El Paso, TX
Charles Edward Sadler, Jr., Weston, WV
Gene Schultz, Fremont, NE
George W. Seeley, Brookhaven, PA
Mario Seita, Natrona Heights, PA
Wallace R. Simms, Upper Marlboro, MD
Linwood Sirois, Fort Huachuca, AZ
Frank Alston Smith, III, Westminster, CA
Garry Christopher Stoklas, Woodland Hills, CA
Arthur L. Taylor, Yakima, WA
William G. Taylor, Jr., Corpus Christi, TX
Herman Terry, Hopkinsville, KY
Frank E. Tolen, Indianapolis, IN
Roger Lee Turner, Bassett, VA
Jerry W. Uchtorff, Dubuque, IA
William G. Underwood, Ashland, KY
William S. Webster, Ringwood, NJ
Bryan L. Wilburn, Florissant, MO
Larry M. Williams, Charlotte, NC

WITH HONORS

Wayne W. Alto, Kansas City, MO
Bill F. Ardrey, Columbia, MO
Harry L. Arnett, Newport News, VA
Rene Baker, Clarksboro, NJ
Robert C. Baker, Monahans, TX
John D. Baniak, Troy, NY
Donald F. Beckett, APO New York
Larry N. Bell, Langley AFB, VA
Thomas W. Berry, Jr., Tetotum, VA
James F. Bingham, Beaverton, OR
John M. Bliss, Clinton, CT
Siegfried Boernert, Hackettstown, NJ
Wyatt Bolin, Columbus, GA
John Boskovic, Willowdale ONT, Canada
James S. Cadorette, Lowell, MA
Gordon Chow, Kitimat BC, Canada
Stephen K. H. Chu, Washington, DC
Wayne R. Cissna, Phoeniz, AZ
Raymond G. Clarke, FPO New York
James E. Collier, Jefferson City, TN
Timothy H. Cook, Pickerington, OH
Juan Galindo Corona, Los Angeles, CA
Melvin C. Coyle, Borger, TX
James Crawford, Norristown, PA
Francisco Cyntje, New York, NY
William Dacey, Spring Valley, CA
Harry W. Daigle, Luling, LA
Gary F. Dean, Sioux City, IA
Vernon L. Dede, Bellevue, NE
Warren D. Deem, Annandale, VA
Irvin D. Doss, Oakland, CA
James M. Douglas, Key West, FL
Ernest L. Dunivan, Villa Park, IL
William A. Durnell, Larkspur, CA
Walter L. Erspamer, Garden Grove, CA
Stephen L. Erwin, Fayetteville, AR
John J. Fitzpatrick, Annandale, VA
Joseph Terral Fontenot, Baton Rouge, LA
Clayton C. French, Fort Smith, AR
Herminio S. Garcia, Chicago, IL
Stuart V. Gibson, New Hampton, IA
Clement R. Granger, Rohnert Park, CA
H. L. Guenther, Houston, TX
Robert M. Halsey, Albuquerque, NM
Charles Edward Hamby, Cheverly, MD
David E. Hamilton, Wheaton, MD
Henry J. Hankinson, Enterprise, AL
James L. Hart, Hollywood, FL
William D. Hart, Fort Gordon, GA
Ronald W. Haynes, Paris, IL
Ronald L. Hicks, Macks Creek, MO
Charles V. Himelright, East Lansing, MI
Donald D. Holsopple, Somerset, PA
Charles Horstman, Cumberland, RI
Douglas Weston Huckaba, Little Rock, AR
Edward J. Hunter, Fort Huachuca, AZ
Joseph J. Johnen, Jr., Milpitas, CA
Raymond Judish, Escondido, CA
Brian D. Kassel, Vienna, VA
Vincent F. Kelly, Tampa, FL
Bernie G. Klassen, Kingsville, TX
Edward J. Koca, Western Springs, IL
Vladimir Kos, Mansfield, OH
Murray J. Lalone, Closter, NJ
Grover Lambert, Absecon, NJ
Richard Lambert, North Babylon, NY
Dietrich H. Lannert, Haskell, NJ
Paul LeDoux, Turners Falls, MA
Edwin A. Long, Syosset, NY
Robert L. Mains, Dearborn, MI
John C. Malone, San Diego, CA
Russell A. Marvin, Stratford, CT
Felix W. Mason, Chicago, IL
Frederick A. Mazur, Des Plaines, IL
Benton W. McCloud, Spring Grove, PA
Richard McIntyre, APO San Francisco, CA
Maynard T. McKee, Columbus, MS
Clifton A. Mercer, Jr., Odessa, TX
J. Avery Merwin, Manchester, VT
John Mesawich, South Hauppauge, NY

Ronald L. Metheny, Central City, KY
William A. Milner, Riverhead, NY
Michael A. Morning, Altoona, PA
Ercie A. Morris, Galloway, OH
Richard L. Movius, Waterbury, CT
Arthur Jack Musgrave, Framingham, MA
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Duane Roettger, Stillwater, MN
Robert D. Savely, Eagleville, MO
Edward E. Schlotterback, Willow Grove, PA
Ernest Shepherd, Wichita Falls, TX
Walter F. Shepherd, Jr., Hillcrest Heights, MD
Everett Johnson Shockley, Lawrence, KS
Thomas A. Smith, Park Falls, WI
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Kenneth D. Soderquist, Robbinsdale, MN
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Adrian Spitzenberger, Fair Oaks, CA
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Allan Zeller, Leonard, NJ
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make a note

That's right!
No ham ads this time.
Remember, if you have something to sell, swap or buy, ham ads are for you and are free. No more than three items per ad, and remember also that publication runs about two months after receipt.

This is just another reminder to please put your student number on all correspondence. It is a guarantee of speedier service.

DIRECTORY OF ALUMNI CHAPTERS

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

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

FLINT (SAGINAW VALLEY) CHAPTER meets 7:30 p.m., 2nd Wednesday of each month at Andy Jobaggy's shop, G-5507 S. Saginaw Rd., Flint, Mich. Chairman: Stephen Avetta, 239-0461.

LOS ANGELES CHAPTER Chairman: Graham D. Boyd, 3177 Virginia Ave., Santa Monica, Calif. 90404. (213) 828-8129.

NEW YORK CITY CHAPTER meets 8:30 p.m., 1st and 3rd Thursday of each month at 199 Lefferts Ave., Brooklyn, N.Y. Chairman: Steve Kross, 381 Prospect Ave., Brooklyn, N.Y.

NORTH JERSEY CHAPTER meets 8 p.m., 2nd Friday of each month at The Players Club, Washington Square, Chairman: George Stoll, 10 Jefferson Ave., Kearney, N.J.

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

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

SAN ANTONIO (ALAMO) CHAPTER meets 7 p.m., 4th Thursday of each month at Alamo Heights Christian Church Scout House, 350 Primrose St., 6500 Block of N. New Braunfels St. (3 blocks north of Austin Hwy.), San Antonio. Chairman: Robert E. Bonge, 222 Amador Lane, Antonio, Tex. 78218, 655-3299

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

SPRINGFIELD (MASS.) CHAPTER meets 7 p.m., 2nd Saturday of each month at the shop of Chairman Norman Charest, 74 Redfern Dr., Springfield, Mass. 734-2609

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

NORTH JERSEY CHAPTER ENTERTAINS NATIONAL EXECUTIVE SECRETARY

Mr. Tom Nolan, the National Executive Secreatry, was warmly greeted by his friends here. His program on trouble-shooting the color sections of color TV sets was intensely absorbed by a very appreciative audience. He used the triggered scope, color bar generator, and color chassis to show the correct wave-forms in this section, and a blackboard to explain in greater degree their shape and meaning. The supplementary information and the exchange of questions and answers made it a most interesting and educational program. The members of the North Jersey Chapter are most grateful for his efforts.

The May 11 meeting was spent trouble-shooting two portable Zenith TV sets. In one, an electrolytic capacitor was replaced and it was discovered that all the

Alumni News

other filters will have to be replaced for complete repair. The other set was more difficult and will require further work.

Frank Nicolle and Joseph Crusco were welcomed as new members to the chapter. The chapter is looking forward to celebrating its 10th anniversary.

SAN ANTONIO CHAPTER HAS BARBECUE FOR EXECUTIVE SECRETARY

At the April 18 meeting, Tom Nolan, our Executive Secretary, talked on troubleshooting the color section of the color TV receiver. Tom stressed the use of the minimum amount of test equipment, and the easy way to troubleshoot, quite often with no equipment. Everyone enjoyed this new approach.

The following evening Tom and his wife Janet were entertained at the home of Bob and Ann Bonge at a wonderful barbecue which was well attended by members and friends of the chapter.

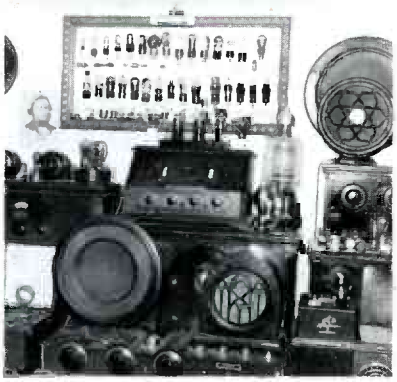
(Editor's Note: Janet and I want to express our sincere thanks for the wonderful hospitality shown by the members and friends of the San Antonio Chapter. As you can see by the pictures in this issue everyone had a wonderful time.)

TORONTO CHAPTER RELATES COLOR TV TO THE HUMAN EYE AND RELIVES THE GOLDEN AGE OF RADIO

Color TV and the human eye were the highlights of the April 11 meeting of the Toronto NRIAA Chapter. The first guest speaker of the evening was Mr. Jim Sands, Manager of Customer Service for Philip Electronics Industries Ltd. Mr. Sands presented an extremely informative color slide program on the variations of television color as transmitted and received in relation to color as seen by the human eye. If you will excuse the pun this presentation was a real eye opener for all who attended the meeting. In addition, Jim Sands discussed the Philips new Module 4 color receiver and concluded with a question and answer period.

The second guest speaker was Mr. Bill Choat, VE3CO, President of the Canadian Vintage Wireless Association (C.V.W.A.). Mr. Choat gave an interesting presentation covering the C.V.W.A. and the technological changes in radio. Choat had six radios on loan from the Canadian Radio Hall of Fame which were the courtesy of the owner, Mr. M. Batsch. The collection included a 1922 Canadian Independent tele-

San Antonio members host Executive Secretary at April meeting (top two photos) and entertain him at a barbecue held at the home of Ann and Bob Bonge (bottom photo).



Impressive and nostaglic antique radio collection at the home of Mr. M. Batsch in Toronto.

phone with earphones and loop antenna; a 1923 Radiola 3A Canadian Westinghouse, 4-tube regenerative receiver; a 1924 Northern Electric R2 superhet with a brown horn speaker; a 1925 Mercury super ten with tower horn speaker; a 1925 Fada Canadian neutrodyne with Amplion horn speaker, and a 1926 Amplion horn, cabinet-type speaker.

The chapter also got its first glimpse of a completed Model 832 computer, built by NRI student Mr. Chang Yun Fui of Toronto. Last, but not least, the chapter welcomed the Director of Graduate Services and Executive Secretary, Mr. Tom Nolan, who discussed the techniques and use of radio in aircraft. The chapter, however, would not recommend to inexperienced flyers Mr. Nolan's navigational backup system of flying 50 feet from the ground along the nearest freeway to check road signs.

(Editor's Note: I have no comment on my fool-proof navigational technique but I must, however, comment with extreme pleasure on the outstanding attendance [over 50 people] and the overwhelming enthusiam of our Canadian NRI students and graduates.)

SPRINGFIELD CHAPTER HOLDS ELECTIONS

In order to expedite the election meeting, the chairman, Mr. Charest requested at the April 14 meeting that the members give the current election serious thought. He mentioned that the present staff had been in office for two years, and since this was their third time around, he suggested a whole new slate of officers.

Charest then turned over the meeting to Mr. Arthur Byron of Chester, Massachusetts. Mr. Byron spoke on digital and analog systems and through his verbal force and persuasiveness held the Alumni members in awe for an hour. The Alumni members appreciated this particular talk for it coincided with NRI's new Computer Course. Our grateful thanks to Mr. Byron.

Mr. Hubney of Windsor Locks, Connecticut, brought in a small Zenith chassis 13N152 which was out of adjust-

Chapter meeting at Toronto includes guests Bill Choat, front row, left; Mr. Batsch, front row, center; and Jim Sands, front row, right.

Jack Thompson, President of NRI, shows an old Canadian magazine ad for NRI to Mr. and Mrs. Lebar of Toronto.

ment. Mr. Charest put this in good shape within a half an hour. The meeting adjourned at 10:30 with the usual good refreshments prepared by Mrs. Charest.

DETROIT CHAPTER SHOWS EDUCATIONAL FILM

After roll call at the April 13 meeting a communication was read from Allen H. Gibbs of Union City, Tennessee who inquired if he could join the Detroit Chapter. Mr. Nagy will get in touch with him.

After the meeting the Howard Sams Color TV Review was shown and discussed. It lasted one hour and 40 minutes. The projector was brought in by David A. Nagy and the screen was furnished by Russ Blaisus. The tape recorders were compliments of the K-L-A Labs, Inc.

NEW YORK CHAPTER GOING STRONG

At the April 5 meeting Steve Kross gave a lecture, using blackboard drawings, on the FET and MOS FET transistors. He also talked about power transistors and power amplifiers. Using the blackboard he talked about sync separator troubles and those parts that cause the most trouble.

At the April 19 meeting, Pete Carter demonstrated using his Tuner Subber on a TV set having tuner trouble. He replaced the tuner in the TV receiver with a Tuner Subber and in a few minutes showed that there was trouble in the original tuner. In addition, Mr. Kross presented a discussion on digital clocks that use liquid type crystals in their construction. Brother Frey called Mr. Kross and told him that he was leaving for Honduras and to the surprise of the chapter Brother Frey showed up at the meeting.

At the May 3 meeting, Pete Carter described some problems he had on two sets that he was repairing and admitted that he spent considerable time locating the trouble. He then showed on the blackboard how easy it would have been if he had checked the set in the places that he showed on the blackboard. Pete then hooked up the Chapter's color set and the color bar generator and found that there was vertical trouble in the receiver. This troubleshooting session will continue at the next meeting.

PITTSBURGH CHAPTER HAS GOOD TURN OUT

Motorola was scheduled for the May meeting, but due to a change in distributors they were unable to give the program. Instead, Tom Schnader held a question and answer session followed by George McElwain and Jim Wheeler using the Chapter's rigged TV; George and Jim threw the switches and the members tried to determine what was causing the trouble.

Jack Gilbert, Director of Public Affairs, Channel 11 TV, is scheduled for the July meeting.

IF YOU'RE NOT READY FOR FOUR-CHANNEL, THEN CONSIDER THE CONVENIENCE OF EIGHT-TRACK CARTRIDGES—PLAYED ON THE TELEX 16-HOUR MUSIC MACHINE. NOW AT GREAT SAVINGS!

TELEX Announces the 16-hour Music Machine!

World's only automatic eight-track stereo tape cartridge changer!

- Automatically switches and selects twelve cartridges in easily removable rotary magazine.
- Uses all standard eight-track cartridges.
- Empty spaces are skipped automatically.
- Dust cover for tape protection included.
- Preamplified output for music system (Amplified Model).
- Auxiliary input for am/fm stereo tuner (Amplified Model).
- Full-range tone and balance controls.
- Operates vertically or horizontally.
- Durable walnut vinyl finish.
- Plugs into any standard stereo amplifier (Preamplified Model).
- Preamplifier output for use with existing home music system (Preamplified Model).

If you think you enjoy the tape player in your car, then...

You ain't heard nothing yet...

...until you've played the same cartridges on the Music Machine!

Amplified Model
Stock No.48EN
Shipped transportation charges collect

Was $299.95

Now $279.95

Add two speakers and your eight-track system is complete.

Preamplified Model
Stock No.148EN
Shipped transportation charges collect

Was $249.95

Now $235.95

If you already have an amplifier, buy this model.

Specifications:

Power Output: 10 watts; 5 watts rms per channel into an 8-ohm load, both channels driven (Amplified Model). **Frequency Response:** 40 to 12,000 Hz. **Third Harmonic Distortion:** Less than 2 percent at 4 watts. **Signal-to-Noise Ratio:** Better than 42 db, below 0 VU level. **Wow and Flutter:** 0.2 percent maximum, weighted. **Cartridge Change Cycle:** 5 seconds maximum (adjacent cartridge). **Crosstalk:** 40 db minimum from 0 level to 1 kHz. **Preamp Output:** 1 volt peak-to-peak minimum. **Speaker Output Impedance:** 8 ohms (Amplified Model). **Magazine Capacity:** Twelve eight-track tape cartridges, standard or double album. **Power Requirement:** 110 volts, 50/60 Hz. **Circuitry:** Solid-state, 20 transistors, 13 diodes (Amplified Model). **Dimensions:** 18¼" x 9" x 16¼". **Weight:** 32 pounds.

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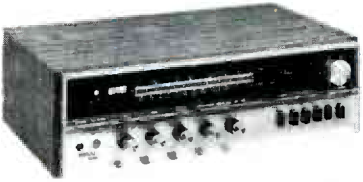

ROYAL 3000

175-watt AM/FM Stereo Receiver

List price $279.95

CONAR's Price $229

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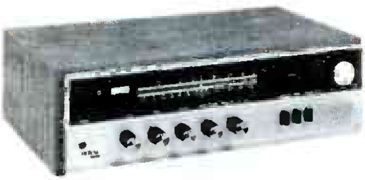


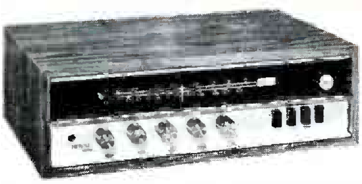
ROYAL 2000

110-watt AM/FM Stereo Receiver

List price $199.95

CONAR's Price $169

Outstanding tuner coupled with a low distortion amplifier (thd 2 percent). Full inputs/outputs for all sound sources. Walnut case included. Weight 20 pounds.



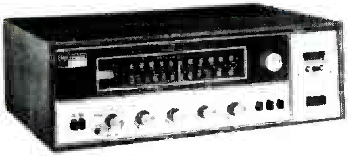
ROYAL 1000

50-watt AM/FM Stereo Receiver

List price $149.95

CONAR's Price $129

Without question, one of the best values in high-fidelity components. Superb tuner, low distortion amplifier (thd 5 percent), full input/output. Walnut case included. Weight 20 pounds.



Fisher 395

180-watt AM/FM Stereo Receiver
with AutoScan Remote Tuning

List price $399.95

CONAR's Price $329

A truly magnificent receiver with automatic, remote, and manual tuning. FM local switch, separate tone controls, a total of two tape inputs, main/remote speakers switches, headphone jack. Power: 180 watts ihf at 8 ohms, 55 watts rms at 8 ohms per channel. Weight 34 pounds.

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"Hi-Track" elliptical magnetic cartridge. Plays all stereo and four-channel matrix. LP records at ¾ to 1½ grams.

List price $54.95

CONAR's Price $24

PICKERING V15E

Elliptical magnetic cartridge. Tracking force 1 to 3 grams. Plays both stereo and four-channel LP's.

List price $49.95

CONAR's Price $20

empire

Model 77E/X easy-mount elliptical cartridge, tracks ¾ to 1½ grams.

List price $34.95

CONAR's Price $14

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Moved since last order?

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Ship to another address? Give Directions here

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12. Finance Charge (See schedule on back)		
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SELECT YOUR TERMS TO FIT YOUR BUDGET

CONAR FINANCIAL RATES:

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4. Sign Payment Agreement and fill in Credit Application.

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

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

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

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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

WHERE DO YOU LIVE?

A →

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? ....

WHERE DO YOU WORK?

B →

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

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

Street .... City .... State ....

PREVIOUS EMPLOYER .... HOW LONG? ....

Name .... Address ....

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

Name .... Address ....

WHERE DO YOU TRADE?

C →

BANK ACCOUNT WITH .... ( ) CHECKING

Street .... City .... State .... ( ) SAVINGS

CREDIT ACCOUNT WITH .... ( ) LOAN

Street .... City .... State ....

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

Street .... City .... State ....

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