INTERPRETING that TV PATTERN

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Part I of a three-part series. How the test pattern on the picture tube can be used to isolate the trouble. Once you have learned to interpret what you see, servicing is simplified.

WITH the rapid changes and new circuits being introduced in the growing television industry, the TV technician is compelled to develop new and modern servicing techniques to keep pace. A troubleshooting procedure, based on the picture tube as a source of information, has been developed by C. W. Hoshour, director of service, *Belmont Radio Corporation*, and presented in recent lectures to technicians throughout the country.

It is a known fact that a good radio technician can shoot trouble in a radio receiver by simply using his ears. He can translate into circuitry, what he hears and usually put his finger on the trouble. By the same token, a TV technician can use his eyes to ferret out service faults. The picture tube is an important and readily available piece of test equipment and it furnishes a great deal of servicing information. If the TV technician knows in what way the various circuits contribute to a normal television picture, he can, by viewing the face of the picture tube, determine what particular circuit is causing a certain trouble. The ability of a technician to interpret what he sees on the face of the picture tube will provide him with a quick, easy, and modern method of television troubleshooting.

The test patterns reproduced in this and the articles to follow are actual photographs of the picture tube of an operating television receiver. The various conditions were simulated in the receiver to give the desired results. Only a few were touched by the artist's brush as the desired conditions could not be set up at the time. The test pattern used is the *RCA* "Indian-Head" superimposed on a pattern consisting of 24 dots horizontally and 14 dots vertically obtained from a composite video and r.f. generator at *Belmont Radio*.

Fig. 1 is the average television picture that can be seen on any normally operating receiver in a local signal area. Obtaining a good television picture depends on the following factors; station transmission limitations, receiver design and adjustments, signal strength, and antenna installation. The station transmission curbs greatly limit the over-all quality of a television picture. Present FCC standards limit the system in bandwidth and resolution and provide a picture which is equivalent to 16 mm film. A 16 mm film has approximately 250,000 picture elements whereas the standard 35 mm movie film has approximately 1,000,000 elements. Thus picture quality is limited because of present transmission standards and "movie quality" should not be expected.

Receiver design and adjustments also play an important role in obtaining a good picture. A receiver should have a tuner with ample gain and a high signal-to-noise ratio, i.f.

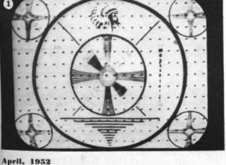


Fig. 1. Normal picture. It is clear, steady, with proper contrast between black, white, and various shades of grey, is properly centered and focused, and has excellent definition.

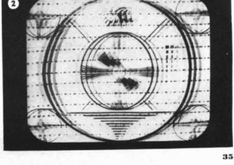
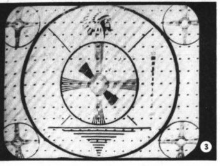
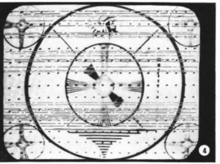
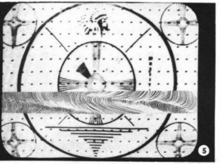
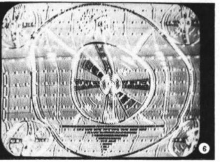


Fig. 2. An example of ghosts or multiple images. The image at the far left is the original unreflected signal while the various displaced images to the right are reflected pictures.









and video amplifiers of sufficient gain and bandpass to obtain all the reproducible frequencies, a good a.g.c. system to prevent overloading in strong signal areas and fading in weaker signal locations, and good sync circuits in order to avoid poor synchronization. Receiver adjustments to fill the screen and give reasonable linearity, r.f. and i.f. alignment, centering, focus, and proper contrast are also important and must be made in order to obtain a good picture.

Signal strength will depend mainly upon the distance from the TV station, station transmitting power, and the surrounding terrain. Buildings, mountains, or hills may reduce the signal strength and produce objectionable ghosts. As a general rule, picture quality will improve with increased signal strength.

Antenna installations will vary with the signal strength available. In low signal areas much more attention must be given to the installation. Such points as height, orientation, length and matching of transmission line, and gain of the antenna must be considered to obtain a good television picture.

There are four basic types of outside interference which are detrimental to a good picture. Their effect on the picture is easily discernible but in many cases the interference can be minimized or eliminated. Many articles have been written on these various types of interference, therefore, only the more important points will be covered in this series. These four types of interference are quite common but since they cause considerable trouble for the technician, they are worthy of consideration.

Ghosts or multiple images are transmitted signals which are reflected from buildings, mountains, or other objects in the vicinity and reach the antenna at different time intervals. The signal time delay causes displaced images, as shown in Fig. 2. Fig. 2 represents the original and three reflected signals. The image at the far left is the original unreflected signal. The sync has stabilized on the first ghost reflection and it has greater signal strength. Thus, it appears that there is one forward and two trailing ghosts.

There is no set or standard procedure for eliminating ghosts. There are many solutions that have proved successful in various locations. However, the same solution may not always produce the desired results. The trial and error method often proves to be the best procedure. In an area where ghosts are present, orienting or rotating the antenna may produce a stronger unreflected signal and decrease the strength of the objectionable signal causing the ghosts. In some cases, pointing the antenna toward the source of reflection rather than the station may produce favorable results. Other suggested remedies include installing a more directional type antenna, using separate channel antennas, installing an antenna rotor, matching the antenna to the receiver, connecting a shorted quarter-wave tuned stub, or eliminating standing waves by obtaining the correct transmission line length.

One other solution may be to relocate or move the antenna. In some cases, moving the antenna only a few feet completely eliminated all traces of ghosts. The distance and direction the antenna should be moved are usually best determined by trial and error. The distance the antenna should be moved can also be determined mathematically. This is accomplished by using the ratio of ghost displacement as related to picture width. The picture

Fig. 3. An example of r.f. interference. Narrow, evenly-spaced bars appear diagonally between a vertical or horizontal position. Bars may be wavy or bent and vary widely in number.

Fig. 4. Ignition interference causes sporadic black and white streaks in the horizontal direction. They move vertically and at random with no particular pattern discernible on the screen.

Fig. 5. Diathermy interference produces a herringbone pattern which tears part of the picture in a horizontal plane. This is generally synced vertically and may also move vertically.

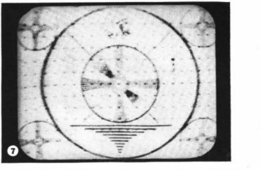
Fig. 6. Mistuning, faulty antenna installation in fringe areas, or overloading causes white following black portions of picture to appear as ghosts with poor over-all definition. May be accompanied by poor sync and horizontal pulling of raster.

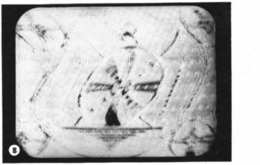
Fig. 7. Normal fringe reception characterized by lack of contrast accompanied by snow and, in some cases, susceptibility to r.f. interference. Good horizontal and vertical sync stability is difficult to obtain under such fringe area conditions.

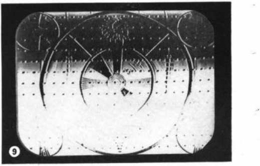
Fig. 8. Ghosts and weak signal conditions are apt to cause snow, poor contrast, poor sync stability, and horizontal displacement.

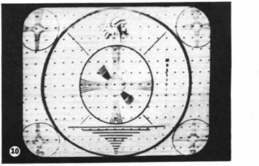
Fig. 9. An example of 60-cycle hum. The light and dark shading of the picture in the horizontal plane usually exists only when a picture signal or carrier is present at the r.f. input.

Fig. 10. Sound bars. Intermittent light and dark shadings of picture in horizontal plane may or may not move vertically.









width corresponds to approximately 9½ miles of the delayed distance traveled by the reflected signal. Displacement of the ghosts, illustrated in Fig. 2, as related to picture width shows an approximate delay of ¼ mile. Knowing the additional distance traveled may assist in determining the reflecting source.

A case of r.f. interference is usually caused by a strong signal whose frequency is higher than the station's received video carrier. The strong signal may be radiated and picked up from high powered radio equipment in the vicinity, local oscillator in a nearby receiver, or radio from ham equipment. The interfering signal beats with the video carrier thus producing a "difference" frequency falling within the video range. The higher the interfering signal is above the video carrier the narrower and more numerous the diagonal lines. An interfering signal approximately 3 megacycles above the video carrier is illustrated in Fig. 3. This type of interference may not affect every station and may vary from station to station in different locations. One point of interest to remember concerning r.f. interference is that the amount of picture interference is governed by both the signal strength of the station and the strength of the interfering signal. The stronger the station signal the less will be the effect of the interfering signal.

Such r.f. interference may also be caused by radiation from video detectors (similar to heterodyne "tweet" in broadcast receivers) and sound discriminators or r.f. high voltage power supplies in older type receivers. Keeping the antenna transmission line away from these portions of the receiver may help reduce the interference. In apartment buildings where local oscillator radiation is offending, the use of a master antenna system completely eliminates this problem. Not much can be done to eliminate r.f. interference unless corrective measures are taken at the source of interference. Means of reducing or eliminating this type of interference include the installation of a more directional, higher gain antenna, the use of wave traps and tuned stubs, or shielding the transmission line to reduce pick-up.

Ignition type interference, characterized by black or white streaks running across the picture (Fig. 4), is generally due to breaking contact-type electrical equipment such as the ignition systems of trucks and cars, cash registers, electric razors, vacuum cleaners, or adding machines. This interference can be picked up by the antenna or transmission line or can come in through the power line. A power line filter installed between the receiver and wall outlet will usually eliminate the power line as a source of interference. Other possible remedies are to relocate the antenna so that it is as far away from street traffic as possible, twist the transmission line approximately one turn per foot, or install shielded transmission line. Another condition which simulates ignition interference may be due to corona or arcing in the high voltage supply.

Diathermy interference, Fig. 5, is generally caused by radiation from x-ray equipment, commercial r.f. heating units, ultraviolet and fluorescent lights, brush motors, and other 60-cycle operated equipment. This type of interference is best reduced or eliminated by installing some type of corrective measures at the source. Since this is not always possible, other methods, such as installing a booster, high pass filters, or tunable stubs must be tried. The last mentioned suggestion has proved successful in various instances. *(Continued on page 150)*

Interpreting TV Patterns

(Continued from page 37)

Outside interferences (excluding ghosts) when caused by radiation of electrical equipment will affect the picture only when such equipment is in operation. Time and effort are required to track down the appliance or equipment causing the interference. When the source has been determined it is possible to minimize the trouble by connecting a large condenser across the contacts, or by installing a booster at the receiver or detuning the i.f.'s.

Since the market for television receivers has almost reached the saturation point in metropolitan areas, TV distributors and dealers are now emphasizing sales in the suburbs and in nearby communities. Technicians will have to face the problem of poor reception in these fringe areas. The cause of pictures like those shown in Figs. 6, 7, and 8, is weak signal strength. Technicians have often modified receivers in order to increase gain and improve the over-all picture quality. These design changes are commendable only insofar as they produce the desired results. The best method is to increase the signal strength at the antenna terminals of the receiver. Since an antenna installation must often be a compromise because of the cost involved, receiver modifications such as substituting higher gain r.f. or i.f. tubes, removing or decreasing a.g.c. to the r.f. or i.f. stages, and realignment to decrease bandwidth and increase gain may be tried to obtain a more favorable picture. Before receiver modifications are attempted, the customer should be advised that while the changes will produce a better picture in the present location, if the receiver is moved to a stronger signal area or if at a later date the signal strength is increased, the receiver may not perform satisfactorily because of the modifications.

Fig. 6 illustrates the results of a faulty antenna installation and station interference in fringe reception areas. In local signal areas this condition may be due to lack of care when tuning in a station, generally tuning to the low frequency side of the signal rather than the high frequency side. This may also be the result of overloading caused by a loss of a.g.c., gassy i.f. tubes, or a defective video amplifier stage. This condition may also be caused by a low-voltage filter condenser which produces 120-cycle hum.

The normal fringe reception test pattern of Fig. 7 is the pattern which may be expected on the screen of a receiver operating in a low signal area, a condition existing in fringe areas. In local signal areas this condition may be caused by a weak or dead r.f. tube in the tuner, i.f. tubes, or associated components.

Ghosts combined with a weak signal condition (Fig. 8) can generally be found in receivers which are operating on inside or built-in antennas in apartment buildings where an outside antenna is not permitted. This condition is also prevalent in cases where antennas are installed in valleys or are located between high buildings resulting in almost complete shielding of the antenna from the signal source. This condition may also be caused by a broken or shorted transmission line. Possible solutions to improve reception include installing an outside antenna where possible, increasing the height of the antenna, re-orienting or relocating the antenna, installing a booster, or performing receiver modifications to increase gain.

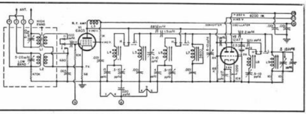
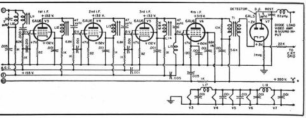


Fig. 11. Schematic of the tuner used in a current Raytheon television receiver.

Fig. 12. The video i.f. amplifier incorporated in a recent Raytheon video set.



A 60-cycle hum is generally due to a short or leakage between the cathode and filament in the i.f. or video amplifier tubes (See Fig. 9). The hum will be noticeable only when receiving a picture (raster will appear normal) if an i.f. tube is at fault or may be present at all times if a filament-to-cathode leakage exists in the video amplifier stage. This condition is also possible when one-half of the low voltage power transformer secondary is inoperative or when one-half of the low voltage rectifier is defective, causing a condition similar to that produced by a poorly filtered half-wave supply. Radiation from a 60-cycle sweep generator being operated near the receiver should not be overlooked as a possible source of the trouble. Substitution of i.f. or video amplifier tubes is a quick solution. One other method is to short the cathode of each defective tube to ground. Start with the higher gain tubes first and test only those tubes that are above ground with respect to 60 cycles. A short or leakage between cathode and filament will immediately show up.

Another common annoyance to the TV viewer is sound bars (Fig. 10). Sound bars may be caused by mistuning of the receiver, microphonic station camera equipment, a microphonic vertical oscillator tube, or microphonic a.g.c. controlled r.f. and i.f. tubes. A microphonic vertical oscillator will cause compression and expansion of the scanning lines which results in light and dark shadings. (A microphonic horizontal oscillator tube will produce a sideward displacement.) Brilliance modulations which show up as light and dark shadings are caused by microphonic r.f. or i.f. tubes which will not respond to vibration without signal. One simple method of determining which section of the receiver is at fault is to tune to an off channel and jar the cabinet. If the sound bars are no longer present an r.f. or i.f. tube is microphonic. If, however, the sound bars remain, the vertical oscillator tube is at fault. Once the troublesome section is found, tap the tubes until the microphonic tube is located. Replacement, obviously will cure the trouble.

In Part 2 of this series the video amplifier, a.g.c. system, sync, and vertical deflection circuits will be analyzed, using the picture tube as the source of information.

(To be continued)

NEW OFFICERS NAMED

THE Florida Association—R & TTG—has elected the following officers to serve one-year terms.

President Steven Petruff will have Shan Desjardines as his vice-president, Thomas M. Middleton as secretary, and A. Ed Stevens as treasurer. Board members include: John Gilbert, Samuel Kessler, C. E. Lawrence, John J. Petruff, Chas. Pierce, Clem Ryan, and Orville E. Smith.

The association voted to affiliate with NETSDA.

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