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tech tips

How To Service Digital Television

One of the recent additions to the video market is digital television. This tech tip explains the differences in digital TV and discusses the servicing aspects of this video format.

What Is Digital TV?

Many television special effects we now consider commonplace have been made possible by the arrival of digital TV. Digital TVs use existing tuner, IFs, and detector circuits, then digitize the composite video signal. Digitizing the video signal allows it to be digitally processed resulting in a better picture and/or special effects not available in conventional analog televisions. The signal is then recovered into an analog signal for transfer to the picture tube.

Even though digital TV is capable of producing sharper images with special effects, it does not need a special input signal for its operation. Digital TV uses the same NTSC signal that conventional TVs use, but the signal is converted to the digital format enabling the enhancements.

Digital televisions first hit the U.S. market in 1985. Their use today is somewhat limited due to higher costs, but their market penetration is expanding as prices decrease. Manufacturers benefit from digital TV production as fewer and more reliable parts are being used, cutting manufacturing and service costs.

Advantages Of Digital TV

One of the main advantages of digital TV is the ability to manipulate the video in ways conventional TV can't. Once the video is in a digital form, it can be processed to increase picture fidelity or

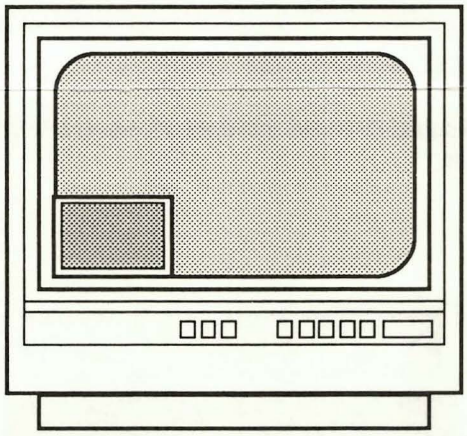

Fig. 1: One benefit of digital TV is the ability to display the picture-in-picture effect.

produce special effects. Some of the specific advantages made possible by digital TV are:

1. Multiple pictures on screen (picture-in-picture)
2. Images with higher perceived resolution.
3. Still picture, detail enlargement.
4. Reduction of component count.
5. Reduction of jitter with better sync locking.
6. Reproduction of more than one format (NTSC, PAL, SECAM, etc.)
7. Picture storage for later recall.
8. Inexpensive decoding of teletext.
9. Ghost reduction (under development).
10. Reduction of snow in picture (under development).

Even though some of these benefits have not yet become available in consumer receivers, the technology is available.

A major advantage of converting to digital TV is seen from the manufacturing standpoint. Component counts and manufacturing costs can be reduced by setting up the operation of the television with computers. Many standard adjustments used in conventional TVs can be eliminated by using digital TV software. Software adjustments eliminate potentiometers and associated circuitry, plus the labor involved for the calibration is minimized.

How Does Digital Television Work?

The whole concept of digital television revolves around the idea of taking the existing broadcast signal, digitizing it, processing it, and then converting it back to an analog signal that can be applied to the picture tube. When the signal is in a digital form, it can be easily processed to increase the picture resolution and provide special effects.

Digital TVs for consumers generally rely on existing analog tuner, IF, and video detector circuits to process the signal down to the video level. According to the Nyquist theorem, the digital sampling rate must be at least twice the frequency being digitized. Due to higher costs of high-speed D/A converters, manufacturers do not foresee the digitizing of the higher RF or IF frequencies. Several manufacturers attempted to digitize the IF frequency, but the cost was too high for a consumer TV.

For the most part, digital TVs do not digitize the signal until it has passed through the video detector stage. After the video detector, the composite video signal is amplified and digitized.

The Nyquist Criterion states that in a digital system, the sampling frequency must be at least two times the highest frequency component of interest in the signal to be sampled.

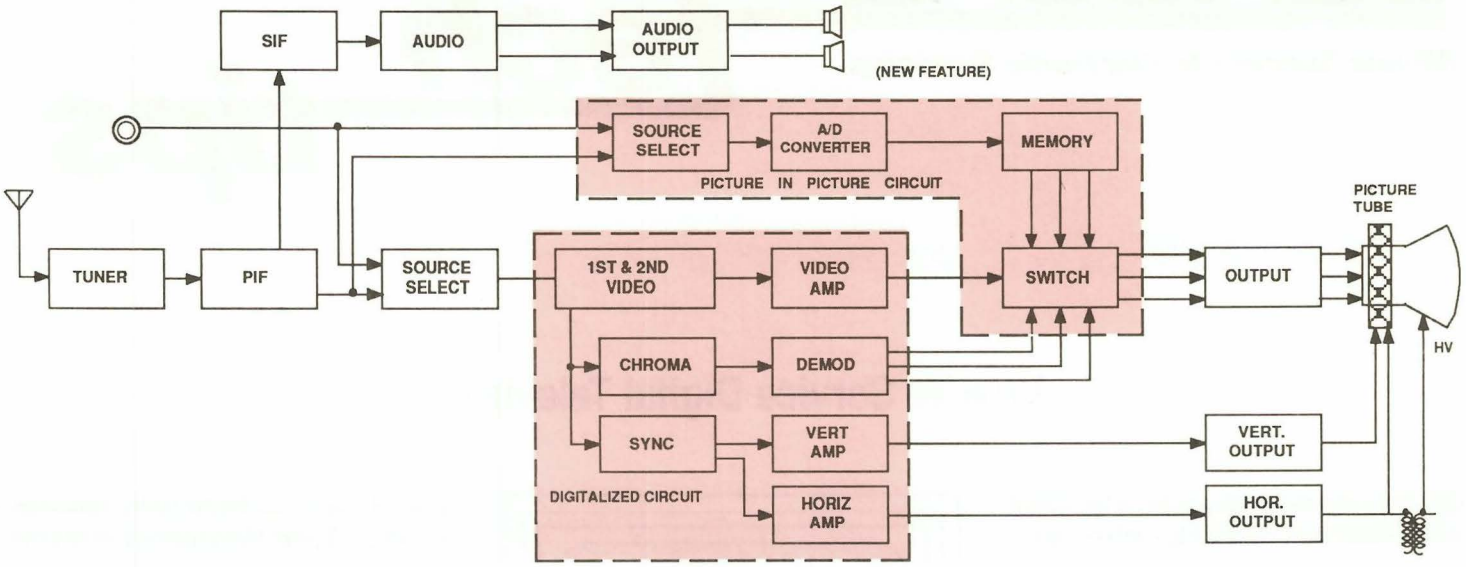

Fig. 2: The simplified block diagram for a typical digital TV shows the digital elements inside the dashed boxes. Use the SC61 Waveform Analyzer to troubleshoot the circuits inside the boxes.

Once the video is in a digital format, it can be processed and manipulated in a number of ways to enhance the picture. Then, the signal must be converted back to the analog format for display on the CRT.

Servicing Digital TVs

Digital TVs, like conventional TVs, break down too. The substitute signals from the VA62A Universal Video Analyzer along with the analyzing capabilities of the SC61 Waveform Analyzer help you repair these TVs quickly and efficiently.

Since the circuits from the antenna through the video detector of a digital TV are the same as a conventional analog TV, you can use the VA62A's RF-IF signals to troubleshoot problems as you normally would. The VA62A helps you pinpoint RF-IF problems with all-channel capability and exclusive IF signals, all with adjustable levels.

The signal is digitized once it passes the output of the video detector. At this point, the SC61 is your greatest asset. The best service method here is to look at the data lines and check for activity. If activity exists, the data line is most likely operating correctly. Some manufacturers even give information in their service literature showing what these data lines look like. Tech Tip #109 shows how to use the SC61 for servicing digital and microprocessor circuits in more detail.

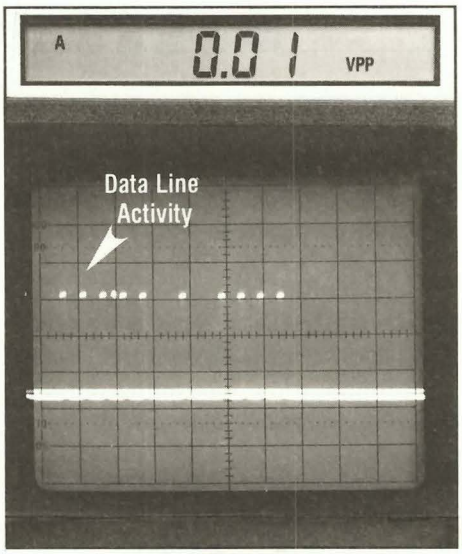

Fig. 3: Use your SC61 Waveform Analyzer to check for activity on data lines in digital TV's digitized circuits.

The remainder of the digital TV's circuits are comparable to an analog TV. The substitute signals of the VA62A combined with the signal analzying capabilities of the SC61 will help you narrow down any problem in any circuit.

NOTE: *There are a small number of large screen digital TVs that use a non-NTSC horizontal scan rate of 31,468 Hz to increase the resolution of the picture in the vertical direction. The SC61 works fine for signal tracing in these circuits, especially since the input is protected up to 3000 volts. Substituting for the horizontal circuit signals of these few sets, however, requires a drive signal of this higher, non-standard frequency.*