SENCORE®
Means Success In Electronic Servicing
tech tips

Understanding Functional Analyzing With The VG91/TVA92 Video Analyzers

Time is money in the service business! Yet hard working technicians often waste time by performing added troubleshooting steps or tasks which do not provide useful information to help isolate the problem. Studies confirm that the cause of these added troubleshooting steps is more often in the troubleshooting technique used and not the technicians technical knowledge.

This Tech Tip explains how a logical, organized, step-by-step troubleshooting procedure called "Functional Analyzing" can increase your troubleshooting efficiency. Furthermore, it explains how to apply signal substitution using the VG91 Universal Video Generator and TVA92 TV Video Analyzer to improve functional analyzing.

Understanding Functional Analyzing

Your highest troubleshooting efficiency comes when you isolate the defective circuit in the fewest steps possible. Functional analyzing changes your troubleshooting emphasis. Instead of searching randomly for a bad stage, functional analyzing has you confirm which stages are good - in a logical, sequential manner until the problem is narrowed down to one functional block of the receiver. It is only after the problem is isolated that meters, scopes, and component tests are used to attack that one stage.

There are two ways to troubleshoot an electronic system: signal tracing or signal substitution. Signal tracing has you start at the input and trace signals towards the output. Signal substitution has you start at the output and inject substitute signals working toward the input. Many technicians depend solely on signal tracing. It is this dependency which causes many good technicians to waste valuable servicing time. Here's why:

Signal tracing increases the number of troubleshooting steps needed to isolate most problems. There are several reasons for this: 1.) Unnecessary measurements are often taken in good circuits. Waveforms or voltages taken in good circuits are sometimes bad because of close interaction with other stages. 2.) At other times, technicians are misled because subtle problems in the waveshape are overlooked or dismissed. 3.) Worst of all, receiver start-up or shutdown protection problems rob stages of supply voltages or input signals resulting in no waveforms to trace. These signal tracing dilemmas cause servicers to abandon effective systematic troubleshooting techniques.

It is only when signal tracing is combined with signal substitution in an organized divide and conquer technique that the highest troubleshooting efficiency can be achieved. To help you achieve this efficiency, every Sencore analyzer is accompanied with a functional block diagram of the electronic system and a functional analyzing troubleshooting guide or troubleshooting tree. The remainder of this Tech Tip shows you how to use the VG91/TVA92 to improve the efficiency of your television receiver/monitor troubleshooting.

Understanding Signal Substitution

The VG91/TVA92 improves your troubleshooting capabilities by providing signal substitution. Signal substitution requires that you inject known good signals or voltages into the major functional stages or blocks of the receiver. With a proper substitution signal applied to the input of a stage, you simply watch the CRT or listen to the speaker to determine whether you are injecting before or after the defective stage.

If the output at the CRT or speaker returns to near normal during signal substitution, you are injecting after the defective stage; if the output remains bad, your injection point is before the defective stage. In this

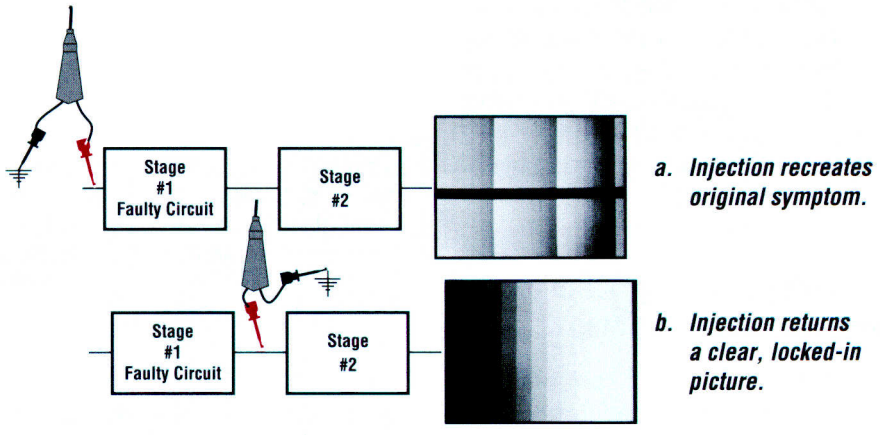


Figure 1: Signal substitution proves stages good leading you to the defective stage.

manner you prove circuits are good and quickly narrow in on the defective stage.

The VG91 and TVA92 provide TV substitution signals that are universal to all TV brands and models. The VG91 substitutes signals in the RF and IF stages prior to the audio and video detectors while the TVA92 provides substitution signals for all stages after the detectors. The TVA92 contains special driving circuits designed to drive luminance, chroma, and deflection stages.

The VG91/TVA92 substitution signals effectively remove ("swamp out") any signal at the injection point and replace it with a known good signal. This is done with low impedance drive output circuits. The substitution signals are variable in level and polarity to match the circuit waveform. In reality, the VG91/TVA92 package is like having a miniature TV station with all the signals required to substitute into any TV stage.

Dividing the TV Receiver Into Functional Blocks

To simplify troubleshooting, the circuits in a television receiver or NTSC monitor can be divided into functional blocks. Although the circuitry in each functional stage may vary from chassis to chassis, the basic functional operation remains the same. There are seven large functional blocks that are used to process signals from the antenna terminals to the CRT screen or speaker in a television receiver.

1. Tuner
2. IF section
3. Video
4. Color
5. Audio
6. Vertical sweep
7. Horizontal sweep

These main functional blocks can be divided into smaller functional blocks. The Sencore Universal TV Receiver/Monitor Block Diagram illustrates the functional blocks found within any TV receiver/monitor (refer to back page of Tech Tip).

Performance Testing Is The First Functional Analyzing Step

An important first step to functional analyzing is a complete performance test with the VG91. Its special video test patterns, adjustable RF-IF levels, AFT tests, and standard outputs allow you to evaluate each of the seven main functional areas of the TV receiver.

Observe the symptoms during the performance tests and relate them to the operation of the functional blocks. For example, reduced picture height indicates a vertical problem. A picture that is visible but has some snow indicates a likely RF or IF problem. Dividing the circuits into functional blocks tells you what stages are working and which to suspect as defective.

The results of the performance tests will guide you to one of the six major symptoms shown on the "TV Analyzing Troubleshooting Guide": 1) Bad audio and/or MTS; 2) Missing or poor video; 3) Missing or poor color; 4) No vertical or horizontal sync; 5) No raster; and 6) Start-up and/or shutdown problems.

Once you identify the symptom(s), refer to the Sencore VG91 & TVA92 Analyzing Troubleshooting Guide to determine the shortest path for finding the defective stage. Now you are ready to use the functional analyzing process to track down the defective stage and then, the bad part.

When several symptoms are noted during the performance test, you need to decide which one to respond to first. Avoid troubleshooting more than one symptom at a time. Always repair circuit problems in the following order.

1. High voltage, start-up, or shutdown
2. Sweep
3. Sync
4. Video
5. Color
6. Audio

Divide & Conquer Technique Using Signal Injection

Injecting signals into stages at random does not make signal substitution an efficient troubleshooting method. Instead, we need a plan of action when injecting signals that keeps our troubleshooting steps at minimum, but still isolates the problem to a single stage.

A divide and conquer procedure isolates the defective stage in the fewest steps possible. You may compare your TV troubleshooting job to the challenge of isolating a worm inside an apple in the fewest steps. You may choose to cut away small sections subtracting from the apple until you stumble on the worm. If on the other hand, you would use "divide and conquer", you would slice the apple in half and repeat the process until you had localized the worm to one small section. The dividing process requires three steps to isolate the worm to the same sized area that requires up to eight subtractive steps.

While isolating a problem in a TV receiver requires more than looking for worms, divide and conquer steps provide the best overall troubleshooting efficiency. The best place to start dividing the television

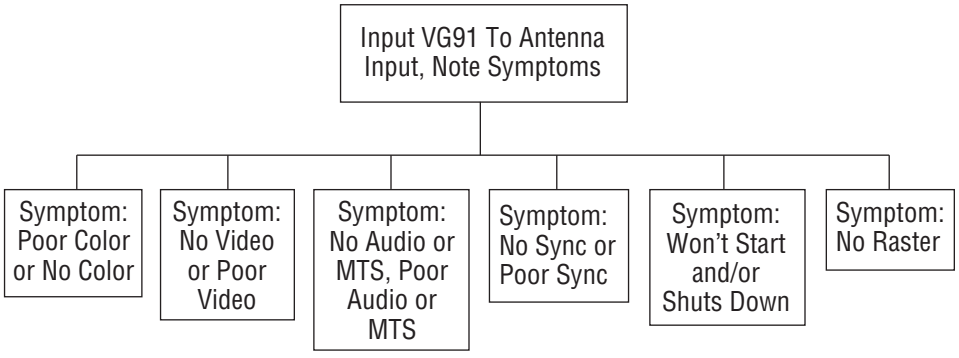


Figure 2: Select the path on the "Trouble Tree" that closely matches the symptom of the TV you are servicing.

receiver is the main detector points. The detectors are what cause the greatest change in the signals. There are three types of detection in a color television receiver. The video detector must change the amplitude modulated IF signal to composite video, the audio detector must change the frequency modulated 4.5 MHz IF signal to audio, and the chroma demodulators must change the phase-modulated composite chroma signal to individual red, blue, and green outputs. The detectors are the most logical place to start injecting signals.

Injecting a signal into the detector results in a division by two of the total number of stages that may cause a problem. Once you determine what stages are properly processing known good signals, you keep dividing the defective stages until the defective stage is found.

You can simplify the process of dividing and conquering circuit troubles by using the Universal TV Receiver/Monitor Block Diagram and the Sencore VG91 & TVA92 TV Analyzing Troubleshooting Guide. The Troubleshooting Guide provides you with step-by-step instructions to isolate symptoms to the defective functional block.

Deciding What Signal To Use

The signal you use depends on which functional stage you are injecting into. When you are substituting into the tuner or IF section use the VG91's RF-IF Signals. When you inject into the audio stage use the VG91's audio frequencies along with the TVA92's Audio Drive Signal. The signal normally present at the input to the video stages and the sync separator is composite video, so when injecting into these stages use the TVA92's Video Drive Signal. In each case, you inject the signal that is normally at that point in the circuit. (See Table 1)

Here are some basic guidelines to follow when using signal substitution:

1. Always input a reference signal from the VG91 at the antenna, IF, or video input of the chassis to synchronize all of the stages. **Do not use a reference signal from another generator or from a broadcast station, as these signals are not synchronized to the TVA92.**

2. Use the waveform shown on the schematic as a guide for selecting the proper substitute signal type, polarity, and amplitude, as shown in Figure 3.

a. Match the drive signal level to the approximate level in the schematic. Too much signal may force a bad stage to operate and lead to confusing results. If no level is shown, never exceed the B+ voltage to the stage.

b. Match the drive signal polarity to the signal in the circuit. If in doubt, start with positive drive. A stage will not be damaged by momentarily applying the wrong polarity drive signal.

3. Monitor the amount of drive signal needed to drive a test point with the TVA92's Output Signal Monitor/DVM. This prevents overdriving a stage with too much signal and provides an indication if driving a shorted circuit point.

Table 1 summarizes what signals to inject from the VG91 and TVA92 to troubleshoot television receivers more effectively. The injection points correspond to the numbers at the inputs of the blocks on the Universal TV Receiver/Monitor Block Diagram.

Functional Analyzing IC Circuits

Functional analyzing is the only effective method of isolating problems in modern

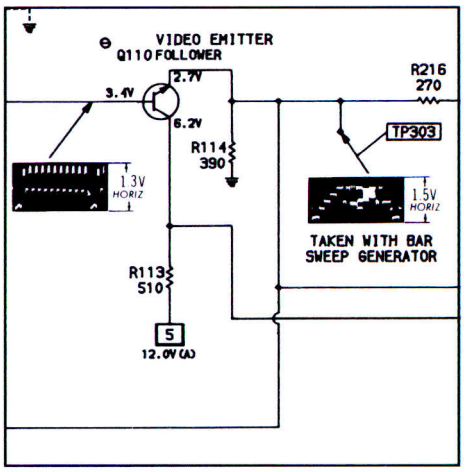


Figure 3: The schematic often gives you the signal type, polarity, and amplitude of the signal.

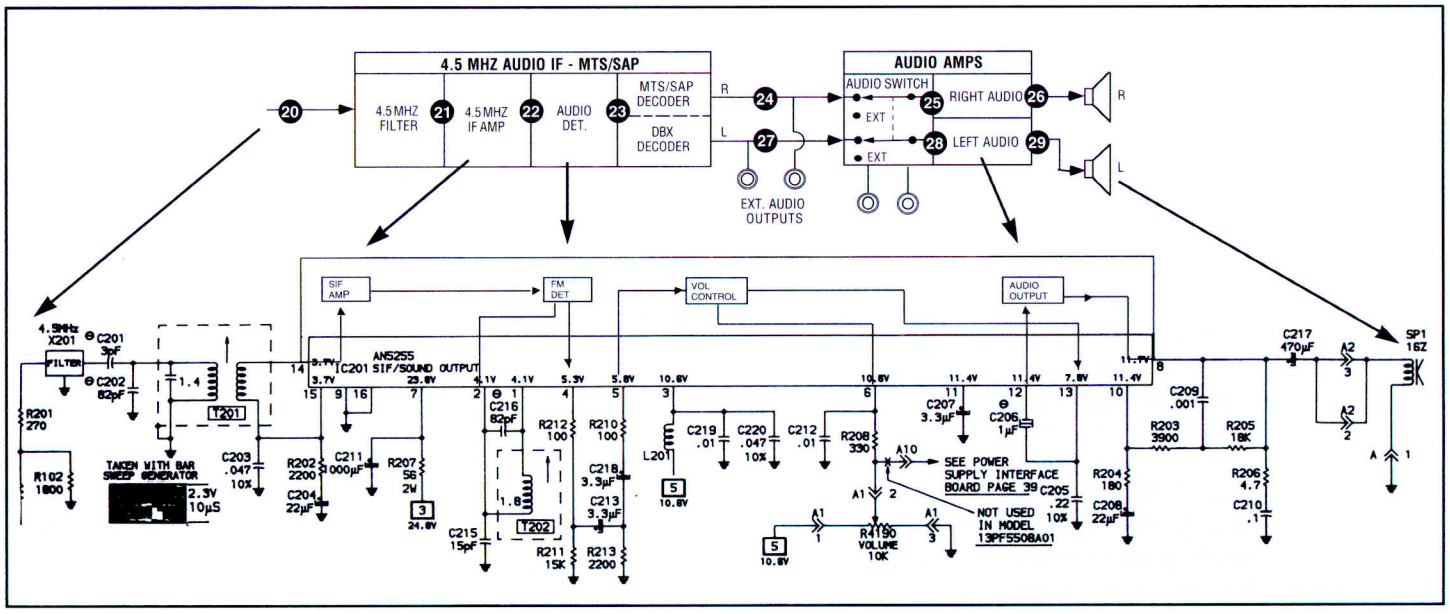
IC circuits. Many technicians do not understand that integrated circuits are not really a component, but many functional stages madeup of many individual components within one package. ICs perform the function of one or several blocks in the Universal TV Receiver/Monitor Block Diagram. To effectively troubleshoot IC circuits, you must analyze the functional stages within the IC using the same methods we've described in this Tech Tip.

Signal substitution can be used effectively to confirm whether functional stages in the IC are good or bad. You may substitute signals using the VG91 or TVA92 into the functional stages of the IC using available input pins of the IC. For example, Figure 4 shows a typical sound IF section in a television. The IC has

Table 1

VG91/TVA92 Drive Signal Substitution Chart

Test Point	Drive Signal	Test Point	Drive Signal
1	RF STD TV/STD Cable	61	Video
2-4	DC Bias Supply	62,63	V & H Sync
3-7	45.75 MHz Video IF	64	Vert Sync
8-10	Video	65-67	Vert Drive
23 (Mono)	Audio	68	[See Vert Yoke Test]
23 (MTS)	MTS Composite	70	V & H Sync
24-26	Audio	71	DC Bias Supply
27-29	Audio	72, 73	Horiz Drive
30-34	Video	74	[Use Dynamic Tests]
40-46	Chroma	75	[Measure DCV]
47-49	Video	76, 77	[Measure DCV*]
50	V & H Blanking	78-82	[Measure DCV, PPV]
51-54	3,58 Mhz	83	H Key Pulse



several functions, it converts the modulated 4.5 MHz sound IF signal to an audio signal, the audio signal is amplified, and sent to the speaker. As you can see, by breaking the IC down to specific stages, you can inject the proper signals from the VG91/TVA92 to isolate the defective stage. You then make meter, scope and component measurements to determine if the problem is within the IC or to a component external to the IC.

You need to treat the IC just as you would a discrete component when signal injecting. Its just like substituting into one of the functional stages shown on the Universal TV Receiver/Monitor Block Diagram. The VG91/TVA92 supplies you with the signals necessary to functional analyze ICs so you know whether the IC is good or bad.

For More Information, Call Toll Free 1-800-SENCORE (736-2673)

SENCORE
3200 Sencore Drive, Sioux Falls, SD 57107

Universal TV Receiver/Monitor Block Diagram