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How The VA62A Multiburst Barsweep Simplifies Video Troubleshooting

Why Is Poor Video So Hard To Find?

Many problems affect the picture of a TV receiver. Troubles which cause a poor picture, such as smear, weak contrast, harsh edges, or poor detail, are tougher to find than problems caused by a dead stage. These problems often don't cause a noticeable difference in either DC bias or peak-to-peak voltage. They only affect bandwidth or waveshape.

Video frequency problems may affect a single frequency, or a whole band of frequencies. To make matters worse, the problem could be in the video detector, in the IF stages, or in one of the video amplifier circuits. The VA62A Universal Video Analyzer has a special video pattern called the Multiburst Barsweep to help isolate these tricky problems.

The Multiburst Barsweep video pattern has samples of ten different video frequencies, ranging from 0 (DC) to 4.5 MHz. You judge the performance of all the video circuits, from the antenna to the picture tube, by simply looking at the CRT screen. To understand why this is possible calls for an understanding of how different video signals relate to frequency.

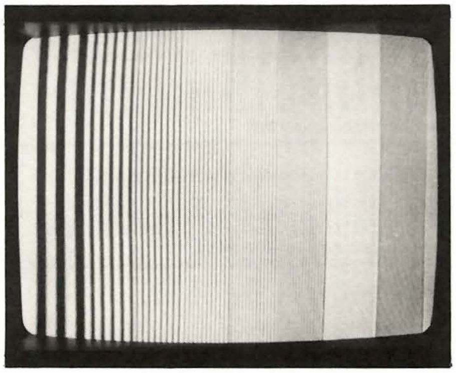


Fig. 1: The VA62A's Multiburst Barsweep video pattern has samples of 10 video frequencies, ranging from DC to 4.5 MHz.

How Video Signals Relate To Frequency.

A video circuit must have enough frequency response (bandwidth) because a video signal contains many different frequencies. The video circuits must treat all the frequencies the same to produce a good picture. But, how do video frequencies relate to picture quality?

A TV picture is made up of 525 horizontal lines, repeating at a rate of 15,734 Hz. Each line changes in amplitude to form the picture as the beam moves across the front of the screen. The video frequency produced depends on how often the amplitude changes in a scan line. We can calculate the exact frequency if we know how often the beam is interrupted as it moves across the screen.

To make these calculations, we need to know the "active time" for one horizontal line. This is the time *between* blanking and sync pulses, but does not include the blanking interval itself. To determine active time, we start with the time for the entire line, *including* blanking. We invert 15,734 (divide it into one) to get 63.5 microseconds. We then subtract the 10.6 microseconds used for blanking and sync, to get 52.9 microseconds for trace time.

Now, let's see what happens as we apply video to interrupt the beam. We will start when the screen is completely white. The video signal is now interrupted only by horizontal blanking. Since the signal is at a fixed level for 83% of the time, it is more like a DC signal than an AC signal.

Next, let's see what happens when we change the picture, by making the left half black and the right half white (See Figure 4). The video signal now becomes a square wave, which forms one complete cycle during the active time of each horizontal line. We learned earlier that this period is 52.9 microseconds. Inverting 52.9 microseconds tells us that the video frequency is now 18.9 kHz.

Now, let's double the interruption rate to form two white stripes and two black stripes of equal size. The time for each cycle is half as long as our first example. This calculates to twice the first frequency, or 37.8 kHz. As we interrupt the screen more often, we can translate the interruptions into frequency by multiplying the interruptions times 18.9 kHz.

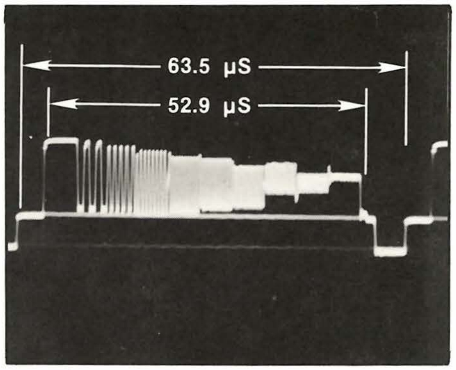


Fig. 2: The composite video signal is "active" for 52.9 microseconds, so this time is used for all frequency calculations.

Most TV pictures have a mixture of large and small objects, instead of a row of identically sized objects. This causes the video signal to be a mixture of many different frequencies. Each different sized picture element produces a signal of the same frequency as it would if it were repeated all the way across the TV screen. Large objects create low video frequencies, and small objects create high frequencies. The drawing in Figure 4 may put this into better perspective.

The ten soldiers across the screen are each one-twentieth the width of the screen. If

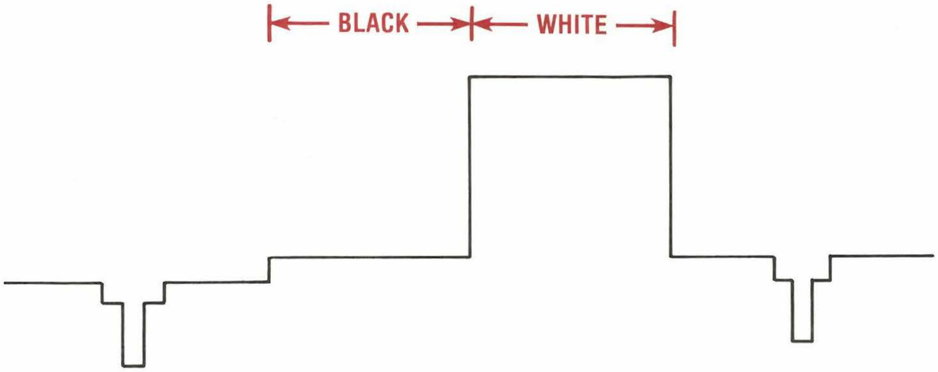


Fig. 3: If the left half of the screen is black and the right half is white, the video forms a square wave with a period equal to the "active" time of the horizontal line — 18.9 kHz.

we think of the soldier as a high level and the in-between space as a low level, the electron beam is interrupted ten times across the screen. The ten soldiers then calculate to 10 times 18.9 kHz, or 189 kHz.

If our video circuits only had 189 kHz of bandwidth, we wouldn't see the soldiers. We would only see their outline; and not a very clear outline at that. We would need more bandwidth to see smaller details.

If the soldiers' ties are one-fifth the width of the soldier, we would need enough bandwidth to place 50 necktie-sized objects (plus equal blank spaces) on the screen. This needs 50 times 18.9 kHz, or 945 kHz of video bandwidth. We'll round this to 1 MHz, which would allow 53 neckties across the screen.

Any picture element one-half the size of the necktie would create a video frequency twice that of the necktie, or 2 MHz. A 2 MHz signal could represent 106 objects across the screen; or it could represent one object 1/106th the screen's width. This might be the bayonet on the end of the soldiers' rifles.

Increasing the frequency to 3 MHz allows us to form objects 1/159th the width of the screen, such as the hair on the soldier's head. Since most TV receivers have 3 MHz video response, this is the smallest object they can show on the picture.

A TV monitor with a direct video input (which bypasses the tuner and IF circuits) may provide a 4.5 MHz response. If so, the monitor will be able to place 238 objects across the screen, with spaces of the same size. These would be objects 24 times smaller than the outline of the soldier.

Now, you know how different sized objects create different video frequencies. Let's next examine how the Multiburst Barsweep pattern relates to this, starting with video processing ahead of the video detector.

How The Multiburst Barsweep Tests IF Circuits

The Multiburst Barsweep pattern provides ten bars (bursts) of video, each with a different frequency. Any rolloff or distortion in the video circuits will affect the corresponding bars. You simply view the screen to see if a video problem has restricted one or more bars.

Sencore chose half-megahertz spacing of the test frequencies because everything in video happens at multiples of 500 kHz. To understand this, we need to look at the way video signals are processed in the IF stages. They must filter unwanted interference, while feeding as much video bandwidth possible to the video amplifiers.

Figure 5C shows the ideal frequency response at the video detector output. It doesn't matter what type of circuits are used in the IF stages. Variations from this ideal response curve will affect the picture, whether the TV has adjustable IF amplifiers or a fixed-tuned SAW filter.

First, notice there are three carriers which call for trapping to prevent interference with the video carrier: 1) The adjacent audio, 2) The on-channel audio, and 3) The adjacent video. The carrier for the adjacent audio (the next LOWER channel) is 1.5 MHz below the video carrier. The sound carrier for the channel we're viewing is 4.5 MHz higher than the video carrier. Then, the adjacent video carrier (the next HIGHER

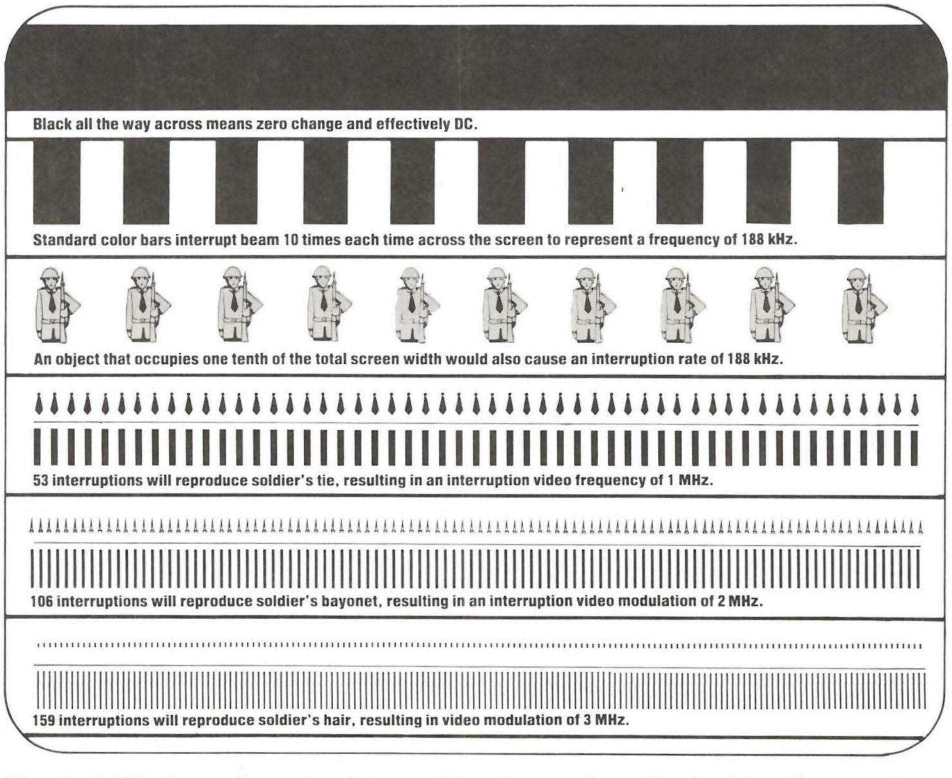


Fig. 4: A TV picture is made of many video frequencies, all mixed together, as these soldiers represent.

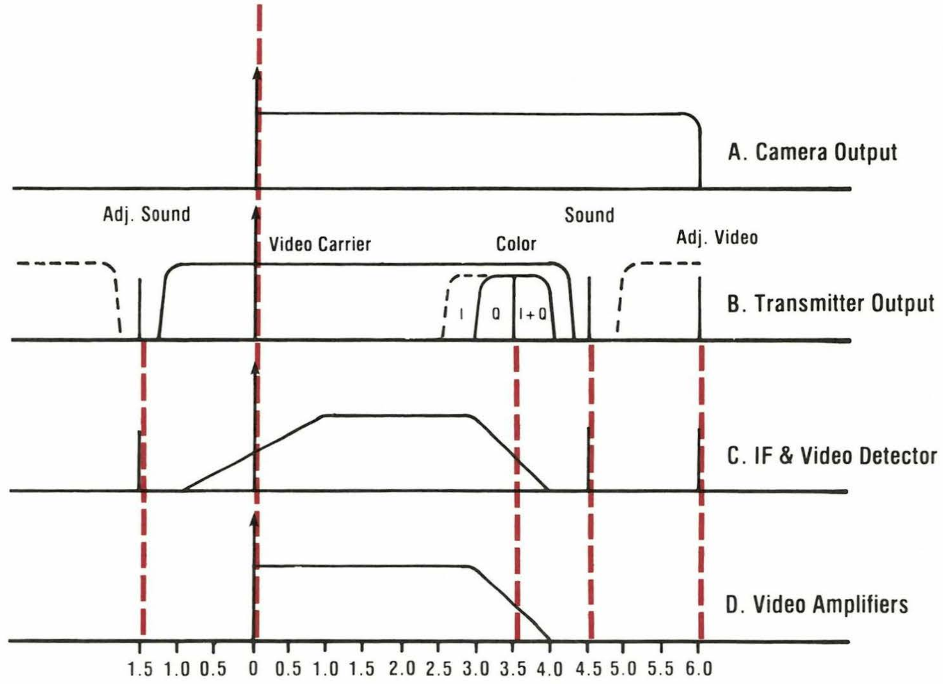


Fig. 5: The relationship of video frequencies: a) The output of the TV camera, b) The transmitter output, c) The combination of the IF stages and video detector, and d) The video amplifier response. A frequency lost in any part cannot be recovered in a later group of circuits.

channel) is 6.0 MHz above the video carrier. Are you beginning to see a trend? Each of these frequencies is displaced by a 500 kHz multiple from the video carrier. Next, let's see what happens at video frequencies below 1.5 MHz.

As we learned earlier, large objects in the picture cause low video frequencies. When these low frequencies are used to amplitude-modulate the video carrier, they produce sidebands close to the carrier. As Figure 5B shows, the video transmitter uses full double sideband modulation (standard AM) when transmitting these frequencies.

Smaller objects produce higher video frequencies which, in turn, form AM sidebands farther from the carrier. Sidebands more than 1.25 MHz from the carrier have only one (the upper) sideband. This is the special vestigial sideband transmission which allows us to squeeze reasonable picture detail into a 6 MHz TV channel.

The IF circuits must compensate for the gradual loss of the upper sidebands as the modulation frequency increases. This compensation gives signals with only one sideband twice as much gain as those with two sidebands. This, in turn, places the video carrier at the 50% point on the bandpass curve. If the carrier is too high or too low on the curve, the picture develops harsh edges or ringing. Checking for proper gain at 0, 0.5, 1.0, and 1.5 MHz ensures that the rolloff is smooth and balanced.

The sideband frequencies represented by 2.0 and 2.5 MHz correspond to the flat area of the response curve. At the highest video frequencies, the gain must be reduced to make room for the 4.5 MHz audio carrier. To prevent ringing, the response must have a smooth rolloff from 3.0 to 4.0 MHz, with the 3.58 MHz color signal at the 50% level.

Now you know the significance of half-megahertz stepping. But, how can we be certain that there is not a problem between each half-megahertz test frequency? We might miss problems if we tested with sine waves. But square wave testing eliminates this, since a square wave needs correct phase and gain response of all its odd harmonics for proper shape. The harmonics effectively fill all the gaps between the fundamental test frequencies. This is why Sencore uses square waves, instead of the sine waves used on generic multiburst generators.

The first use of the Barsweep is to troubleshoot any kind of video response problem. It also, by the way, lets you re-align the IF stages if you want. But, its first use is for troubleshooting.

How The Video Amplifiers Affect The Picture.

If a video amplifier restricts gain of some frequencies, the picture will have the same poor quality as when you have a problem in the IF stages or the video detector. The same VA62A video pattern that dynamically tests the IF stages tests video amplifiers too. This isolates troubles like bad peaking coils or compensation capacitors.

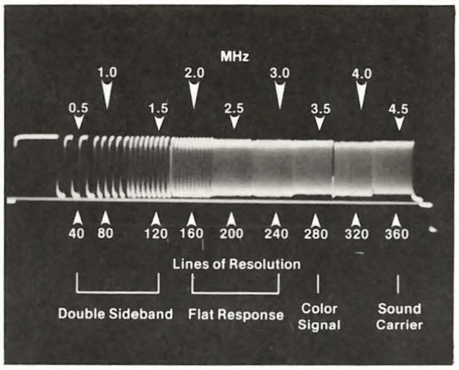


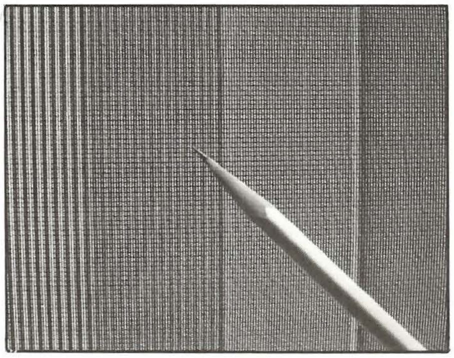
Fig. 6: The half-megahertz steps of the VA62A's Multiburst Barsweep relate directly to the video circuits, as shown here.

As you can see, the Multiburst Barsweep pattern lets you check the video response every half megahertz to confirm that all the video stages have the correct response. You simply look at the CRT screen to see if all the bars are getting through to the output. Next, we'll learn how to interpret the results.

How To Test Response By Looking At the CRT.

Figure 7 shows how to tell if each Multiburst Barsweep frequency has made it to the CRT. You know a frequency has reached the CRT if the bar shows detail in the form of black and white vertical lines. In addition, the brightness (white level) of each bar shows how the gain at one frequency compares to the others. Simply lower the brightness or contrast controls to see whether all bars have the normal brightness level. Restricted bars will turn dark before the others.

A



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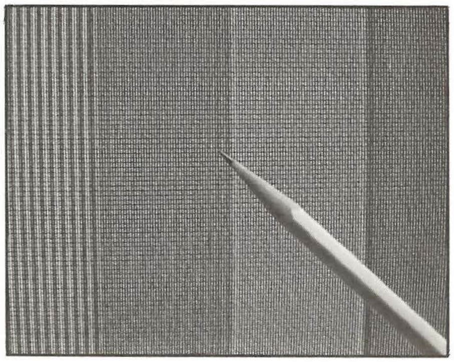

Fig. 7: Look for individual black and white stripes to tell if a test bar has detail. a) Stripes indicate the 3.0 MHz bar is present, b) Poor response results in a gray bar.

To identify frequencies, use the ''Interrupt'' buttons. Simply, reach up to one of the buttons, and watch the CRT as you turn a bar off or on. If the bar wasn't the one that you wanted to identify, move over a button or two until you are interrupting the one you want. Then, just look above the button and read the video frequency of the test bar. Now, let's see what to consider normal response.

A color TV receiver should show video response to 3.0 MHz when feeding through the antenna. The 3.5 MHz bar must always be filtered (show no detail) to confirm that the color trap is working correctly. The 4.5 MHz should be trapped as well.

A high resolution monitor with a direct video input (which bypasses the tuner) may show video response as high as 4.0 or even 4.5 MHz. Even in these monitors, however, the 3.5 MHz (color) signal should show no detail, since the color signal still must be trapped from the video circuits.

Most black and white sets only show video response to 2.0 or 2.5 MHz. The lower bandwidth gives the appearance of added sensitivity, since high frequency noise is filtered in the video circuits.

In each case, the Multiburst Barsweep tests every video circuit from the input, right to the CRT. Simply, look at the CRT to see whether the circuits show normal response.

Isolating Problems

Use the VA62A's signal injection features to isolate the cause of the poor picture. The RF/IF Generator lets you inject modulated signals into the antenna or any IF stage. The Drive Signals section lets you inject composite video into any stage after detection, using the ''Video Pattern'' drive signal.

You simply watch the screen as you inject substitute signals. If the pattern returns to normal, you know that you are injecting the VA62A signal AFTER the defect. If the screen still shows a problem, you know that the VA62A's good signal is affected by the defect, proving that you are injecting ahead of the problem. The defective stage is the one that gives *good results* when injecting at its *output,* and *bad results* when injecting at its *input.*

You don't need to disconnect components when substituting signals from the VA62A, because it swamps out the existing signal. When injecting into stages after the video detector, remember to leave the VA62A RF cable connected to the antenna terminal. This provides sync for the the other stages, allowing the phase-locked substituted signal to lock properly onto the screen.

For more information
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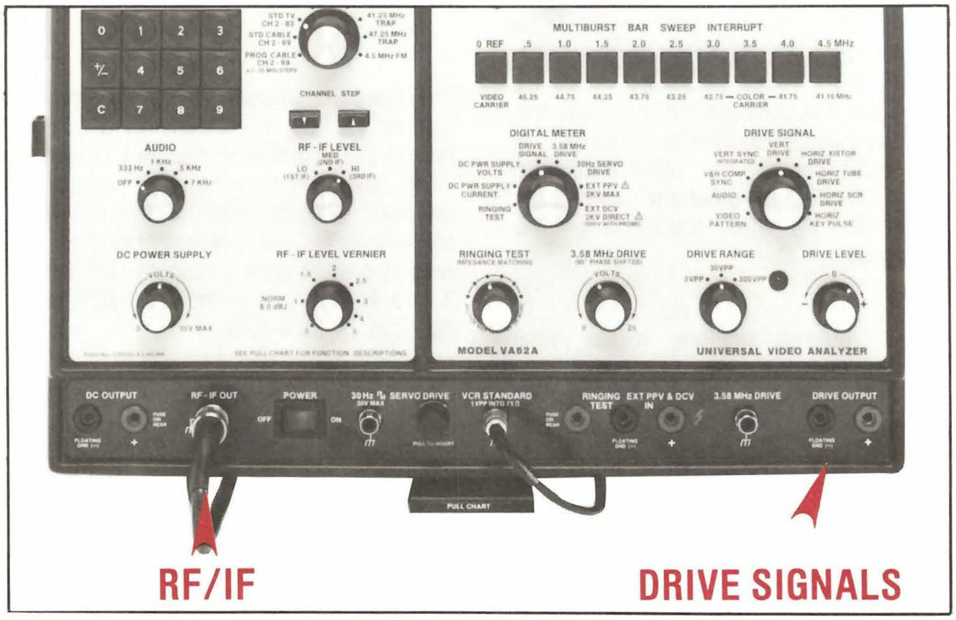

Fig. 8: You identify the bad circuits by injecting substitute signals from the VA62A and watching for an improvement in the picture. Circuits before the video detector receive signals from the RF/IF output (left), and circuits after the detector receive signals from the Drive Signals section (right).

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