SENCORE NEWS

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Issue #147 Nov./Dec. 1989

The All New Audio Analyzing Team For The 1990s—Gives You More Capability Than Any Other Instrument Combination . . .

New

SG80 AM Stereo - FM Stereo Analyzer—Industry Approved; C-QUAM; Makes AM Stereo And FM Stereo Look Alike To Simplify Servicing ***page 4***

New

PA81 Stereo Power Amplifier Analyzer—The Missing Link In Audio Analyzing; Walks Troubles Out Of Any Power Amplifier ***page 22***

New

PM82 Powermax 5 kW EIA/IHF Audio Power Multiplier—Increases Your Power Amplifier Analyzing Capability ***page 9***

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Extended Fall Specials Page 16

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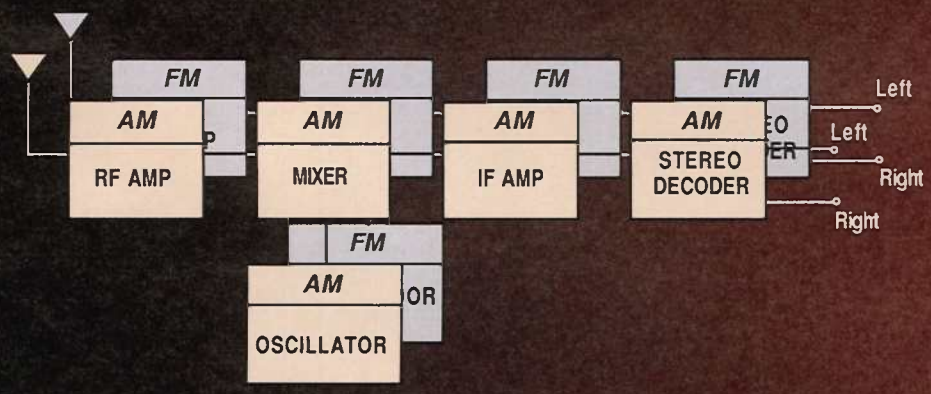
- Twice the capability for less than 1/2 the cost of stand-alone test instruments.



New

"Makes AM Stereo and FM Stereo look alike—simplify servicing with the SG80"

SG80 AM Stereo-FM Stereo Analyzer ™

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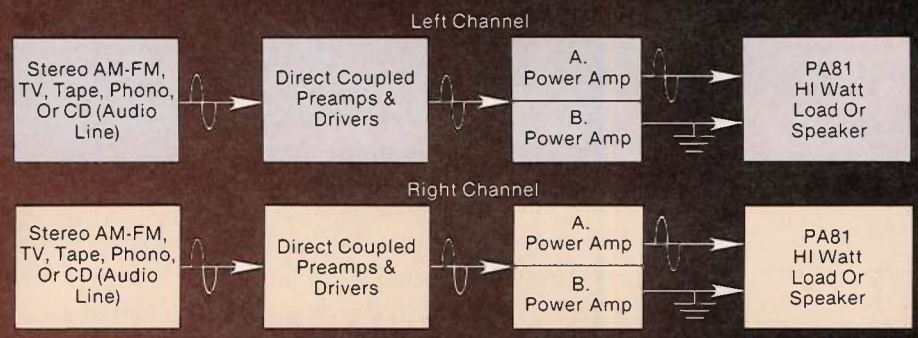

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Why Is An Analyzer Required To Be Successful When Servicing Modern Receivers?

by Brian Phelps, Marketing Communications Writer

> "The SG80 is the latest in receiver analyzers— it supplies all the signal required for substituting in every tuner, receiver, or car radio ever manufactured."

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Let's look at the classification of existing servicing tools. The majority of the instruments we've found servicers to be using are classified as generators. They provide limited signal formats and levels, no true troubleshooting signals, and can be fairly expensive. Typically, generators are designed by or for audio product engineers to be used in the design labs. Unfortunately, you may even see some of the service literature developed around these engineering generators.

The key to remember here is that generator requirements are different. Even though engineers may have many of the same needs as servicers, they still specialize with one product and one design question. Engineers are dealing more with products that have never worked before, and they are searching for design defects or limitations.

Let's look at some of the key areas where a standard generator falls short when it comes to servicing AM and FM stereo receivers. First, most generators provide either AM or FM RF frequencies only. If you want to service both signal formats you would need two generators, each with its own leads and special instructions.

Most Older Generators Don't Provide The Accuracy Or Stability Required To Analyze Modern Receivers

Next, most generators use LC type oscillators which are prone to frequency drifting. The servicer must tune in the digital receiver and then "tweak" the generator in for the best audio. Some generators even supply an internal frequency counter to digitally display the frequency, but you must still "tweak" the carrier frequency as the LC oscillator drifts.

Finally, if you've looked at a receiver's specification sheet lately, you'll see some pretty impressive specifications listed. You can expect to see sensitivity of 15 dBf, separation of greater than 50 dB, and signal-to-noise of 76 dB or greater. We've found that with the new technology used in modern receivers, the receiver is actually testing the older generators operation. To completely and accurately test to this degree of specifications you need more than a standard AM or FM generator.

Answering all the specific troubleshooting, performance testing, and alignment needs of audio servicers requires more than a simple generator. It also requires the abilities to test from the front end to the audio outputs, and to inject into key points of the receiver to isolate defects. This can

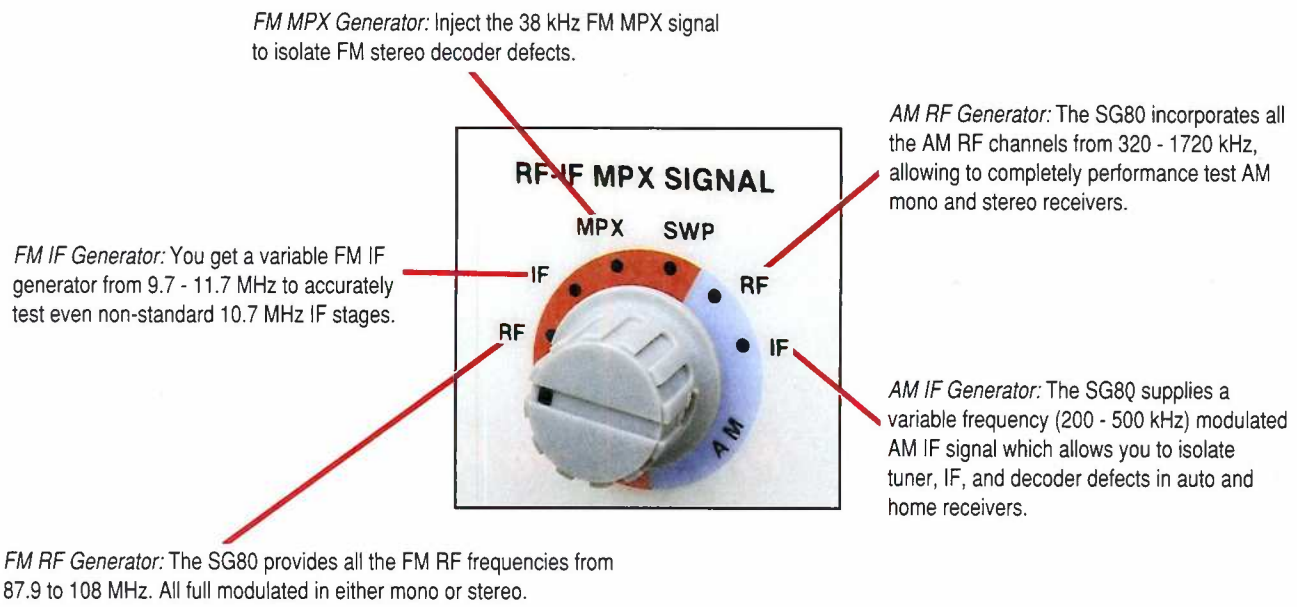


Fig. 1: Only the SG80 AM Stereo - FM Stereo Analyzer provides all the signals of standard generators and the convenience of one fully integrated unit to solve the profitable receiver servicing challenges.

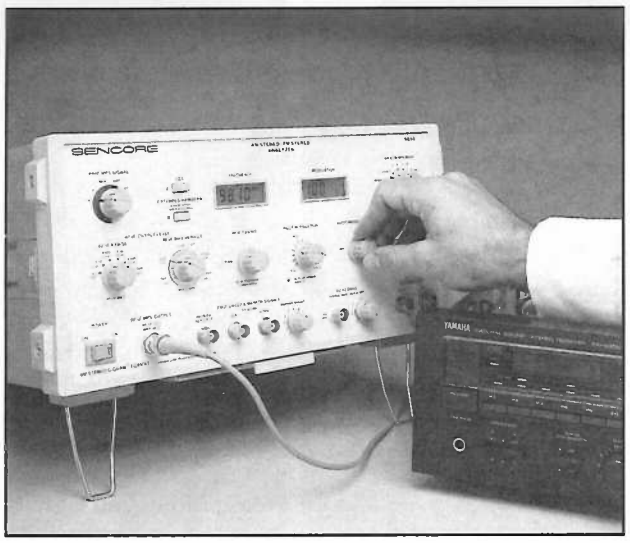


Fig. 2: The SG80 provides all the internal specifications and external features to confidently return repaired receivers to your customers.

only be accomplished by an *analyzer* designed for the servicer.

The answer to your needs is here, with the **All New SG80 AM Stereo - FM Stereo Analyzer—** "Now, For The First Time, A High Performance, AM Stereo (C-QUAM) - FM Stereo Analyzer, Integrated Into One Unit, Allowing You To Performance Test, Troubleshoot, And Align To Manufacturers' Requirements."

Here's what the SG80 provides for you:

- Complete AM Stereo - FM Stereo Analyzer—exceeds manufacturers' requirements
- Patented FM analyzing signals isolate any FM receiver defect
- Exclusive integrated AM Stereo C-QUAM analyzer
- Digitally accurate performance tests meet EIA/IHF requirements
- Exclusive, tuneable FM-IF Sweep and Markers—aligns all IF stages
- Expandable FM features for future service needs, plus SCA compatible
- Twice the capability for less than 1/2 the cost of stand-alone instruments

Imagine all that combined into one instrument! The SG80 is the only complete AM Stereo And FM Stereo analyzer on the market today. Read on to see how you can use the SG80 to solve tough, even hidden, receiver defects.

Functional Analyzing (Signal Injection) Should Be Used To Give You The Success You Demand In Your Business

When we introduced the SG80 AM Stereo - FM Stereo Analyzer we actually introduced two new ideas to the AM/FM receiver service industry. The first and most obvious is the product itself, supporting patents and several exclusive, time-saving analyzing features. The second introduction is the advanced functional analyzing approach to troubleshooting in the audio service industry.

Functional analyzing is simply the use of signal injection and signal tracing to isolate defects. The SG80 provides all the signals needed for injecting from the antenna terminals to the audio stages.

NOTE: *The PA81 Stereo Power Amplifier Analyzer is used for signal tracing, and is the complimentary unit to be used with the SG80.*

Your first thoughts on signal injection may be:

How and why does it work?
Or, how can one instrument provide all the signals for receivers from Akai to Yamaha?

These are good questions. First, let's look at the history of signal injection and how it fits the SG80 AM Stereo - FM Stereo Analyzer.

Sencore first introduced signal injection to receiver servicing with our SG165 AM/FM Stereo Analyzer in 1971. Since its introduction we've sold over 7,000 stereo analyzers, with hundreds of thousands of audio products having been serviced. The SG80 is the latest in receiver analyzers and supplies all the signals required for substitution in every tuner, receiver, or car radio ever manufactured.

Signal substitution allows the working functional blocks to operate normally by supplying the correct input signal. Supplying a signal to the antenna terminals is one form of signal substitution.

The key to remember when substituting signals is to look for improvement in the operation of the receiver.

For example, if the tuner section of a receiver is defective and not passing any signal, you won't see normal operation when supplying a signal to the antenna terminals. However, when you inject an IF signal from the SG80 at the output of the tuner, you'll see normal operation return to the receiver. This identifies the tuner as containing the defect.

The SG80 AM Stereo - FM Stereo Analyzer Provides All The Signals You Need To Troubleshoot Any Section Of The Receiver

But how can one instrument provide all these signals? If you were to look at any receiver ever manufactured, you would see that it has the same basic stages as any other receiver. They all have a tuner, IF, detector and stereo decoder. At the inputs and outputs of these stages or blocks, each and every receiver will have the same signals, only different levels. These signals are provided by the SG80 AM Stereo - FM Stereo Analyzer.

The SG80 provides the FM RF signals from 87.9 to 108 MHz, FM IF signals variable from 9.7 to 11.7 MHz, FM MPX, and FM SWP to align FM IF stages. Plus, you get AM RF signals from 520 to 1720 kHz and AM IF variable from 200 to 500 kHz. All of these signals may use any combination of modulating signals to test every operation of the receiver. The SG80 also provides audio tones (400, 1kHz, and 5kHz sine or square) for injecting into any audio amplifier stage.

If a service technician were to try to memorize the circuit operation of each manufacturer's receivers, he would be undertaking a tremendous task. This is not the most practical means of servicing and is the reason for service literature.

To help simplify your troubleshooting, one important tool you should use to help relate all the receivers to each other is the Universal AM Stereo And FM Stereo Block Diagram as shown in Figure 4.

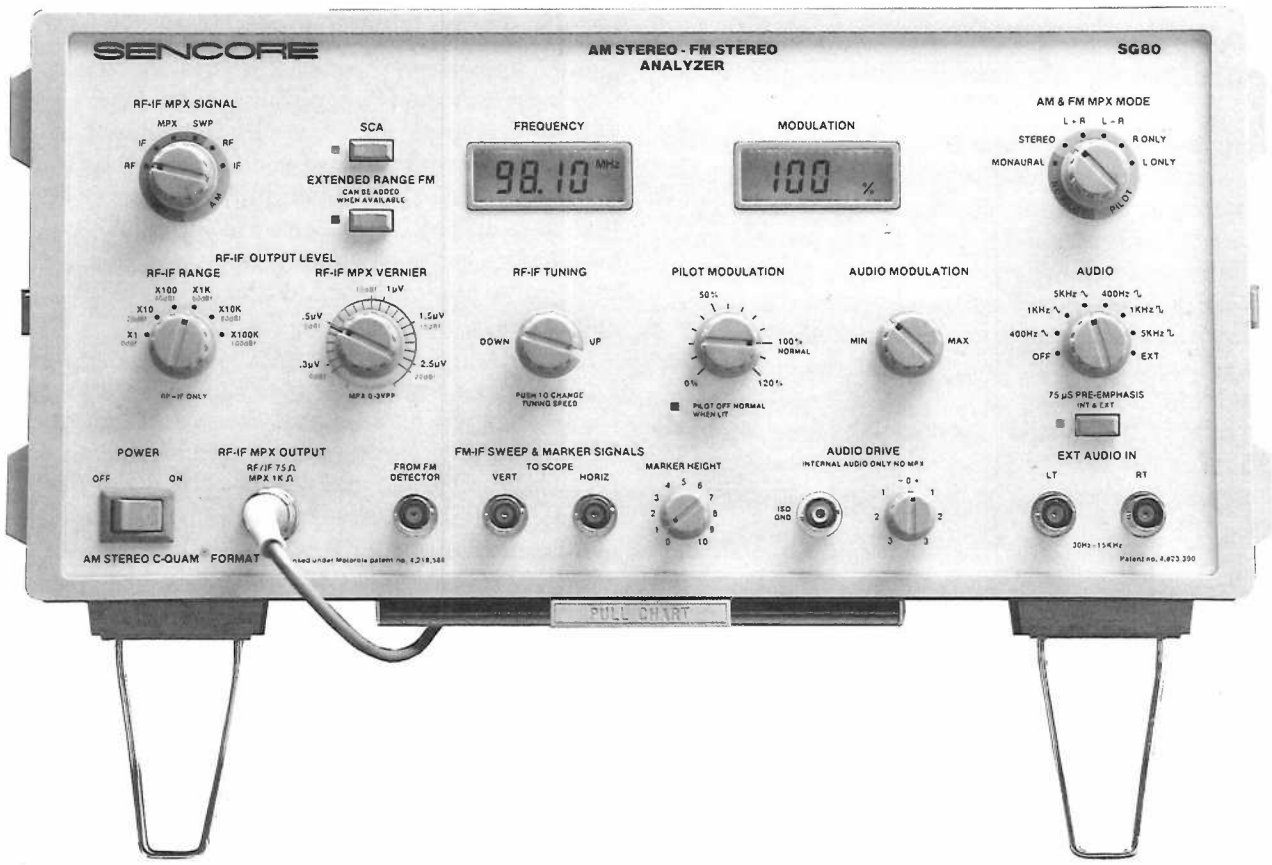


Fig. 3: You get all the signals required for injecting in any AM or FM receiver from the antenna terminals to the audio stages.

NOTE: *For the remainder of this article we will be using the AM analyzing capabilities of the SG80 to highlight and simplify its operation. Future issues of the Sencore News will be devoted to troubleshooting both AM and FM receivers.*

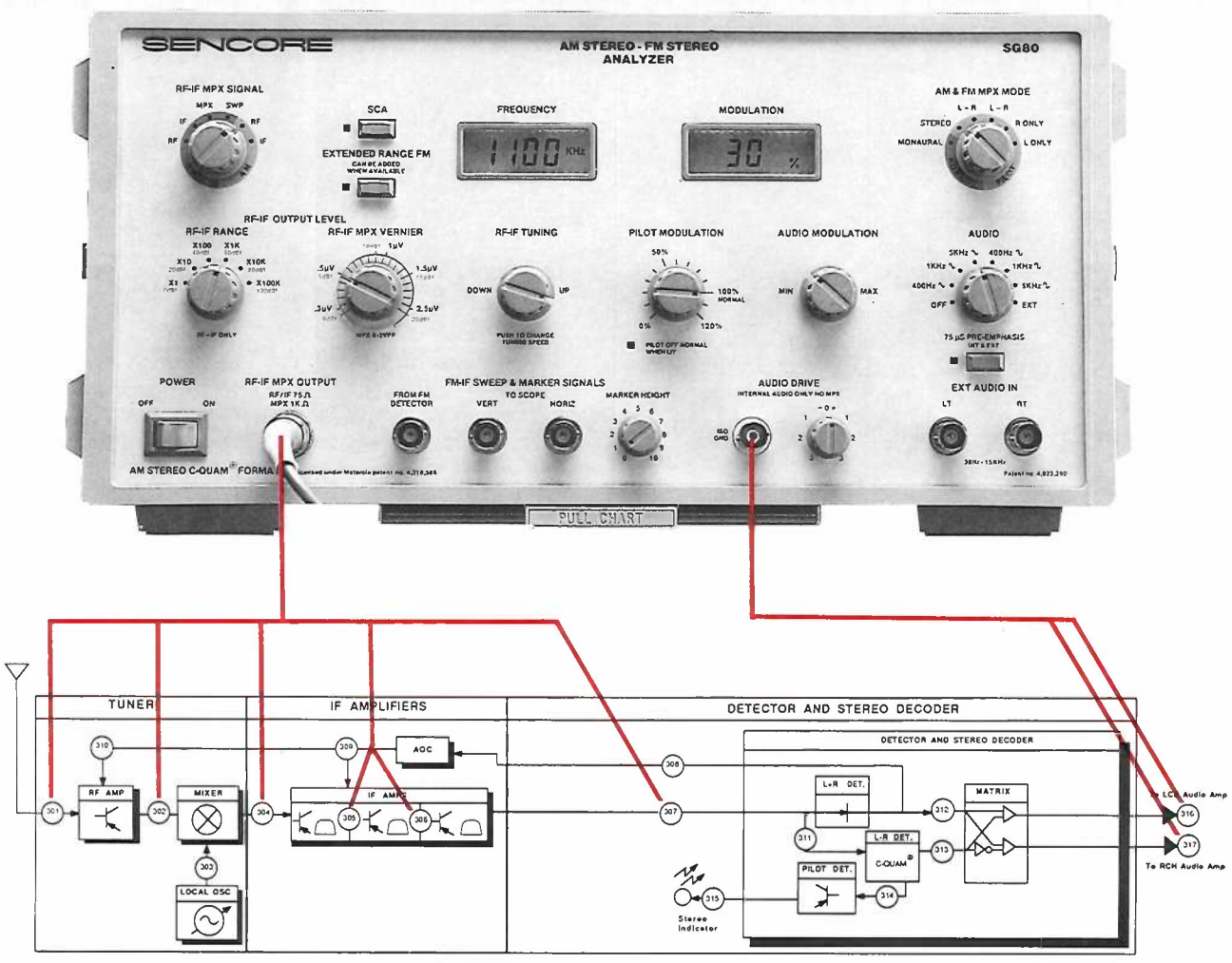


Fig. 4: Use the Universal AM Stereo And FM Stereo Block Diagram to relate all AM receivers to one common troubleshooting tool. Then, use the SG80's signals to isolate any defect to the individual stages.

Use The Universal AM Stereo Block Diagram To Help Relate All AM Mono Or Stereo Receivers

The Universal AM Stereo Block Diagram contains three main sections; the tuner, IF Amplifiers, and the detector and stereo decoder. Every receiver's tuner section uses an RF amplifier to provide gain of the incoming RF signal. In order to produce the correct IF frequency, the incoming signal is mixed with a local oscillator tuned to either 455 kHz or 262 kHz above the incoming signal's frequency.

The output of the mixer produces the four combinations of the two signals (input, local oscillator, sum, and difference). The difference frequency will be equal to the IF frequency of the receiver. The IFs then amplify and filter any unwanted signals to produce the cleanest possible signal. The output of the IF amplifier is fed to the detector and stereo decoder circuits where the modulated signal is converted to audio. The audio is then fed directly to an amplifier that may be in the same unit or connected by external cables. (See the article by Rick Meyer on page 7 for an in-depth explanation of AM Stereo C-QUAM operation.)

For a better understanding of signal injection and the use of the Universal AM Stereo - FM Stereo Block Diagrams, let's walk through a typical receiver application and see how the SG80 AM Stereo - FM Stereo Analyzer can solve even mysterious defects with ease.

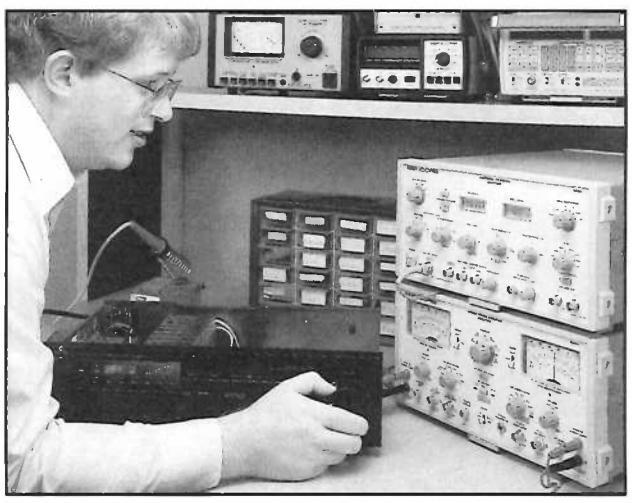


Fig. 5: When using the SG80 to signal inject, simply monitor the receiver's output for an improvement in operation. This quickly identifies all working and non-working stages of the receiver.

Solve Poor Stereo Separation Defects As Easy As 1, 2, 3!

Let's suppose you are working on a Delco car radio, or maybe you have one in your shop already—the customer's symptom is the AM Stereo sound is not as good as it used to be. You know from past experiences that this description can lead to a defect in almost any section of the radio; the tuner, IF, stereo decoder, or even the audio amplifier. Using the SG80 AM Stereo - FM Stereo Analyzer's signal injection technique and the Universal AM Stereo Block Diagram, let's see how quickly you could isolate this defect:

1. Complete Performance Test: The first step before any in-circuit troubleshooting is done should be to completely performance test the receiver from the antenna to the audio stages. This is easily done with the SG80 AM Stereo - FM Stereo Analyzer by connecting to the antenna terminals and testing the sensitivity, separation, signal-to-noise, and other key specifications. Record your test results and compare to the manufacturers' recommendations.

It is important to run a complete performance test whenever possible. By completing the test you may be able to isolate a defect to a particular stage. For example, if you know the FM works but the AM doesn't, you automatically can eliminate any common stages like the audio amplifiers. From the performance test you will know if the receiver is working and how good it is working. If for example, the separation tested low, you now have the key result area to look for improvement as you signal inject. Let's look at what we already know:

A. The receiver has poor separation.
B. The defect is somewhere between the antenna terminals and the audio stages.

That's not much to go on, is it? Or is it?

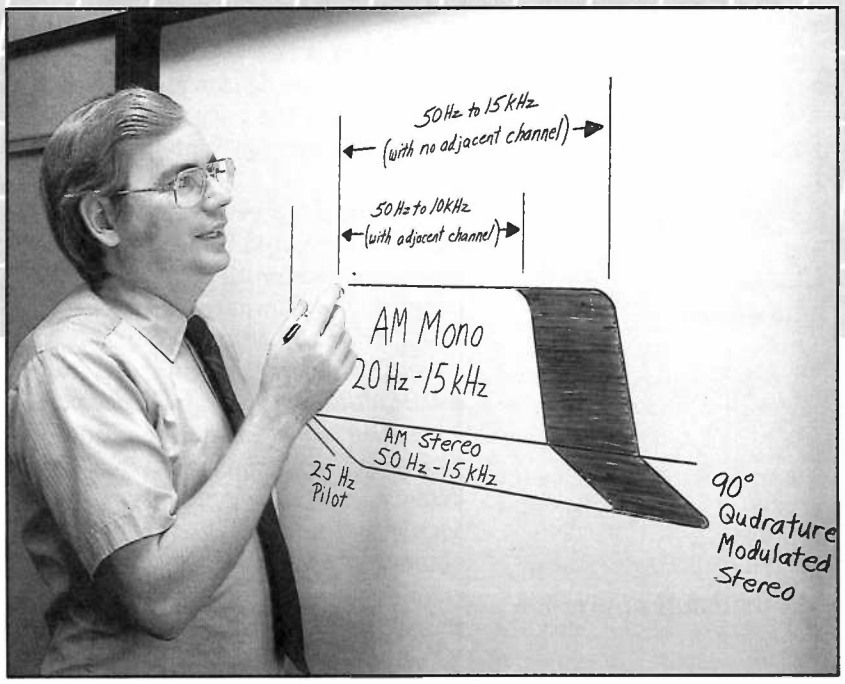
2. Isolate The Defect: The next step is to use signal injection and isolate the defect to either the tuner, IF Amplifier, or detector and stereo decoder stages. This is done by monitoring the speakers' outputs for improvement as you inject a known good signal at the various stages.

In this example, when we set the SG80 for AM IF and injected at the IF input there was no improvement in the response of the receiver. We then proceeded to the output of the IF amplifiers. As soon as we connected to the test point, we regained our separation. This positively identified the IF amplifiers as our defective stage.

3. Replace The Component, Performance Test, And Return To Your Customer: You've already done the toughest part of servicing the receiver (locating the defect). Now, all that remains is to replace the defective component and retest the receiver.

To maintain the quality service expected by your customer and demanded by yourself, it is best to complete a written performance report card. The report card not only guarantees that you've caught every defect, but provides a copy of the receiver's operation for the customer, increasing their perceived value of your services. Plus, the SG80's computer operation allows you to run a complete performance test automatically in a matter of minutes. (The PA81 Stereo Power Amplifier Analyzer is also automated for direct readout of performance results.)

The SG80 AM Stereo - FM Stereo Analyzer is the only true answer to the receiver servicing challenges you encounter on a daily basis. In fact, it's the only AM Stereo - FM Stereo analyzer on the market that is truly "Innovatively Designed With Your Time In Mind". Plus, the SG80 makes FM Mono/Stereo and AM Mono/Stereo receivers as easy to service as 1, 2, 3. Call today, toll free **1-800-SENCORE** and reserve your SG80 AM Stereo - FM Stereo Analyzer and start cashing in on your true audio service potential. ❐



Learn How C-QUAM AM Stereo Works

by Rick Meyer, Application Engineer

> "The "Big Three" auto manufacturers have adopted C-QUAM as their standard for AM Stereo."

In June of 1977, the FCC officially announced that it would consider proposals for AM stereo broadcast systems. The FCC, however, set down some objectives that they felt must be met by any AM stereo system. Their main objectives included compatibility with existing AM systems, compliance with existing bandwidth limitations, simplicity of design, and the maintaining of existing service range and reception quality.

After years of debate and testing, C-QUAM, an AM Stereo system developed by Motorola, won widespread acceptance by key manufacturers. The "Big Three" U.S. auto manufacturers have adopted C-QUAM as their standard for AM Stereo. Let's see how this widely accepted AM Stereo system works.

Quadrature Modulation Solves The AM Bandwidth Problem

All modulation can be represented by a combination of in-phase and out-of-phase signals. Engineers call the in-phase signal the "I" signal and the out-of-phase signal the "phi" or "Ø" signal. A perfect AM signal with no distortion consists of only "I" signals. FM, on the other hand, causes the phase of the signal to constantly change and, thus, consists of "Ø" signals. AM Stereo uses a combination of "I" and "Ø" signals to transmit both the L+R and L-R signals. Since the "Ø" signals are modulated with a *90° phase shift*, we will call these signals "Q" signals for Quadratured (see Figure 1). The L+R information consists of the "I" signals and the L-R signal is quadratured and consists of out-of-phase, or "Q" signals. This is called a QUAM, for quadrature modulated signal.

At first glance, it looks quite simple to generate an AM stereo signal. Simply feed the L+R signal to the modulator of the AM transmitter and the L-R signal to a second modulator with the carrier 90 degrees out of phase with the first transmitter. A problem develops at the receiver, however.

The envelope detectors used on most AM receivers don't discriminate between in-phase and out-of-phase signals. They see the simple vector addition, or the RMS total, of the "I" and "Q" modulation. When only an L+R, or "I" signal, is present, there is no problem. Under stereo conditions, however, the envelope detector sees both the "I" and "Q" signal and the resultant signal appears highly distorted. C-QUAM, or compatible QUAM, was developed by Motorola to overcome this problem.

How C-QUAM Solves The Compatibility Problem

To understand how C-QUAM AM Stereo overcomes the problem with envelope detectors, let's see how the C-QUAM signal is put together at the transmitter.

The C-QUAM transmitter starts out by creating a QUAM signal and then modifies this signal to produce a compatible or C-QUAM signal. To do this, the left and right audio signals are combined together to form an L+R and L-R signal. These signals are applied to two balanced modulators to create "I" and "Q" signals (see Figure 2). The "I" modulator is fed a reference carrier signal and the L+R signal. The "Q" balanced modulator is fed a 90 degree phase shifted reference carrier signal and the L-R signal. The output of the "I" balanced modulator consists of the in-phase sidebands only. The output of the "Q" balanced modulator consists of out-of-phase sidebands only. These "I" and "Q" sidebands are combined with the original reference carrier signal to create the QUAM signal.

Now remember that a pure QUAM signal produces a distorted output from an envelope detector since the envelope detector sees the average RMS combination of the "I" and "Q" sidebands.

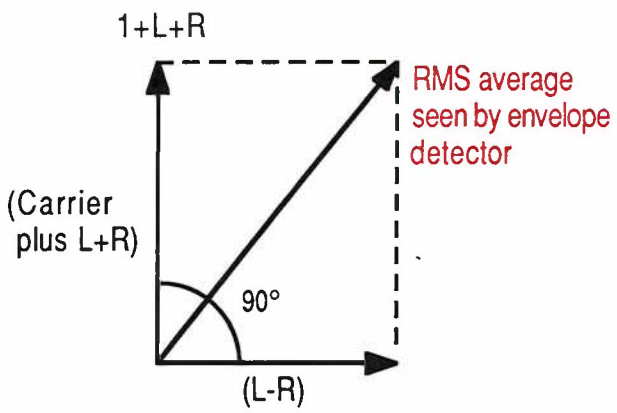


Fig. 1: A standard envelope detector found in mono receivers will detect the average RMS voltage of the "I" and "Q" signals resulting in a distorted output.

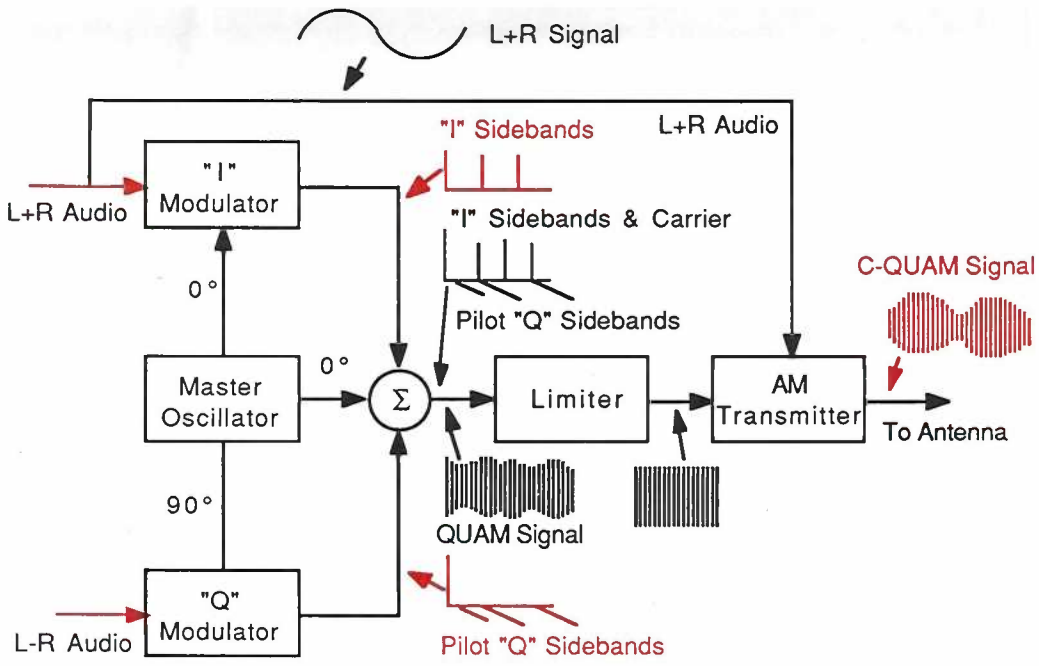


Fig. 2: The C-QUAM Transmitter uses a limiter to eliminate "I" signals and then AM modulates the resultant "Q" signal to give full compatibility.

To solve this, the C-QUAM transmitter feeds the QUAM signal through a limiter. The limiter clips the QUAM signal and removes the incompatible amplitude variations in the signal that would cause distortion from an envelope detector. All that is left are the phase modulated "Q" sidebands. These sidebands are fed to the transmitter and used as the RF carrier. This phase modulated carrier is then amplitude modulated with the same L+R information that originally modulated the "I" modulator. The end result is a signal that contains both the L+R and L-R signals and yet looks like L+R information only to a standard envelope detector.

As is the case with FM stereo, AM C-QUAM stereo uses a pilot to tell the stereo circuits that a stereo signal is present. In the C-QUAM system, a 25 Hz pilot is added to the L-R signal before it is fed to the "Q" balanced demodulator. This signal is detected in the receiver to turn on the stereo circuits. Figure 3 shows the complete C-QUAM signal including the quadratured AM Stereo and pilot.

Let's now look at the receiver and how it converts this C-QUAM signal back into the original left and right audio signal.

The C-QUAM Decoder Reverses The Signal Limiting Done At The Transmitter

If you were to look at a C-QUAM AM Stereo signal with an oscilloscope, it would look no different than a mono AM Stereo signal. A mono receiver using a simple envelope detector would extract the amplitude modulation L+R signal from the C-QUAM AM Stereo signal.

In a C-QUAM Stereo receiver, the signal is split into two paths. One path feeds to a standard envelope detector that extracts the L+R information (Figure 4). This signal is then fed directly to the stereo matrix decoder. The second portion of the signal is fed to a circuit called a gain modulator. The gain modulator can be thought of as simply a voltage controlled amplifier.

In order to understand how the decoding process works, lets assume that the gain modulator has a unity gain and the signal feeds through it with no change. The C-QUAM signal is then fed to both an "I" and a "Q" demodulator. The "I" demodulator compares the incoming signal to an in-phase reference signal. It extracts the equivalent L+R signal. The "Q" demodulator compares the incoming signal to a 90 degree phase shifted reference signal and outputs only the out-of-phase, or L-R signal.

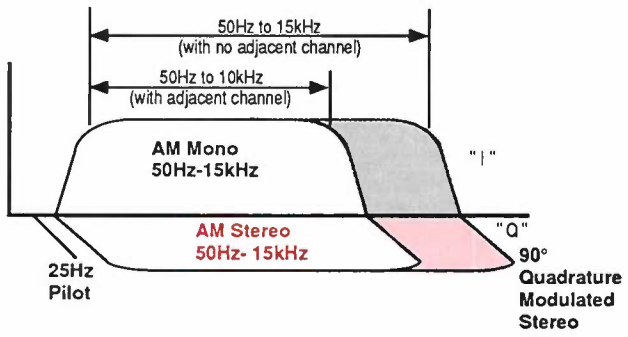


Fig. 3: The C-QUAM AM Stereo signal is supplied at the same frequency but in quadrature with the mono signal.

But wait! Remember what was done to the signal at the transmitter. The QUAM signal was run through a limiter and the L+R information was removed. The L+R information seen by the "I" demodulator is not really the L+R information that was fed to the "I" modulator at the transmitter. Rather it is the L+R information that was added after the Quam signal was fed through the limiter. Thus the output of the "I" and "Q" demodulators are not really the desired information.

In the C-QUAM receiver, the modified QUAM signal is corrected by feeding the incorrect L+R information from the "I" demodulator to a comparator. The comparator outputs a voltage if the signal from the "I" demodulator is different from the L+R information obtained from the envelope detector. This creates an error voltage. The error voltage is fed to the gain modulator which amplitude modulates the signal in a reverse manner. When the incoming signal is reverse modulated correctly, the L+R signal coming out of the "I" demodulator matches the L+R signal from the envelop detector. When this happens, the L-R signal from the "Q" demodulator is also correct.

The L+R signal from the envelope detector and the L-R signal from the "Q" demodulator is fed to the matrix decoder to produce the original left and right audio signals.

The C-QUAM Pilot Prevents False Triggering Of The Stereo Circuits

As was shown earlier, a pilot signal is fed to the L-R signal at the transmitter before it is fed to the modulators. In the receiver, the pilot signal is extracted from the L-R signal by a 25 Hz bandpass filter. The designers of the C-QUAM system wanted to ensure that the AM Stereo circuits did not randomly turn on and off due to short term variations in the signal condition. When a strong AM Stereo station is tuned in, the pilot detect circuit must detect at least 7 consecutive cycles before it will turn on the stereo circuits. This eliminates false triggering of the stereo circuits due to noise. If the signal conditions are bad, the pilot detect circuits look for at least 37 consecutive cycles before turning the stereo circuits on. This again prevents false triggering of the AM Stereo circuits. If the signal is lost, the pilot detect circuit counts for 7 cycles before turning off the stereo circuits. This prevents nuisance tripping of the AM Stereo circuits. Do you have questions about C-QUAM or AM/FM analyzing? Give your Area Sales Engineer a call at **1-800-SENCORE.** ❐

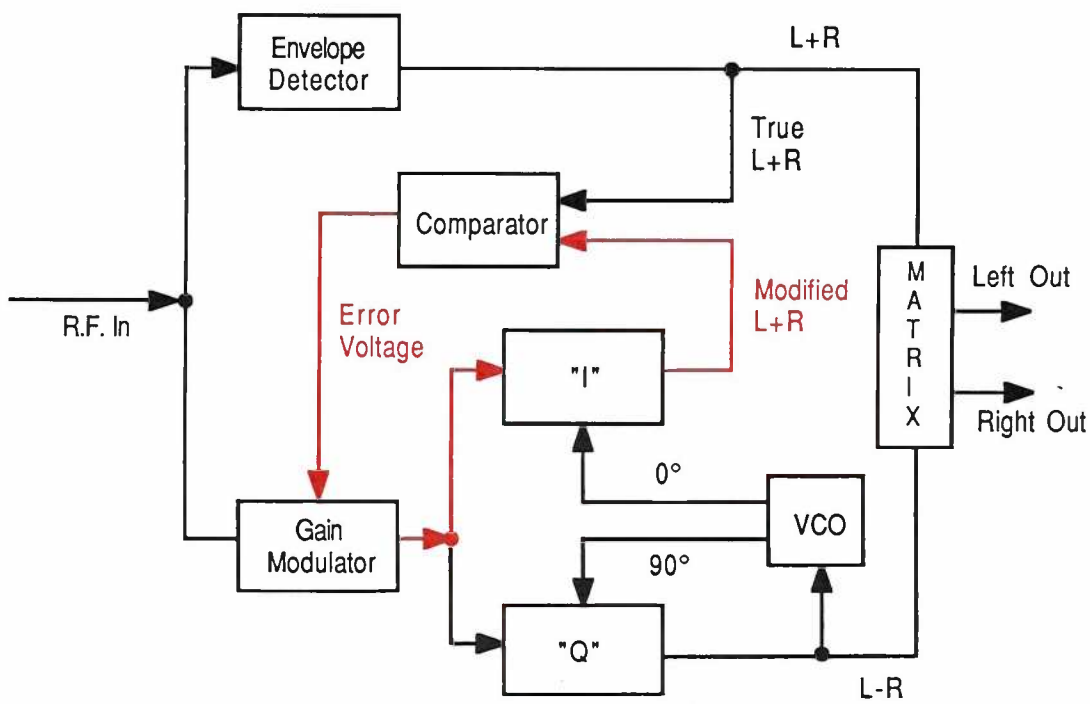
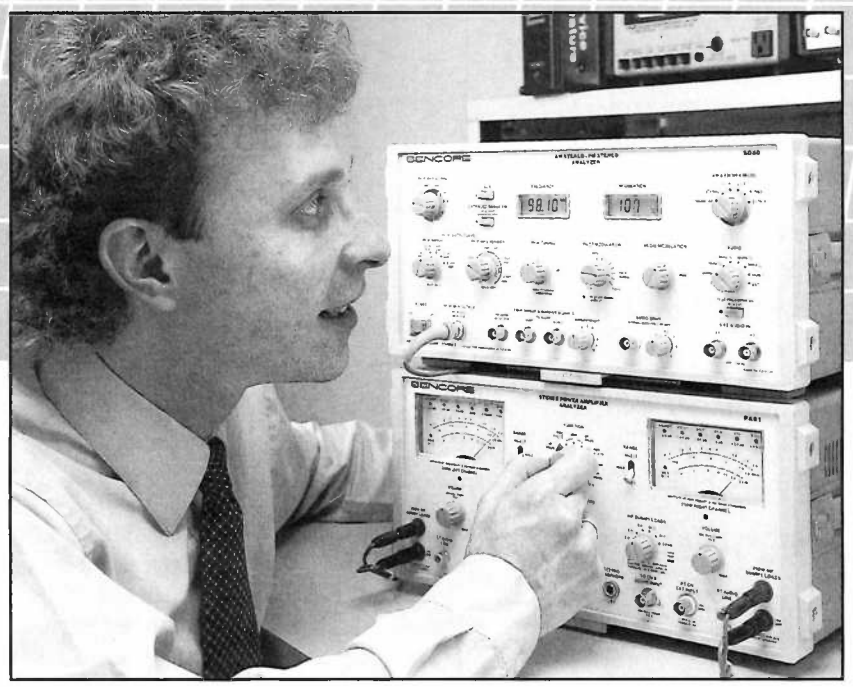


Fig. 4: The C-QUAM decoder corrects the modifications to the QUAM signal that was done at the receiver.



How To Test And Repair AM And FM Receivers With Sencore's New Audio Analyzers

by Greg Carey, CET

Sencore's new audio analyzers give you more capability than any combination of audio testers. The different Sencore units let you put together whatever capabilities you need for different analyzing needs.

A typical Sencore audio bench has two analyzers; a signal source and a signal tester. These two units replace at least 20 separate pieces from competitive sources. The cost of separate pieces is at least 3 times more than the Sencore Analyzers, not to mention the cost of the extra bench space.

Sencore's approach offers an even bigger benefit—the tests increase your productivity. Time saved translates to higher income per hour and, in turn, to better audio servicing profits.

This article covers three things: 1) Why Sencore offers different choices in signal testing, 2) The basics of the SG80 analyzer, and 3) How the SG80 and the PA81 work together to simplify your audio testing. We will start with an overview of Sencore's audio analyzing scheme.

> "Time saved translates into higher income per hour and, in turn, to better audio servicing profits . . ."

The Role Each Analyzer Plays

Sencore breaks audio analyzing into two roles: signal generation and signal testing. The SG80 AM-Stereo - FM-Stereo Analyzer generates the signals needed to service front ends, IF stages, detectors, and stereo decoders. Sencore offers several choices for the signal measurements, depending on your applications.

SG80	PA81
Low Noise RF Generator	2-Audio Wattmeters
AM Stereo C-QUAM Generator	2-Audio Voltmeters
FM MPX Generator	10-Load Resistors
Sweep & Marker IF Generator	2-Patch Boxes
Low Distortion Audio Generator	Intermittent Tester
Function Squarewave Generator	Line Tester
RF Level Meter	Computer Controller

Fig. 1: The two Sencore audio analyzers replace a minimum of 20 items on the typical service bench.

You design your Sencore audio bench to meet your requirements. If you have only one audio technician, you may fully equip one bench. If you have several technicians—each specializing in a different audio work—you can have different combinations of Sencore analyzers on each bench.

For example one bench might be reserved for servicing tuners. Another bench might be equipped to service power amplifiers. A third bench might be for high powered amplifiers.

If you service a fair amount of auto-sound or commercial audio equipment, you might also want your amplifier analyzer to be portable.

Testing Amplifiers

When you are testing a stereo system, you must have a way to monitor each stereo output. Some technicians use shop speakers to absorb the output power. Speakers are noisy, plus they have different impedances at different audio frequencies. This varying impedance affects tests.

Many technicians use a general purpose voltmeter to monitor the amplifier output. This causes several problems. First, most AC voltmeters don't have enough bandwidth for accurate readings at all audio frequencies. Second, voltmeters call for calculations, because the readings must be converted to power or decibels. Third, you need two identical meters to compare channels.

The Sencore amplifier analyzers correct all these limitations. Audio dummy loads eliminate the annoying howl of shop speakers. Their non-inductive design provides a constant impedance for all audio test frequencies. Ample power ratings let

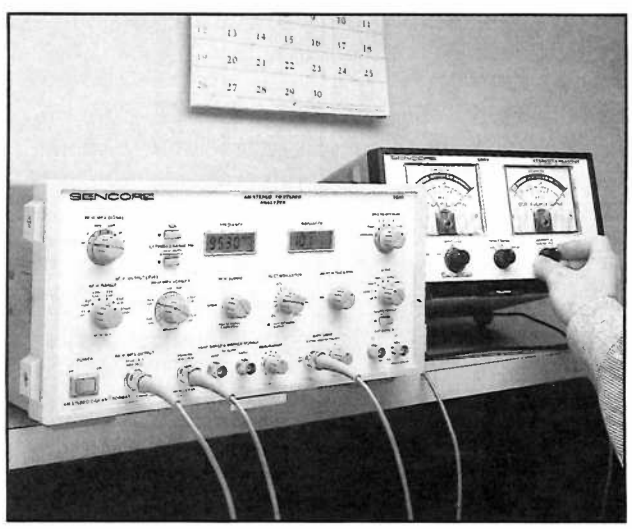


Fig. 2: The SR68 Stereo Readout Unit provides dummy loads usable to 100 watts and basic metering functions.

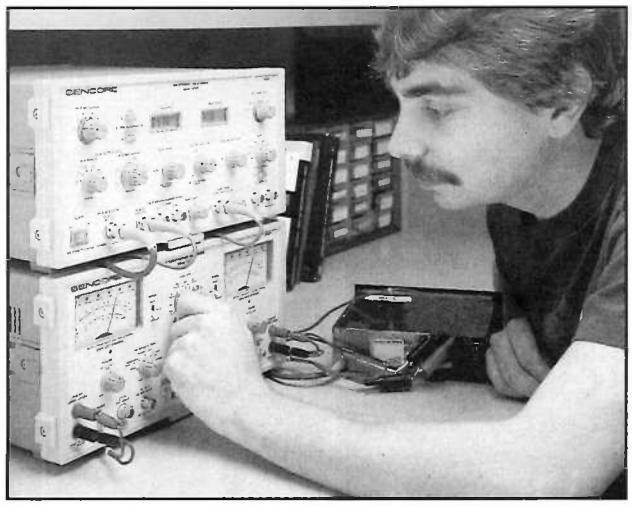


Fig. 3: The PA81 Stereo Power Amplifier Analyzer offers higher power (to 250 watts/channel) and more tests than the SR68.

you dynamically test amplifiers for extended periods to sweat out intermittents.

The dummy loads tie directly to two meters. You compare left and right outputs at a glance. Calibration is in watts and decibels to give direct readings at any test impedance.

The Basic Amplifier Tester

The SR68 Stereo Readout Unit provides basic amplifier tests for low-powered systems. It has non-inductive dummy loads with switch-selectable impedances of 4, 8, 16, or 32 ohms. It lets you test up to 20 watts per channel continuously, or 100 watts per channel for 5 minutes.

Its meters directly read power, with manually selected 10 and 100 watt scales. A third meter function reads decibels to 40 dB.

Since the SR68 is battery operated, you can take it into a car to test the receiver, external equalizer, amplifiers, boosters, and other parts of an auto-sound system. After you've determined which pieces are bad, you can bring the SR68 back to the service bench and power it from AC to find and fix the problem.

The PA81 Is A Full Analyzer

The PA81 Stereo Power Amplifier Analyzer provides a more complete answer than the SR68. First, its fan-cooled dummy loads are 5 times larger. The PA81 tests amplifiers at 100 watts continuous power, or to 250 watts per channel with reduced testing time. The loads are non-inductive for reliable results.

The PA81 lets you switch high-Q filters into the autoranging meter circuits to track down problems caused by power supply hum, subcarrier or CD clock leakage. It has a special programmable dB function which lets you automatically make decibel readings as high as 126 dB.

The PA81 adds troubleshooting features to the amplifier output tests. Measure RMS volts, decibels, or DC voltage at any amplifier test point. The two channels quickly compare a test point in the one amplifier to the equivalent test point in the other channel.

The PA81 has three indicators: 1. The autoranged meters, 2. Built-in speakers with independent volume controls, and 3. A dual-trace scope connected to the isolated output jacks.

A special DC protection circuit protects your amplifier from damage and helps find intermittent amplifier conditions.

Just like the SR68, the PA81 can be operated from a rechargeable battery for testing on location, whether in high powered auto-sound or sound reinforcement systems. AC power takes over back on your bench.

Testing High Power With The PM82

You might find that 250 watts per channel (or 500 watts when connected in parallel) is still too small for some of the amplifiers you service. If so, the Sencore audio system lets you go even farther. Simply add the PM82 "Powermax" 5KW Decade EIA/IHF Power Multiplier to your PA81 Stereo Power Amplifier Analyzer.

The Powermax soaks up 90% of the amplifier's power before feeding it to the PA81. Its fan-cooled, overload-protected load resistors bring your capabilities to 2500 watts per stereo channel or 5000 watts in parallel. The loads remain non-inductive, even at these amazing power levels.

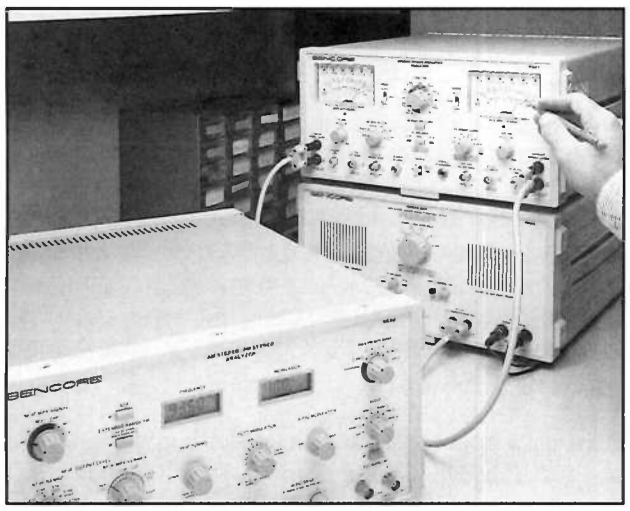


Fig. 4: Adding the PM82 "Powermax" to the PA81 extends its measuring range to 2500 watts per channel, or 5000 watts on monoaural units.

* FMX is a trademark of the FMX Company.

The PM82 case matches the PA81 and SG80 for component-type styling even when working with the "monster" systems.

You have many options when designing a Sencore audio bench. You can use the SG80 with the SR68, the PA81, or a combination of the PA81 and the PM82. The meters are portable for testing on-site. Back at the bench, the signal analyzers work directly with the SG80.

The SG80, Your Receiver Analyzer

Any of the signal analyzers team up with the SG80 AM-Stereo - FM-Stereo Analyzer to test or troubleshoot any receiver or tuner. Combining the SG80 and PA81 lets you zero in on bad stages with a combination of signal injection and signal tracing.

The SG80 is a fully integrated AM-Stereo - FM Stereo analyzer that meets or exceeds manufacturers' requirements for all testing and servicing. It is much more than an RF generator, however, since its exclusive analyzing signals let you inject signals into any front end, IF amplifier, stereo decoder, or audio stage.

The FM signals let you quickly divide sections to identify defective circuits. A patented multiplexing process exceeds broadcast standards so the SG80 signals are always correct.

Motorola-licensed C-QUAM AM signals test, align, or troubleshoot AM receivers which include these high-quality stereo circuits.

The digitally tuned generator lets you test the latest digital radios. An exclusive IF sweep test lets you test ceramic filters or IF stages, including those in receivers with user-selectable bandwidths.

An SCA signal lets you set FM traps. Plus the SG80 can be updated later if some form of extended range FM (such as the system proposed by FMX*) is ever accepted by the industry.

That explains the main SG80 tests. Let's now look at each section in more detail to understand how each of these tests gives more effective testing and troubleshooting.

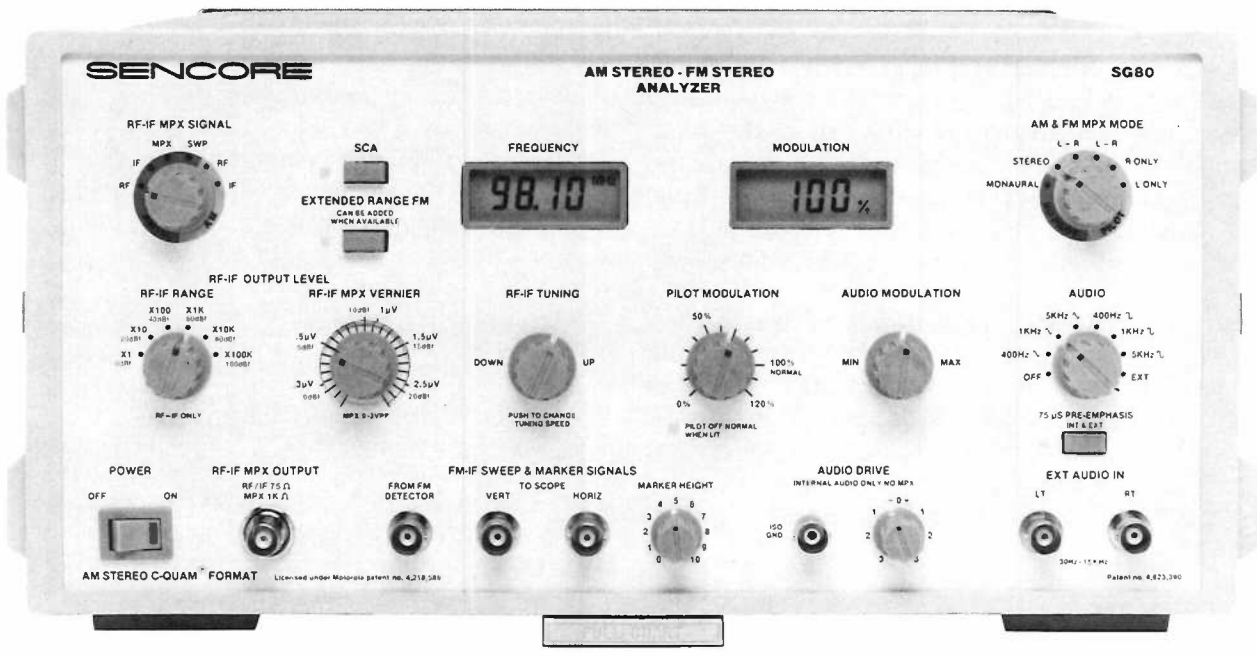


Fig. 5: The SG80 provides all the signals needed to isolate problems in any AM or FM stereo receiver.

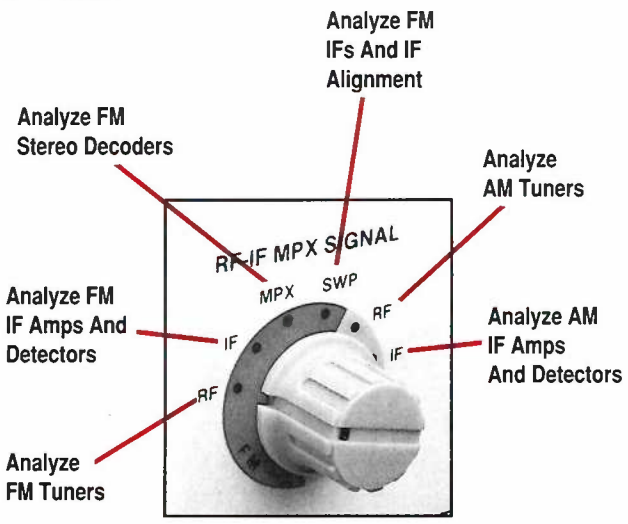


Fig. 6: The SG80 provides test signals to feed into any front end, IF amplifier, audio detector, or stereo decoder stage. This full analyzing capability lets you find any problem faster.

The SG80's Special Tests

First, let's look at the RF signals. These signals feed into the antenna, the RF stage, or the local oscillator to isolate front-end troubles. Since you have both AM and FM signals, you use the same methods to troubleshoot any front-end problem.

Second, the SG80 provides signals to troubleshoot IF circuits. The signals are crystal-referenced, but are also adjustable in frequency for testing ceramic filters tuned to different frequencies than the nominal 10.7 MHz for FM stages, or for the 262 or 455 kHz for AM radios.

Third, the SG80 produces stereo signals. The FM signal needs a separate switch position, while the AM signals do not because of the differences in the stereo systems. FM must have a separate "MPX" signal, because the subcarrier-based stereo decoder is after the FM detector. C-QUAM AM signals remain part of the substitute IF signal, because stereo is phase-modulated directly onto the carrier.

The SG80 gives you complete control of pilot level, audio modulation frequencies, audio pre-emphasis, and composite modulation. A digital modulation meter reads out total audio modulation.

With this understanding of the SG80 and PA81, let's see how to use them as a team to troubleshoot receiver problems.

Using The SG80 and PA81 Together

Troubleshooting starts with a performance test. The performance test identifies symptoms which direct your tests. You use the SG80 and PA81 to isolate the bad stage, and then have only a few components to test with conventional troubleshooting methods.

Most performance tests have three main steps: 1. Setting the SG80 to produce a reference signal, 2. Measuring the initial conditions, and 3. Reading the meters again after changing the SG80 signal.

The PA81's programmable decibel feature simplifies most of this testing. You use the PA81's programmable function for such tests as stereo separation (crosstalk), FM quieting, signal-to-noise, etc.

The key to this simplified approach is the way the PA81 stores a dB reference. The "dB PROG REF STORE" button becomes active when you select any of the 3 programmable functions. Pressing the button causes the internal microprocessor to memorize both channels' signal levels (*NOTE: they can each be a different level*) and makes them the new zero-dB points.

When you change the SG80's signal level or modulation, the autoranged PA81 meters show the dB change from the stored value. Simply read the meter for the final results. For example, if the meter shows a reading of "+6 dB" and the "-40 dB" range LED is lit, you algebraically add -40 and +6 for a final result of -34 dB.

Now, let's run through an actual test to see how this works. We will use stereo separation, since it is one of the most important measures of receiver performance.

To test for separation:

1. Feed the SG80 signal into the receiver's antenna. Connect the receiver's left and right outputs to the PA81's dummy load or line input.

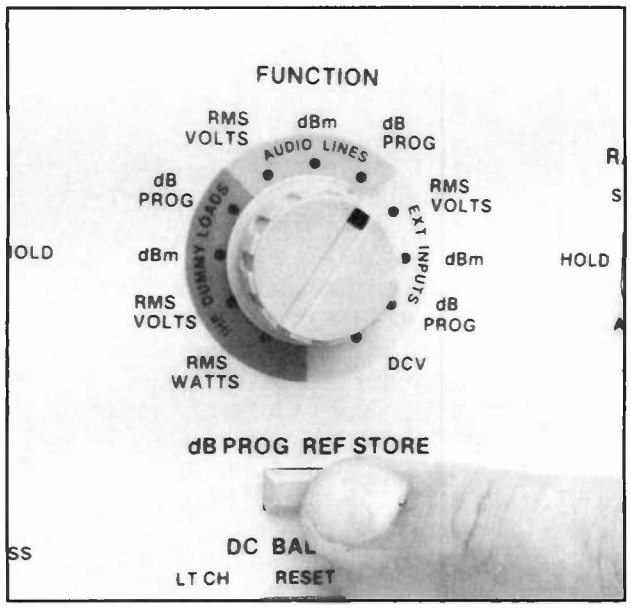


Fig. 7: The PA81's programmable dB function memorizes the reference signal level for each stereo channel when the program button is pressed.

2. Tune the receiver and the SG80 to an unused frequency in the band. (*NOTE: The standard frequencies called out in service literature are 98.1 MHz for FM or 1100 kHz for AM. The SG80 automatically tunes to these frequencies when you first apply power.*)

3. Set the SG80 output for a standard test signal level of 65 dBf (set the RF-IF Vernier to "5 dBf" and the RF-IF Range switch to "+60").

4. Set the SG80's AUDIO switch to "1 kHz", and its PILOT MODULATION control to its "100% Normal" position.

5. Set the SG80's AM & FM MPX MODE switch to the "L+R" position, which puts exactly the same amount of audio into both stereo channels. Adjust the AUDIO MODULATION control until the digital modulation meter reads 100%.

6. Set the FUNCTION switch on the PA81 to the programmable dB position which corresponds to the input used (line or dummy load). Press the "dB PROG REF STORE" button. The PA81 changes both meters to read zero dB.

7. Move the SG80's AM & FM MPX MODE switch to the "R Only" position. This removes all modulation from the left stereo channel.

8. Determine the amount of crosstalk in the left stereo channel (which, in theory, should be zero) by reading dB scale on the left PA81 meter.

That's all there is to a separation test. You can check the reverse separation by moving the SG80's modulation mode switch to the "L Only" position. Since the PA81 has already memorized the "L+R" value, you just read the right channel meter.

All other dB readings are done in the same manner. Set the SG80 to establish the dB reference, press the dB PROG REF STORE button, and change the SG80 to the second test condition. Then read the meter.

What do you do if there is a problem? If the symptom points to the audio circuits, switch the PA81 to one of the troubleshooting functions marked in blue on the panel. Then connect your troubleshooting probe to a test point associated with the symptom and make your test. If the signal is incorrect, you know the defect is in an earlier stage. Keep moving back towards the input until you identify the problem.

Since most problems only affect one channel, you can use the second PA81 probe to compare between the good and the bad channel.

If the problem could be in the RF, IF, or stereo decoder circuits, leave your PA81 set to monitor the output, and use signal substitution. Move your SG80 signal toward the output one stage at a time. Watch the PA81 meters as you inject the known-good SG80 signal at each test point. If the problem clears up after connecting to a new test point, you are injecting after the bad stage. Move back one stage and analyze the circuits.

After clearing all problems, do a complete performance test to confirm you haven't missed a problem. Then, re-align any circuits that may need a touch-up. That's all there is to it. ❐

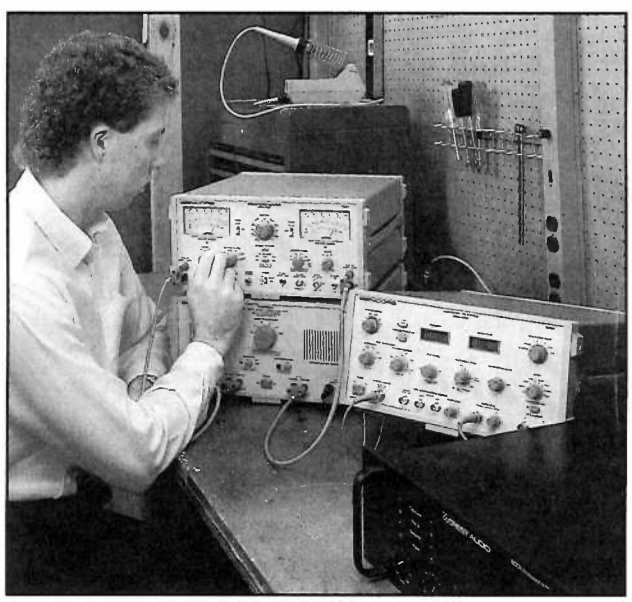
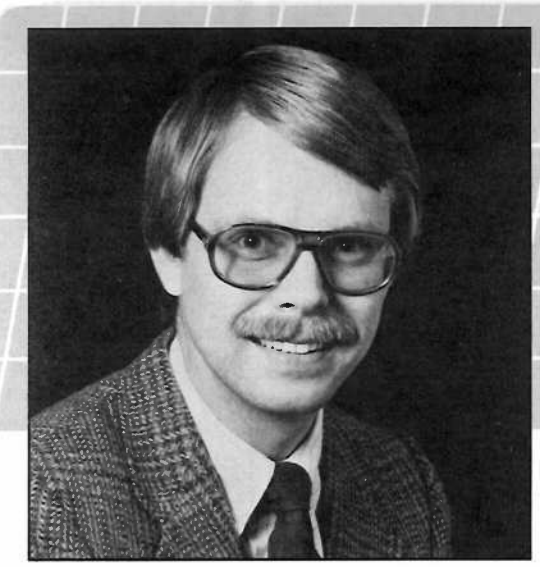


Fig. 8: The Sencore audio analyzers work together to make any audio testing, troubleshooting or alignment job easier.



Your Number One Tax Saver For 1989 — A Whopping $10,000 Test Equipment Write-Off

by Randy Koepsell, V.P. Finance

> "Tax Savings offer an excellent opportunity to improve your business . . ."

It's time for your year-end 1989 tax planning. The number one business tax saver is still the $10,000 write-off. Business equipment purchases up to $10,000 can be completely written off as a business expense in 1989 (IRS Code Section 179).

Basically, there are two individual tax brackets, 15% *and* 28%. This means that if you are in a 15% tax bracket, your net out-of-pocket cash for a $10,000 purchase is $8,500. In a 28% tax bracket the net is $7,200.

15% Tax Bracket
$10,000 x 15% = $1,500 Tax Savings
$10,000 – $1500 = $8,500 out-of-pocket cash

28% Tax Bracket
$10,000 x 28% = $2,800 Tax Savings
$10,000 – $2,800 = $7,200 out-of pocket cash

One limitation is that your taxable income must be at least as much as the equipment cost in order to take advantage of this. Assuming you meet the income requirement, *if you do not take advantage of this write-off you lose it for 1989.*

If you have already purchased over $10,000 of equipment you still have a tax savings opportunity. Business equipment purchased above and beyond the $10,000 can be depreciated. Generally, first year depreciation is 20% of the purchase price. First year tax savings on $10,000 of business equipment is $300 in a 15% tax bracket and $560 in a 28% tax bracket. Here's how the first year depreciation works:

$10,000 x 20% = $2000 depreciation

$ 2,000 x 15% = $ 300 tax savings the first year (15% tax bracket)

$ 2,000 x 28% = $ 560 tax savings the first year (28% tax bracket)

Note that you cannot expense equipment *and* depreciate it. It's one or the other, not both.

Tax savings offer an excellent opportunity to improve your business ($10,000 is an especially nice write-off). *Plan your business equipment purchases now* to maximize your tax savings and minimize your costs. In the process, you will be updating with the latest in electronic test equipment when you buy from Sencore. ❐

Sencore's Extended Fall Specials Savings

How to calculate your savings:	Enter Your Figures Here:	Example Special #3
STEP 1: Fill in the catalog price of the equipment you are interested in purchasing:		$7780
	Catalog Price	
STEP 2: Write in the amount of savings shown in our specials*:		$990
	Specials Savings	
STEP 3: Subtract Step 2 from Step 1 to find your net cost of the equipment:		$6790
	Your Net Cost	

*** This is what Sencore Saves You If You Order *Before December 29!***

$10,000 Write-Off Savings

The Number One Tax Saver For 1989: IRS Code, Section 179 lets you write off up to $10,000 of business equipment purchases as an expense. This means your investment in Sencore Test Equipment now, in 1989, can mean saving thousands on your tax bill!

	Enter Your Figures Here:	Example
Step A: Multiply your net cost from Step 3 times your tax bracket (15% or 28%) to calculate your tax savings using up to a $10,000 write-off.		$1901.20
	Net Cost x Tax Bracket	
Step B: Take the savings you calculated in Step 2 above, and add step A to it. This is your total savings.		$2891.20
	Specials Savings + Step "A" Above	

Depreciation Savings

The Second Way You Can Save: If you have already used up your $10,000 capital equipment write-off, the IRS still lets you depreciate your business investments. This allows you to update your equipment, plus write off some of the expense. It's as easy as A, B, C:

	Enter Your Figures Here:	Example
STEP A: Take your first year's depreciation of 20% on the amount in Step 3 above (Step 3 x 20%).		$1358
	20% x Your Net Cost	
STEP B: Multiply Step A by your Tax Bracket percentage (15% or 28%).		$380.24
	Your Tax Bracket % x Step "A" Above	
STEP C: Take the savings you calculated in Step 2 above, and add Step B to it. This is your *first year* savings! Plus, you can depreciate the remainder over the next five years!		$1370.24
	Specials Savings + Step "B" Above	
	Your First Year Savings	**Your First Year Savings**

All New Buyer's Guide

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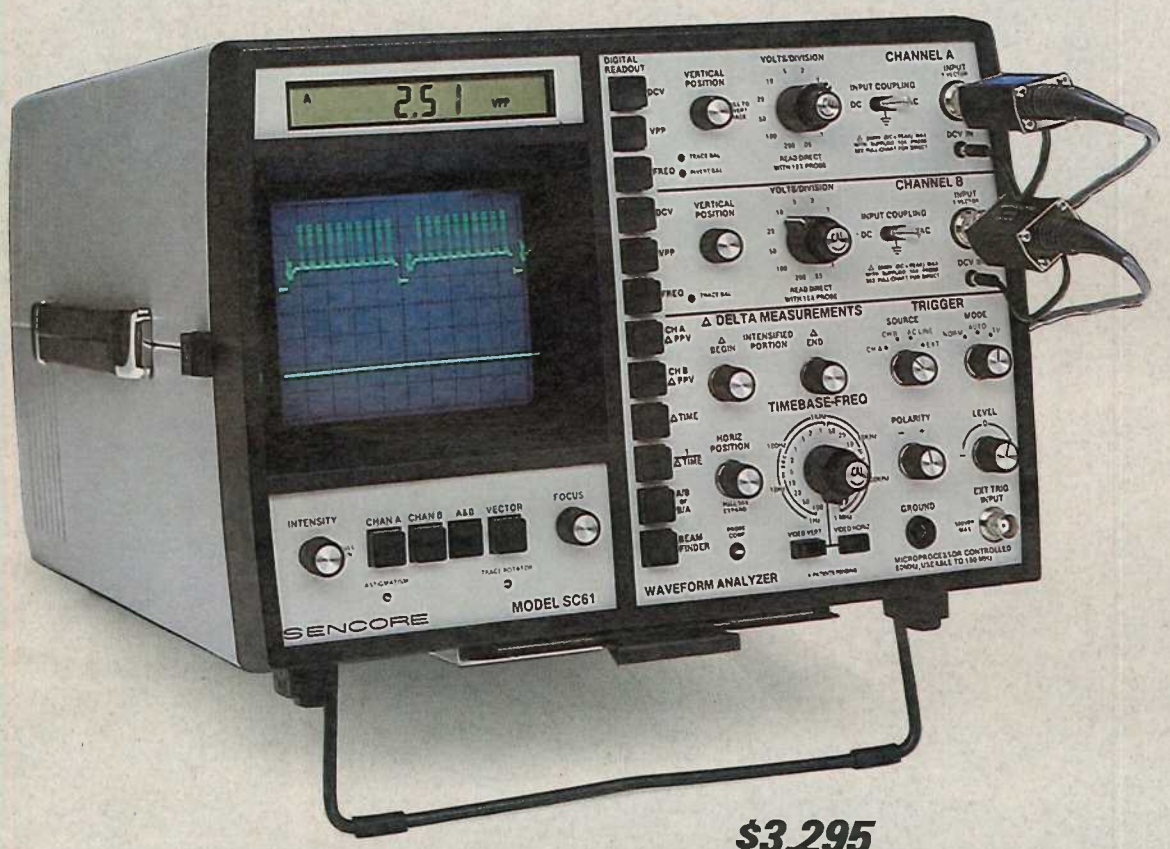
60 MHz (usable to 100 MHz) Dual Trace Waveform Analyzer



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- Automatic Peak-To-Peak Volts
- Automatic Frequency Measurements

Delta Digital Tests Analyze Any Part Of The Signal:

- Delta Peak-To-Peak Volts Of Any Part Of The Signal
- Delta Time For Any Time Reading
- 1/Delta Time—Frequency Of Any Part Of The Signal

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A Real Troubleshooting Confidence Builder. There are other digital readout oscilloscopes, but none completely eliminates graticule counting and calculations like the SC61 Waveform Analyzer. The SC61 gives you high performance, dual trace capability with 60 MHz bandwidth (usable to 100MHz). The innovative, time saving auto-tracking digital readout automatically gives you every waveform parameter you need for fast troubleshooting.

Fiddle-Free Operation. Spend your valuable time troubleshooting rather than fiddling with trigger controls. Innovative ECL (Emitter Coupled Logic) sync circuits allow you to quickly lock onto any waveform, and keep it locked.

Handle Four Times The Signal Level Compared To Any Scope. Safely and without worry measure from a small 5 mV all the way up to 2000 Volts Peak-To-Peak or DC, with protection to 3000 volts. No need to worry about expensive repair bills caused by excessive high voltage.

Human Engineered For Ease Of Use. Most scopes waste valuable time with complex set up procedures and interpretation errors. The SC61's innovative design allows you to quickly lock onto a waveform, and read DC volts, Peak-To-Peak volts, and frequency simply with the push of a button.

AUTOTRACKING™ Digital Accuracy. You can completely analyze any waveform up to 100 MHz 10 times more accurately than conventional oscilloscopes. The AUTOTRACKING™ digital display instantly gives you DC volts, Peak-to-Peak volts, , and frequency to accurately analyze any waveform parameter.

Innovative Delta Functions. Isolate interfering ripple on power supply lines, or analyze the frequency of a glitch on the leading edge of a squarewave with the exclusive Delta features. Measure Peak-To-Peak voltage, time, and frequency of just a portion of the waveform to quickly isolate problem areas.

Automatic Frequency Ratio Test. Just connect one probe to the input and the other to the output of multiply or divide stages, push the ratio button, and instantly read the ratio between the two frequencies.

Plus Many Extra High Performance Features• Dual delayed signal trace so you see the leading edge of the waveform on both channels. • Add, subtract or view both channels separately. • Post deflection, high intensity, blue phosphor 8 × 10 cm CRT provides (easy-to-view) trace, even under high ambient lighting conditions. • IEEE 488 Bus Compatible • Push button X-Y vector display with 4 MHz response for accurate phase comparisons. • Z-Axis input. • Beam finder. • TV VERTICAL and TV HORIZONTAL video preset positions with sync separators.

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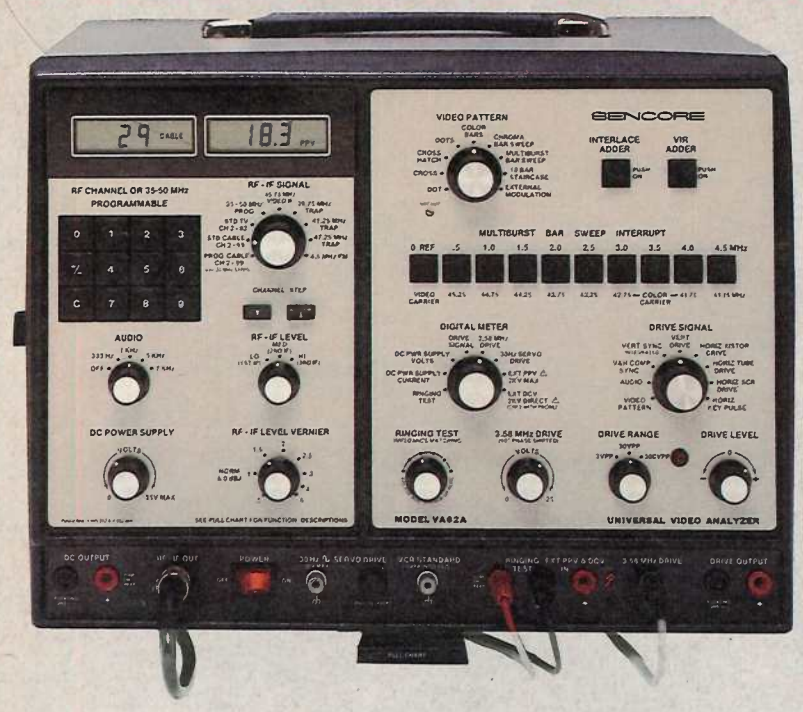
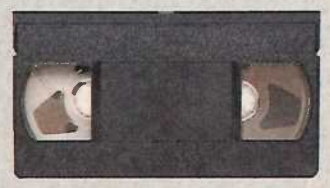
VA62A Universal Video Analyzer™





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Isolate Video Troubles In Half The Time With The Only Universal Video Analyzer.

- Identify tuner problems with all-channel VHF, UHF and Cable RF generator.
- Pinpoint IF troubles with modulated troubleshooting signal and exclusive programmable IF/RF generators.
- Isolate any problem with patented video and standard color-bar patterns.
- Find defective stages, without disconnecting parts, using exclusive phase-locked drive signals.
- Test yokes and flybacks, plus measure signal levels with autoranged digital meter.
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The Only NTSC Video Servicing System Guaranteed To Cut Your Servicing Time By 54% Or Your Money Back.*

The VA62A Universal Video Analyzer equips you for successful servicing in the expanding video market. It ends expensive parts substitution and eliminates embarrassing call-backs.

Eliminate Aggravating Tuner Questions. Tests for every VHF, UHF and cable channel to confirm the tuner is working correctly. Also lets you duplicate any cable carrier shift.

Dynamically Isolates IF Troubles. Patented signals let you set IF traps—a must for cable—by simply looking at the CRT. Plus, the VA62A lets you do full IF alignments without confusing cables or complicated adjustments.

Improved phase-locked video patterns simplify troubleshooting and alignment in convergence, color, and luminance stages:

- **Patented Multiburst Bar Sweep.** Shows video smear, reduced resolution, harsh picture edges, and ghosting, right on the CRT.
- **Ten Bar Staircase.** Isolates brightness and contrast problems; helps you align synchronous detectors.
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- **Interlaced and Vertical Interval Reference (VIR).** Exclusive signal adders modify any pattern to test digital vertical oscillators and automatic color circuits.

Patented Phase-locked Drive Signals. Isolate troubles without disconnecting components by substituting the signals needed to prove any tube, transistor, or IC stage good or bad.

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VC63 VCR Test Accessory™

The VC63 Solves The VCR Service Challenge With Substitute VCR Signals, Phase-locked To Your VA62A

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Quickly, Easily, And Accurately Test, Troubleshoot, And Verify Any Mono/Stereo Sound Or SAP Channel Or Your Money Back

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- Exclusive Adjustable RF/IF COMPOSITE SIGNAL And AUDIO Levels Match And Isolate Troubles In Any Stage—Including The Decoder
- The Only Tester Guaranteed To Tie Troubles Down To Any And All Stages

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Updates Your VA48 or VA62A Video Analyzer To Expand Into Analog/Digital Monitor Service

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- Exclusive Phase-locked Generator Locks The ST65 To Your VA48 Or VA62A For Rock-Solid Analyzing
- E-Z HOOK™ Leads For Fast Hookup To Separate R,G,B,I Inputs

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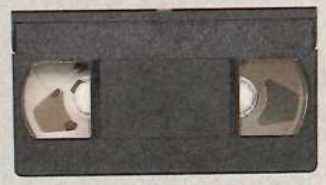

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- Test Every CRT (Old Or New) On The Market—No Need To Buy Additional Sockets
- Exclusive Tests Cover CRT's Full Dynamic Range, From Cutoff To Peak Emission—For Highest Test Reliability
- Guaranteed To Safely Restore 9 Out Of 10 Weak Or Shorted CRTs—Or Your Money Back
- Guaranteed To Be Totally Protected From Damage From Charged CRTs—Keeps Your Investment Working For You

Test Every CRT On The Market. The CR70 gives you the know how and confidence to test and restore every CRT of every type in use today.

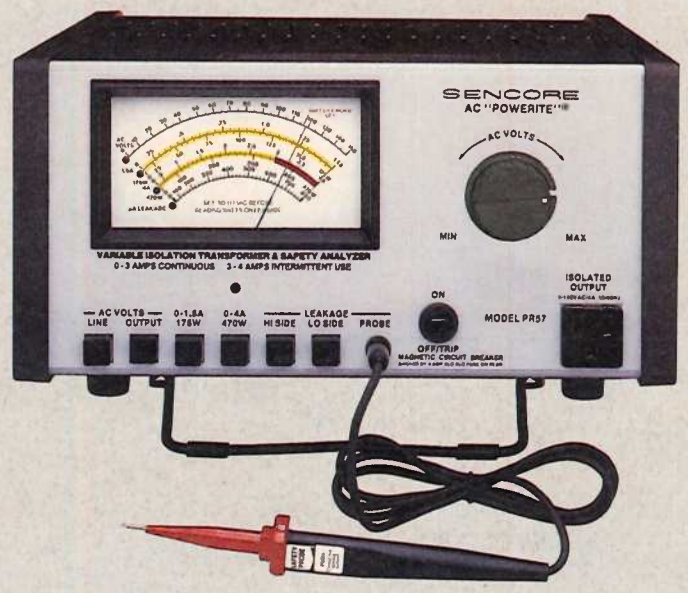
- All B&W and Color Video CRTs
- Projection CRTs
- Computer Display CRTs
- Closed circuit video CRTs
- Camera pickup tubes—broadcast, industrial and surveillance CRTs
- Even scope, radar, and other industrial CRTs

PR57 "POWERITE"® Variable Isolation Transformer And Safety Analyzer

One Totally Integrated Supply Lets You Know Your AC Power Is Right And Safe

- Variable Isolated 470 Watt Power Transformer To Isolate Your AC Line And Vary Your Output Voltage From 0 To 140 Volts
- Voltage, Current, And Wattage Power Monitor To Determine That The Equipment Under Test Is Not Drawing Excessive Current (Or Wattage) At Any Voltage Setting
- AC Line Leakage Safety Tester To Assure That Excessive Leakage Current Is Not Present On Any Exposed Part On The Equipment Being Tested

Avoid Embarrassment And Risk—Know Beyond Doubt That Your AC Power (And The Equipment You Service) Is Right And Safe. The PR57 ''POWERITE'' is an integrated supply that lets you know your AC power is right and safe. It includes a variable isolated 470 Watt power transformer to isolate your AC line and vary the output voltage from 0 to 150 volts. Monitors voltage, current, and wattage to determine that the equipment under test is not drawing excessive current at any voltage setting.



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ST66 Stereo TV Analyzer™

The Only Stand Alone, Portable Analyzer On The Market For All MTS Compatible Stereo TV/VCR Circuits

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- It's A Complete Portable, Battery Operated MTS Stereo TV And VCR Analyzer
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- Quickly Eliminates The RF/IF Section As A Source Of Trouble—Test From The Antenna To The Speakers/CRT With One Simple Connection

PA81 Stereo Power Amplifier Analyzer™

"The Missing Link In Audio Analyzing"

New!

IEEE 488 BUS-COMPATIBLE

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The PA81 Stereo Power Amplifier Analyzer Picks Up Where Other Systems Leave Off And Where Servicers Have The Most Trouble . . .

- Fills The Missing Link In Audio Analyzing
- Twin Autoranged Frequency Compensated Wattmeters
- Built-In IHF/EIA Filters And Loads
- Monitor Sound Quality Every Step
- Signal Tracer With RMS And/Or dB
- Automatic DC Balance Monitor For Intermittent Troubleshooting And Circuit Protection
- Standard Audio Line Tester
- Separation Tests To An Unprecedented 126 dB

Dynamically Analyze Stereo Power Amplifiers Anywhere, In Less Than 1/2 The Time You Now Take, With Superior Accuracy And Reduced Measurement Errors, To An Unbelievable 5000 Watts And To IHF/EIA Specifications*

End Confusion In Audio Amplifier Analyzing. Measure audio signals from milliwatts to the highest kilowatt power found in amplifier systems. Dual meters assure accuracy in RMS, dB or watts, at all levels, so you can follow any schematic or service procedure.

Assures Stereo Power Amplifier Balancing. Sensitive meters let you trace, balance, and compare the signals and bias of each stage with its opposite, to speed troubleshooting in direct coupled stages. Analyze push-pull amplifiers dynamically at all power levels to isolate defective stages and compensation networks that affect tracking and output quality.

Analyze Separation At Every Stage. Measures the small audio signals from CDs, turntables, tape decks, microphones or AM/FM stereo systems, at their correct impedances. Tracks alignment and automatically shows separation to over 100 dB at all power levels, to confirm that troubleshooting is necessary.

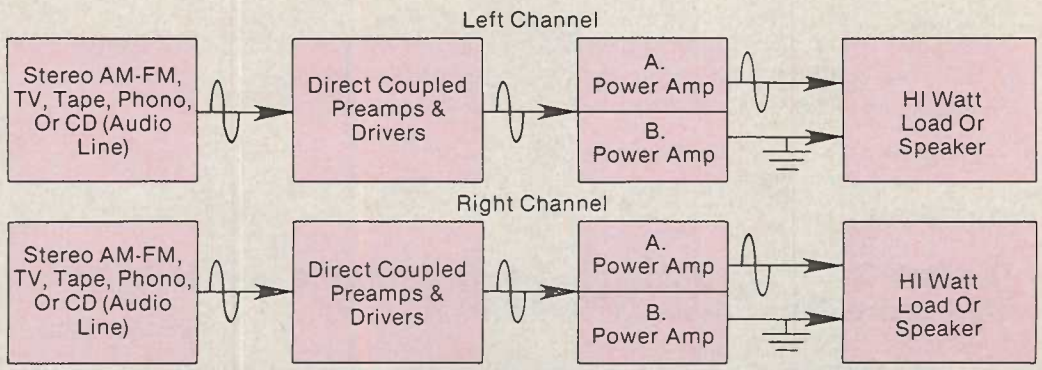
Guaranteed Accurate Measurements. Includes Institute of High Fidelity (IHF) and Electronic Industries Association (EIA) dummy loads to substitute for the speakers—avoids annoying audio and gives accurate, standard measurements. Custom made zero reactance, high wattage dummy loads test both channels in any system at the correct impedance. Built-in IHF/EIA audio filters block out hum and eliminate such frequencies as the 19 kHz pilot and CD clock signals; avoids time-consuming connections and measurement errors.

* From 500 Watts (250 Watts/Channel) to 5000 Watts (2500 Watts/Channel) with optional accessory.

Find Costly, Time-Consuming Intermittents. Monitors power amplifiers for DC balance continuously during tests, burn in, or troubleshooting—immediately disconnects the loads and indicates which channel failed. Prevents excessive currents and costly destroyed components.

Monitor Sound Quality At All Power Levels. Automatically adjusts scope outputs, earphones, and internal speakers—no more fiddling with scope levels or blasting out shop speakers as the power is "cranked-up".

Analyze All Audio Power Amplifier Systems Anywhere. Gives you one, approved, battery-operated, integrated system to reduce analyzing time, eliminate costly call-backs, and prove to your customers that their system or audio component is serviced right.



Walk troubles out of any power amplifier stage, step by step, with the PA81.

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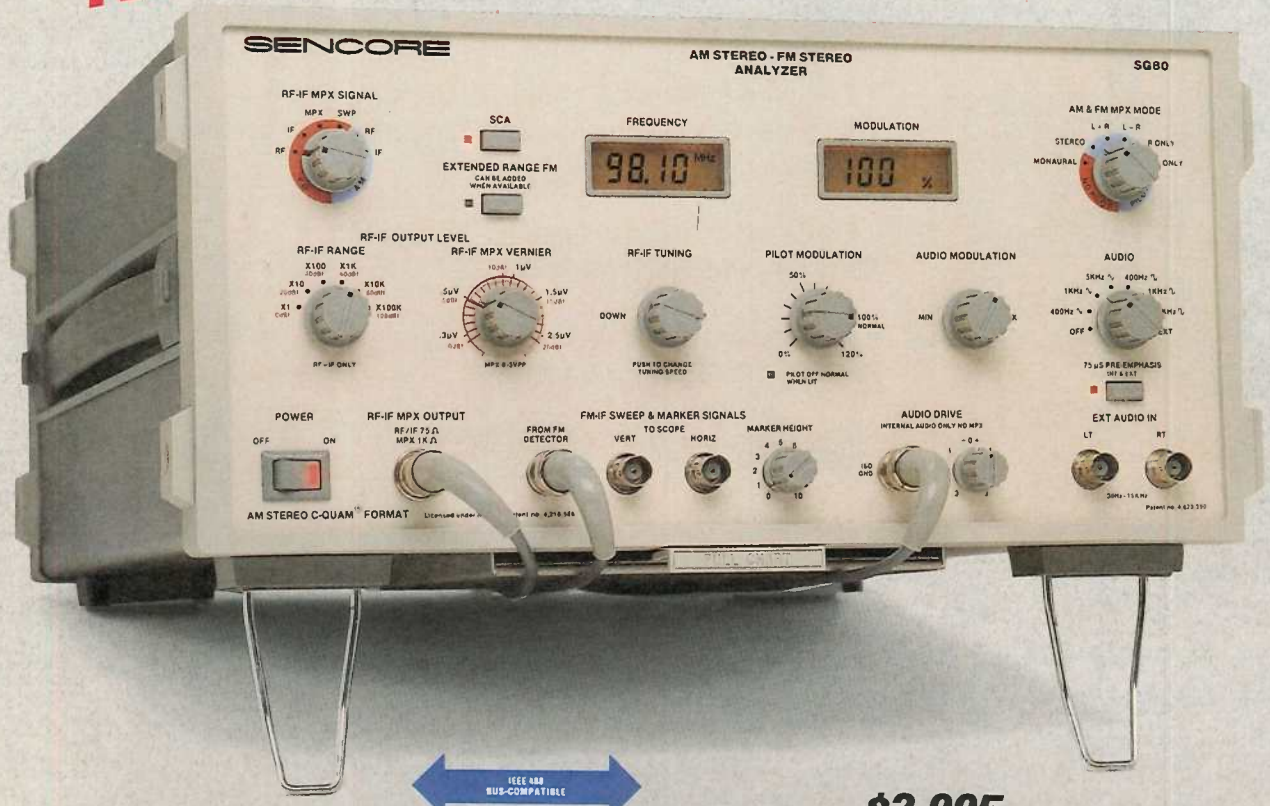
SG80 AM Stereo-FM Stereo Analyzer™

New!



IEEE 488 BUS-COMPATIBLE

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$3,995

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- One Fully Integrated AM Stereo-FM Stereo Analyzer That Meets Or Exceeds Manufacturers' Requirements For Every Testing And Servicing Need
- Patented FM Analyzing Signals Let You Quickly Divide And Conquer Any FM Receiver Defect
- Exclusive AM Stereo C-QUAM Analyzer, For The First Time Totally Integrated Into One Complete Unit
- Completely Performance Test The Receiver's Specifications With Digital Accuracy To Manufacturer And EIA/IHF Requirements
- Exclusive, Tunable FM-IF Sweep And Markers Let You Positively Match And Align All IF Stages, Including Ceramic Filters
- Expandable FM Features For Future Service Needs, Plus SCA Compatible
- Twice The Capability For Less Than 1/2 The Cost Of Stand-Alone Test Instruments

Now For The First Time, A High-Performance AM Stereo (C-QUAM)-FM Stereo Analyzer, Integrated Into One Unit, Allowing You To Performance Test, Troubleshoot, And Align To Manufacturers' Requirements

You'll never turn away stereo service work again, or be embarassed because you aren't equipped to handle the new AM stereo receivers; no more wasted time fiddling with generators that drift, or guessing at sensitivity, selectivity or separation. No more hassle with multiple instrument setups and tangled cables to perform alignments or make performance tests. Your new SG80 AM Stereo—FM Stereo Analyzer eliminates these problems, plus cuts your service time on every receiver repair, from the earliest mono model to the newest hi-tech stereo.

The SG80 AM Stereo-FM Stereo Analyzer meets or exceeds manufacturers' requirements for every testing and servicing need. You get every substitute signal needed to completely performance test (to the tightest industry specs) or quickly service the entire AM Stereo-FM Stereo receiver.

Patented FM analyzing signals allow you to quickly divide and conquer any FM receiver defect. Conventional generators lack the accuracy, stability, and purity to meet the service demands of today's receivers. Only by developing an entirely new patented method were we able to generate the signals necessary to quickly prove modern receiver stages good or bad to the most demanding specifications. Use the SG80's substitute signals to isolate any RF, IF, or stereo decoder defect.

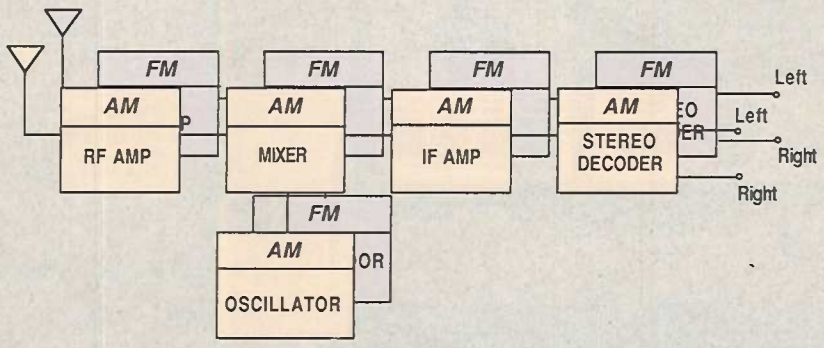
Exclusive AM Stereo C-QUAM analyzer, for the first time totally integrated into one complete unit. The SG80 incorporates AM Stereo servicing capabilities with all the signals and specifications needed for complete testing, aligning, and troubleshooting of the new AM Stereo receivers.

Digital accuracy for complete performance testing of receiver specifications to manufacturer and EIA/IHF requirements. Digital accuracy reduces errors and speeds servicing; full capability, and precision control give you 100% confidence on every repair.

Exclusive, tunable FM-IF Sweep and Markers allow you to positively match and align all IF stages, including ceramic filters. In just minutes, you can confidently analyze and align FM-IF stages for the proper bandwidth and shape, plus prove that you are using the correct replacement ceramic filters—solves "tough dog" IF troubles fast.

Expandable FM features for future service needs, plus SCA compatible. The SG80 provides a modulated SCA signal (internally adjustable—factory set at 67 kHz), for complete performance testing and adjustment of FM receiver SCA traps. Plus, you can expand your SG80 to service the new extended range FM when available.

Twice the capability for less than 1/2 the cost of stand-alone test instruments. It would take seven separate instruments at more than twice the cost (and many more cable hookups) to even approach the capabilities of the SG80 AM Stereo-FM Stereo Analyzer. With innovation, time savings, superior capability, error-free digital accuracy, and Sencore support, your SG80 is unbeatable—at less than half the cost.



"Makes AM Stereo and FM Stereo look alike—simplify servicing with the SG80"

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FS73 CHANNELIZER JR.™ /TV-RF Performance Tester

- All Channel Digital Tuner—Tunes In Any Cable, HRC, ICC, VHF, UHF, And FM Channel
- Exclusive 5 Microvolt (–46 dB) Sensitivity With Automatic Attenuation And Ranging For Fast Hands-Off Operation
- Exclusive Automatic Hum And Signal-to-Noise Tests On Any In-Use Channel
- Microprocessor Controlled Fine Tuning With Readout Of Frequency Offset

IEEE 488 BUS-COMPATIBLE — RS232 Compatible

$2,395

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Completely Performance Tests Every Single TV Channel, In Any RF Distribution System, To FCC Specifications, 100% Automatically And 100% Faster Than Ever Before

Finally, automatic readings at the touch of a switch. No more tuning, measuring, and calculating to find audio-to-video ratios, signal-to-noise, and hum. The FS73's microprocessor does these performance tests (and more) on any channel automatically.

Microprocessor Controlled Digital Tuner Covers Every Channel. Check any system—UHF, VHF, all cable channels (plus the 5-50 MHz channels), and the FM broadcast band. The FS73's digital tuner uses PLLs throughout for fast, accurate results.

Super 5 Microvolt Sensitivity And Autoranged Attenuator Leaves Hands Free To Make Critical Adjustments. Measure the lowest signal levels at an antenna, to the strongest signals at the output of an amplifier automatically.

Exclusive, Automatic Fine Tuning With LCD Readout Of Off-Channel Frequency Locates Shifted Channels Fast. Tests non-standard shifted channels, too. AFT circuits lock the FS73 to the carrier and tell you how far the carrier is from its assigned frequency.

Tune To Standard Cable Shifted Channels In Seconds. Select between HRC, ICC or non-shifted cable systems and the microprocessor automatically offsets the tuner the correct amount for each channel and displays the deviation from the standard frequency on the LCD readout.

Exclusive Signal-To-Noise Test (Even On In-Use Channels) Simplifies Testing And Saves Time. Compares the signal on any channel to the noise level on that same in-use channel. The FS73 measures the actual noise within the channel and automatically calculates the S/N ratio.

Eliminate Tedious Pilot And Carrier Measurements—Read Audio-To-Video Ratio And Hum On Any Channel (While It's In Use) Automatically. No more calculations! Simply tune the channel, select the A/V or Hum tests, and the microprocessor does the rest. It's fast, easy, and error free.

Perform All Tests Under Computer Control With IEEE 488. Allows hands-off performance checks of all channels, and continuous, unattended monitoring for interference when used with a computer.

FC71 Portable 10 Hz to 1 GHz Frequency Counter™

- Five Times More Accurate Than FCC Requirements Even On The Toughest Job; .5 Parts Per Million
- Exclusive Microprocessor Time Base For Super Stability From –12 F to 122 F
- Measures All Signals, Even Complex And Noisy Signals, With Exclusive Sensitivity Control
- Super 5 mV Average Sensitivity Over Full Range
- Automatic Crystal Check Tests The Fundamental Frequency Of Any Crystal
- Frequency Ratio Compares Two Frequencies And Displays The Ratio Directly
- Double Shielded For Interference-Free Frequency Measurements Anywhere
- Automatic Readings With IEEE 488 Computer Interface (IEEE 488 Bus Compatible)

IEEE 488 BUS-COMPATIBLE — RS232 Compatible

$1,295

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FS74 CHANNELIZER SR.™

TV-RF Signal Analyzer

$3,495

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IEEE 488 BUS-COMPATIBLE

RS232 Compatible

- All Channel Digital Tuner—Tunes In Any Cable, HRC, ICC, VHF, UHF, And FM Channel
- Exclusive 5 Microvolt (−46 dB) Sensitivity With Automatic Attenuation And Ranging For Fast Hands-Off Operation
- Exclusive Automatic Tests, Even On Fully Modulated Channels:
  - Audio-to-Video Carrier Ratio Test
  - Hum Test On Any In-Use Channel
  - On-Channel Signal-to-Noise Test
  - Digital Readout Of Frequency Offset
- Exclusive Picture Quality Check With Integrated Wide Band Video Monitor—Isolates Problems Meters Can't Show
- Exclusive ACV/DCV Measurements Through RF Input Or Special DVM Input—No Need To Carry Additional Test Instruments

Thoroughly Analyze And Pinpoint Any RF Video Trouble In Any RF Video Distribution System, Accurately And Automatically, In 1/2 The Time, Or Your Money Back

Locate Problems Quickly And Accurately. Whether the problem involves abnormal signal levels, excessive hum, elusive ghosts, unwanted signal interference or some other system defect, the FS74 is guaranteed to help you pinpoint the trouble fast, accurately, and 100% automatically.

Tune All Standard Off-Air, Cable, And FM Channels Quickly And Accurately. The FS74's microprocessor is a field strength meter exclusive. Quickly tune the FS74 to the exact carrier frequency. The LCD displays channel number and frequency offset to 10 kHz resolution. Select HRC, ICC or non-shifted cable systems with microprocessor speed and accuracy.

Bring In Weak Signals With The Best Sensitivity Available. Super sensitive, 5 microvolt (−46 dBmV) sensitivity on all frequencies means you can analyze signals all the way back to the receiving antenna. No more fiddling with attenuator inputs or undependable range switches either. The RF input to the FS74 is fully autoranged. Simply connect a cable to the input and measure signals to a full volt (+60 dBmV) automatically.

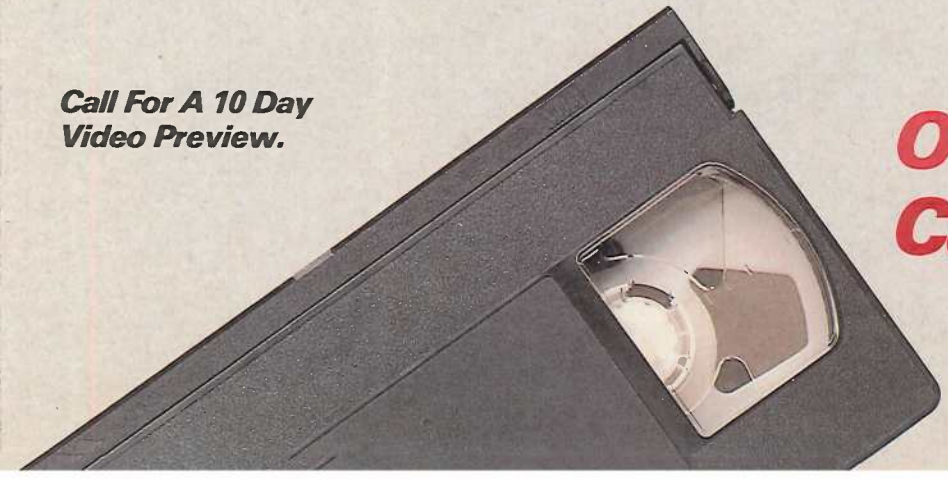
Microprocessor Control Makes All Tests Fast And Simple. All tests can be made on an in-use channel without removing or decreasing modulation, or adding special carriers.

Exclusive Built-In Wide Band Monitor Makes Tough Picture Quality Checks In A Snap. The wideband monitor is an intergal part of the FS74. Just turn on the monitor and view any of the television channels in full detail on the CRT. Its full 4 MHz bandwidth helps you isolate problems that affect large-screen receivers, but will go unnoticed on portable televisions.

Built-In Autoranging AC/DC Voltmeter And Ohmmeter Means You'll Never Be Caught Short. Your troubleshooting capabilities are rounded out with AC and DC voltage measurements and a special low resistance ohmmeter right at your fingertips. Measure to 200 volts, right through the RF input. Or, measure the resistance applied to the EXT DVM input up to 200 ohms.

The FS74 CHANNELIZER SR. is guaranteed to pinpoint TV-RF trouble quickly. Call **1-800-SENCORE** for more information. Or send for a "10 Day Video Preview" on the FS74.

Call For A 10 Day Video Preview.



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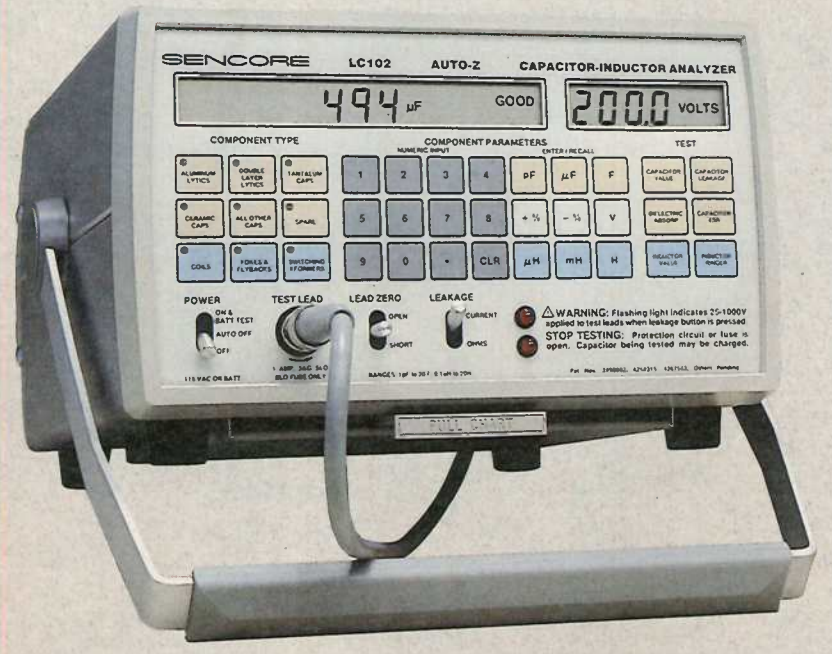
Pricing Note: All prices shown are U.S. dollars. Canada must add applicable Duty, Freight, and F.S.T. Prices and specifications subject to change without notice.

LC102 AUTO-Z™

New!

And Improved!



- New, Improved, Dynamic, Mistake Proof, LC Analyzer That Finds Defective Components That All Other Testers Miss
- Dynamically Tests Capacitors For:
  - Value From 1pF to 20F
  - Leakage With 1 kV Applied
  - Dielectric Absorption
  - Equivalent Series Resistance (ESR)
- Dynamically Tests Inductors From 1 uH to 20 Henrys For Opens, Shorts, Value, And Even One Shorted Turn
- Dynamically Tests SCRs, Triacs, High-Value Resistors, And Transmission Lines As An Added Bonus
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- Extends Your Testing Capability To Places Where An AC Cord Won't Reach With Rechargeable 9-Hour Battery Or AC Operation

THE Z STANDARD

It's like having your own Standards Engineer with you at all times.

IEEE 488 BUS-COMPATIBLE

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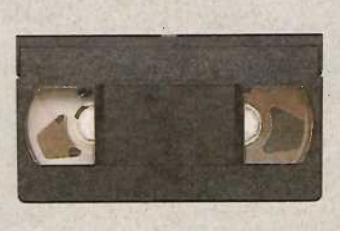

LC101 Z Meter™ *Capacitor-Inductor Analyzer*

New!

- Exclusive Dynamic Tests Analyze Capacitors For:
  - Value
  - Leakage
  - Dielectric Absorption
  - Equivalent Series Resistance (ESR)
- Dynamically Analyzes True Inductance Value And Effective Q (Quality) With A Patented Ringer Test
- Finds Distance To Within Feet Of Open Or Shorted Transmission Lines
- Checks Leakage As Low As One Microamp With Up To 1000 Volts Applied In Cables, Switches, PC Boards, And Connectors

$995

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IB78 RS232 Interface Accessory

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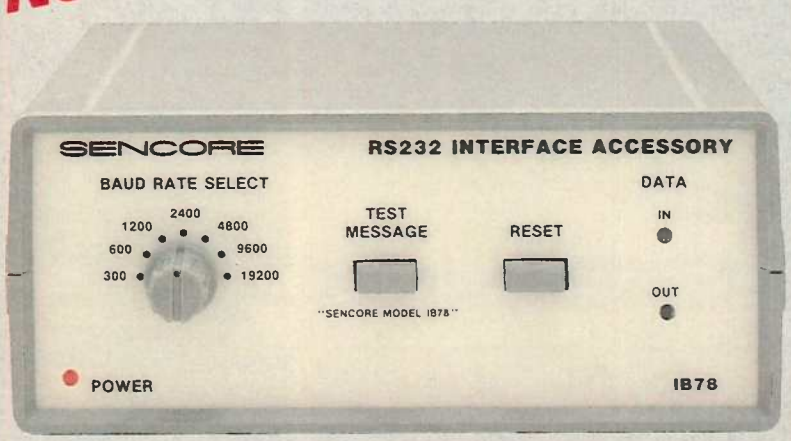

- Adapts Your Interface-Ready Sencore Instrument To Any Personal Computer, Without Costly Modifications
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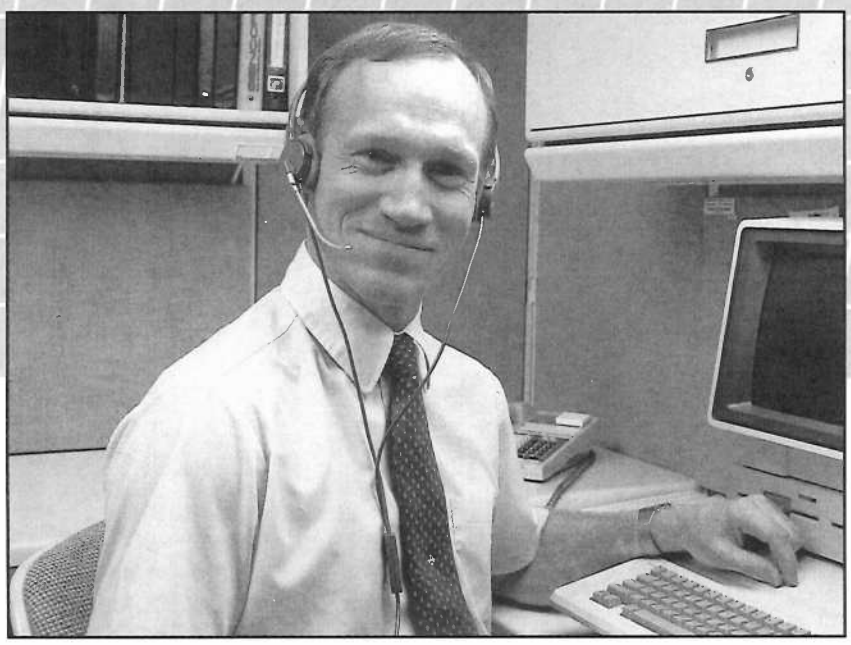
- Lets You Modem Your Tests And Measurements, Eliminating Unnecessary Trips To Remote Locations
- Exclusive Automatic Setup And Test Message Simplifies Use With Any RS232 Compatible Computer Or Controller
- Selectable Baud Rates Along With Data, Parity, And Echo Settings Match Any RS232 Configuration
- Data Indicator Lights Inform You When Data Is Being Sent Or Received

$395

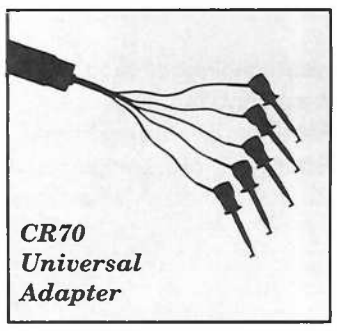
U.S. Funds

RS232 Compatible



Customer Questions And Application Tips To Speed Your Troubleshooting

by Tom Schulte, Application Engineer



CR70 Universal Adapter

Q. How do I use my CR70's Universal Adapter to test any type CRT?

A. The CRT sockets supplied with the CR70 Universal CRT Analyzer and Restorer allow you to test the CRTs found in direct view and projection TVs, monitors, scopes, and cameras. A few CRTs, however, use special sockets that don't match any of the CR70's supplied sockets. The Universal Adapter (supplied with your CR70) allows you to test those special CRTs on the spot, without the hassle of buying special sockets.

The Universal Adapter plugs onto the CR70 test cable and extends out to five test clips. To use the Universal Adapter, first preset the CR70 front panel controls as follows:

CR70 Control	Special setting when using UA
F1	1
F2	2
K	3
G1	4
G2	5

Notice that you set these controls differently when using the Universal Adapter than when using the regular sockets. Leave these five controls at these special settings for the entire time you are using the Universal Adapter. The remaining front panel controls are set the same as when you are using the regular sockets.

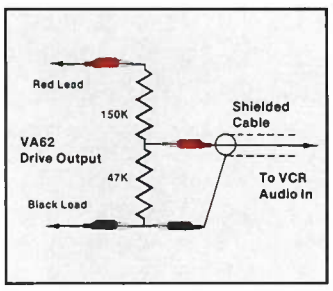
Next, hook the Universal Adapter to the base of the CRT. Use the pin numbers in the setup book to attach each clip to the correct CRT pin. To make things easier, let's use an example from the CR70 Setup Book, tube number A36JAR53X. The setup information is listed below:

CRT NUMBER	SKT	CRT TYPE	F1	F2	FIL	NEG BIAS	GUN	K	G1	G2
A36JAR53X	UA	VIDEO	4	5	6.3	68V	R	7	6	8
							G	9	6	8
							B	3	6	8

The setup book shows that the filaments (F1 and F2) are pins 4 and 5. Simply hook the Universal Adapter F1 clip to pin 4 and the F2 clip to pin 5 on the CRT. Following the information in the setup book for the red gun, hook the K clip to pin 7, the G1 clip to pin 6, and the G2 clip to pin 8.

Now that you've set up the CR70 controls and hooked up the Universal Adapter clips, you're ready to test the red gun of the CRT in the normal manner. When you finish testing the red gun and are ready to test the green gun, *don't move the F1, F2, K, G1, or G2 controls on the CR70 front panel.* Instead, move the K, G1, and G2 Universal Adapter clips to the pins shown in the setup book for the green gun (or just the K clip if the tube has common grids).

Any CRT can be tested in this same easy manner. If you have questions about using the CR70 or the Universal Adapter, give Sencore a call, toll free at **1-800-SENCORE** and ask for Application Engineering. They'll help you with any question you may have.



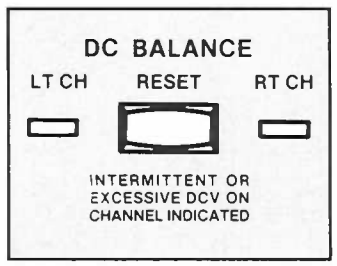
Q. How can I use my VA62 to feed video and audio to VCR line level inputs?

A. Your VA62 Universal Video Analyzer includes a VCR STANDARD jack on the lower front panel that supplies standard composite video. Use the VIDEO PATTERN control to select the desired video pattern. Simply use the supplied RCA to RCA cable to connect the VCR STANDARD jack on the VA62 to the Video In jack on the VCR back panel.

The DRIVE OUTPUT section of the VA62 will supply audio to the audio line input. Use the AUDIO switch to select the desired audio tone. A voltage divider, as shown in the figure above, will make it easier to adjust the DRIVE OUTPUT signal level to the very low level needed at the VCR audio line input.

To feed VCR audio inputs with your VA62's DRIVE OUTPUT:

1. Connect the VA62's DRIVE OUTPUT through the voltage divider to the VCR's Audio In jack.
2. Turn the VA62's AUDIO control to the desired frequency.
3. Set the DRIVE SIGNAL control to AUDIO, the DRIVE RANGE to 30 VPP, and adjust the DRIVE LEVEL control to maximum (30 VPP).



Q. Why does my PA81's DC Balance feature trip occasionally?

A. The PA81 Stereo Power Amplifier Analyzer includes a fast-acting DC Balance circuit to protect the amplifiers you troubleshoot. The DC Balance circuit automatically monitors the DC voltage on the amplifier's speaker output lines while you are doing any other testing.

If the DC voltage on either speaker line exceeds 1 volt for more than 50 milliseconds, the PA81 DC Balance circuit trips, opening both left and right channel dummy loads. They remain open until you press the RESET button. This protects the amplifier output stages from the excessive load current that would result from a DC balance problem. The PA81 also lights a left channel or right channel DC Balance indicator light to tell you which channel has the problem.

There are a number of ways the DC Balance feature proves invaluable during your amplifier troubleshooting:

1. It protects you when you replace expensive output devices and turn the amplifier back on, gambling that you've found all the faulty components.
2. It protects you when you're probing in the circuit and you short two traces, causing a DC shift that would take out the output devices.
3. It protects you against intermittent fault conditions within the amplifier that happen unexpectedly and take out the amplifier output devices.
4. It allows you to burn-in an amplifier after repair without worrying about an intermittent fault burning up expensive components.

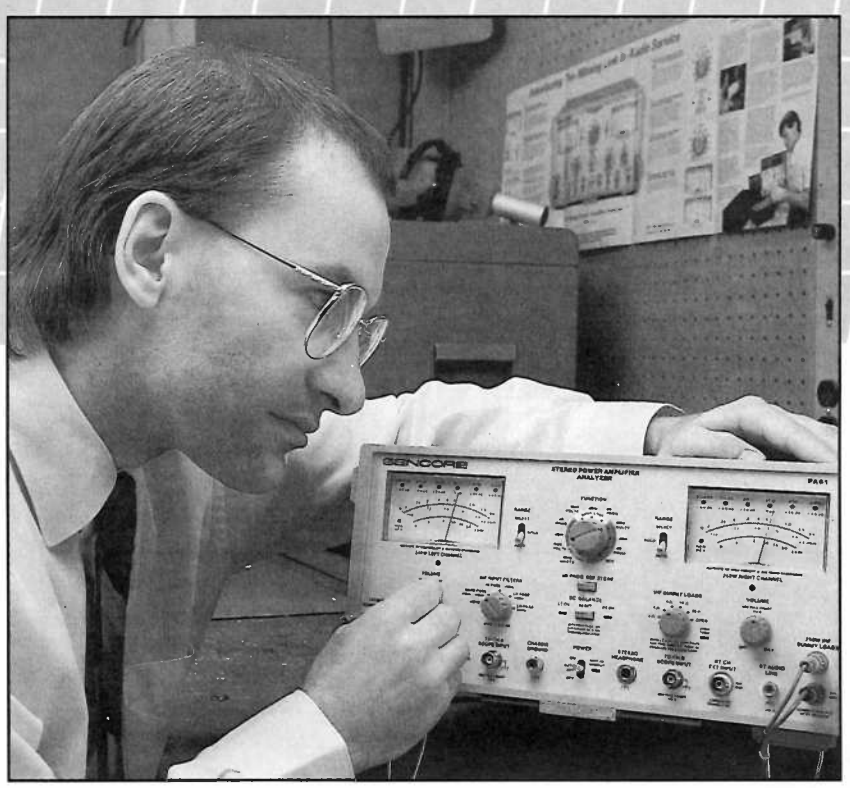
There are a couple of conditions that can cause the DC Balance circuit to trip even though there isn't a fault with the amplifier. The average DC level at some amplifiers' outputs tends to shift slightly as you advance the amplifier volume control. Depending on the amplifier design and how fast you advance the control, the average DC output may exceed the level required to trip the DC Balance circuit.

Also, when you apply changing program material to the amplifier input instead of a steady test tone, the average DC level changes with audio content. On loud program peaks, the average DC level at the amplifier output may exceed 1 volt for longer than 50 milliseconds, causing the DC Balance circuit to trip.

In either case, when the DC Balance circuit trips, simply push the Reset button to resume normal operation. The DC Balance circuit will continue monitoring for DC Balance problems in the amplifier. ❐

Update Your Audio Bench With The PA81 Stereo Power Amplifier Analyzer™

by Larry Schnabel, Marketing Communications Writer



> "Audio servicers tell us two things cost them more time and money than anything else: burning up components and tracking down intermittents . . ."

Many servicers tell us they are already set up with all of the audio amplifier servicing equipment they need. They give us a long list of equipment they've accumulated over the years and tell us they really don't need any more audio analyzing equipment.

The answers become even longer when we ask them how they set up and perform some of the standard audio amplifier tests. They go into long, detailed accounts of how they gather high-powered resistors and rigged-up circuits to match the impedance of the amplifier under test or filter out various frequencies. They describe how they hook up the tests with series and parallel combinations, then read a voltage off a separate meter to plug into some formula for the final result.

After all the dust has settled, we ask the servicers if they would be interested in doing all those tests, plus more, in one integrated unit. The answer is always, "Yes", with a tone of anticipation. Then we tell them about the PA81.

The PA81 Stereo Power Amplifier Analyzer is designed to pinpoint hard to find problems in stereo and monaural audio power amplifiers in a fraction of the time you now take. The real beauty of "The Missing Link In Audio Analyzing", however, is the fact that you can perform all your audio amplifier tests without using several different parts and pieces of test equipment. You don't have to construct temporary dummy loads, calculate or interpolate power readings, or wonder if your bench components are doing the job they were intended to do.

Twin Autoranged Wattmeters Make Each Job A Snap

One of the tests audio servicers need to make is the power output test of an amplifier. Many servicers, however, just skip this test, while others attempt to measure audio power with a collage of resistors, leads, and meters that aren't accurate or calibrated. Once they do have it set up, they have to use conversion formulas and a calculator to figure the audio power, inducing more chance for error.

Measuring audio power with the PA81 Stereo Power Amplifier Analyzer is as easy as connecting the amplifier to the PA81 and reading the audio power on the dual autoranged, frequency compensated wattmeters. The PA81 measures up to 250 watts per channel, adequate for most of your audio analyzing.

The independent analog meters let you make stereo adjustments or set up controls while you monitor both meters for level and balance. Digital readouts tend to bounce around making it hard to track small changes in the audio signal. The PA81 analog meters are identical, easy to read, and accurate to industry standards at all audio frequencies.

Built-in IHF/EIA Components Make Your Work Easier and More Accurate

The Institute of High Fidelity (IHF) developed certain guidelines and testing standards to ensure all audio equipment is tested the same way. These IHF standards were adopted by the Electronic Industries Association (EIA), which are now referred to as IHF/EIA industry standards. Dummy load termination resistors must have the same impedance at all audio frequencies and power levels, according to IHF/EIA standards.

Industry test standards also require low and high pass filters for a number of audio tests. These filters limit the audio measurements to a specific frequency range while maintaining a flat frequency response for all tests. Many servicers are trying to get by without these industry standard components and filters, but without much success.

The PA81 Stereo Power Amplifier Analyzer provides you with the dummy loads (2, 4, 8, 16, and 32 ohms) to service all stereo audio amplifiers. Each dummy load meets IHF/EIA standards and has matched left and right channels to provide equal and proper loading for both stereo channels. The PA81's dummy loads can handle up

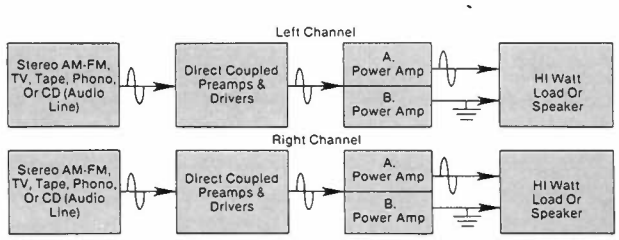


Fig. 1: The PA81 Stereo Power Amplifier Analyzer gives you all the tests you'll need to walk troubles out of any amplifier stage.

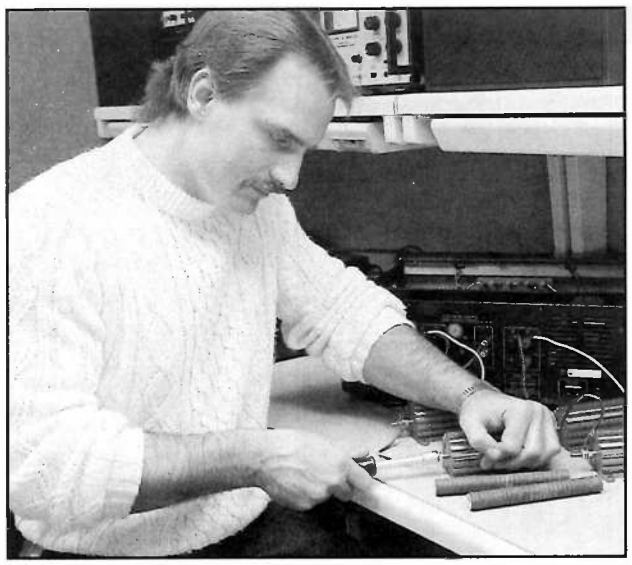


Fig. 2: Rigging up resistors for audio power measurements can be time consuming and inaccurate.

to 250 watts per channel and are fan cooled to prevent overheating.

The PA81 provides four matched filters for each channel at the turn of a knob, and a NONE position for unfiltered testing. The standard filters let you detect unwanted noise by eliminating selected signals before they are measured.

Monitor Sound Quality At All Times To Prevent Backtracking

Sound quality can be fine at low levels but it can deteriorate as the power is "cranked up". Loudspeakers are generally too loud to use for high power testing, yet you need to know the quality of the audio signal when the power is increased. Most servicers don't check the sound quality at higher power levels. They either don't want to listen to a stereo turned wide open or fear the amplifier or speakers will be damaged.

The PA81 lets you check the quality of the audio signal at any power level, in three different ways! Built-in high quality speakers let you trace the problem to any stage just by listening to the sound. Each channel is autoranged and has its own volume control so you can monitor the audio quality without the tremendous blast associated with most high power amplifiers.

If you don't want to disturb others, you can listen to the audio quality through the headphone jack on the PA81 front panel. Using the autoranged headphone jack signal defeats the PA81's internal speakers while you listen in silent comfort for any distortion in the audio signal.

The PA81 also provides buffered, autoranged outputs to connect to an oscilloscope for audio quality checks such as clipping and ringing. The PA81 floating ground outputs let you use an oscilloscope to analyze the audio signal even on non-common ground systems.

RMS And dB Signal Tracing Let You Tie Down Troubles In Any Stage

An RMS or DC voltmeter is still a very valuable tool for servicing an amplifier with one defective channel. You can compare signals from the working channel to the signals in the non-working channel to help narrow the problem down. Sometimes service literature makes reference to stage gain in decibels (dBs). A dB is simply a ratio of an output level to an input level. Of course, you can still use a simple voltmeter to measure the input and output voltages, but you need a calculator to figure the gain since the formula is slightly complicated.

All of the signal tracing confusion has been eliminated with the PA81 Stereo Power Amplifier Analyzer. The PA81 has external meter inputs for both the left and right channels so you can compare readings and trace problems without the inconvenience of jumping back-and-forth between channels.

You simply touch the test leads to the circuit point and read the autoranged PA81 analog meters for RMS volts, DC volts, or gain in dB. The external inputs give you a wide measuring range so you can measure signals from the microphone to the output stages of a high-powered amplifier.

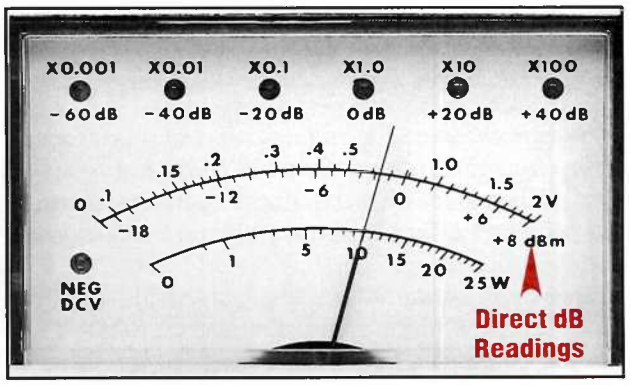


Fig. 3: The PA81 automatically calculates and displays the gain directly in dB, saving you time and reducing chance for error.

Built-In DC Balance Monitor And Protection Circuit Speeds Intermittent Troubleshooting

Audio servicers tell us two things cost them more time and money than anything else: accidentally burning up components and tracking down intermittents. A lot of the expensive component damage is caused by out-of-balance push-pull audio power amplifiers. Expensive speaker coils are often the first to go followed by the output stages.

To complicate matters, these costly component burn-up problems may be intermittent. You can replace the smoked parts, only to have them burn up again 10 seconds or 10 hours later. Intermittents in DC-coupled circuits may not lend a clue to which channel shut the system down, meaning you have to start your troubleshooting from scratch again.

The built-in DC Balance feature on the PA81 Stereo Power Amplifier Analyzer puts an end to wasted time and burned up components caused by DC imbalances and intermittents. The PA81 continuously monitors the DC voltage present at the Dummy Load inputs. If the DC voltage reaches 1 volt or more, a protection relay opens and disconnects the dummy loads automatically to prevent costly damage to any of the amplifier's components.

To identify which channel is out of balance, an LED comes on indicating which channel has the problem. The LED stays on until you reset the loads with the RESET button on the front panel. Now you have a way to detect which channel the intermittent is on, even if you were tending to other servicing jobs.

Check Audio "Line Outputs" To Make Sure The Input Signal Is Good

Problems such as low output, poor separation, or distorted sound are not always caused by the power amplifier. Occasionally one of the source devices that feeds the amp causes the problem, such as a VCR audio output, cassette deck, CD player, or phonograph.

You just can't hook your volt-ohm meter across a "line output" and measure the signal, however. The audio source must be properly terminated for accurate measurements, but a meter still doesn't let you check the quality of the signal. And you can't hook up a speaker to these outputs either, because they don't have the power to drive most speakers.

The PA81 Stereo Power Amplifier Analyzer lets you test the left and right line outputs of any audio component source without the need for external amplifiers or speakers. The PA81's AUDIO LINE inputs let you measure the level of the audio signal, but it also lets you listen to the quality of the signal with the its built-in speakers.

The AUDIO LINE inputs are terminated in the industry standard 10 k ohm line impedance for accurate, distortion-free measurements. You'll never have to worry about the input signal to the amplifier again with these time-saving tests.

The PA81 Stereo Power Amplifier Analyzer Is The Missing Link In Audio Analyzing

Call us today at **1-800-SENCORE** and talk to your Area Sales Engineer. He'll show you how you can put the "Missing Link In Audio Analyzing" to work for you. Update your bench today, and see how the PA81 can help your audio troubleshooting efficiency. ❒

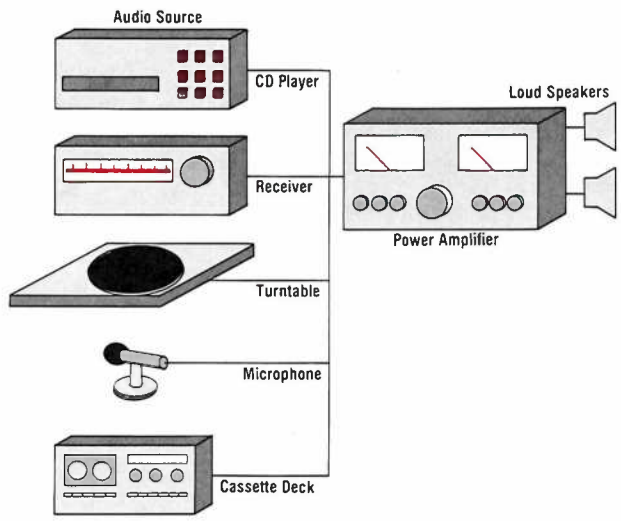


Fig. 4: The PA81 lets you check the source signal before it reaches the power amplifier.

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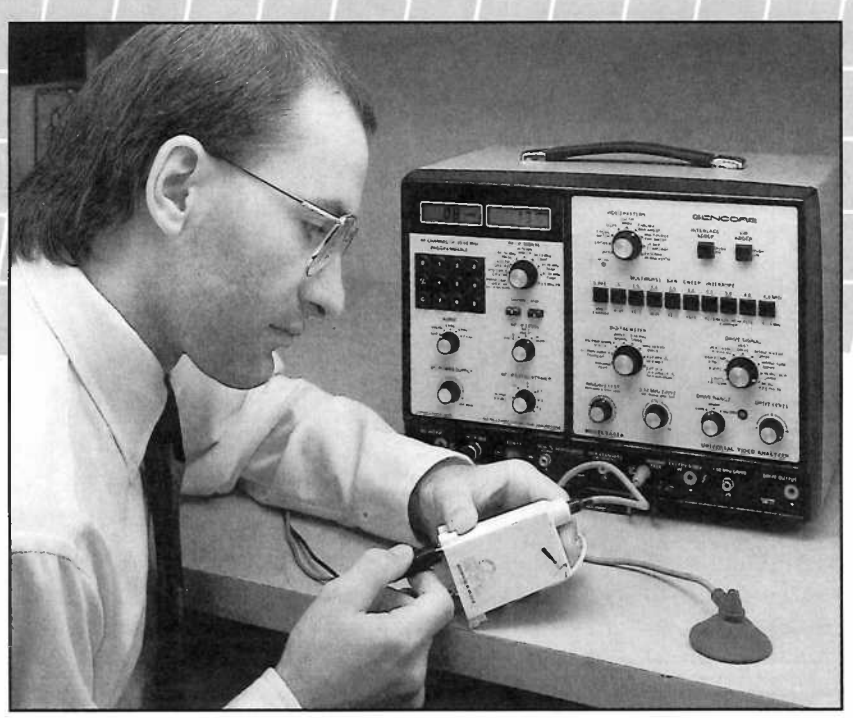


Dynamically Test Your IHVTs "Good" Or "Bad" With Sencore's Exclusive Tests

by Larry Schnabel, Marketing Communications Writer

> "The main difference in an IHVT is the addition of the high voltage diodes . . ."

Some components in television sets fail more often than others. Some of these common failures are also the most expensive, meaning you can't afford to replace them needlessly.

One of these common and expensive failures is the integrated high voltage transformer (IHVT). The IHVT poses a special challenge to servicers as it differs slightly from the conventional flyback transformer. Since the IHVT is a relatively expensive part in a TV, you don't want to rely on substitution or guessing in your everyday troubleshooting. We'll start by explaining the IHVT, then show you several dynamic and accurate methods of testing your IHVTs.

The IHVT—A Flyback With A Little Something Extra

Early television receivers used a conventional flyback transformer and a high voltage multiplier (doubler, tripler, quadrupler) to rectify the flyback output pulses and form the high voltage DC that was supplied to the picture tube. The flyback and high voltage multiplier were separate components that rarely failed at the same time.

An IHVT is similar to the flybacks used in older TVs with an important exception: the IHVT includes the high voltage multiplier circuits in the same package. A TV receiver using an IHVT is easily recognized by the high voltage lead emitting from the IHVT leading directly to the second anode of the CRT (see Figure 1).

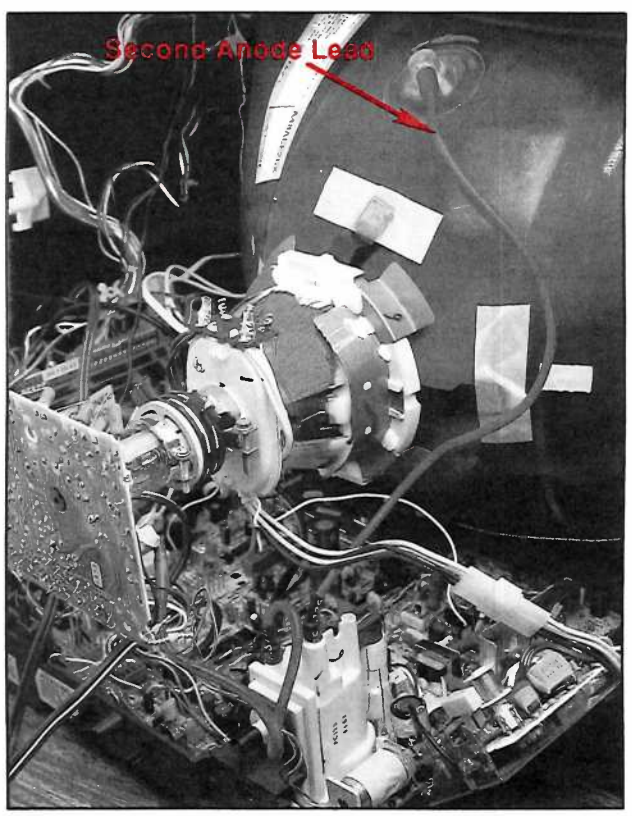


Fig. 1: An IHVT is easily recognized by a second anode high voltage lead and flyback in one package.

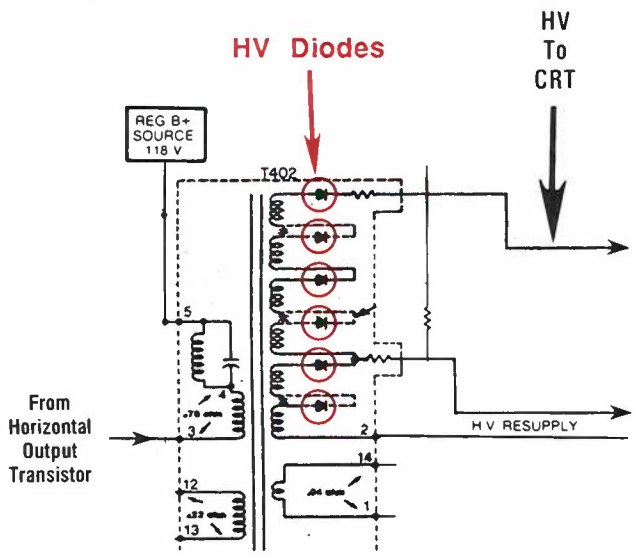


Fig. 2: IHVTs are similar to conventional flyback transformers with the exception of integrated high voltage diodes.

The IHVT is made up of primary and secondary windings on a common ferrite core. For efficiency, the windings are wound tight and close together making the operation of each winding dependent on all other windings in the transformer. Just one shorted turn in any winding will affect the operation of all the other windings.

The main difference in an IHVT is the addition of the high voltage diodes as shown in the schematic in Figure 2. The high voltage diodes are responsible for rectifying the flyback pulse and creating the second anode voltage without the need for an external component or circuit. Their design creates a special challenge for servicers as everything is in one package.

What Goes Wrong With IHVTs?

Integrated high voltage transformers can develop several different kinds of problems, most of which can be very hard to pinpoint with conventional

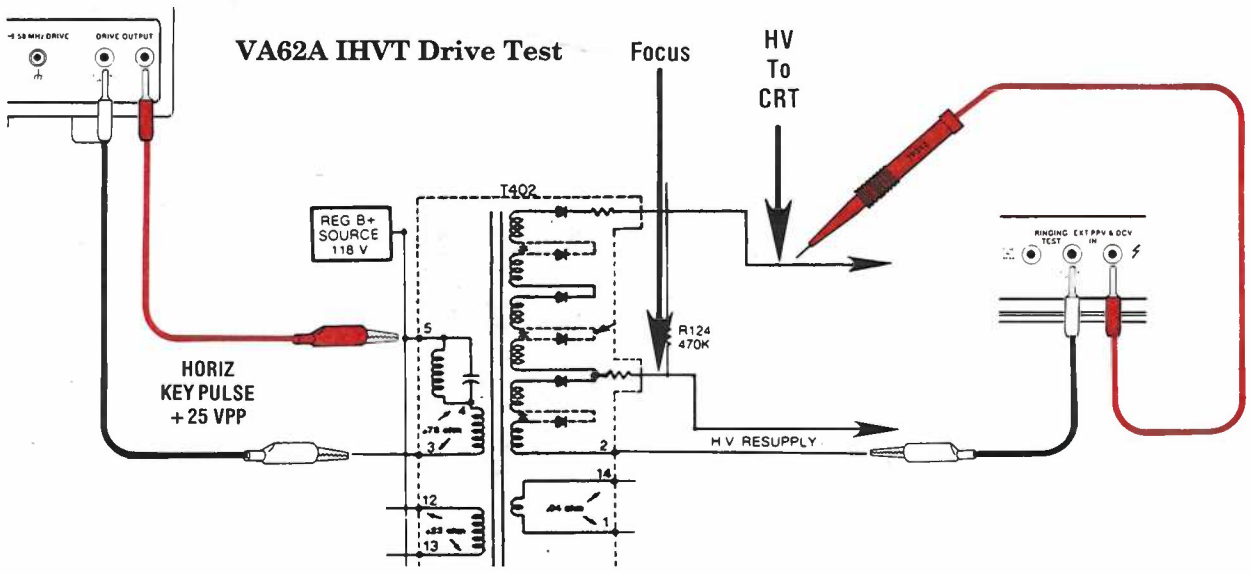


Fig. 3: Drive the primary winding for the IHVT drive test while monitoring the voltage on the secondary winding.

troubleshooting methods. Occasionally, a defective IHVT will show visible signs of failure such as excessive heat damage or a cracked core. Unfortunately, most IHVT failures give no visible clue to help your troubleshooting. The failure modes, however, can be sorted into the following categories:

Shorted Turn(s): The most common IHVT failure is the shorted turn. The short can be two shorted adjacent wires causing a single shorted turn, or many turns shorted together. In either case, even one shorted turn reduces the efficiency of the IHVT and can cause shutdown. In some cases, the effect of the short may cause further circuit damage due to excessive current flow.

A shorted turn represents only a few hundredths of an ohm difference in the winding's total resistance. Most ohmmeters don't have the accuracy or resolution to find a single shorted turn. You need a dynamic test to locate this hidden type of defect.

Shorts (Leakage) Between Windings: A short or high resistance can develop between two adjacent IHVT windings. A short between windings is not as common as an actual shorted turn, but the results are equally unfavorable. Shorts can also develop between a winding and transformer core, or to ground. In any case, this often overlooked failure can cause shutdown and further damage to circuits because of excessive current flow.

Open Windings: When a winding of an IHVT opens, a pulse or scan derived voltage is lost. Depending on the winding that is open, the symptom may vary from high voltage shutdown to one defective circuit such as blanking or AGC.

High Voltage Diode Failure: The high voltage diodes responsible for creating the second anode high voltage are included in an IHVT. These diodes fail just like other diodes—they can open, short, or become leaky. If the resulting high voltage is low, the CRT picture can be dim and out of focus. Higher than normal voltage may cause damage to other components or shutdown.

Since the high voltage diodes are in the same package as the flyback transformer itself, it's impossible to separate and test them individually. When you suspect an IHVT is causing a problem, you must be able to dynamically test it without swapping for a new one. Most servicers can't afford stocking substitute IHVTs nor do they have the time to change a complicated component that may not even fix the problem.

In summary, you'll want to check for all defects: shorted turns, shorted windings, open windings, and high voltage diode problems. Proving the IHVT "good" or "bad" saves troubleshooting time and parts costs, plus helps you keep your IHVT inventory down.

Collector PPV	CRT HIGH VOLTAGE			
	20K	25K	30K	35K
500	1000	1250	1500	1750
700	700	890	1000	1250
900	550	690	830	970
1100	450	560	680	790

Fig. 4: Use the ratio between the normal high voltage and collector PPV to determine the proper output voltage for the IHVT test.

Prove IHVTs Good Or Bad With Three Exclusive Tests!

Sencore has three dynamic tests to take the guesswork out of your IHVT testing. With three simple tests, you will know proof-positive if your IHVT is "good" or "bad". You won't have to swap IHVTs anymore or carry a profit-robbing IHVT inventory.

Ringing Test, Patented: You can use the ringing test on either the VA62A Universal Video Analyzer or the LC102 AUTO-Z to dynamically test IHVTs — in or out of circuit! The patented ringing test shows if shorted turns (even only one shorted turn) are present in either primary or secondary windings with one connection. In addition, the ringing test will tell you if you're connected across an open winding.

The ringing test of the VA62A and LC102 pulses the primary winding of the IHVT and counts the oscillations (rings) that occur before the waveform decays to a preset level. Our engineers have proven that a good IHVT rings 10 or more times, while an IHVT with even a single shorted turn rings less than 10. The GOOD/BAD point is backed by years of servicers like yourself who have proven the test reliable, every time.

Dynamic VA62A IHVT Drive Test: You can use the HORIZONTAL KEY PULSE drive signal of the VA62A to drive the IHVT primary to prove that the pulses are rectified and multiplied by the internal high voltage diodes. You simply drive the primary of the IHVT while monitoring the DC voltage at the second anode lead. A bad diode or winding will reduce the IHVT's output voltage.

The DC output voltage of the IHVT is dependent upon two things: the normal high voltage of the CRT, and the normal peak-to-peak voltage present at the collector of the horizontal transistor. Our engineers have already tested all combinations of IHVT ratings for you, and put it in a table (see Figure 4). The table tells you what voltage you can expect for the particular IHVT you are testing. A good IHVT will produce a DC voltage equal to or greater than the listed amount in the table.

Shorted Winding (Leakage) Test: The LC102 AUTO-Z lets you make the final test on IHVTs. You can use the LC102's leakage voltage to test for shorts or leakage between individual windings of the IHVT. A short or leakage between adjacent windings can cause problems such as excessive current flow, an absent keying pulse, or scan-derived power supply problems.

Simply apply the maximum LC102 leakage voltage (999.9 volts) across any two windings that are not connected in any way. There should be zero leakage current flow between any two non-connected windings. Any leakage reading indicates leakage between windings and an overrange reading indicates a dead short. Either reading indicates an IHVT that should be replaced.

***NOTE:** The IHVT Drive Test and the shorted winding (leakage) test are out-of-circuit tests.*

An ohmmeter and other conventional methods can't always find this type of problem. The LC102 leakage test will test for leakage current through resistances all the way up to 1 gigohm, something most ohmmeters can't do.

Are you interested in learning more about IHVT testing? We have Tech Tips that will help you understand and become more familiar with these time-saving tests. Call **1-800-SENCORE** and ask your Area Sales Engineer about your IHVT testing and how you can receive these helpful Tech Tips. ❐

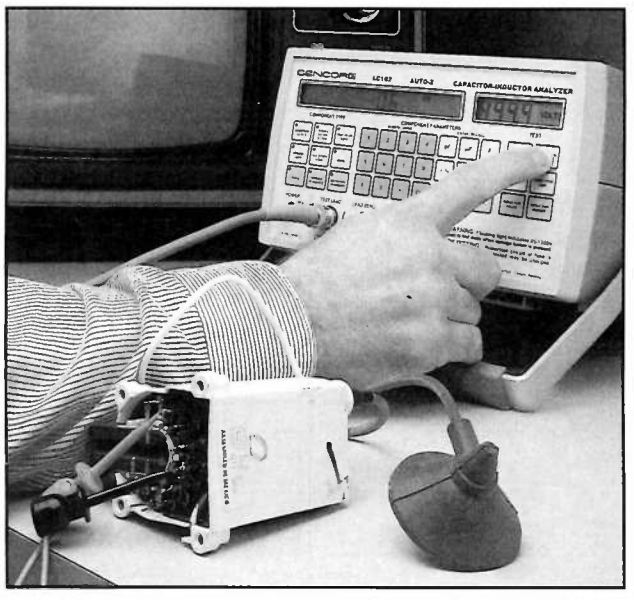
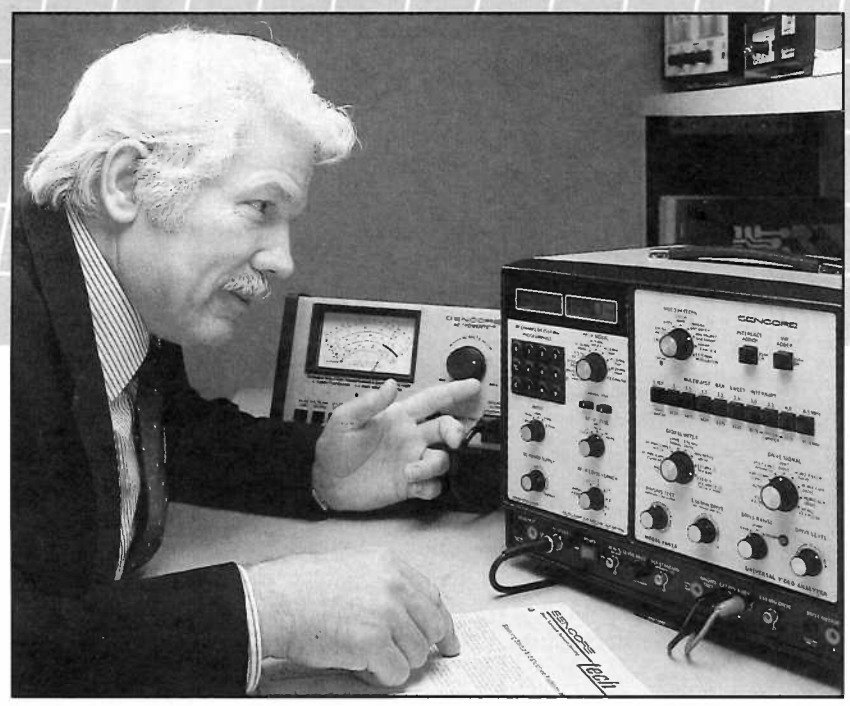


Fig. 5: Test for leakage or shorts between IHVT windings with the LC102 AUTO-Z.



Using Your VA62A Universal Video Analyzer™ To Solve Startup And Shutdown

by Cherlan Coffman, Editor

> "Safety circuits are needed to protect the user, unfortunately they give servicers a considerable challenge . . ."

Servicers have a healthy respect for the TV's CRT anode lead and can easily see the need for quick shutdown should it come loose. Failures that increase the risk of X-Ray radiation or otherwise affect user safety, although not as obvious, deserve equally fast shutdown. In fact, these failures need safety circuits to *prevent operation* (startup) and *protect the user* (shutdown). Startup and shutdown circuits, unfortunately, give servicers a considerable challenge.

The first step in troubleshooting startup and shutdown circuits is understanding how the circuits function. The second step is learning how your VA62A Universal Video Analyzer can help. Since scan-derived power runs most of the circuits in a modern TV (except the horizontal output stage), we'll start with a look at the scan-derived power system: the regulated DC source, the output transistor, and the scan-derived voltage source.

Regulated DC Source

The regulator is driven by a full or half-wave power supply that provides between 140 and 170 volts DC. The regulator can be as simple as a pass-transistor and a zener reference. In many cases, however, the regulator is an SCR driven by a separate oscillator which is controlled by scan derived power. *Use your VA62A's digital meter to prove the voltage supplied to the regulator as well as to monitor the regulator output.*

> ***Warning**: In modern TVs, the supply is connected directly to the AC line—an isolation transformer, such as the PR57 "POWERITE",® is mandatory, to allow test instruments to be safely connected.*

Horizontal Output Transistor: The SCR regulator provides a constant voltage to the horizontal output transistor, which in turn keeps the 25 to 35 kV high voltage constant for changing line voltages and different flyback loads. *Your VA62A's special horizontal drive signals let you substitute up to the horizontal output transistor to prove the horizontal stages are working.*

Scan-Derived Voltage Sources: The flyback supplies the high voltage to operate the CRT, the keying pulses needed in other stages, plus the *scan-derived* DC voltages used by all other circuits in the receiver. A typical flyback transformer, for example, will have a low voltage winding to power the IF, video, color and sound stages, and a higher voltage winding to power the vertical and video output stages. Plus, ***and this is important,*** the *horizontal oscillator* is also powered from the flyback output! *Your VA62A provides a special current limited DC power source, allowing you to substitute for the horizontal oscillator power and get the set started.* Here's the basic problem:

Continued on page 30.

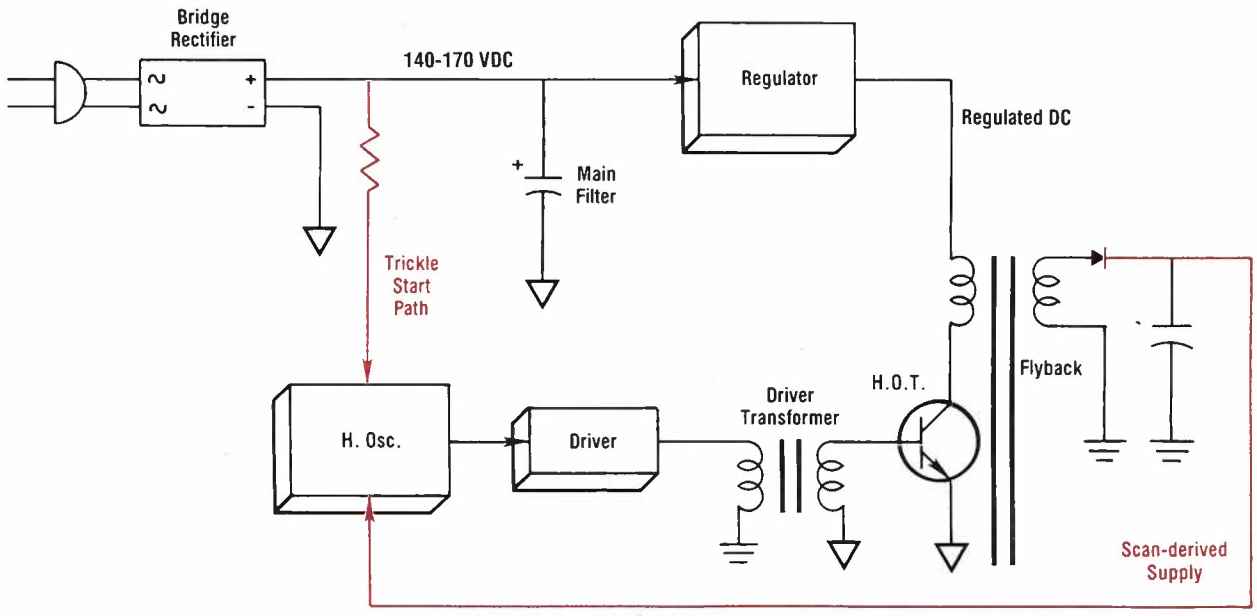
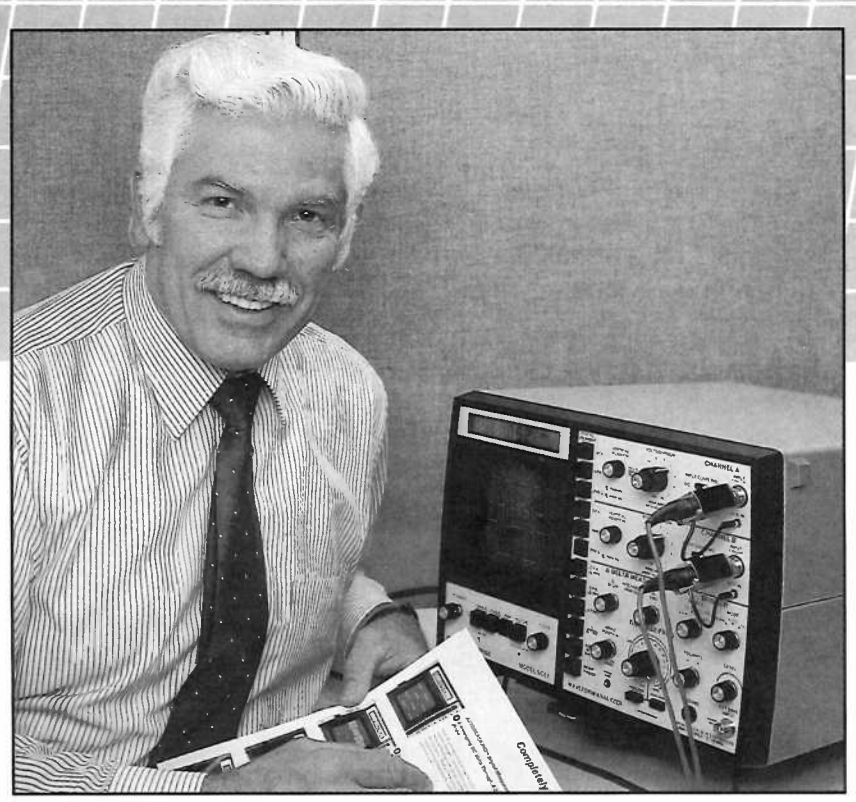


Fig. 1: The scan-derived power system includes the regulated DC source, the horizontal output transistor and the scan-derived supply.

Learn Why The SC61 Waveform Analyzer™ Has Become The Instrument Of Choice For Professional Servicers

by Cherlan Coffman, Editor



> "The SC61 Waveform Analyzer—built the way scopes always should have been. It quickly becomes the instrument you depend upon."

Your SC61 Waveform Analyzer gives you time-saving, profit building confidence.

Troubleshooting Confidence: Simply connect the probe, press, and read the digital display . . . you don't even need to look at the CRT. Plus, you can connect to any test point without worry, even the Horizontal Output Collector.

Measurement Confidence: With just the one probe hooked up, you can measure VPP, DCV, and FREQ at any test point at the push of a button—save time, eliminate multiple cable hookups, and simplify your testing. Best of all, you get the answers you need to make troubleshooting decisions—fast, accurate, and error free.

Waveform Analyzing Confidence: Analyze any waveform 100% automatically and error free — with microprocessor controlled digital accuracy, fiddle-free sync and push button ease.

Investment Confidence: A true source of service profit. By increasing your confidence, your test instruments help you bring increased customer satisfaction, creating more service dollars—that's the bottom line. Let's take a closer look.

" With the SC61's speed and accuracy, my productivity has increased 40% . . . The SC61 should be on every bench. "
James Sims - Oxnard, CA

Sencore SC61 Waveform Analyzer Obsoletes Scopes—Increases Confidence In Every Repair

The oscilloscope always had a problem—it just wasn't right for the servicer: The trace had to be sharper, for better accuracy; the sweep had to be faster, for higher frequency, the graticules had to be lit, to decrease reading errors, etc. Unfortunately the problem went on for years. Every scope improvement involved a better way of counting the graticules on the CRT. The graticules were the limiting factor in the accuracy and use of an oscilloscope. One solution? Etch the graticules into the CRT's inner glass to minimize errors from paralax. That should have done it! The concept was easy. The better you could count the graticules, the more you could find out about the signal. The result was agony (Figure 1).

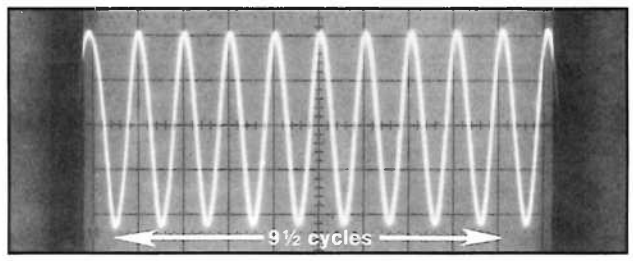


Fig. 1: The frequency of the signal can be determined by counting the number of complete and fractional cycles and multiplying by the frequency marking on the TIMEBASE switch—that's agony!

Once the graticules were counted, you still had to calculate your answer depending upon where the attenuator and sweep knobs were set. Calculations were time consuming and plagued with error. Scopes have improved over the years, as you know—most now have far better methods of counting the graticules. A few even calculate the position of cursors and show them on an on-screen display. These scopes, however, leave far too much room for operator confusion and time-consuming error to be chosen for service work. Here's why:

Servicers are routinely pulled "off track" on simple service jobs by not completely analyzing each test point. It's far too easy to miss the small tell-tale signal differences, DC voltages, or frequency errors that can prove a circuit good or bad. And, it's inconvenient and time consuming to hook up and use a scope, DVM, and frequency counter for every test point.

For success as a servicer, you have to measure and compare the voltages shown on schematics, such as DCV, PPV and Frequency. And, you must make these measurements at any test point, without error, and without loading the circuit with extra probes . . . you want to make these measurements quickly and accurately, even at the push of a button if possible, but more importantly, for successful servicing you need the ability to make these measurements simply, without confusion or chance of error. You are interested in *analyzing the signal*, not in counting the graticules or wasting time with complicated set-

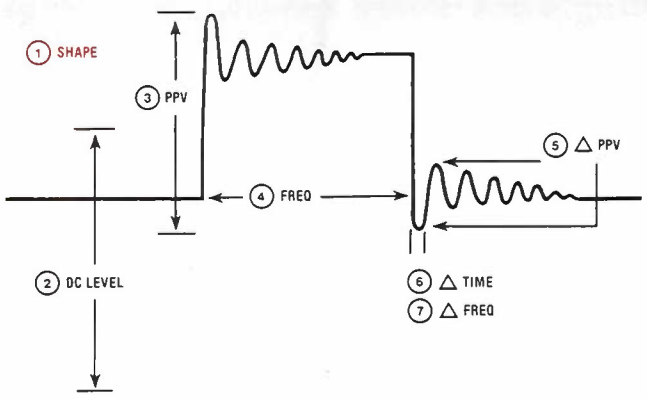


Fig. 2: These seven steps let you fully analyze any waveform. With the SC61, you only use the CRT for step #1. The digital readout provides steps #2 through #7.

ups. Sencore engineers concentrated on the signal instead of the graticule—to analyze the signal completely, without error, with only one probe hooked up. The result was the SC61 Waveform Analyzer, the only instrument designed to overcome the problems servicers experience with scopes. The SC61 Waveform Analyzer—designed and built for servicing; the industry recommends it; over 11,000 successful servicers regularly use it.

Autotracking gives you the answer you need, at the push of a button:

You can completely analyze any waveform up to 100 MHz 10 times more accurately than conventional oscilloscopes. The AUTOTRACKING™ digital display instantly gives you DC volts, Peak-to-Peak volts and frequency to accurately analyze any waveform parameter.

HV protection to 3000 Volts keeps your investment working for you.

Handles four times the signal level compared to any scope. Safely and without worry measure from a small 5 mV all the way up to 3000 Volts Peak-to-Peak or 2000 Volts DC. No need to worry about expensive repair bills caused by excessive high voltage.

> *"The SC61 promotes "clear thinking"; its ability to make several measurements at a test point with only one lead attached lets you march right through a circuit — keeps you focused on solving the problem."*
> ***Edward M. White - Brookston, IN***

Human Engineered for ease of use, speeds servicing and eliminates errors:

Most scopes waste valuable time with complex setup procedures and interpretation errors. The SC61's innovative design allows you to quickly lock onto a waveform and read DC volts, peak-to-peak volts, and frequency with just the push of a button.

100 MHz Gaussian roll-off lets you analyze waveforms to 100 MHz as clear and clean as most 200 MHz scopes.

The rate at which the response rolls off can be more important than the exact bandwidth. Generally, a slow Gaussian roll-off is desired (Figure 3).

The Bandwidth of an oscilloscope can be increased by modifying the roll-off characteristics beyond the 3 dB point. Peaking circuits are often used to extend the higher limit of the 3 dB bandwidth. This has an affect, however, on the rate of roll-off, which can be disastrous for complex waveforms that need the response out beyond the 3 dB point.

Servicers are often advised that they need a 100 MHz scope with delayed sweep. It's true, you do need the answers that a 100 MHz delayed sweep scope can give. But, you also need the simplicity, accuracy, and error-free operation only your SC61 can give. Your SC61 is designed to give you the

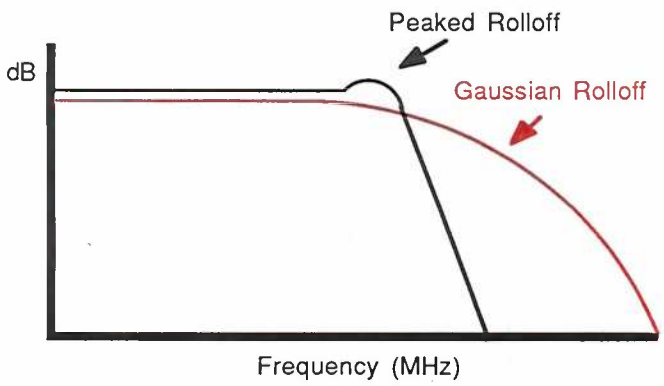


Fig. 3: Your SC61's smooth Gaussian roll-off ensures that complex waveforms are displayed nearly equal to scopes that have bandwidths to 200 MHz.

very same answers as any 100 MHz delayed sweep scope, without the well known frustration and time-consuming hassle. First, your SC61's bandwidth is especially designed with an exclusive Gausian roll-off that lets you view waveforms to 100 MHz. Plus, using the HORIZ POSITION control, you simply center the area of the signal you want to analyze further, pull to expand, and use the powerful Autotracking SC61 digital readout functions. You get the same answers provided by the best delayed sweep scope, ten times faster and with no chance of error.

You can try the SC61 Waveform Analyzer on your bench risk free. Just imagine a tester that helps you get started troubleshooting on any product, a tester so easy to use and so capable that you can hook up the probe *anywhere* in the circuit without being afraid of damaging the tester or the unit you're testing, *even if you were to connect it to a circuit that had 3000 VPP on it.* Imagine an instrument that with only one probe hooked up tells you everything you need to know about a circuit test point so you can make troubleshooting decisions and quickly move on to the next test point, and the next, analyzing each test point automatically until you've found the bad stage or component. Imagine an instrument built the way "scopes" always should have been built—one that works like you do to analyze circuits logically and effectively, at the push of a button.

Imagine these benefits in one easy to use instrument—the SC61 Waveform Analyzer—imagine using it on your service bench.

> *"32 years in the industry and I've seen no other equipment that can touch its convenience and ease of use; I love it."*
> ***James W. Harris - Huntsville, AL***

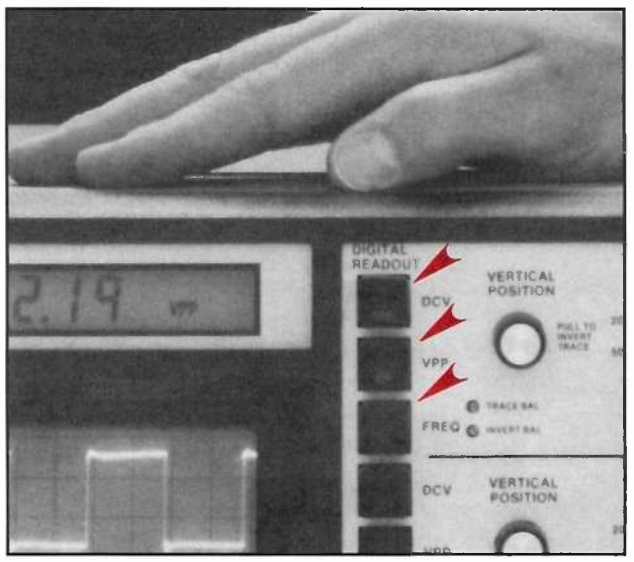


Fig. 4: The AUTOTRACKING functions are DC volts, peak-to-peak volts and frequency. Each automatically tracks along with the CRT to measure the parameters from the entire waveform.

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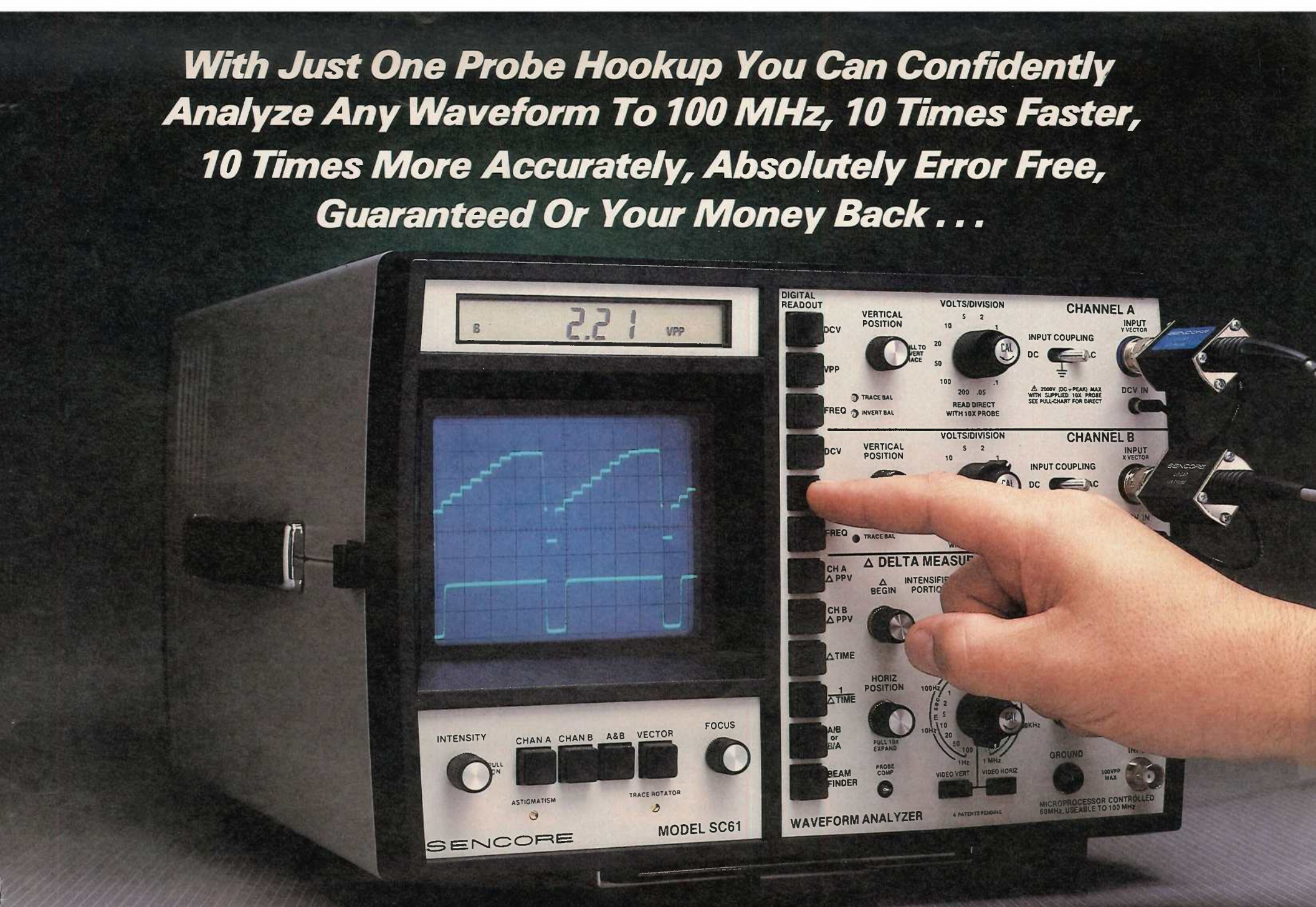

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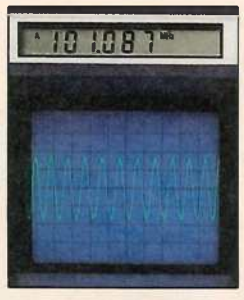

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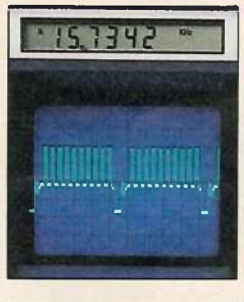
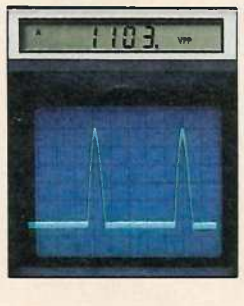
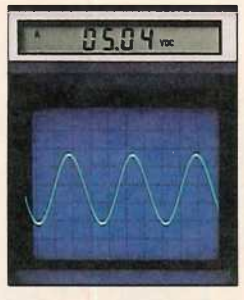


Rock-Solid Sync - ECL Logic Circuits And Differential Amplifiers Give Fiddle-Free Operation. Lock onto tough video waveforms and other evasive signals easily. The SC61 gives you complete control over even the hardest to trigger signals.

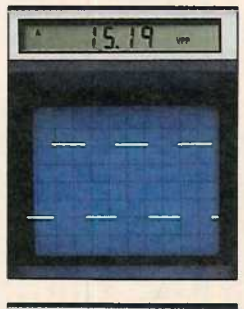


Four Times The Measuring Range - Measure from 5 mV To 2000 Volts (3000 Volts Protection) For Expanded Signal Handling. Now you can confidently measure the pulse on the collector of a horizontal output transistor without the fear of damaging your instrument. Only the SC61 gives you this peace of mind.

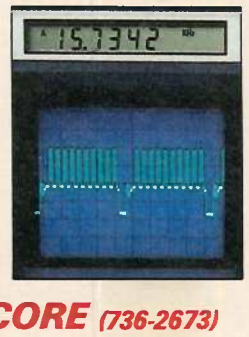
AUTOTRACKING™ Digital Readings Analyze The Whole Signal.



Autoranging DC Volts Through Single Probe. Now you can quickly determine DC Volts, at the push of a button, while still viewing the waveform. The SC61 gives you .001 Volts resolution for superior accuracy.



Automatic Peak-To-Peak Volts - Even If Variable Control Is "Out Of Cal." Now, eliminate the errors that are common to conventional scopes. The SC61's Automatic Digital Readout will tell the EXACT level, even if the attenuator is left "Out Of Cal."

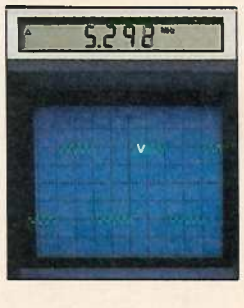


Automatic Frequency Measurements Without Sensitivity Adjustment Or Range Switching. The SC61 will display the frequency of any waveform without the hassles of other "digital" scopes. Simply lock in the waveform and push a button. It's that easy.

Delta Digital Tests Analyze Any Part Of The Signal.

Delta Peak-To-Peak Volts - Peak-To-Peak Volts Of Any Part Of The Signal. Analyze part of a waveform by setting the starting and stopping point with the "Delta" controls. The (Delta) PPV function of the SC61 lets you measure any part of the waveform you want, like the color burst on a composite video signal.

Delta Time For Any Time Reading - Including Delay Between Traces. An easy way to determine the time of any waveform segment or between two waveforms.



1/Delta Time - Or Frequency Of Part Of The Signal - Finds Sources Of Interference Or Ringing. Track down the source of interfering ripple on a power supply line, or on top of a digital waveform, with the 1/DELTA TIME function. Simply intensify one cycle of the interfering signal and read the signal's approximate frequency.

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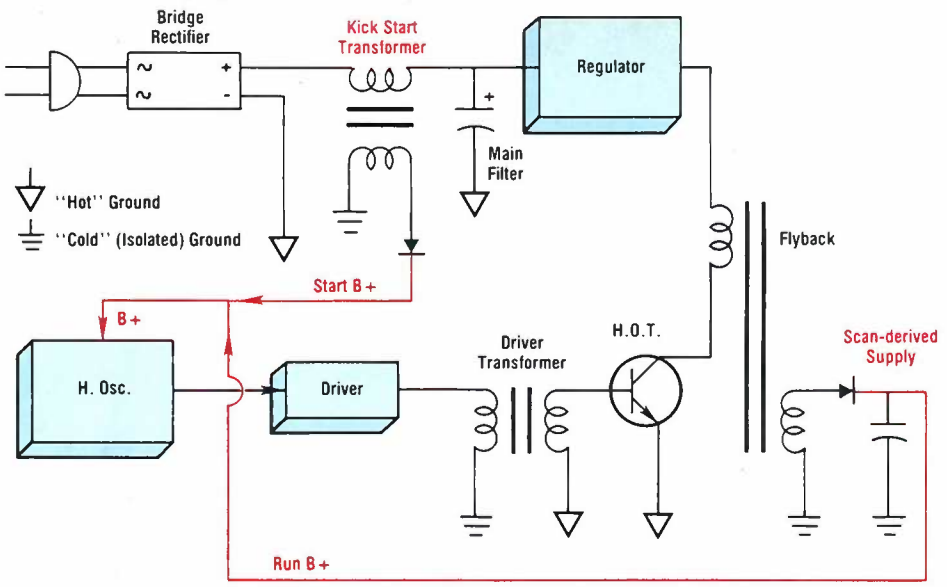

Fig. 2: If the horizontal oscillator hasn't started by the time the main filter capacitor is charged, the receiver shuts down.

Continued from page 26.

- There are no scan-derived voltages unless the horizontal output is operating.
- The horizontal output is driven by the horizontal oscillator.
- The horizontal oscillator is powered by a scan-derived voltage.

This "loop" must be started for the TV to work.

Start Circuits (Trickle And Kick Start)

There are two types of horizontal oscillator starters, "trickle start" and "kick start." (See Figures 1 and 2) The starter used depends on whether the chassis is connected to the AC line directly (as with Admiral chassis) or whether the chassis is electrically isolated from the hot ground by the flyback transformer (as in RCA chassis up to the CTC108).

Trickle Start: This starting circuit is less complicated because there is only one ground. A large value resistor is simply connected between the unregulated B+ line and the horizontal oscillator (Figure 1). The resistor will not supply enough current to operate the receiver, but will allow the oscillator to operate. The flyback output supplies power to the horizontal oscillator as soon as the horizontal oscillator has started, closing the powerloop.

"kick" start (used in most RCA chassis): This circuit supplies a small amount of voltage to the horizontal oscillator for just a few seconds after the receiver is turned on (Figure 2). This small power supply has its own AC line isolation transformer to prevent electrical connection between the chassis and the AC line. The primary of the transformer is connected between the unregulated B+ and a large electrolytic capacitor returned to "hot" ground. The transformer supplies an output only during the time the capacitor is charging. If the horizontal oscillator has not started by the time the capacitor is fully charged, the power supply loop is not completed and the receiver quits.

Each type of starter circuit gives a different "shutdown" symptom, which provides valuable troubleshooting clues.

- *The kick-start system only allows the horizontal oscillator to start once each time the receiver is turned on*. You may hear a short audio rushing sound or the crackle of high voltage when the receiver is first turned on, but there will be complete silence after that.

- *The trickle start circuit allows the set to restart each time the shutdown circuit activates.* This produces a "put-put-put" sound as the audio and high-voltage circuits are alternately turned on and off.

Shut Down Circuits Can Prevent The Receiver From Operating

Unsafe conditions, that produce X-radiation or stress components in the horizontal output stage will activate the shutdown circuits. Three basic shutdown circuits are used (Figure 3). Some receivers use only one of these circuits, while others have all three types:

- Horizontal Oscillator Shutdown
- Output Power Supply Shutdown
- Horizontal Frequency Shift Shutdown

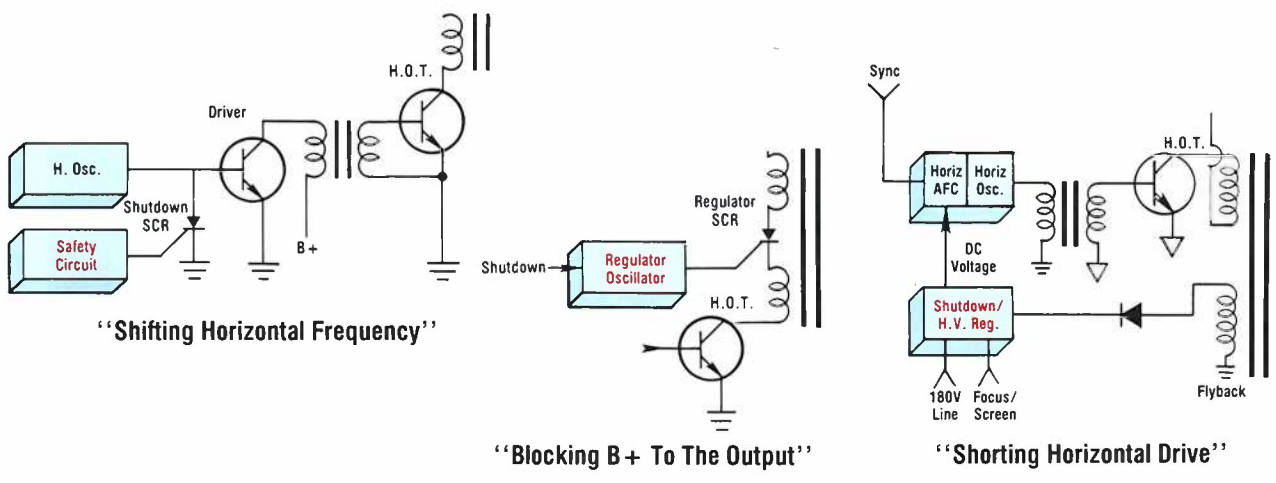

Fig. 3: The safety circuits trigger one or more shutdown circuits to stop the horizontal outputs.

Horizontal Oscillator Shut Down: This is the most common type of shutdown circuit; it simply disables the signal from the horizontal oscillator to the output transistor.

- The signal may be killed in the oscillator itself
- The oscillator output may be shorted to ground

This shut down circuit is activated by a pulse from the flyback transformer. The pulse amplitude tells when everything is operating normally. When the pulse is too large, the receiver is developing excessive high voltage. A level detector, triggered by this flyback pulse, turns on an SCR or transistor in the oscillator (or driver stage) to kill the oscillator signal.

Output Power Supply Shutdown: This circuit senses the amount of current in the emitter of the horizontal output transistor. It interrupts the regulated DC (by stopping the separate regulator oscillator used in these chassis) if the voltage across a small value resistor in the emitter circuit is too high. The receiver shuts down when the regulated supply is interrupted.

Horizontal Frequency Shift Shutdown: RCA used this protection circuit in the CTC83 through CTC97 chassis. It does not result in complete shutdown, but rather pulls the horizontal oscillator off-frequency to reduce the high voltage to a safe level. The circuit is triggered from any of three input samples:

1. The 180 volt DC supply
2. The CRT screen grid and focus voltages
3. A pulse from a separate winding on the flyback transformer

The horizontal hold control has no effect if this shutdown circuit is activated.

Isolate The Problem To The Power Supply Or Shutdown Loop

Use the receiver's symptoms when it is first turned on to decide whether to troubleshoot the power supply or the shutdown loop. Generally, a power supply problem results in a totally dead receiver. A shutdown problem, on the other hand, allows the set to operate for a split second before the shutdown circuits take over and kill the operation . Simply turn the volume control to about half volume before turning the receiver on, and listen for a rushing sound or a "put-down" symptom. Either indicates a shutdown condition.

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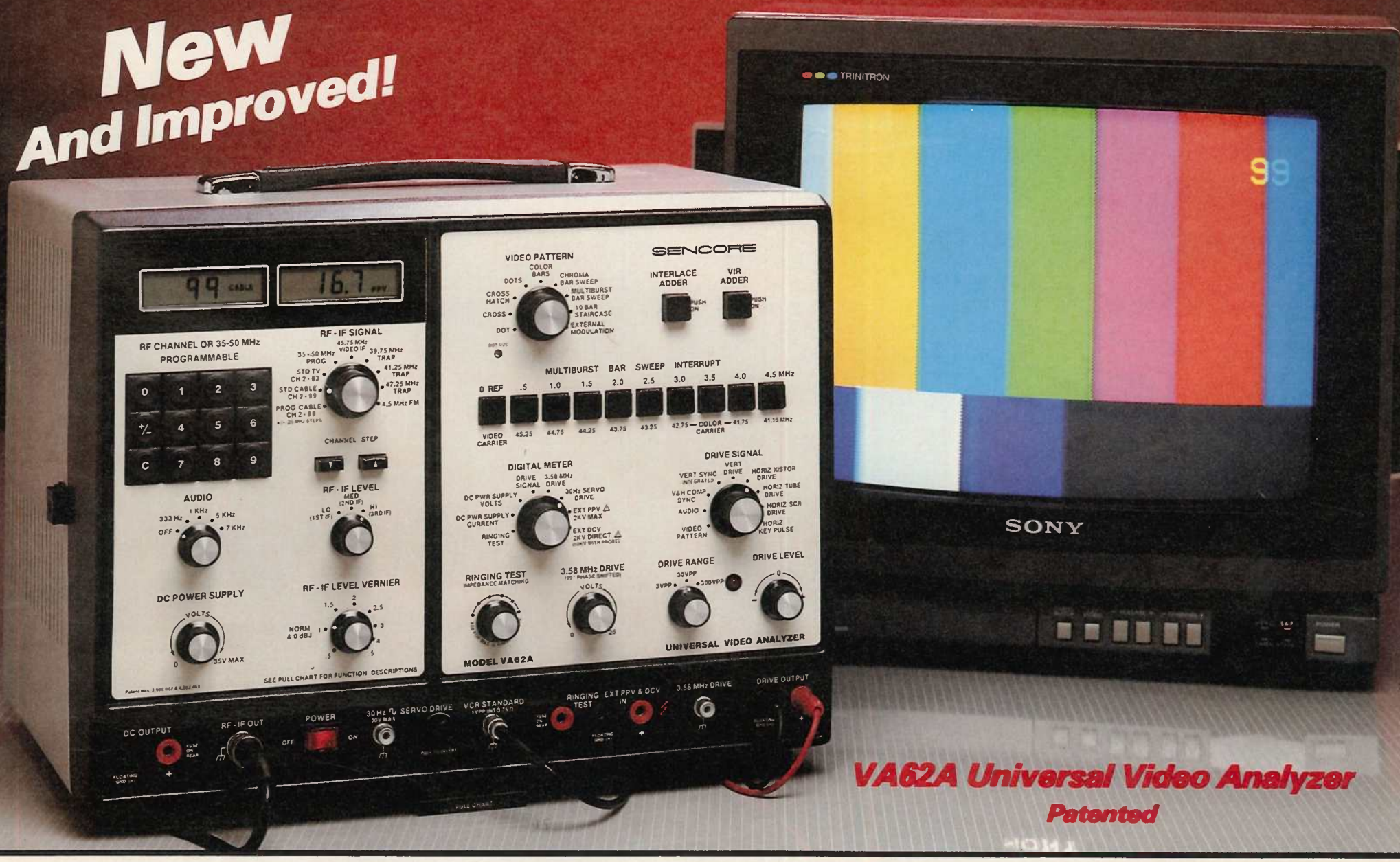

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