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Issue #149 Mar./Apr. 1990

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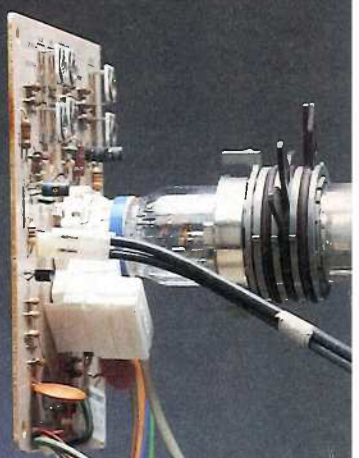

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How The SG80 AM Stereo - FM Stereo Analyzer ™ Simplifies Troubleshooting Of High-Performance Receivers

by Rick Meyer, Application Engineer

- **Keeps Your Stereo Profits High—With Reduced Troubleshooting Time**
- **Allows Functional Analyzing With Proven Substitute Signal**
- **Premium Performance Eliminates Doubt—Increases Troubleshooting Confidence**

Lets You Identify Any AM/FM Receiver Problem, Isolate The Defective Stage, And Performance Test . . . Three Steps To Successful Servicing

Is your stereo servicing bench equipped to service tough problems effectively? You might answer, "Of course it is; I have thousands of dollars worth of the latest high-performance test equipment." You may believe, as many audio servicers do, that high performance specifications automatically mean an instrument equips you for effective service. This is far from true. Most high-spec instruments are designed to test the performance of receivers but do nothing to help you troubleshoot them. The Sencore SG80 AM Stereo - FM Stereo Analyzer, on the other hand, is the only receiver analyzer designed to specifically help you isolate defective circuits in AM/FM receivers fast and accurately.

Does this mean you must decide between the SG80 and a performance spec tester? Not at all. In fact, the SG80 gives you as good or better performance testing capabilities than any other instrument on the market. In addition, it gives you troubleshooting capabilities not available anywhere else. As we will see in this article, the SG80 is the only instrument that helps you keep your stereo profits high by reducing wasted troubleshooting time, particularly on tough receiver problems.

Why You Need A Circuit Analyzer, Too

Many stereo service technicians downplay the need for a receiver analyzer because they say most of their service involves defective amplifier stages. Amplifier servicing is a major part of audio servicing. But what about those receivers that come in with problems such as poor sensitivity, no FM, no Stereo, or such? One technician explained, "You look at it and think, 'What could it be?' You don't know where to start because you don't see them that often. FM sensitivity problems are tough if you depend on off-the-air signals. I can spend more time trying to decide on what's wrong in a receiver front-end problem than on completely rebuilding a power amp section."

This is where the SG80 helps. Using a simple three-step process, you identify the problem, localize it to the defective stage, and after the repair is finished, you do a final complete performance check. Your initial overall performance test identifies if there is a problem in the receiver. You may notice that it requires more signal than usual to get a good output signal, or you may find that the separation is poor. Once a problem is identified, you then use the troubleshooting signals of the SG80 to isolate the problem down to the defective stage. Once the stage is repaired, you perform a complete performance test to verify that the repair job is thorough and that there are no other problems present. That's the secret formula.

Understanding The Advantages Of Signal Substitution

Without a dedicated functional analyzer, you are limited to only one method of isolating problems: signal tracing. Signal tracing works in some cases, but it is not always effective in FM circuits, RF & IF stages, or detector circuits. Signal tracing is a subtractive process. You analyze the signal at each test point with a scope, meter, or other instrument, hoping that the signal you are measuring is obviously abnormal. When the signal is definitely bad, you can be fairly certain the problem is in some stage before the test point you are testing. This is not always true, of course, if there are feedback paths or if the

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problem causes loading of earlier stages. In addition, the signals in the early stages are often very small, so small that an oscilloscope will not always display the results. In addition, an oscilloscope tells little about the quality of an FM signal. It tells you something is there, provided it is of sufficient amplitude, but you can't effectively know the quality of the modulation on the carrier since it is FM in nature. An "almost good" signal also leaves you in doubt since schematics rarely tell you how much tolerance to expect from one unit to the next.

FM Stereo Multiplex (MPX) Signal: A stereo FM receiver contains a decoder section which separates the right and left signal from the multiplexed signal. The SG80 provides an MPX signal that consists of the composite stereo information without any RF or IF carrier. This signal allows you to inject signals between the FM detector and the stereo decoder. You need this signal to separate stereo decoder problems from IF or RF problems.

FM IF Signals: FM IF problems are particularly difficult to troubleshoot with a scope.

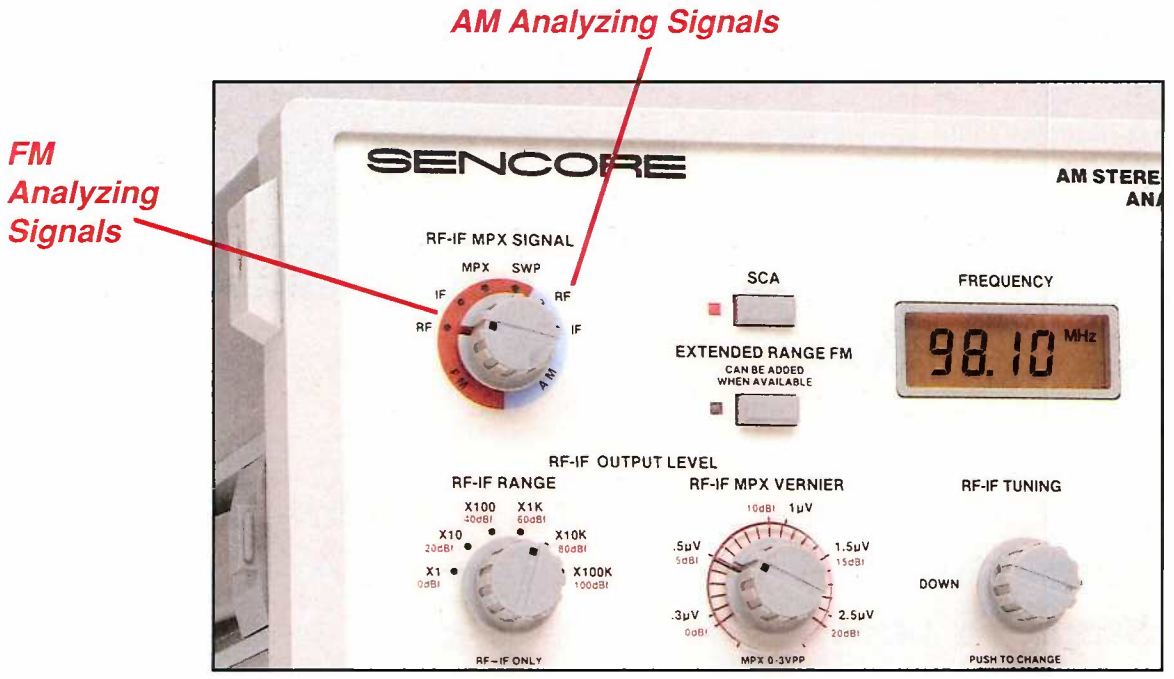


Fig. 1: The SG80 provides all the AM and FM troubleshooting signals needed to analyze any AM Stereo or FM Stereo receiver.

Signal injection, on the other hand, is just like taking a signal from a unit you know works properly and injecting it into the stages of the defective unit. You simply monitor the output of the receiver with an oscilloscope, or your ears, to determine if the signal is normal when you inject at each test point. By walking back through the receiver, you can identify where the signal becomes bad. That is the stage that has the problem. The SG80 provides you with all the signals needed to walk through any FM/AM receiver, stage by stage, with confidence in your results.

FM Troubleshooting Signals Let You Walk Through Any FM Tuner

The FM troubleshooting signals contained in the SG80 AM Stereo - FM Stereo Analyzer let you analyze any type of FM problem, whether it is in the stereo decoder, the IF amplifiers, or the RF amplifier or mixer stages. The signals from the SG80 provide either stereo or mono modulation so you can isolate distortion or separation problems. All signals are fully amplitude adjustable to match the signal levels found at each stage. Let's take a look at each signal starting from the output and going back to the antenna terminals.

Audio Drive Signal: The ultimate signal you want from the FM tuner is a good audio signal. The SG80 audio drive signal lets you start right at the output of the stereo decoder to ensure that all stages after the decoder are working properly. The audio drive signal can be adjusted to any level between zero and 3 VPP so you can drive any stage up to the voltage amp stages in a receiver.

First, early IF stages contain signal levels that are often smaller than those that can be seen on an oscilloscope. Secondly, a scope compares amplitude changes verses time. An FM IF signal is a frequency modulated signal, thus, it cannot be readily analyzed using a scope. Signal injection is the only effective way to isolate IF troubles.

The SG80 IF generator provides fully modulated signals to inject directly into any IF stage. The stereo modulation helps you isolate stereo problems easily. Simply measure the stereo separation while you inject the SG80 IF signal at each IF injection point. Finally, the fine tuning feature of the SG80 lets you match the SG80 IF signal to the frequency of the IF stages. This is particularly important for use in modern frequency shifted ceramic IF stages.

FM RF Signals: The SG80 provides fully modulated RF signals to inject at the antenna or mixer input. The RF output from the SG80 can be varied from a small 0 dBf (0.3 uV) signal for sensitivity tests to an amazing 120 dBf (250,000 uV) signal to blast through bad stages. The RF signals bring you all the way back to the antenna input for complete analyzing capabilities.

AM Troubleshooting Signals Extend Analyzing To AM Radios

The SG80 also provides all the signals needed to inject into any AM stage to isolate troubles quickly in AM radios. The SG80 amplitude modulates the carrier signal with the selected audio tone to allow you to inject at any test point from the antenna to the detector. Let's look at the troubleshooting signals available on the SG80 for AM troubleshooting.

Audio Drive Signals: The same audio drive signal used for FM troubleshooting after the detector can also be used for AM troubleshooting. This is a standard audio signal adjustable up to 3 VPP.

AM IF Signals: Two main IF frequencies are common in AM receivers: 455 kHz and 262 kHz. The SG80 automatically tunes to the 455 kHz IF frequency, but can be quickly tuned to the 262 kHz IF frequency if you service receivers with this type of IF system. You can inject the IF signal directly into the input of the detector or anywhere else along the AM IF signal path. In addition, the SG80 provides C-QUAM stereo modulation for troubleshooting AM stereo radios. You can inject the AM IF signal directly into the C-QUAM decoder IC to isolate problems to the decoder or earlier stages. *(NOTE: An MPX signal does not exist for AM Stereo due to the way the C-QUAM signal is made up. The input of a C-QUAM decoder IC is always an IF signal.)*

AM RF Signals: The SG80 also provides an AM RF signal that you can inject into either the antenna terminals or any of the RF stages prior to the mixer. This allows you to identify bad AM RF amplifier stages.

Now that we've given you an overview of the SG80 troubleshooting signals, and how functional analyzing works, lets see how the SG80 simplifies troubleshooting a typical tuner problem.

Case History: The "Fuzzy" Receiver

A customer brought in a Yamaha RX-1100U receiver with the complaint of "fuzzy sound" on his favorite station. We noted that this station was some distance away. This gave us our first clue.

A Quick Performance Test Identifies The Problem

Later that afternoon, we decided to check out the RX-1100U receiver. We placed it on the bench and fired up our SG80 AM Stereo - FM Stereo Analyzer. The backlit LCD frequency display sprang to life and displayed 98.10 MHz, the standard FM RF test frequency. We checked the front panel controls on the SG80 and confirmed that the RF-IF OUTPUT LEVEL was set at the EIA/IHF standard 65 dBf output level. We set the AM & FM MPX

Fig. 2: The signal strength meter gave a quick indication the receiver had poor sensitivity.

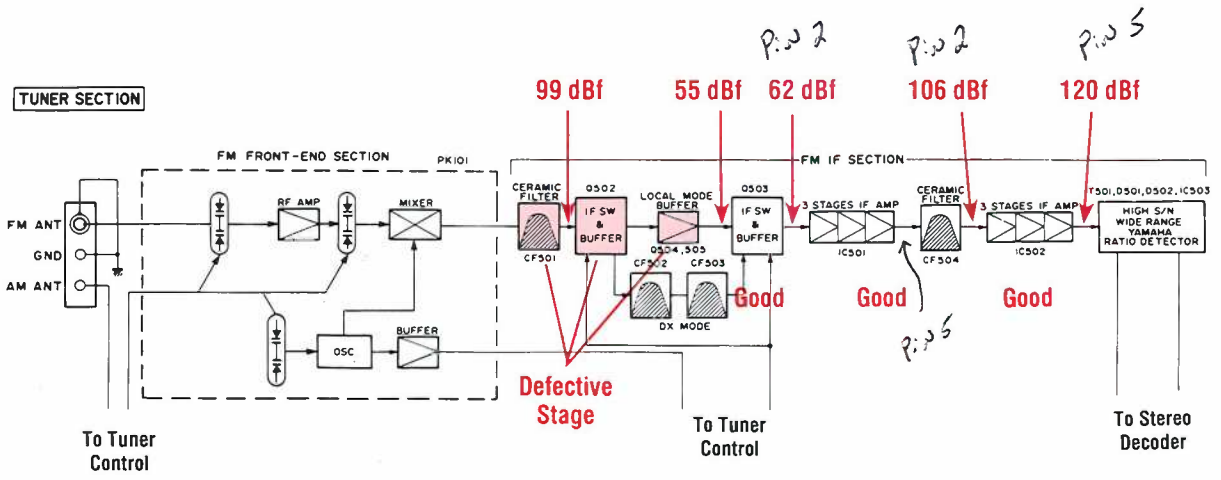


Fig. 3: Injecting signals into each stage of the FM IF section located the source of the poor sensitivity.

MODE switch to STEREO and the AUDIO switch to 1 kHz. We confirmed that the PILOT MODULATION control was set already at the 100% NORMAL pilot position. Finally, we adjusted the AUDIO MODULATION control to give a 100% total modulation level as displayed on the backlit MODULATION LCD display. We were ready to start.

We hooked the RF cable to the RF-IF MPX OUTPUT jack on the SG80 and the other end to the antenna input of the receiver. We connected the receiver speaker outputs to our PA81 Stereo Power Amplifier Analyzer and pushed the PA81 power switch to on.

We applied power to the receiver and tuned it to 98.1 MHz. A 1 kHz audio tone came out of the speakers on the PA81. We also detected a little hissing noise in the background. The bargraph level display on the receiver was indicating less than one-half signal strength. That was odd . . . we were applying the standard RF test level. We should be getting an excellent output from the receiver.

We turned down the RF-IF MPX VERNIER control to 0 dBf, giving us a 60 dBf signal output. The sound coming from the PA81's stereo speakers was now extremely noisy. We had to turn the signal level up to 75 dBf before we obtained a somewhat clean sounding 1 kHz tone and a full signal strength reading on the receiver's signal strength meter. We switched the AM & FM MPX MODE switch to R ONLY and observed good stereo separation. Likewise in the L ONLY mode, the PA81 confirmed that the stereo separation was good. Our initial performance test had quickly identified a sensitivity problem.

The Troubleshooting Signals Locate The Bad Stage

We pulled the service manual for the RX-1100U and looked at the block diagram to get a general overview of the FM section. We observed a typical FM front end with an RF amp, mixer, and oscillator section. The IF section was composed of several ceramic filters, two transistorized IF switches, and two ICs serving as IF amplifiers. The output of the last IF IC stage fed to a ratio detector which then fed the detected signal to the MPX circuit.

Based on the symptom, we did not suspect a problem with the detector or MPX circuits. We were receiving audio and were obtaining good stereo separation. The problem was a gain problem in either the IF or RF section. We decided to use the troubleshooting RF and IF signals of the SG80 to check the gain of the various RF and IF stages. We expected to see some stage gain in both IF amplifier ICs and the RF amp, but very little gain in the two IF switching stages. Even though the impedances at each point we would be injecting into would be different, we knew we could still use the relative signal level required to drive each stage as an indication of its amplifying ability.

We disconnected the RF cable from the SG80 and substituted the 39G221 Test Lead. We decided to first inject a signal at the output of the IF stage to get a starting reference point. We connected the test lead to pin 5, the output pin, of IC502 and listened for a tone from the speakers of the PA81. We turned the RF-IF OUTPUT LEVEL controls up to 120 dBf and heard the audio tone. The signal strength display on the receiver read nearly full scale. This set our reference level.

We next moved our test lead to pin 2, the input pin, of IC502. Good audio was observed and the signal strength display on the receiver read full scale. We turned the RF-IF OUTPUT LEVEL controls on the SG80 down until the display on the receiver just started to drop. The RF-IF OUTPUT LEVEL controls read 106 dBf. The last IF stage was indeed amplifying.

We next moved our test lead to pin 5, the output pin, of IC501. Good audio was heard and the level indicator on the receiver read just slightly less than full scale, as it did at the previous test point. This proved that the ceramic filter, between the IF amplifier stages, was functioning.

We moved the test lead to our next injection point, pin 2 of IC501. Again, good audio was heard from the PA81 speakers. The level indicator on the receiver now read full scale. We turned the range and level controls down until the level indicator on the receiver again read just slightly less than full scale. The RF-IF OUTPUT LEVEL controls on the SG80 now read 62 dBf. IC501 was obviously amplifying. This was becoming quite puzzling.

We hadn't found anything suspicious with the IF amplifier stages so we decided to continue on with our signal injections. There were two transistorized switching stages between the IF amps and the tuner section. We injected into the base of the second stage, Q503. Again good audio was heard. We found that we could turn the RF-IF OUTPUT LEVEL controls down to 55 dBf and still get the same signal strength indication from the receiver display. Q503 appeared to have some amplification.

We next moved our test lead to the base of Q502. The signal was now very weak and noisy. We turned up the RF-IF OUTPUT LEVEL controls on the SG80 until we heard good audio and the signal strength display on the receiver showed a good level. We looked at the RF-IF OUTPUT LEVEL controls and discovered they were now set to 99 dBf. There was definitely no gain in this stage! In fact, we had found the problem. We moved the test probe to the collector of TR502 and found that we had to turn the RF-IF OUTPUT LEVEL control on the SG80 back down to 55 dBf for an equivalent signal level indication.

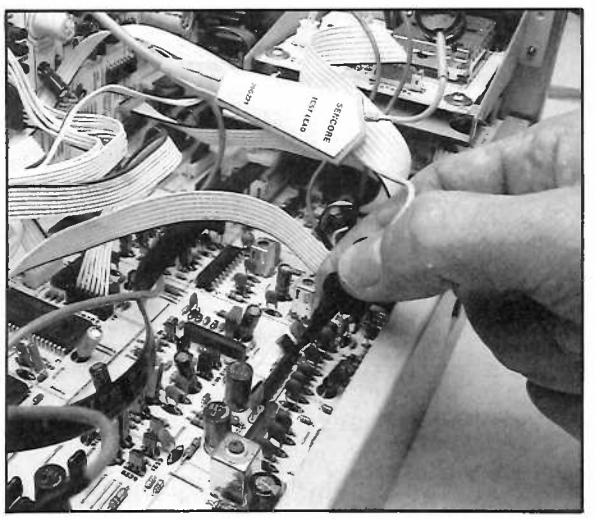
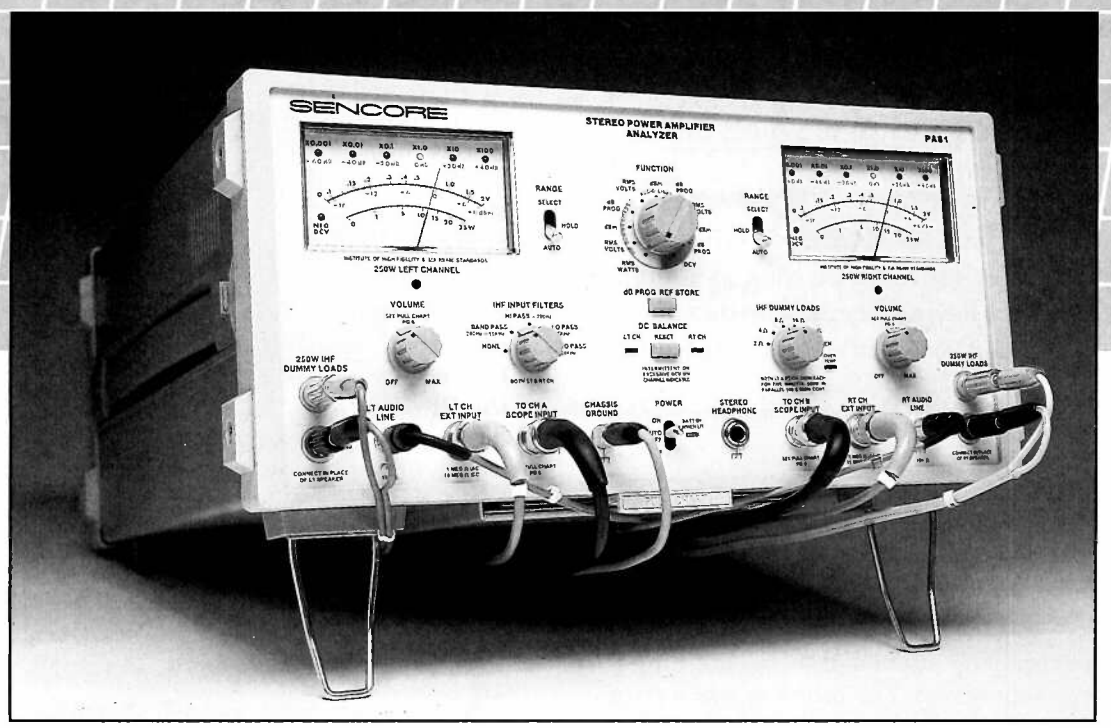


Fig. 4: The SG80 IF injection signal gave positive proof that IC502 was functioning as it should.

A Final Test Locates The Bad Component

We removed Q502 and checked it with the TF46 Super Cricket. It was open. We replaced Q502 and turned the receiver back on. We removed the test lead from the SG80 and replaced it with the RF cable. We switched to FM RF and reset the RF-IF OUTPUT LEVEL control to 65 dBf. We heard a good, noise-free, 1 kHz tone coming from the speakers with no evidence of noise. We were able to turn the RF-IF OUTPUT LEVEL down to 41 dBf before the signal strength display on the receiver even started to drop. We were still able to hear a good signal even at this lower level. We completed our performance test and wrote up the bill on the repair job.

The above repair is just one of many examples that prove the time-saving advantage of using the SG80 troubleshooting signals to fix tough dog receiver problems. We used the SG80 to isolate the problem down to a single stage and then analyzed that stage using conventional troubleshooting methods. Isolating the defective stage with the SG80 takes only minutes and increases your overall troubleshooting productivity tremendously. In many cases, it's the difference between profit and loss on a job. ❐



The front-panel layout is both practical and attractive. All operating switches and controls are placed widely apart, leaving plenty of working room. A black dot on each knob plus the large black letters and figures are so legible that you can read all functions and ranges from 5 feet or so.

Report From The Test Lab

The PA81 Stereo Power Amplifier Analyzer ™

by Carl Babcoke, Consumer Servicing Consultant, ES&T Magazine

As Seen In The Jan. 1990 Issue Of "Electronic Servicing & Technology"

The model PA81 Stereo Power Amplifier Analyzer from Sencore dynamically tests stereo amplifiers with power outputs up to a total of 500W, measured according to Electronic Industries Association/ Institute of High Fidelity (EIA/IHF) standards. Many unique testing functions and techniques also are included for quick, dependable troubleshooting of hi-fi stereo circuits.

Here is a partial list of features and functions:

• Twin autoranging analog meters (one for each channel) each have six ranges with LED range indicators.

• The user can measure rms audio power to 100W per channel for continuous operation or 500W for intermittent operation.

• The automatic dcV-Balance monitor system has an LED for each channel. The LEDs light red and blink every second if more than ±1V appears at the input to the dummy-load resistors. A relay also disconnects the analyzer's malfunctioning input signal from its dummy resistor within 50 ms.

• An open circuit or one of five dummy-load resistances can be selected by the Dummy Loads switch.

• The user can choose one of four input-frequency filters or no filter.

• For signals entering the left or right audio-lines inputs, the Function switch offers ac measurements of rms acV, dBm or dB Prog (programmed) at 10kΩ input impedance. The purpose is to test standard audio lines.

• For signals entering the external inputs, the Function switch can select rms acV, dBm, dB Prog or dc-voltage measurements. This is the only function having dcV. These functions are for signal tracing and troubleshooting almost anywhere. Input impedances for ac voltages are 1MΩ; dc voltages have 15MΩ.

• For signals from the dummy-load resistors (amplifier's output), the FUNCTION switch offers rms watts, rms acV, dBm and dB Prog.

• All types of decibels have the same voltage or power ratios, but those with letters following the dB have specific reference levels. Most decibels in the analyzer are measured by the dBm standard where 0dBm equals 1mW across a 600Ω load (which calculates to 0.775Vrms). Programmed dB readings depart from the zero reference of the dBm standard and, therefore, are given in dB, not in dBm.

• An Over Temp indicator lights when the internal temperature becomes excessive. A fan gives sufficient air circulation to maintain a safe temperature. A total audio power up to 200W is dissipated continuously in the dummy-load resistors. Higher powers require limited operating times.

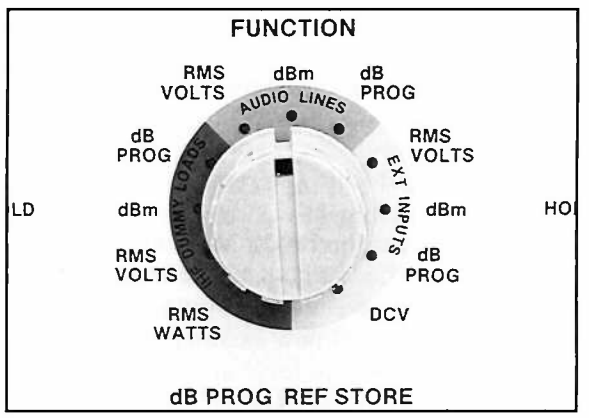
• Two internal speakers with volume controls, driven by internal amplifiers, are available for each channel. These volume controls are not entirely responsible for controlling the huge span of sound from a whisper to perhaps +35dBm (45Vrms) at 250W per channel that is obtained at maximum power. Sencore has provided a tie-in with the autoranging circuitry so both channel volumes are reduced or increased in 20dB steps.

• Power for the unit can be obtained from one of three sources: a power adapter that operates from 105/130Vac lines and can recharge the optional battery; a fused cigarette lighter plug for 12V operation; or a rechargeable battery pack, which is good for about five hours of operation.

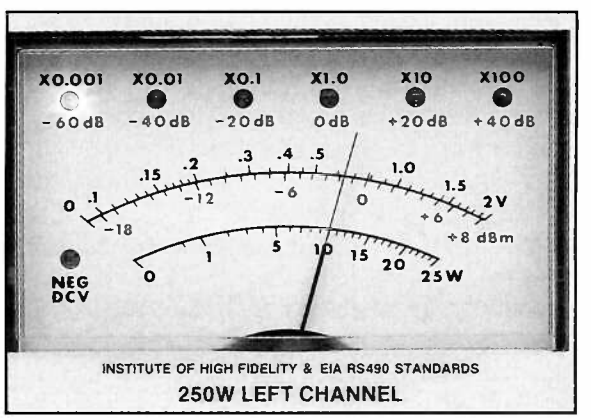
• The analyzer comes with a 13-page instructional pull-out chart.

The dB Programming Feature

When you want to use a reading from the unit you're testing as a 0dB reference for a measurement at another test point, you use dB Prog. Whatever signal level is being measured when the Store button is pushed becomes the



All three external components of the dcV-Balance feature are located on the front panel below the Function switch and the dB-Prog-Ref-Store push button. A dc voltage higher than ±1V from the amplifier that is connected to the dummy-load resistors opens the circuit between amplifier and load resistors. Also, an LED blinks to warn of a defect and show which channel is affected. The two Range switches are between the Function switch and the meters on both sides. Each switch controls the method of range selection for its respective meter.



new 0dB reference, and subsequent dB Prog readings are relative to this new 0dB. Both channels undergo programming simultaneously, but they can have different 0dB references.

This feature is useful for troubleshooting, such as checking the gain of a transistor or the gains or losses of cascaded stages.

Remote Operation

Tests can be automated by using the model IB72 IEEE 488 bus-interface, which connects between the PA81 and a controller or automated system.

In the basic "talker" mode, a technician selects the desired functions and ranges. The resulting readings are sent to the IEEE interface through an IE233 bus cable. As a "listener," the PA81 receives commands from the controller to select certain functions or ranges. In this mode, the panel controls are locked out electronically, and the controller automatically steps the unit through the required tests.

The third mode is a combination "talker/listener." All functions except the dummy-loads resistances and the volume controls can be controlled via the bus interface.

Versatile External Inputs

In several important ways, the two external inputs are different from the other two functions from the same switch. First dc voltages can be measured, along with the usual rms acV dBm and dB Prog functions. Also, the Ext-Input grounds are not connected to each other or to chassis ground. These independent grounds add flexibility during troubleshooting. For example, one input probe can be connected across a transistor's base resistor and the other across its collector resistor without one reading having any effect on the other.

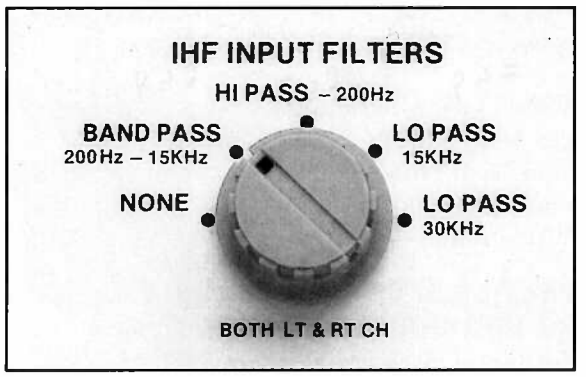
The isolated grounds also help broaden the areas suitable for dcV testing because both external probes can be used on the same channel.

Isolated Grounds

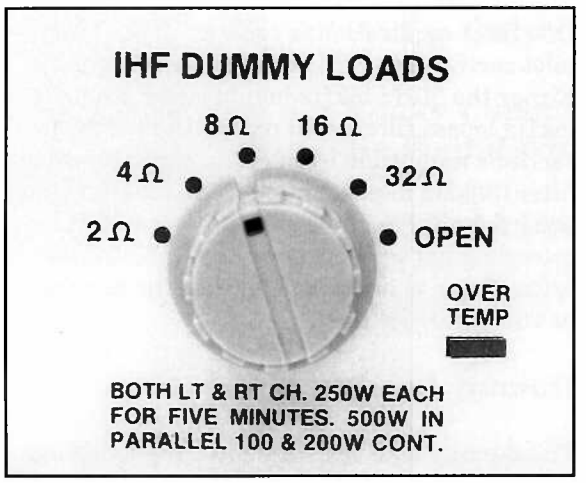
For maximum safety and flexibility, the unit has several sets of isolated grounds. First, the conventional chassis grounds: The two audio lines cables, two scope cables, one stereo jack and the chassis-ground post are connected to the frame and chassis ground. The two sets of binding posts for audiopower input to the dummy-load resistors are not grounded to the chassis, nor to each other. The two external-input grounds are not connected to anything on the panel, the chassis ground or to each other.

Unusual Meters

Although the twin analog meters might appear ordinary, they're not. The meter faces are only a small part of each meter's circuitry. IC-based circuitry controls the meters. These



Specifications for the four input filters are in agreement with the IHF standards.



Five load resistors of IHF values are selected by the IHF Dummy Loads switch for both channels. Each resistor can tolerate power dissipation of 100W (per channel) indefinitely, and for gradually reduced times up to a maximum of 250W per channel for five minutes.

ICs are why some functions can have as many as six ranges, although each meter's face has only three scales.

Self-Test At Power On

Immediately after power is switched on, the meters produce quite a visual show. The first time I used the meter, I noticed that the display activated all the LEDs, and the meter pointers moved smoothly from zero to maximum and back to zero. I initially thought this was caused by power-on surges, but nothing appeared to happen randomly. I concluded that this was a self test.

Autoranging Surprises

With analog autoranging in this unit, one of the six LEDs shows the range, and the reading is shown by the pointer position vs. the range value. Both digital and analog autoranging are equally easy to use and to obtain a reading. With analog, the pointer can show quick changes of audio, but without the frantic search for a stable reading that is common with digital meters.

The scope's input level and the internal-amplifier sound volume are tied to the steps of the autoranging. This eliminates many adjustments of scope gain controls and the volume controls.

Each meter has a Select/Hold/Auto toggle-type, 3-position range switch. Moving the toggle to the down position, where it locks, activates the autoranging for that channel. With Auto, the analyzer selects the proper range and stops there during a measurement. When the probe is removed from the circuit, the meter downranges to the minimum range and remains there until the next test.

The switch's center position selects the range-hold condition that locks in whatever range is in use, thus overriding the autoranging. When a specific range is needed, use the Select position of the switch to move the range multiplier LED up one position for each time the momentary-contact switch toggle is moved upward.

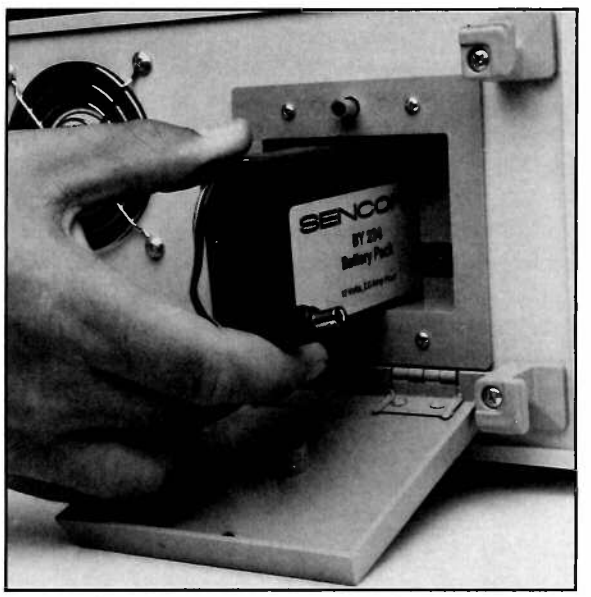
Manual ranging by the Select switch operates only for upranging. During Auto fully-automatic operation, however, the internal circuits supply downranging as well as upranging.

Learning About Autoranging

Upranging is triggered when an increasing signal reaches the +8dBm calibration line on the dBm scale, regardless of the range in use. This upranging operation ends with the next higher dBm range at the –12dBm line.

Downranging is triggered when the signal level is decreasing and reaches the –15dBm line on the dBm scale, regardless of the range in use. Downranging ends on the next-lower range at the +5dB line.

Coverage from one upranging to the next is 20dBm (12+8=20); the coverage between downrangings also is 20dBm (15+5=20). These ranges give complete decibel coverage. However, the dBm scale has calibrations down to –18dBm, so there are three extra dBms that can be used in manual operation by the Select and Hold switches.



When 120Vac power is not available, a BY234 rechargeable 12V battery can be used to power the unit for up to five hours.

The difference between –12dBm and –15dBm at the low end and +8dBm vs. 5dBm at the high end of each range is the hysteresis that prevents unstable autoranging triggering.

Input IHF Filters

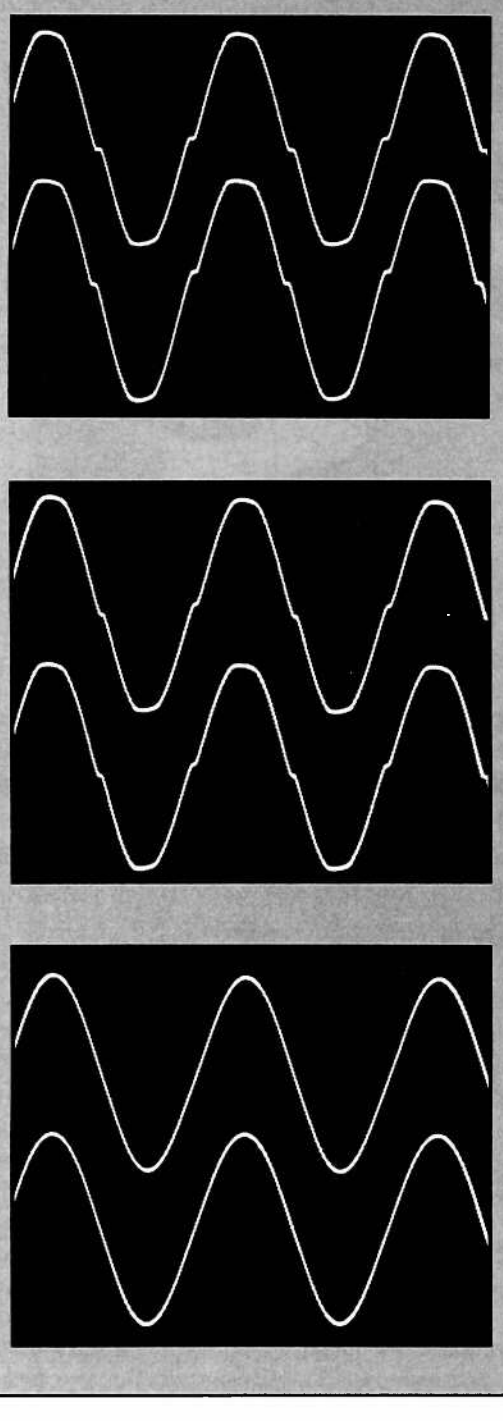
Five positions are available from the IHF Input Filters selector switch:

- No filters provides a flat frequency response from 0Hz to 200kHz.

- Bandpass filter circuits pass all frequencies between 200Hz and 15kHz.

Repairing A Tube-Type Amp

These waveforms were produced during final repairs of an old tube-type stereo amplifier. In the first photo, both positive and negative tips are rounded. That is typical of mild overload with tubes (whereas transistor amplifiers usually have sharper edges at the clipped tips of the sine waves). In the second photo, notch distortion near the sine waves' vertical centers is excessive. In the third photo, the sine-waves' positive and negative peaks of channel 2 (bottom trace) are not symmetrical, probably indicating one weak 6BQ5 output tube or stage. After the tubes were more nearly matched (no new ones were available), the powers of both channels and the waveforms were nearly identical, as shown in the second photo. Notches near the vertical centers were caused by the overbiased output tubes failing to draw current quickly enough at the beginning of each peak. The notches disappeared and the flat tops filled out as the power was slowly decreased. The third photo shows the undistorted sine waves produced by reducing the output power slightly.



• Hi-pass filter circuits pass all frequencies between 200Hz and 200kHz.

• The lo-pass l5kHz filter passes all frequencies below 15kHz, including the below –200Hz hum area. This filter forms a good pair with the bandpass filter for measuring 120Hz and 60Hz hum in the amplifier's output.

• The lo-pass 30kHz filter passes the audio spectrum below 30kHz. It is useful for removing digital-clock noises above 30kHz without obscuring the CD test material or the music's harmonics.

One filter application is removal of the l9kHz pilot carrier from FM receiver audio signals. Either the 20Hz-l5kHz bandpass or the l0Hz-l5kHz lopass filters will reduce the l9kHz carrier's amplitude by 30dB or more. Another filter (30kHz lo-pass) removes the digital-clock noise from the audio signals of compact discs, providing better accuracy during separation tests. There is no hum filter, but the hum can be calculated easily.

Dummy Loads

The dummy-load resistors have the following specifications:

• Values are 2Ω, 4Ω, 8Ω, 16Ω and 32Ω, ±1% (IHF specifications).

• Position six of the Dummy-Loads switch opens the load circuit. This feature helps identify tendencies toward oscillation or other instability, which often is more severe with no load.

• The reactance of any dummy-load resistor is lower than 10% at all frequencies lower than 200kHz.

Lab Tests

I decided to test two amplifiers: a 45W per channel, transistorized AM/FM-stereo with digital tuning and readouts; and a 30-year-old tube amp. (For a detailed description, see the sidebar.) I used the analyzer to perform minor repairs on this amp, which gave me an opportunity to use rms watts, the audio input lines and the external inputs, plus functions of rms volts, dBm and dcV during the repairs.

Although the analyzer can perform many tests well, the capability to test stereo-amplifier high-wattage powers easily and accurately is perhaps the most important.

Here is a streamlined method for testing the powers of stereo amplifiers, including the presetting of amplifier controls and analyzer adjustments:

• Connect an external audio generator to the amplifier's AUX inputs.

• Connect the amplifier to the dummy-load.

• Adjust the amplifier's tone controls, including subsonic and loudness, for flat bass and treble response.

• Adjust the Dummy-Loads selector to match the amplifier's rated output impedance.

• Adjust the IHF Input-Filters switch to 200Hz-l5kHz bandpass.

• Rotate the Function switch to rms watts.

• With shielded cables, connect the PA81's scope outputs to your dual-trace scope's inputs.

The actual amplifier-power measurements usually are performed quickly and easily according to the following steps:

• Slowly increase the signal level of the 400Hz sine waves while you watch the rms-watts range on both meters. These readings should increase slowly and remain approximately equal. Notice the upranging at 25W. Continue slowly increasing the level until the scope shows a small amount of sine-wave peak clipping.

• Reduce the level until the clipping barely disappears. With or without clipping, the sine waves should be free from oscillation, distortion or ringing. Record the two wattage readings.

PA81 Specifications

• The rms watts function for the stereo channels covers 0W to 250W in two ranges: 0W to 25W and 0W to 250W. The accuracy is ±3% of range full-scale at lkHz with an 8Ω load.

• Dummy loads: 2Ω, 4Ω, 8Ω, 16Ω and 32Ω, ±1%, plus open; reactance lower than 10% below 200kHz; rated for l00W of continuous power or 250W of intermittent power per channel.

• Channel separation is better than l00dB at lkHz.

• rms volts covers 0.2mVrms to 200Vrms in six ranges for audio line and dummy-load inputs. For external inputs, the 0.2mV range is deleted. The accuracy of these ranges is ±2% of range fullscale; the frequency response is 20Hz-20kHz at ±2% .

• dBm covers –72dBm to +48dBm in six ranges for audio-line and dummy load inputs. The range from –72dBm to –52dBm is deleted for external inputs. Accuracy is ±0.5dBm at lkHz; the frequency response is 20Hz to 20kHz with a variation of only ±0.2dBm.

• dc volts covers 0V to ±200Vdc in four ranges for external inputs only. Accuracy is ±3% of range full-scale.

• Impedance of the audio line inputs is l0kΩ paralleled by l00pF.

• External-inputs impedances are lMΩ for ac tests and l5MΩ for dcV tests.

• Scope levels are 2V ±5% rms when the meters are reading full scale.

• Dimensions are 7" x l4" x l6.7" (HWD); weight is 15.8 pounds (17.2 pounds with battery).

• Power drawn from the 12V source is about 4.2W; from the 120Vac source, the power is less than 26W.

Servicing VCRs With Your VA62A Universal Video Analyzer ™

by Greg Carey, CET

- **Provides Signals Needed For Functional Analyzing**
- **Simplifies Luminance And Chroma Troubleshooting With Optional VC63 Accessory**
- **Isolates Servo Problems Fast**

Your VA62A Is The Key, It's Designed For Functional Analyzing— Provides The Signals You Need For VCR Analyzing

Seminar travel provides the opportunity for me to visit with a large number of professional servicers and to show how Sencore instruments simplify servicing. At break time, the talk often turns to the troubles that have been the most challenging. As you might guess, VCRs are a popular "tough dog" subject. In most cases, however, the "tough" troubles might easily have been simplified.

In VCRs, for example, knowing that a trouble is in the audio isn't enough—you have to isolate the symptom to record, play, or servo circuits, and then pin the trouble down to the problem stage. The possibilities can keep you troubleshooting for hours—unless you use functional analyzing, a universal block diagram, and have the special signals necessary to prove each function good or bad. Your VA62A is the key, it's designed for functional analyzing—and it provides the signals you need for VCR servicing.

Like TVs, VCRs work with the standard television signal (NTSC). VCRs tune the station, detect the video/audio and store it on tape, or route it to a TV or video monitor for display. Many of the functional circuits used in TV are also used in VCRs: power supply, tuner, IF, video amps, etc. That's why TV servicers have a good start on VCR servicing. Unlike TV, however, VCRs come in many configurations.

Standard VCR formats, such as VHS, Beta, 8 mm, U-Matic, and some broadcast formats, use the same scheme for recording video information onto the tape. These VCRs separate the luminance and chroma information from the video and apply different recording techniques to each. The luminance information modulates an FM carrier before it is recorded.

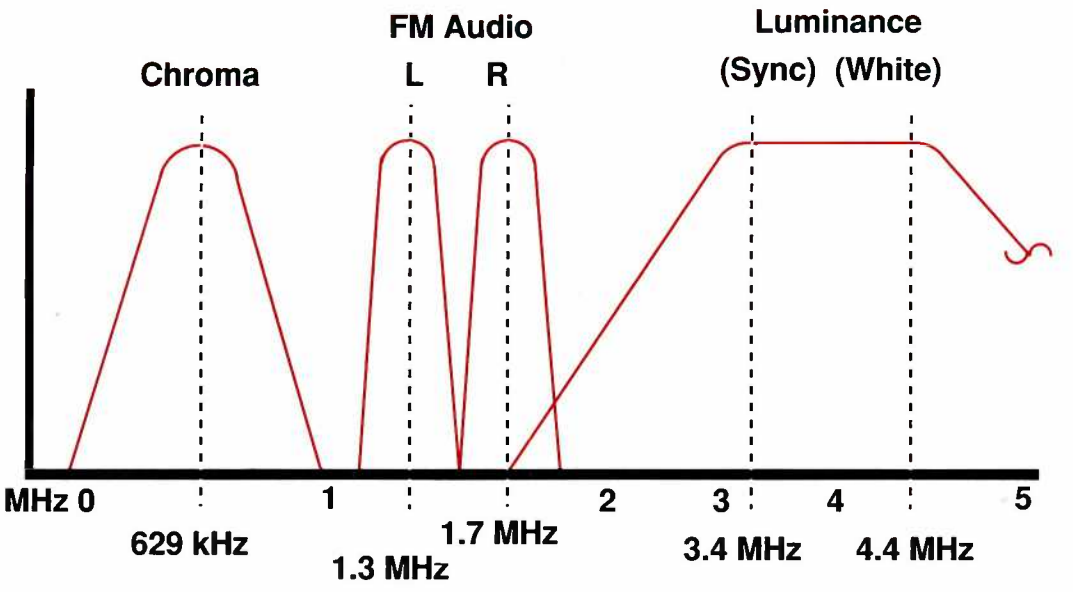


Fig. 1: The Luminance information modulates an FM carrier—the chroma information is down converted; both are recorded on the video tape along with audio.

The chroma information is down-converted in frequency and then recorded (Figure 1).

When the VCR is in the playback mode, the information is taken off the tape and the luminance and chroma information is modified back to the original form. These two signals are then mixed together to form the original NTSC signal

Since these VCRs are functionally the same, you can take advantage of the highly successful "functional analyzing" method of troubleshooting, using your VA62A Universal Video Analyzer.

Your VA62A helps you pinpoint tuner, IF, or video problems throughout the VCR, plus lets you substitute the special 30 Hz servo/head switching signals required to analyze record and playback.

The VA62A's "VCR STANDARD" jack supplies the one volt peak-to-peak into 75 ohms composite video signal needed by standard video inputs. This allows any signal chosen by the VIDEO PATTERN switch to be fed directly into the VCR's video input, bypassing the tuner and IF stages.

The 30 Hz SERVO DRIVE is built into the VA62A because all VCRs use the same 30 Hz

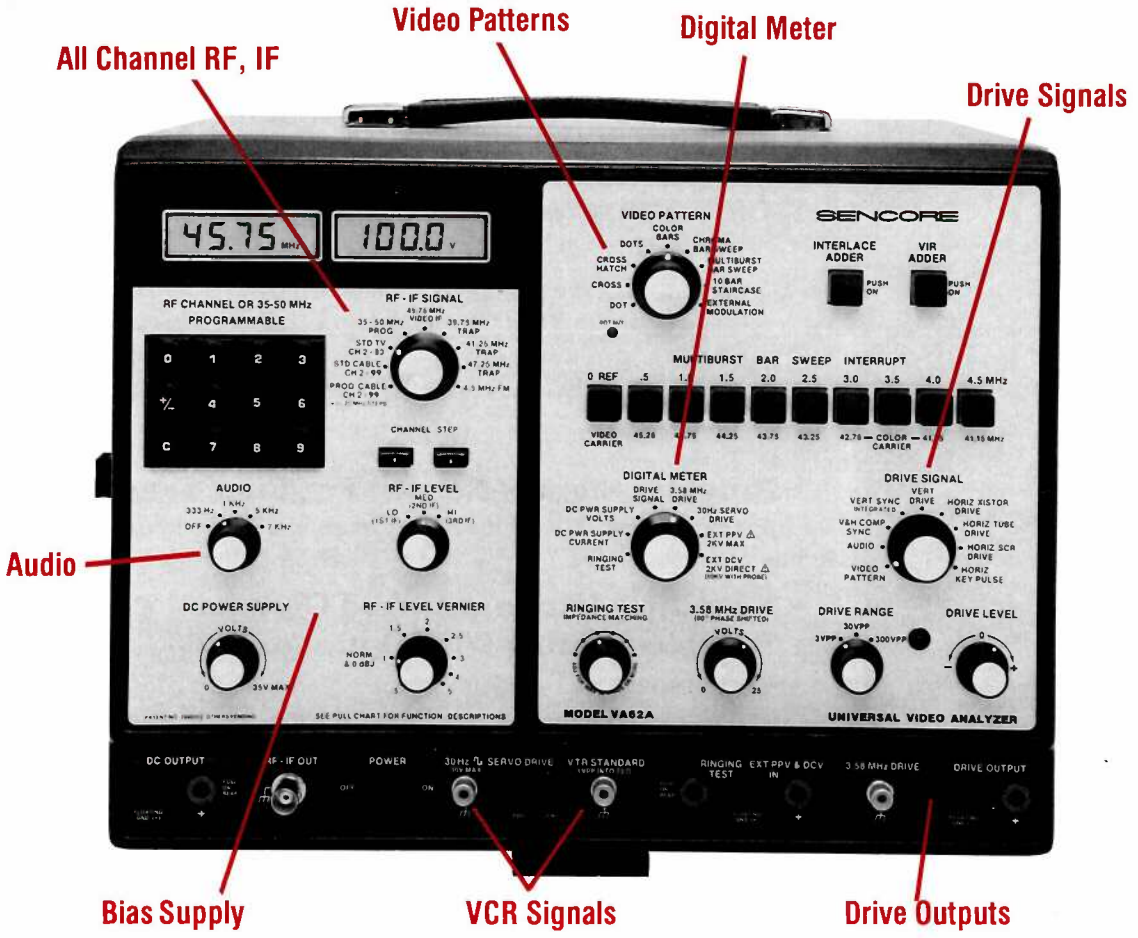


Fig. 2: Your VA62A gives full support for video servicing.

signal for servos and head switching. The signal can be adjusted in amplitude with the 30 HZ SERVO DRIVE control, and the phase can be reversed by pulling the SERVO DRIVE control to its "out" position to match the phase of servo signals in the circuits.

Isolating Recording Problems

Use signal tracing to troubleshoot recording problems. Inject the VCR STANDARD signal at the video input, and trace the signals through the circuits using your SC61 Waveform Analyzer.

Use the Sencore Universal VCR Block Diagram (form #3038) to find corresponding test points on the manufacturer's block diagram for the VCR you're servicing, or use it to find specific test points on the schematic. To receive a FREE copy of the Universal VCR Block Diagram, simply pick up your phone and Call **1-800-SENCORE**; ask for your Area Sales Engineer.

Isolating Playback Luminance Problems

Signal substitution simplifies playback troubleshooting. Use signals from the VC63 VCR Test Accessory when injecting into circuits *ahead of the FM video demodulator* and signals from the VA62A drive output to inject into stages *after the detector* (Figure 3).

When injecting signals, match the level of the test signal with the peak-to-peak amplitude shown on the schematic for each test point. For example, if you need a 0.3 volt signal, set the switch to the "X.1" position and the control to "3." If you need 2 volts, set the switch to the "X1" position and the control to 2.

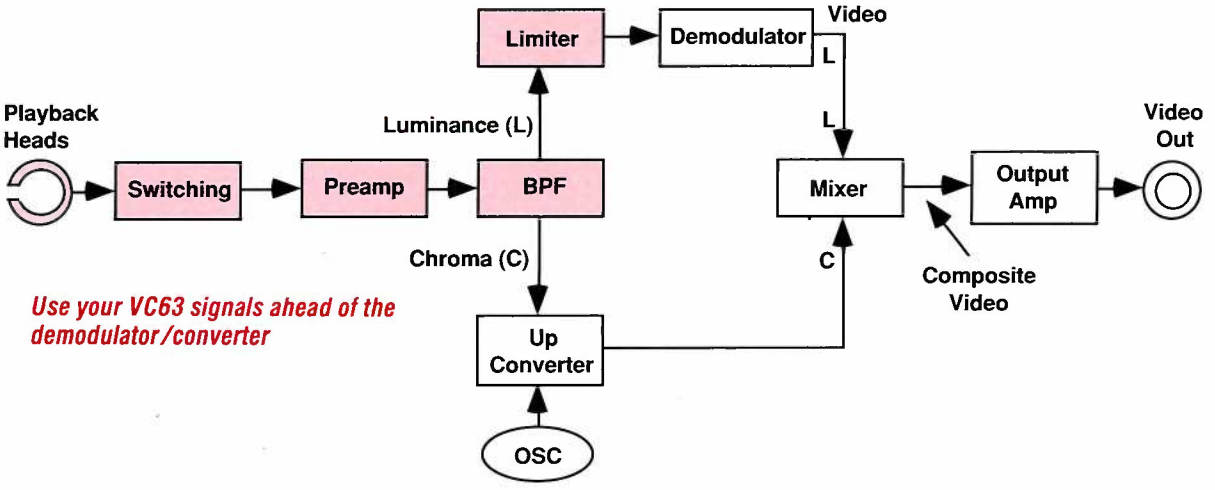


Fig. 3: General Block diagram of VCR playback circuits.

Head Related Problems

When one head (or related circuit) fails, you see a signal come through from the tape, overlayed with a high level of noise The reason for this symptom is that each video head picks up one of the two video fields. The path from the good head supplies a full vertical field of video, and the bad head path produces random noise during the second field.

Use the VC63's "playback Head Sub" function to isolate problems related to the heads. This function duplicates the tiny signals normally found in the high-gain head amplifiers. Since the schematic rarely shows the head signal level, when you use the VC63 "Playback Head Sub" function in the head amplifiers, try all settings of the OUTPUT LEVEL control to see if any produces a picture on the monitor. The

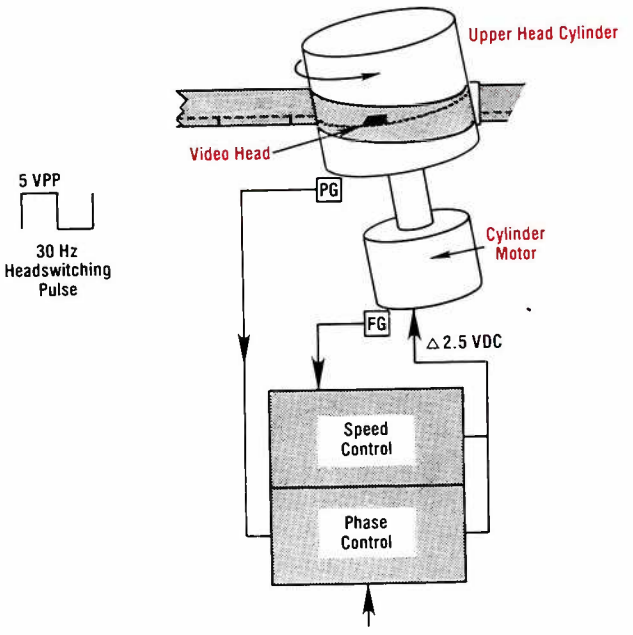


Fig. 4: Basic Cylinder Servo

VC63 prevents overdriving by limiting the PLAYBACK HEAD SUB signal to 5 millivolts. If you don't see an output at any setting of the control, you know the circuit has low sensitivity and is the cause of the problem.

If you do get a signal, use the VC63's calibrated output to compare the sensitivity of each test point to its companion test point in the second head path. If one side needs much more signal than the other, you know the two head amplifiers do not match.

Play back your "work" tape to provide a signal for the circuit path that is not being substituted. The tape should contain a different video pattern than the one used for injection, so that you can tell whether the signal is coming from the tape or from the VC63. When you make your "work" tape (See Tech Tip #107), do not include a crosshatch pattern. This allows you to use the crosshatch for video head injection.

When injecting signals before the head switcher, you should see the picture from the VC63 flicker at a 30 Hz rate, either mixed with noise or with the video tape signal. If, on the other hand, you see no signal when injecting into one of the head amplifiers and a signal without flicker when injecting into the second amplifier, you know that the head switcher is stuck in one position. The problem

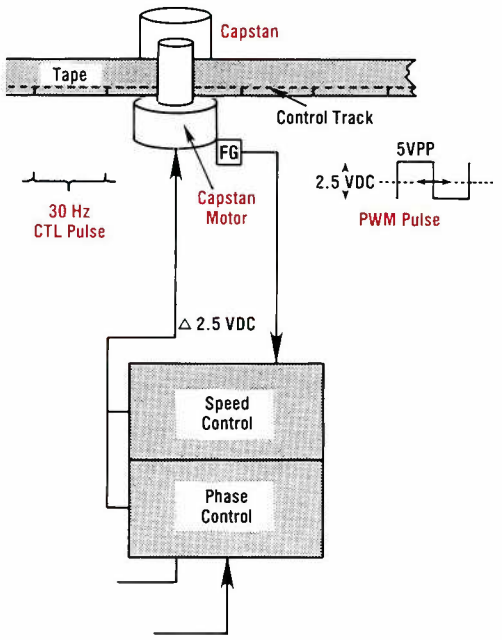


Fig. 5: Basic Capstan Servo

could be a defective head switching IC or that the switching IC is not receiving the square wave it needs.

Injection will usually produce a combination of the tape signal and the injected video pattern. The two patterns will not be in sync with each other, but that is not a problem. If you see both patterns on the screen, you know both head circuits work. If you see the VC63 signal (the crosshatch pattern) alone, you know that the VC63 is replacing the tape signal, and you need to move the injection point to the second head circuit. If you again see the crosshatch pattern come through (either with or without the tape signal in the background), you know the second set of circuits also works correctly, showing the problem is ahead of the injection points.

A control track is also recorded on the tape when it is initially recorded. This signal is used to control the speed of the capstan and, thus, the speed at which the tape is pulled through the VCR. Figure 4 shows a basic cylinder servo system: Figure 5 shows a basic capstan servo system.

8 mm VCRs are an exception to the basic servo system. The 8 mm VCR uses pilot signals recorded along with the video and chroma signals. These pilot signals are then used to control the action of the servo circuits.

Isolating Servo Problems

A servo problem *always* produces a randomly tearing picture or an out of sync picture. If you see a tear which stands still in the picture, the servos are working, but they may be out of adjustment.

If you have a servo problem, you must decide whether the problem is in the circuits which control the video heads or those which control tape speed and motion. This divides the number of servo circuits in half. Use your test tape's audio signal to make this determination.

Listen to the audio while the tape plays back. If the audio plays at the correct speed, without fluctations, the tape speed is correct, the capstan servos are working and your problem is in the head servos. If the audio plays at the wrong speed, or the tone fluctuates, you know the tape motion is affected and that the problem is in the capstan servos. (Turn the Hi-Fi circuits off when making this test on the models which record audio using the spinning heads.)

If you have a tape speed problem, check whether the problem affects all tape speeds or only some. Use the first section of the VA62A test tape, which includes video signals recorded at each tape speed, to check the speed selection circuits. If only one or two speeds are affected, the problem is in the automatic speed selection circuits and not in the servos themselves. If all three speeds have speed errors, the trouble is in the servos.

The important thing is to look for is a change in the old symptom. If the change is an improvement or a worsening of the old symptom, we know the circuit is responding to our injected signal.

Some servos use a phase detector (similar to the phase detector in the horizontal oscillator of a TV receiver) to compare the feedback signal with the reference signal. Others use a sample-and-hold (often marked "S/H" on the schematic) to compare two frequencies. In either case, the output is a DC signal. Injecting the substitute DC will override the signal. If we see the symptom change, we know the inside loop is responding correctly and we need to work on the outside loop. If not, we need to work from the injection point towards the monitor.

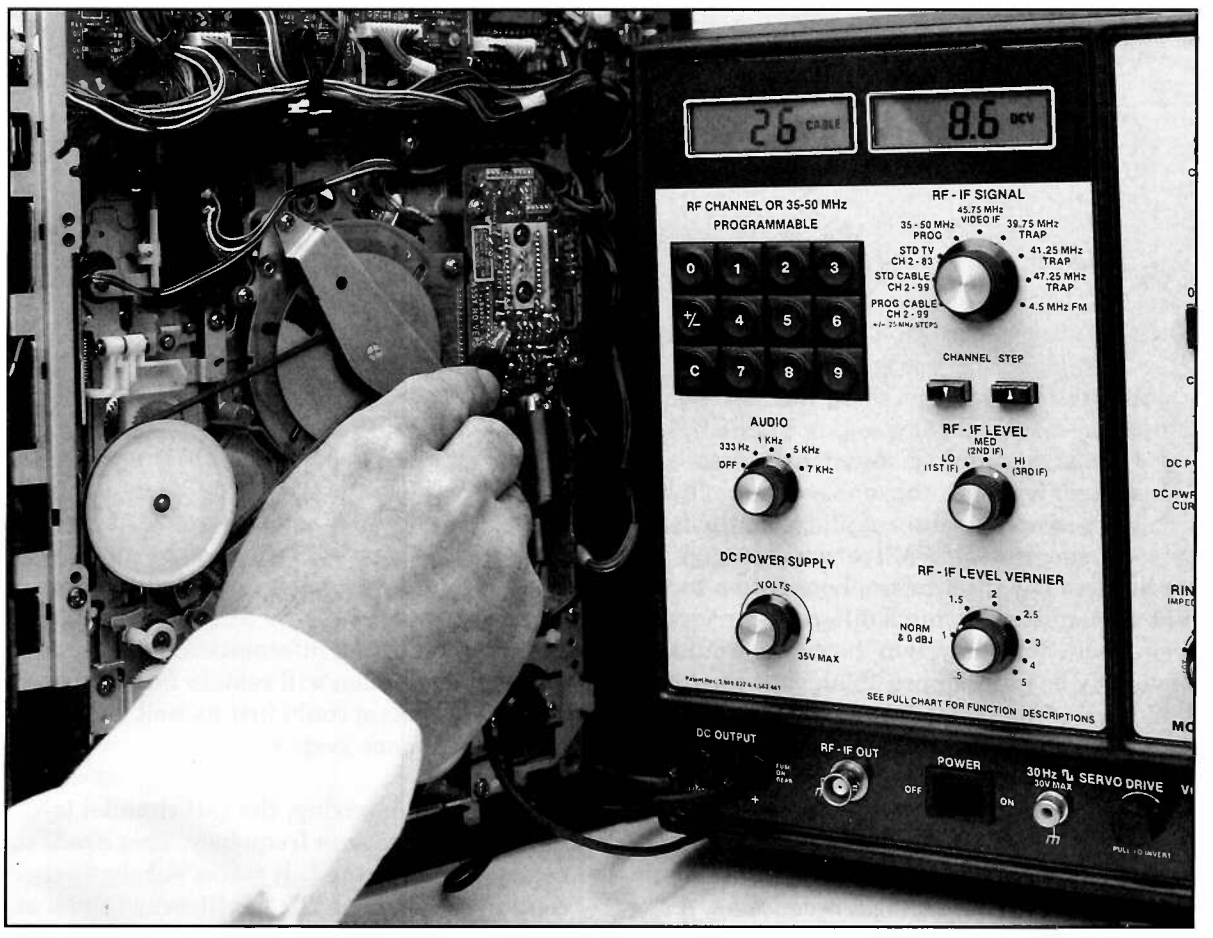


Fig. 6: Your VA62A DC Power Supply lets you break the servo loop by injecting a DC Level at the servo speed control test point.

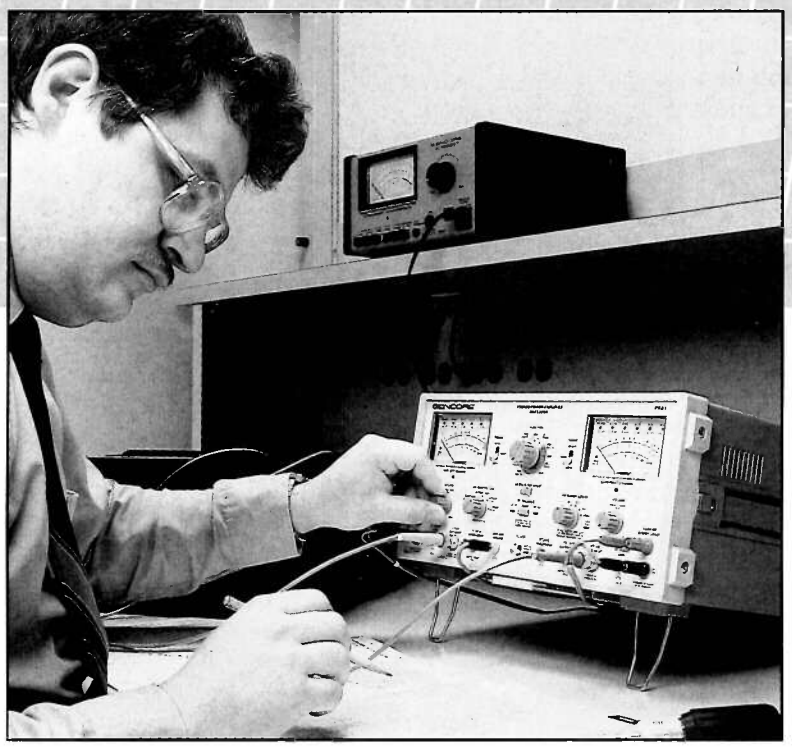
Breaking The Servo Loop

We use the same test methods to isolate the bad circuits, whether the problem is in the head servos, or in the capstan servos. Therefore, you must find a way to break into the feedback loop to tell which parts of the loop work and which parts do not.

To break a loop, inject a signal in place of the feedback signal. If all later circuits work correctly, you will see the symptom change. If, on the other hand, the circuits did not respond to the substituted signal, the problem is between our injection point and the output.

The VA62A DC POWER SUPPLY lets us break the servo loop as well as troubleshoot automatic feedback circuits. We inject a DC level that is close to the normal DC level at the servo speed control test point and then adjust the DC voltage up and down slightly from the normal level. The motor for the servo should increase or decrease in speed to show it responded to the changing voltage (Figure 6).

Do you have questions on VCR servicing or want more information on the VA62A Universal Video Analyzer? Call **1-800-SENCORE** and ask for your Area Sales Engineer; you'll be glad you did. ❐



Understanding The Stereo Multiplex (MPX) Signal

by Paul Nies, Application Engineer

- **Quickly Recognize Problems That Affect Stereo Reproduction**
- **Learn How Receiver Alignment Affects Stereo Separation**

Learn How MPX Maintains Compatibility With FM Mono Broadcasts While Producing Top-Quality FM Stereo . . .

If we could design a stereo broadcast system from scratch, one solution might be to simply feed the audio from the left microphone into one FM transmitter, and the audio from the right microphone into a second FM transmitter having a different carrier frequency. Such a system, however, would obviously be quite impractical, very wasteful, and barely functional. We must find some way to send two channels of intelligence on a single RF carrier.

But stereo presents yet another problem—our new stereo system must also be fully compatible with existing monaural broadcasts. A stereo receiver must be able to work with a monaural broadcast, while a mono receiver must be able to work with a stereo broadcast.

These requirements (1. separate stereo channels, 2. monaural/stereo compatibility, and 3. modulation of a single RF carrier) are satisfied by the MPX signal which was approved by the FCC for commercial broadcast in 1961. The MPX signal that is used in FM broadcast stereo is shown in Figure 1. (As you see, the MPX signal is made up of several signals, hence the term multiplex.) Let's take a closer look at each of the components of this MPX signal.

The FM Multiplex Signals

L+R: The L+R signal (often called the main channel) is produced by simply pre-emphasizing and summing the signals from the left and right audio channels. This is done to insure compatibility with mono receivers. (When a mono receiver picks up a stereo broadcast it only uses this part of the transmission.) In a stereo receiver, however, the L+R channel is carefully combined with the L-R channel to recreate the original left and right channels.

L-R: The L-R stereo subchannel is produced by adding the left and right audio inputs in a matrix, as shown later in Figure 2. At the receiver this process is reversed by applying the L+R and L-R signals to a second matrix (as shown later in Figure 3). If all goes well, the critical phasing information vital to proper stereo reproduction will remain intact, if not, our stereo system could just as well have remained a mono system.

Besides this matrixing, the L-R channel is also moved higher in frequency. This needs to be done because the L-R stereo subchannel contains the same basic intelligence (audio at 50Hz to 15kHz) as the L+R channel does. Thus, to keep them separated, the L-R channel AM modulates a 38kHz signal, called the "subcarrier". The end result of this process is that the original L-R information is moved up in frequency to 23kHz - 53kHz. (Remember that in AM modulation the bandwith is twice the modulating frequency.) The L-R information at its new frequency, and the L+R information can now both FM modulate the same RF carrier without interfering with one another.

Notice in the illustration in Figure 1, that a hole exists in the center of the L-R stereo subchannel where the 38kHz subcarrier should be. This is because the subcarrier is removed through the use of a balanced modulator in order to conserve modulation power and maintain mono reception quality. We call this Double Sideband Suppressed Carrier Modulation (DSBSC) — here's why it's done:

In an AM modulated signal, such as the L-R subchannel we've created, the carrier (in this case the 38kHz subcarrier) contains no intelligence. But this 38 kHz carrier would always

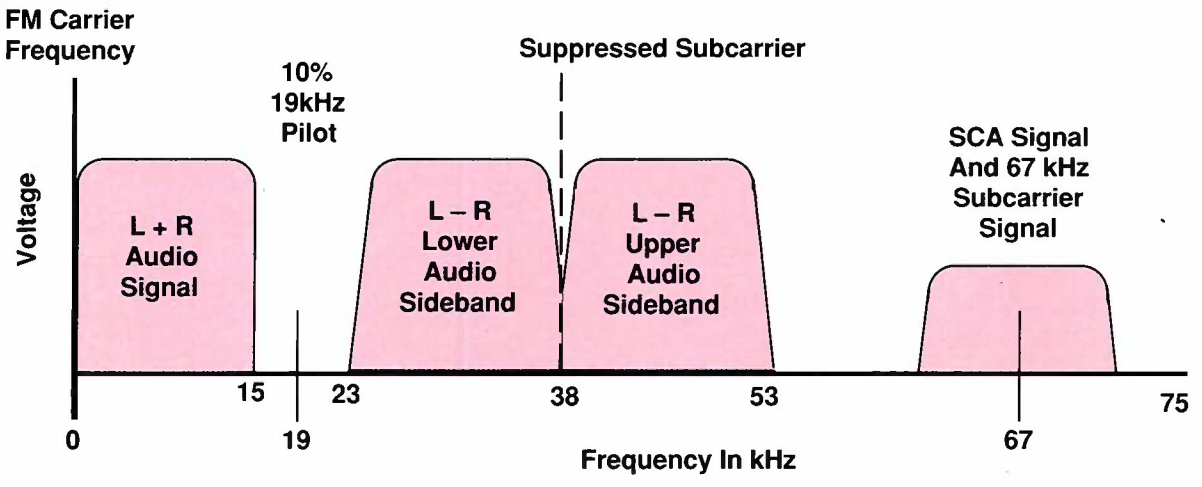


Fig. 1: Signals in the upper MPX sideband.

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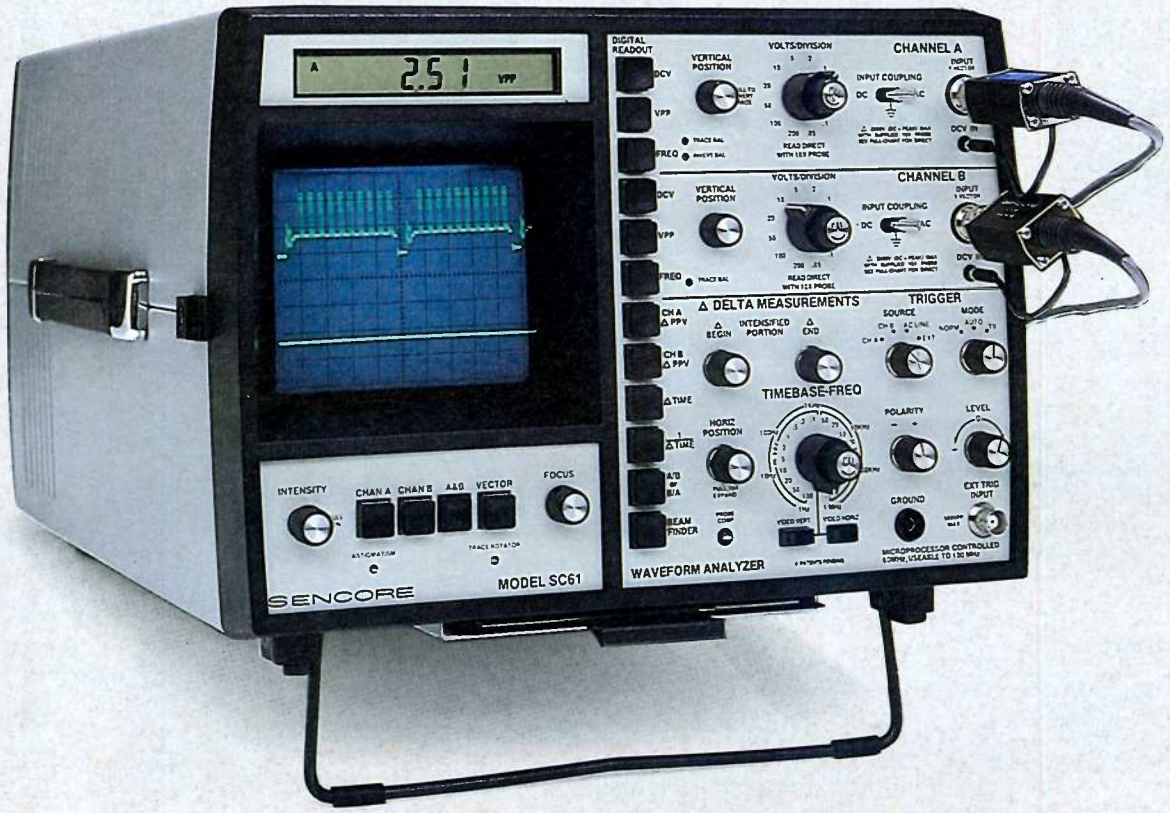

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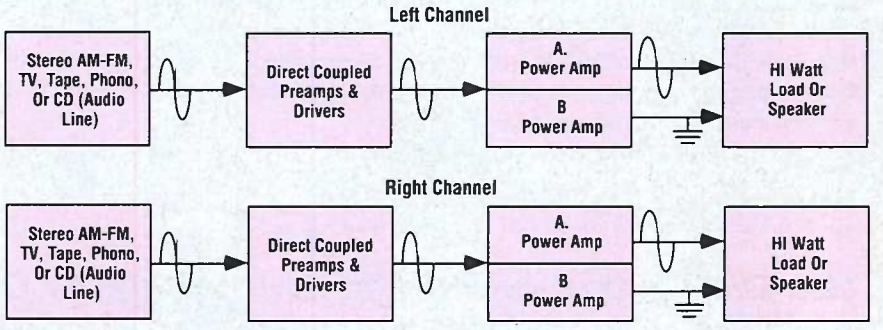

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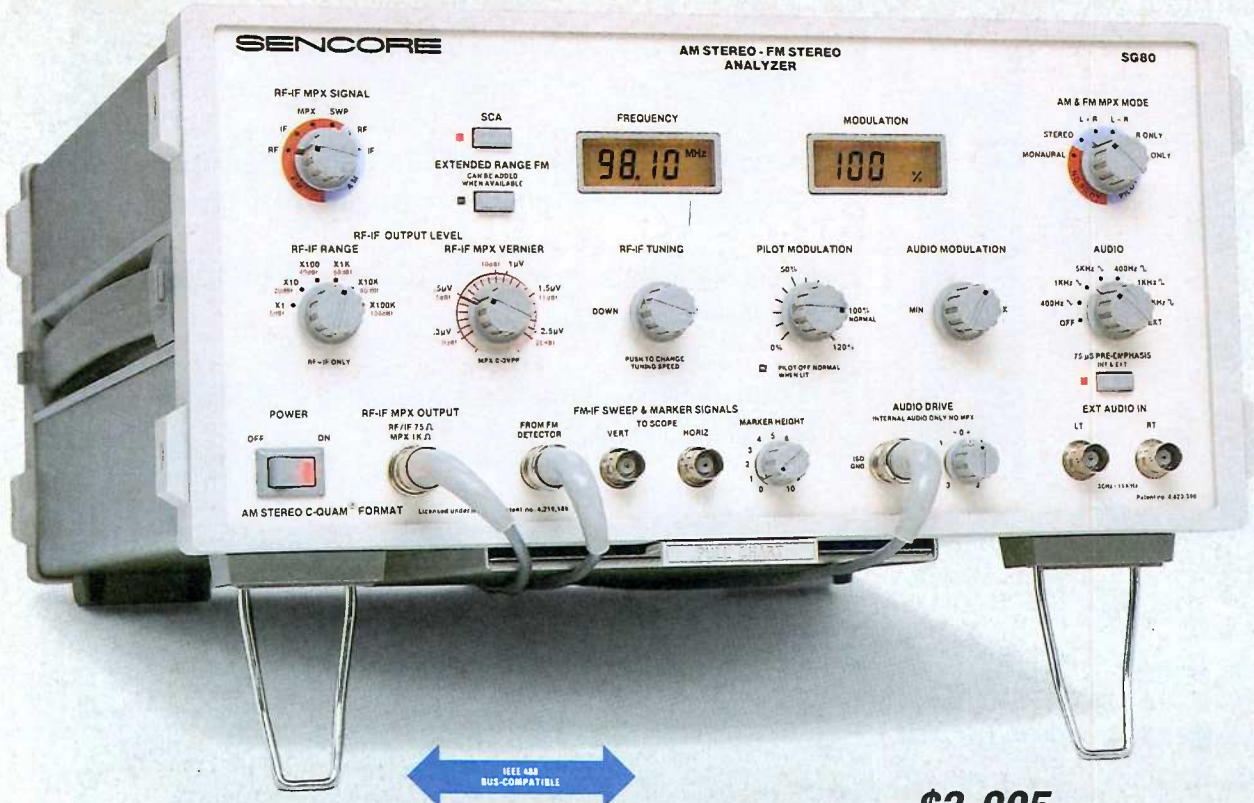

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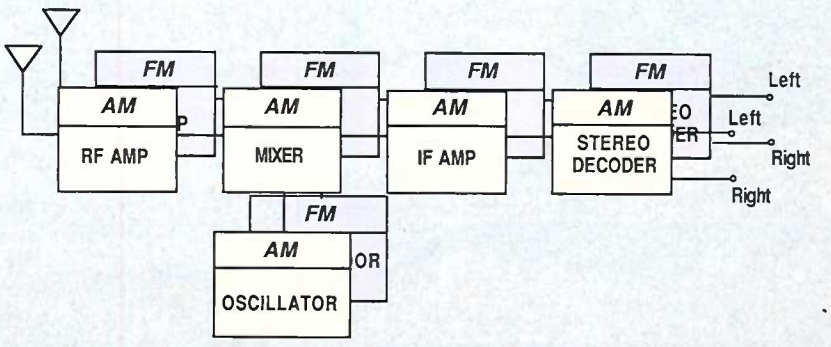

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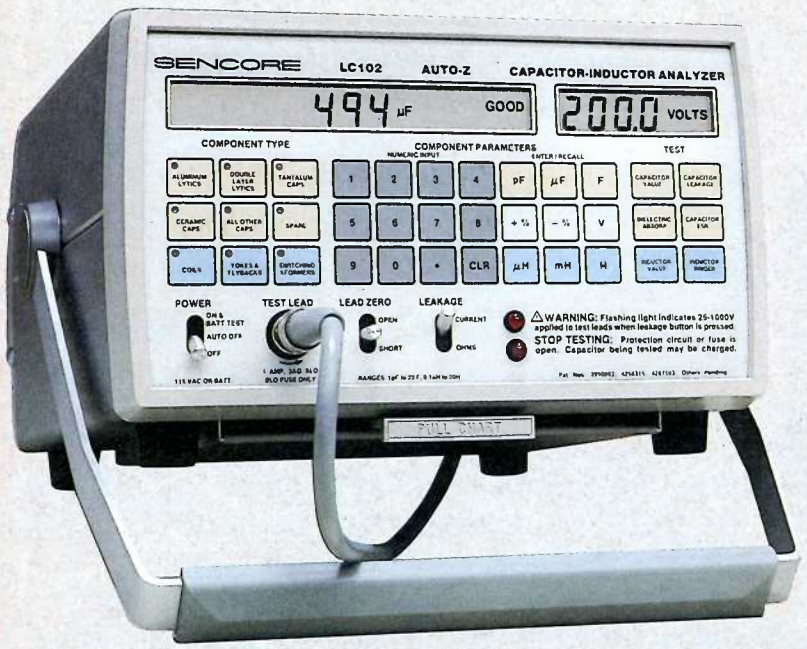

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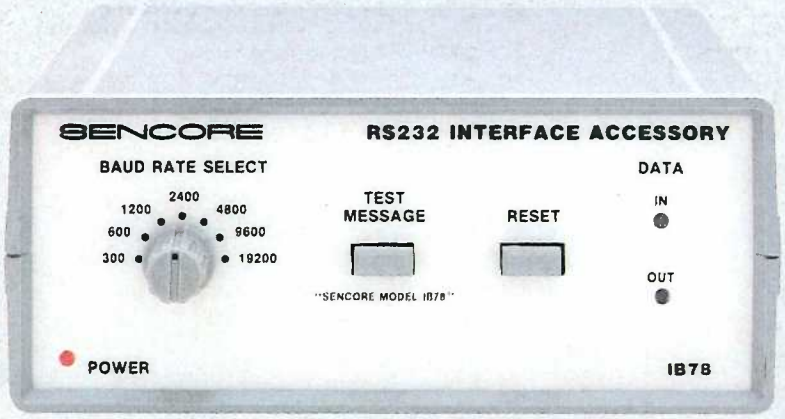

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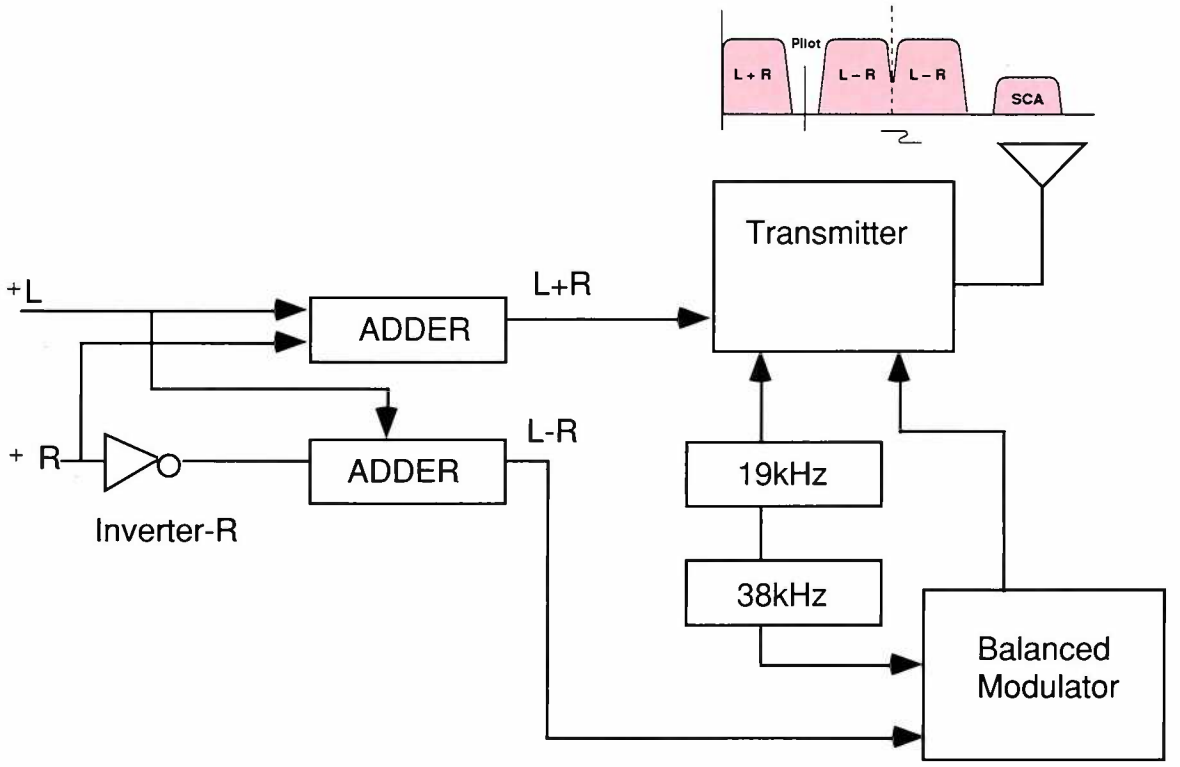


Fig. 2: Signals from the left and right audio sources are "multiplexed" at the transmitter.

add useless modulation to the main FM carrier. To prevent overmodulation of the FM carrier, the modulation of the main L+R channel would need to be reduced, which would degrade mono reception. But, with the subcarrier removed, both the L-R subchannel and the L+R main channel can provide maximum modulation to the RF carrier without causing overmodulation. It might seem that the modulation from the L+R channel would still need to be reduced. After all, won't 100% modulation from the L+R channel plus 100% modulation from the L-R subchannel produce overmodulation? The answer is no. The reason is because the L+R and L-R channels interleave—that is when one provides maximum modulation for the FM carrier the other is at minimum. No combination of audio intelligence will ever overmodulate the RF carrier.

You may be wondering why an AM process rather than an FM process is used to move the L-R information to a new frequency. One reason is quite simple. Recall that in order to achieve good stereo, the phasing differences between the left and right audio sources must be extracted from the L+R and L-R subchannels. If FM were used to move the L-R subchannel this critical phasing would be nearly impossible to maintain.

19 kHz Pilot: At the receiver, the L-R subchannel must first be lowered back to its original frequency before it can be matrixed with the L+R signal. This would present no problem if the stereo subchannel that is transmitted contained the 38 kHz subcarrier. But since it is not, it must be reinserted. In order to reconstruct the original left and right audio with good separation and low distortion, a 38 kHz signal that *exactly* matches the original 38kHz in frequency and phase must be reinserted. In order to obtain a nearly perfect match, a 19 kHz pilot which is 1/2 the 38 kHz subcarrier frequency is sent. (In actuality, a 19kHz signal is used at the transmitter to obtain the 38 kHz subcarrier. A sample of that 19kHz is sent as the pilot).

SCA: The last portion of the MPX signal is the Subsidiary Communications Signal (SCA). This transmission, which was approved by the FCC in 1955, allows radio stations to broadcast music to private subscribers if they choose. Since the intelligence on the SCA channel is audio, it must also be moved to a higher frequency to prevent interfering with either the L+R or L-R channels. In the case of the SCA channel, an FM modulation process is used. The SCA channel is mono only, and only has a 7 kHz audio bandwidth. Some better-quality FM receivers contain an SCA trap that prevents the SCA signal from interfering with the L+R and L-R channels which would degrade the audio fidelity.

In the stereo decoder block, the 19 kHz pilot is recovered and doubled in frequency to regenerate the 38kHz subcarrier. Most quality receivers use a type of PLL circuit to insure exact reproduction of the 38kHz subcarrier. If the regenerated 38 kHz is off by even 2 Hz or less, or is a few degrees out of phase with the original 38kHz, degraded separation will occur. The 38kHz subcarrier is then combined with the DSBSC L-R intelligence in a DSBSC demodulator. The output of this demodulator is L-R information at its original 50Hz to 15 kHz frequency.

The only thing needed to get stereo is to combine the L+R and L-R channels. This is done in the stereo matrix, which is shown in Figure 3.

(Subscribers to an SCA service have a special receiver that detects the special SCA signal. Such receivers normally do not have the stereo decoder circuits, nor the stereo matrix. Instead, they have a second FM detector located after the main FM detector).

Obtaining Top Stereo Performance

From this review of MPX theory you can see some of the areas that are critical to good quality stereo reproduction: the bandwidth of the RF and IF stages must be sufficient otherwise the L+R and L-R sidebands will be restricted and poor separation and even distorted audio will occur; the FM detector must be aligned properly, if not poor separation and distortion will again result; the pilot recovery,

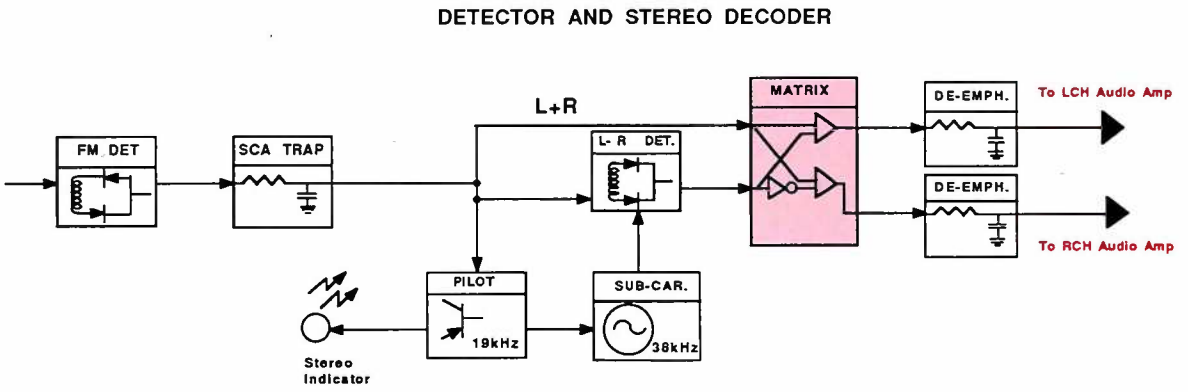


Fig. 3: The receiver's stereo decoder recovers the left and right audio signals.

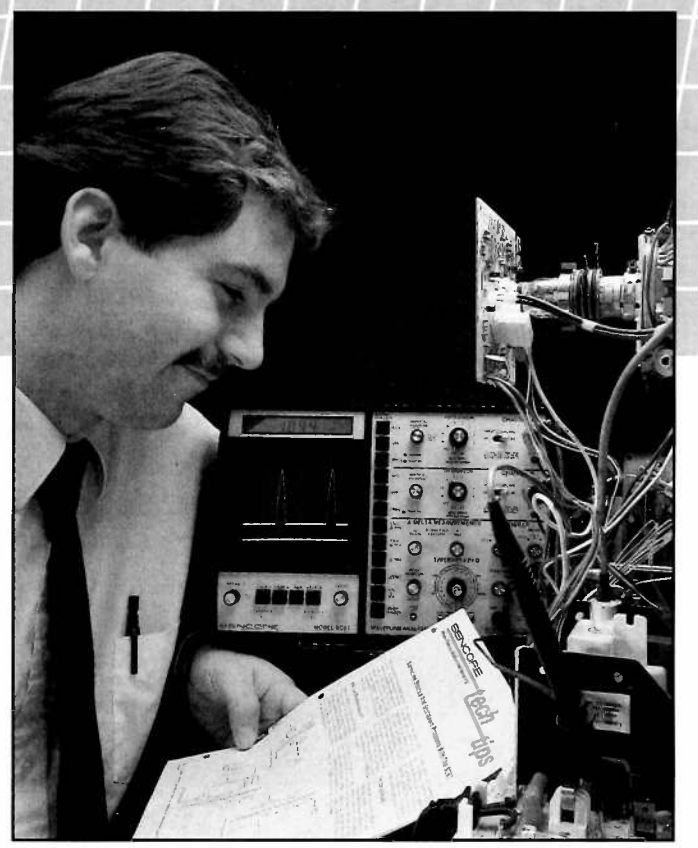
The Stereo Decoder

The block diagram of the MPX portion of a receiver is shown in Figure 3. The first block is an FM detector. The FM detector removes the MPX modulation from the RF carrier, and has at its output the MPX signal that we've already studied, and seen in Figure 1.

Since nothing was done to the L+R signal before it modulated the carrier at the transmitter, it is ready to be combined with the L-R signal in the matrix. The stereo subchannel, however, is not yet in its original L-R form. The L-R stereo subchannel must first be moved back down to the 50 Hz to 15 kHz signal where it started out. This is done in the stereo decoder block.

and 38kHz regeneration circuits must be nearly perfect if the receiver is to come close to 65 dB separation; the SCA trap, if used, must be set to reject any signals which may cause noise in the stereo circuits.

In short, every stage in the receiver must be operating at optimum performance. Only then will your customer realize the full benefit of today's high-performance stereo tuners and receivers. To find out how you can be sure every receiver you work on is performing as it should, call your Area Sales Engineer today at **1-800-SENCORE** and ask him about the All New SG80 AM Stereo - FM Stereo Analyzer. ❐



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There is one test point which gives the most information about startup and shutdown problems. If your test equipment is properly protected, you can connect to the collector of the horizontal output transistor (HOT). Protection is important, since the test point normally has between 900 and 1500 volts (peak-to-peak). Most scopes are protected to only 600 volts, and some to only 400 volts. The Sencore SC61 Waveform Analyzer, however, can make measurements to 2000 volts, and is protected against overloads to 3000 volts.

To analyze this signal, you need to know its normal makeup. In the next few paragraphs, we will explain the signal in general terms. See Sencore Tech Tip #118 if you want more details about analyzing this signal.

Waveshape

Figure 1 shows the ideal waveshape. The two most common waveform defects are a deep saddle or a noisy baseline. A deep saddle often shows there is a short — either in the flyback itself or in one of its loads. Since the normal saddle depth varies from one receiver to the next, be sure you compare the measured waveform to the schematic to see how much is normal. Hash, ringing, or noise on the baseline could be caused by a mechanical defect (such as a cracked core), or by a defect in the driver transformer.

DC Voltage

Improper DC voltage can cause either startup or shutdown problems. Startup problems are often caused by a failure in the power supply circuits. Shutdown problems can be caused by the regulator allowing too much voltage to be applied to the output transistor. Voltages which are low (but present) indicate a bad power supply or excessive loading in the output stage—a bad output transistor or load on the secondary of the flyback transformer which is drawing too much current.

Peak-to-Peak Level

The amplitude of the collector signal tells whether the output stage is running efficiently. If the pulse is too large, the high voltage will build too high, and trigger the shutdown circuits. Excessive amplitude may be caused by a bad DC regulator, the pulse being too narrow, or by an open in one of the secondary flyback loads.

Pulse Width

If the flyback pulse is too narrow, the high voltage increases rapidly. The pulse should be between 12 and 14 microseconds. The SC61's Delta Time function lets you quickly check for the correct time. (Remember to make the

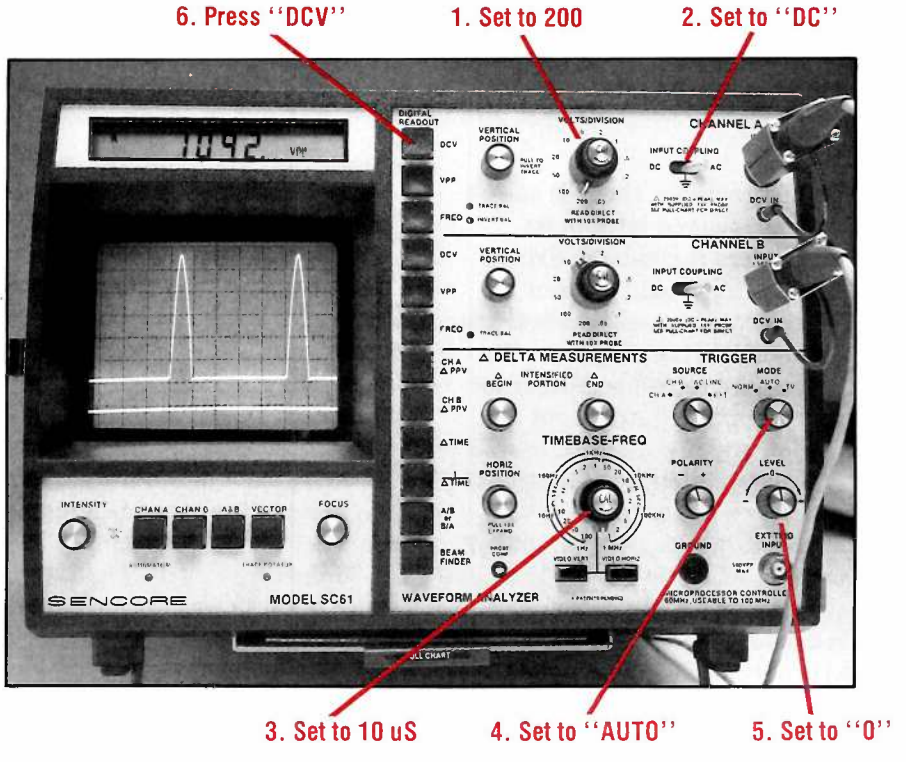


Fig. 1: Before turning on the TV, set the SC61 up to view whatever happens when power is first applied.

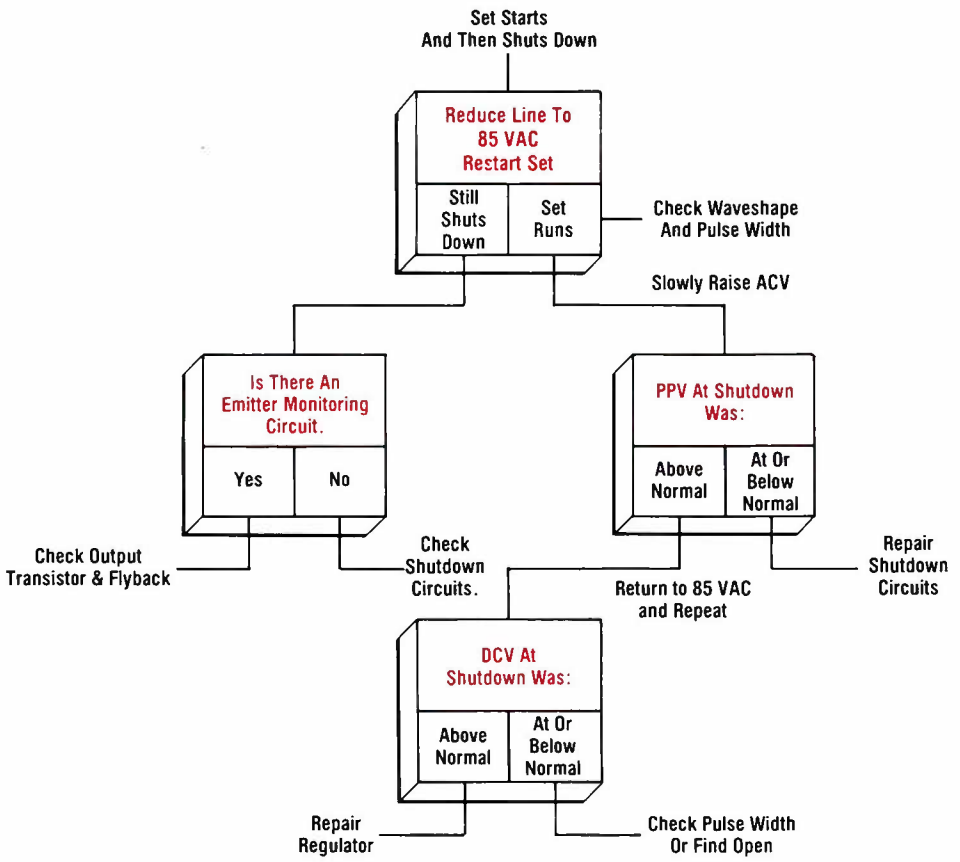


Fig. 2: Follow these steps to find out what is causing a shutdown condition in a TV.

reading from the 10% to the 10% levels on the pulse, not from the baseline to the baseline.) The most common cause of a narrow flyback pulse is a reduction in the capacitance between the emitter and the collector of the output transistor.

The First Step

Your first troubleshooting step needs to separate startup from shutdown problems. This must be done when you first apply power, since a quick shutdown has the same outward symptoms as a startup problem. The collector of the output transistor lets you do this reliably.

WARNING

1. Always connect the TV to an isolation transformer before making connections to the internal circuits.
2. Do not try these procedures with test equipment protected to less than 2000 volts DC plus peak AC.
3. Observe all precautions applying to testing circuits with high operating potentials.

The following procedures will use the features of the SC61 Waveform Analyzer and the PR57 "POWERITE"® Variable Isolation Transformer and Safety Analyzer.

Before you apply power to the TV, get your SC61 Waveform Analyzer ready to observe the collector at the moment of turn-on. Connect the Channel A probe to the transistor collector and the probe's ground to the chassis. Then follow these steps:

1. Set the "Channel A" VOLTS/DIVISION switch to "200".
2. Set the "Channel A" INPUT COUPLING switch to "DC".
3. Set the TIMEBASE-FREQ switch to "1 microsecond."
4. Set the TRIGGER MODE switch to "Auto". *(NOTE: Don't use the "TV" mode, since you are not looking at composite video.)*
5. Set the TRIGGER LEVEL control to "0" to detect any signal that comes along.
6. Press the "Channel A" DCV Digital Readout selector button.

Your SC61 is now set up and ready to display whatever happens the first few moments after you apply the power. Set your variable, isolated supply to normal line voltage, and watch the SC61's CRT as you turn on the power.

If flyback pulses appear, and stay on the screen, you don't really have a startup or a shutdown problem. Some other circuit is causing a symptom that looks like a dead receiver.

If flyback pulses build and then disappear, you know that the set started, and was then shut down. Some shutdowns happen in less than a second. Others may not occur until the CRT filaments warm up and the picture tube begins to draw beam current.

If no flyback pulses appear, check the digital display to see if there is any DC voltage present. For more startup/shutdown tips, call **1-800-SENCORE** and ask your Area Sales Engineer for a copy of Tech Tip #131. ❐

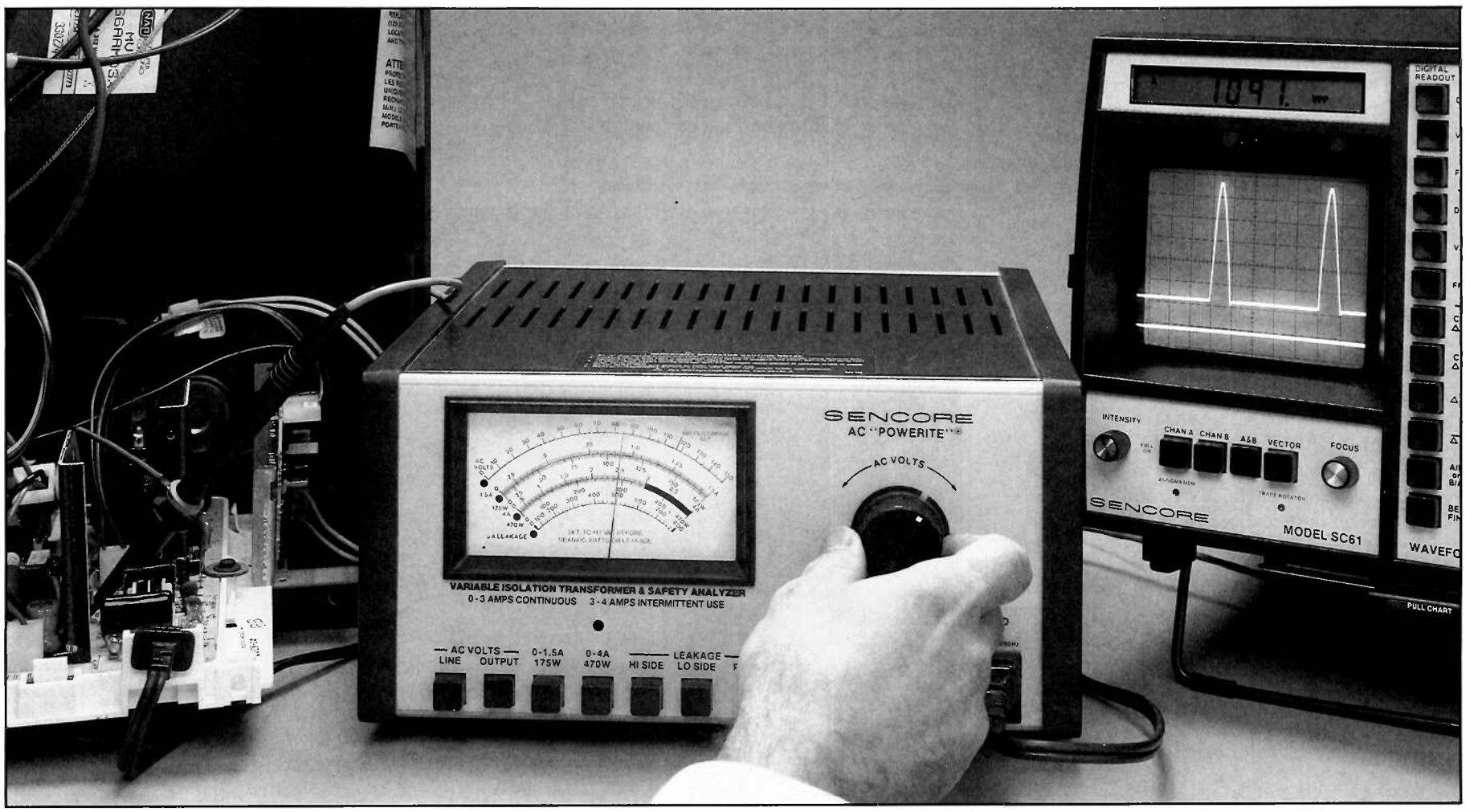


Fig. 3: When you reduce the AC voltage below the regulator's operating point, you have manual control of the voltage at the output transistor.

The NTSC Signal Format Is Your Key To Servicing Video

The key to successful TV and VCR service is the composite video signal (Figure 1). This important signal, originating at the TV camera, contains all the information needed to synchronize the scanning raster to produce a picture on the CRT, line-by-line and field-by-field.

In the TV camera, video is produced by scanning a photosensitive target with an electron beam. The camera's scanned image includes luminance (B & W video or Y), chrominance (red (R), blue (B), and green (G)) as well as the horizontal and vertical scan information.

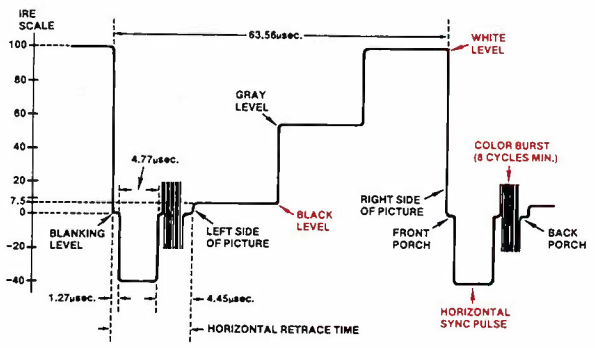


Fig. 1: The drawing above represents one horizontal line of video information. Note the important parts of this waveform: black level, white level, sync, and color burst.

Luminance (Y): Luminance or "Y" refers to brightness information, or simply black and white. The Y signals occupy a band of frequencies from DC to about 4.2 MHz; luminance is formed by adding the primary red, green, and blue video signals in the following proportions:

.30 Red
.59 Green
.11 Blue

or Y=0.30R + 0.59G + 0.11B

Chroma: The color signals (red, blue, and green) are processed into R-Y and B-Y, and become the I (in phase) and Q (in quadrature or 90 degrees out of phase) inputs to a balanced modulator whose carrier is positioned near the high end of the TV channel (at 3.58 MHz). Green is recovered at the receiver as the R-Y (red minus luminance) and B-Y (blue minus luminance) signals are processed.

A precision 3.58 MHz signal is necessary at the receiver to properly demodulate the color components, therefore eight or ten cycles of the color carrier (color burst) are included in the composite signal as a reference to phase-lock the receiver's color oscillator.

Composite video includes the scanning signals, color reference, and picture elements from the scene the TV camera sees. The TV station transmits the luminance, color, and sound on a 6 MHz Television Broadcast Channel. Television receivers, regardless of make, model, or manufacturer, receive the signal, detect the video, sync, color, and sound components and present a picture with sound for the viewer. Television circuits vary with manufacturer and model; some are complex and others straight forward, but all have one important thing in common—they all use the same *standard* TV signal.

Use The Universal Block Diagram To Simplify Troubleshooting

Block diagrams help you break the equipment into functional blocks. In the case of a TV, the basic blocks are the tuner, audio, video, scanning, CRT, and power supply. A "Universal" functional block diagram is possible because TVs from every manufacturer must receive and process the same standard TV signal.

Servicing TV With Your VA62A

TV troubles cause easy to recognize symptoms when you relate them to raster, sync, video, color, or audio. Can you tell which functional block the following customer symptoms indicate?

Customer: "All it has is a single horizontal line." Your analysis? Raster — prove the vertical stages good or bad.

Customer: "It just keeps rolling and rolling; sometimes it stops and we can watch it." Your analysis? Sync — start by proving the sync separator good or bad.

Customer: "There's no picture, just snow." Your analysis? Video — where do you start? Prove the tuner good or bad, then move to the video IFs.

Customer: "All the colors are wrong." Your analysis? Color — prove the CRT can produce red, green, and blue, then move to the color circuits.

Customer: "The sound comes and goes." Your analysis? Audio — start at the sound IF and work right up to the speakers.

Are most symptoms more comoplex? No, not really, once you're familiar with how TVs work and have a basic block diagram, you can zero in on any functional block. Then use your VA62A substitute signals to isolate the trouble to the defective stage.

When a set comes into your shop, give it a quick performance check, including such things as tuning, video, brightness, contrast, color, sync, vertical, horizontal, convergence, and sound. With your VA62A, you can check all of these important functions without taking the back off the set.

To increase your TV servicing success, Call **1-800-SENCORE** and ask your Area Sales Engineer for a copy of Sencore's popular "TV Proof of Performance Test". ❐

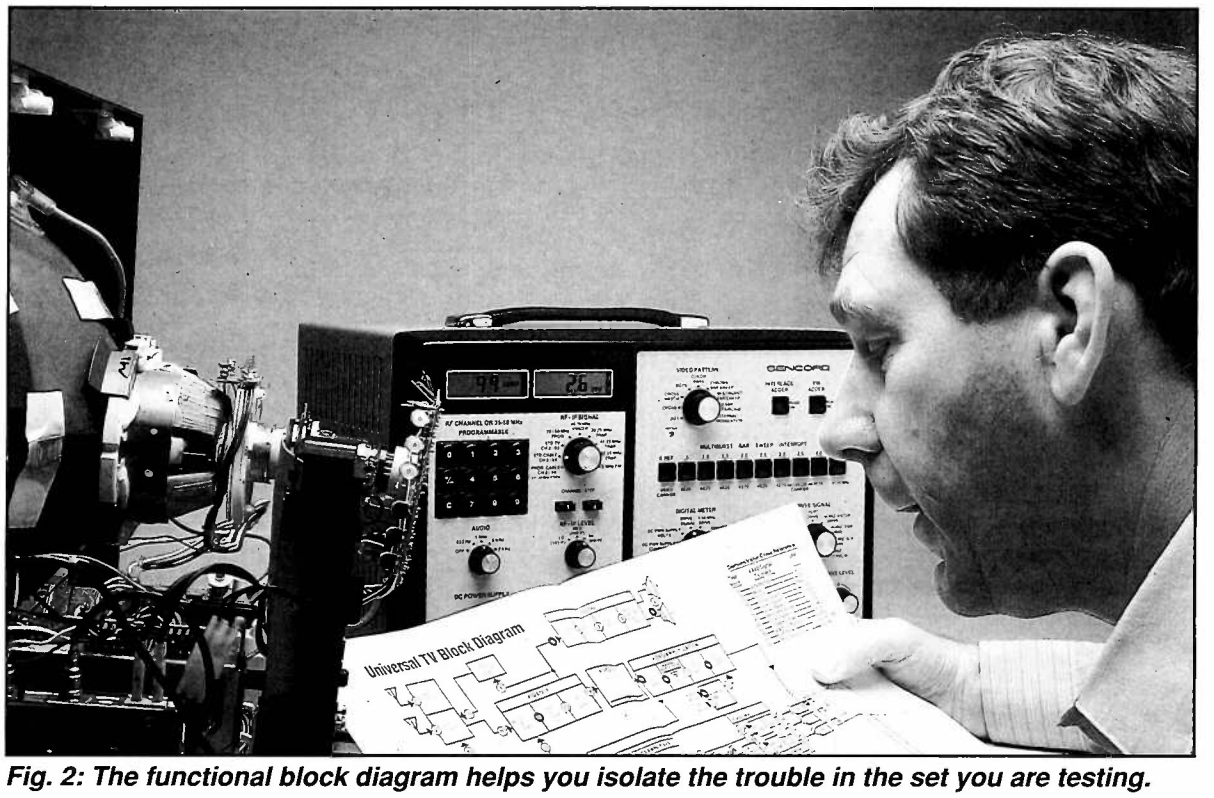
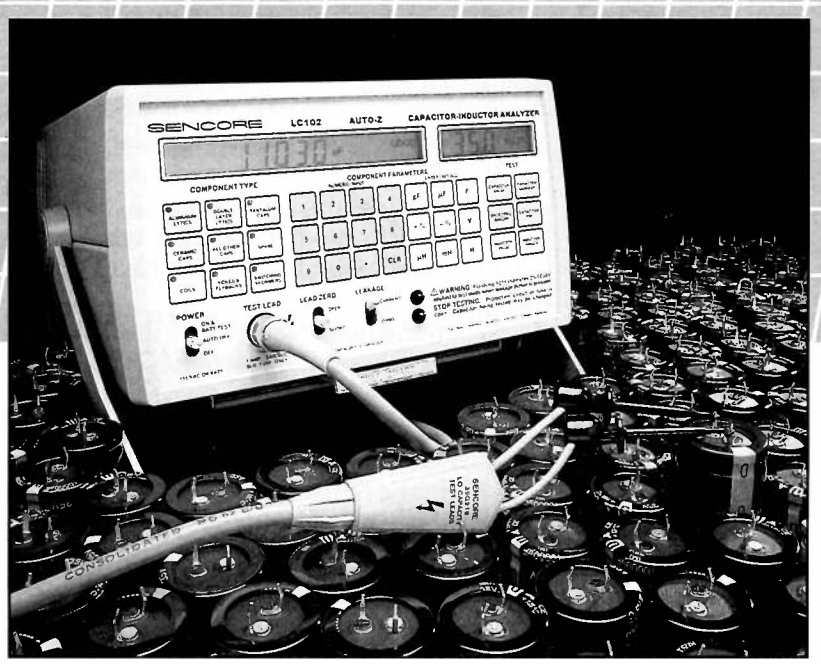


Fig. 2: The functional block diagram helps you isolate the trouble in the set you are testing.



Understanding Capacitors: How They Fail, And How To Pin Down Cap Troubles With Your Auto-Z

by Larry Schnabel,
Marketing Communications Writer

- **Dielectric Absorption Can't Be Found With "Value Only" Testers**
- **Leaky Capacitors Act Like Resistors—Most Can't Be Found With An Ohmmeter**
- **ESR Robs Power From The Circuit—Only The Z Meter's Patented Circuit Can Measure ESR Dynamically**

Capacitors Can Change Value, Become Leaky, Increase In ESR, And Develop Dielectric Absorption Just By Sitting On The Shelf . . .

Did you think capacitor use was on the decline? It might surprise you to learn that more capacitors are used in today's modern solid-state chassis than were used in the old tube sets. With modern condensed circuitry and extra filtering needs, you'll be seeing a lot more defective capacitors, not less.

Naturally, capacitors and the problems associated with them are here to stay. Your challenge is to recognize symptoms of defective capacitors and track them down as fast as possible.

Most capacitors fail in-circuit, but they also fail just lying in the parts bin. These failures can be traced to one of four things: value change, excessive leakage, excessive dielectric absorption (DA), or high equivalent series resistance (ESR).

The LC102 AUTO-Z™ is the only capacitor analyzer on the market that lets you make all four of these important tests automatically. In this article, we're going to take a look at some actual case histories of capacitor related problems. You'll see why the AUTO-Z is such an important part of everyday troubleshooting.

Capacitors Change Value

How often have you seen a set that has the "bends" or 60 Hz ripple, like the set shown in Figure 1? Several types of failures commonly cause this kind of problem. A bad rectifier, a bad filter choke, a bad filter capacitor, a circuit loading a power supply, or a combination of several things could be the cause.

In the set shown here, we found that a 600 uF, 200 VDC filter capacitor had decreased in value. The LC102 AUTO-Z showed the capacitor's value had actually fallen to 320 uF, almost 50% lower than the marked value. The lower capacitance value couldn't meet the filtering requirements for this power supply (figure 2).

Even though the LC102 easily found this capacitor defect, only about 25% of the problems associated with capacitors are value related. Three out of four failures are caused by other problems. A "value only" capacitance meter isn't enough to find most of the capacitor problems in today's circuits.

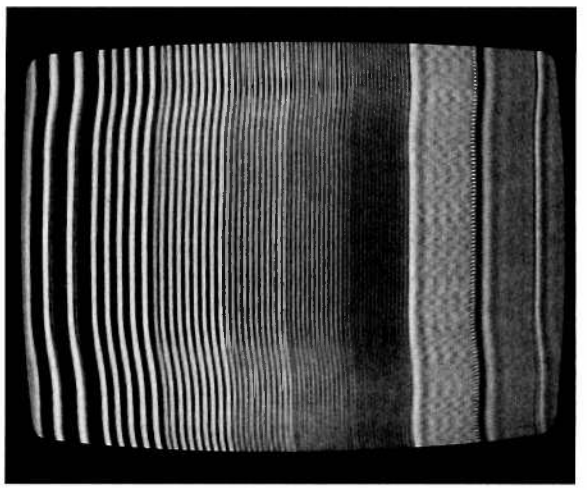


Fig. 1: A television with ripple in the picture usually has a problem with one of its power supplies. Is the problem a loaded down supply, a bad rectifier diode, or a bad filter cap?

Dielectric Absorption—The Hidden Failure

One common problem associated with capacitors is dielectric absorption (DA). DA is one of those "mystery" problems you won't find with a "value only" tester. Dielectric absorption can cause very real circuit problems. Let's consider the experience of one of our customers to see the effect of DA.

A customer was convinced that the AUTO-Z which he had recently purchased was not finding bad capacitors. The capacitors were 22 uF and were located in the vertical stage of a television. The customer knew the capacitors were bad because replacing them cured the linearity problems. He told us the AUTO-Z tests he performed showed the capacitors as "GOOD".

Measuring one of these capacitors on the AUTO-Z showed a value of 24.5 uF and less

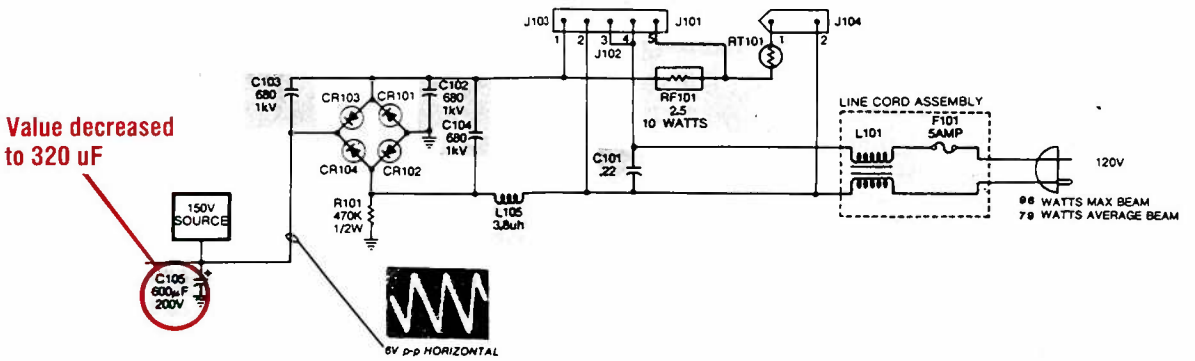


Fig. 2: The AUTO-Z's Capacitance Value test showed C105 had decreased in value to 320 uF causing the ripple in the picture.

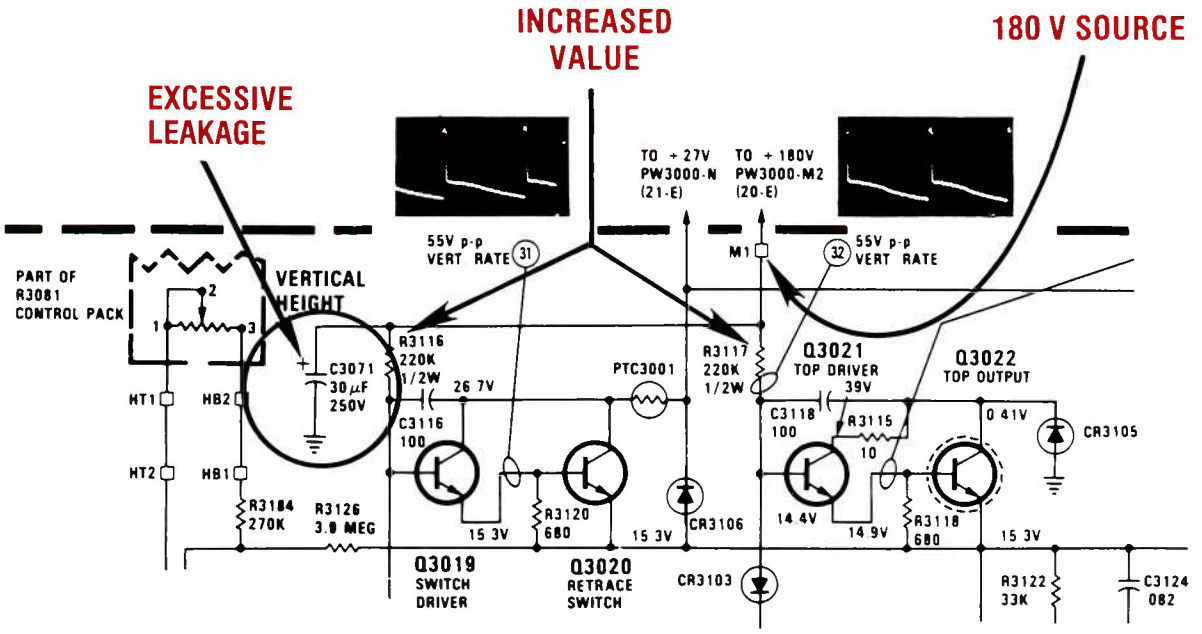


Fig. 3: The defective transistors and high-value resistors in this TV vertical section failed because of C3071. The LC102 AUTO-Z traced the problem down by revealing a high amount of leakage in the capacitor.

than the maximum allowable leakage, both which read "GOOD" on LC102's display. It sure appeared to be a good capacitor.

However, the customer had forgotten to perform the ESR and dielectric absorption tests as these tests were still new to him. The capacitor passed the ESR test without any problems, but the DA test yielded some interesting results. The AUTO-Z dielectric absorption test showed 13%—bad enough to cause the poor linearity in this set.

Dielectric absorption is the result of a capacitor remembering a charge that was applied to it. The results of this DA "memory" vary, depending on the circuit the capacitor is in. In the previous example the capacitor was not allowing the vertical ramp to be properly shaped. As the voltage on the capacitor changed, the memory effect of DA opposed the change, resulting in a non-linear picture.

Some circuits (like this vertical stage) will be severely affected by DA. In other cases, a small amount of DA tells you the capacitor has aged to the point where it should be replaced. Even if it's not causing a circuit problem yet, it may be nearing the end of its life.

Any capacitor that has more than 5% DA should be questioned, especially in a critical waveshaping circuit like the vertical stage of a TV. Capacitors used as filters in power supplies, however, can tolerate much higher levels of DA (up to 15%) before you see a noticeable change. Be certain you judge the performance of the capacitor on the type of circuit it's used in and the circuit's operation.

Capacitor Leakage Upsets Bias Voltages

Capacitors are supposed to block DC while passing an AC signal. When a capacitor develops leakage, it allows DC current to pass through in large amounts. This causes bias voltages to become incorrect and power supplies to load down. That's what happened with the following chassis.

The set came in for repair having only a single horizontal line across the screen. Several quick checks isolated the problem to the vertical output stage. A little closer analysis of the output stage showed that most of the transistors were biased into cutoff. When the technician checked the transistors, he found that most of them were bad.

Further checking showed that the bias resistors (see Figure 3), R3116 and R3117, had greatly increased in value. When they were replaced, a full raster returned, yet a continuous flickering indicated that something was still wrong. Measuring the voltage at M1 showed that the 180 volt supply was low, even after all the transistors and related bias components were confirmed good.

One possible culprit remained—C3071. The capacitor's value was OK, but the AUTO-Z's leakage test showed a high amount of leakage. The capacitor had so much leakage that it was acting like a resistor and loading down the 180 volt power supply.

While a leaky capacitor acts like a resistor, you cannot find a leaky cap with an ohmmeter or even a voltmeter. Leakage in a capacitor is not linear; it depends on the voltage applied to it. The LC102's Leakage Test applies up to 1000 volts to catch even the capacitors that break down under full load.

ESR Is More Of A Problem In Today's Circuits

ESR is the Equivalent Series Resistance of a capacitor. It is a standard characteristic, expressed in ohms, that represents all of the energy losses in the capacitor, despite the source. Capacitor ESR is a combination of lead resistance, foil/capacitor plate resistance, resistance of the lead welds, and the energy lost in the dielectric itself.

Capacitor ESR robs power from the circuit. Charging current flowing into and out of the capacitor must flow through the ESR, wasting energy in the form of heat. In power supplies operating at 60 Hz, heat loss is fairly low. However, in many modern circuits, such as switching mode power supplies, the operating frequency is in the kilohertz range. This causes the current to flow at a higher rate, and the heating effect increases.

ESR decreases the ability of a capacitor to filter correctly. In effect, you are placing a resistor in series with the capacitor. ESR can also affect the time constant in critical timing circuits or upset DC biases. Let's look at an example of a failure caused by high ESR.

Example: In one defective speaker system, there was no output from one of the high frequency tweeters. It was suspected that this speaker had been damaged by excessive power. The tweeter was checked, and, as suspected, found to be defective.

When the new tweeter was installed, the output was low and distorted. New suspect? The crossover network. It was the only other component that could cause a loss of high frequencies in this unit. Figure 4 shows the schematic of the crossover network. Notice the only components that could affect the output to the tweeter are L1, C1, and R1. The high frequency level control, R1, was checked; it tested good

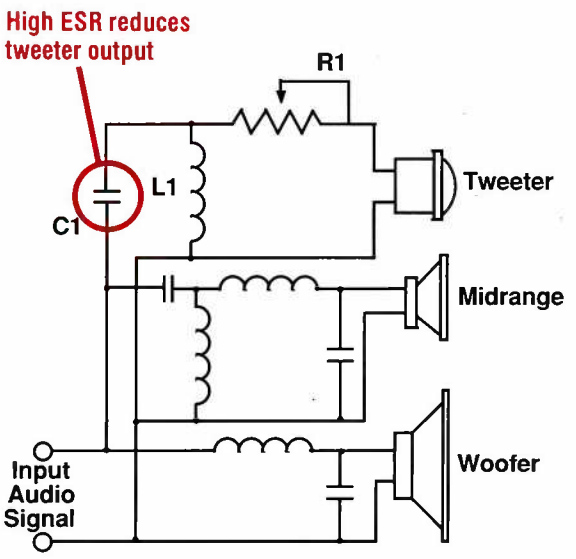


Fig. 4: The ESR in C1 limited the signal delivered to the tweeter.

Capacitor C1 (10 uF, 200V) was removed from circuit and checked with the AUTO-Z. The value read 10.8 uF, well within the tolerance range for this capacitor. Leakage and dielectric absorption also showed "GOOD" indicating their values were within the acceptable limits.

When ESR was tested, it measured 176 ohms with the display plainly showing "BAD". The maximum limit for this type of capacitor is 27 ohms, as shown in the lookup charts in the LC102 manual. But since the chart is already entered in the internal memory of AUTO-Z, there was no need to look up the number. The AUTO-Z does that for you automatically.

Since this capacitor was in series with the level control, it dropped most of the signal and decreased the speaker output. Replacing the defective capacitor found by the AUTO-Z restored the full power delivered to the tweeter.

Watch For Value Change In Shelf Electrolytics

Electrolytic capacitors have a moist, "paste-like" dielectric. The capacitor's body is sealed to prevent air from drying out the dielectric. Nevertheless, the dielectric eventually dries out and the capacitor's value drops drastically. Ceramic capacitors are also subject to drastic

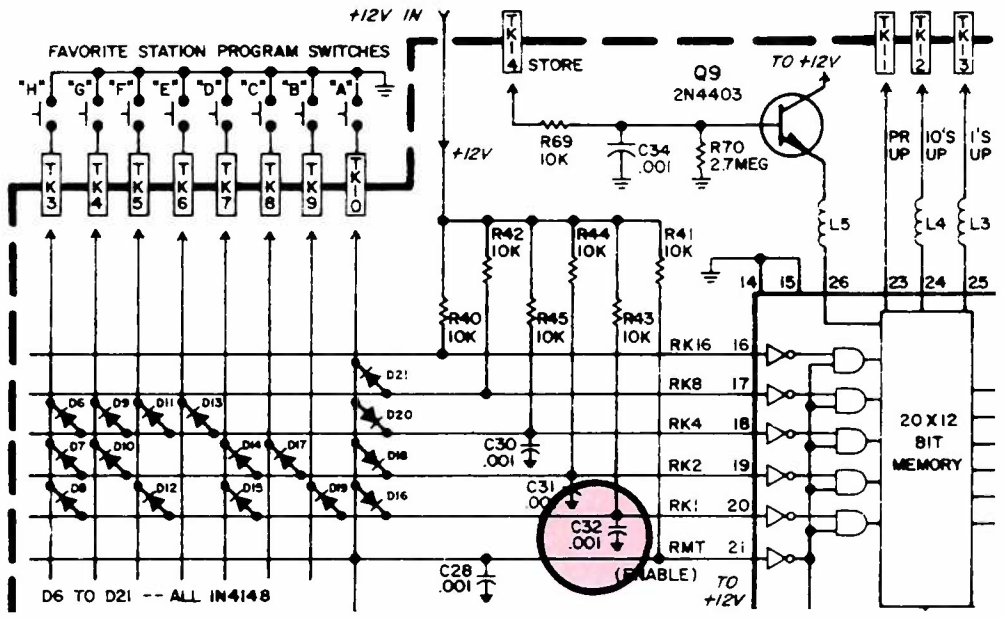


Fig. 5: You should always check replacement capacitors with your AUTO-Z before installing them. In this Sylvania set, the replacement capacitor was also defective, resulting in the set randomly tuning channels.

"on shelf" value changes. Instead of the dielectric drying out, the plates in ceramic capacitors become cracked from mechanical stress. An example of this failure happened to a technician who was working on a Sylvania set (Figure 5).

The set came into the shop several days after an electrical storm hit the area. The customer complained that the set was stuck on a particular channel and he couldn't choose any other. Being familiar with this symptom, the service technician quickly found the problem: C32 (.001 uF) on the memory module was shorted.

He found a replacement capacitor in his parts bin and replaced the defective capacitor. It fixed the problem—or so he thought.

It didn't take too long for the shop to get a call from the customer. This time the set wasn't stuck on a particular channel; the set was changing channels randomly.

After studying the output lines of the encoder and the keyboard, the technician decided that the encoder was causing the set to switch to a different channel—not unlikely since the memory/encoder chip was probably damaged by the electrical storm. Of course, he didn't have the IC, so he had to order one.

After a week, the IC finally arrived. The technician carefully installed the new IC, only to find that the set still randomly switched channels. He knew it wasn't the chip, so maybe it was something on the chip's input. One by one he removed and checked the capacitors on the input lines. They all checked OK, except C32, again. This time, it measured just 2.5 pF. The tech replaced the capacitor again, this time checking the replacement with his LC102 AUTO-Z, and the set worked fine.

The technician wasted more than a week because he didn't check the shelf capacitor before he inserted it in circuit. Don't count on replacement capacitors being good. Capacitors can change value, become leaky, increase in ESR, and develop dielectric absorption just by sitting on the shelf. You should always test replacement capacitors with the AUTO-Z first, even if they just came from the supplier!

The Case Of The Leaky Capacitor

As electrolytic capacitors age on the shelf, they often develop leakage. Placing a leaky capacitor into a circuit can have disastrous results, as this technician told us:

The technician worked for a company that manufactured photographic equipment. He explained that they were using a 1240 uF, 360 VDC capacitor in the power supply of a camera strobe unit. At the time of production, the company ordered an extra 3,000 capacitors for their service centers to use as replacements. Most of the replacement capacitors sat on the warehouse shelves for 3 years before they were needed. Then, one by one they were used in service units.

Fig. 6: Capacitors can develop leakage just sitting on the shelf. Use the LC102 AUTO-Z to detect and reform these capacitors.

The technician was in for a surprise when he turned on the power to one of the serviced units. Several replacement capacitors had developed excessive leakage while sitting on the shelf. About 15 minutes after power was applied, heat and pressure caused the capacitors to explode, spewing oxide paste throughout the power supply.

You can prevent this from happening in your shop by checking every capacitor you take off the shelf with your AUTO-Z. If the leakage is below (or quickly falls below) its acceptable amount, you can put the capacitor into circuit without worry.

If the leakage is above the maximum allowed, you can reform the capacitor's dielectric with the AUTO-Z's test voltage. The dielectric can reform when a voltage, with a limited current, is applied to the capacitor's terminals for a period of time. Your Z Meter provides the necessary test voltage and current limiting to allow you to reform electrolytic capacitors.

Capacitors Develop DA On The Shelf, Too

Dielectric absorption can also develop while capacitors sit on the shelf. Here's an experience a servicer told us about that shows the importance of doing all four capacitor checks, especially on off-the-shelf replacements.

A TV came into the shop with a vertical height problem. The picture wasn't completely collapsed, but it had very poor linearity. Suspecting bad capacitors, the technician checked every capacitor in the vertical feedback loop with his "value only" tester.

When each checked good, he decided to recheck them with his LC102 AUTO-Z. Each capacitor showed good value, good leakage, and good ESR. But, one of the 50 uF capacitors had 50% dielectric absorption.

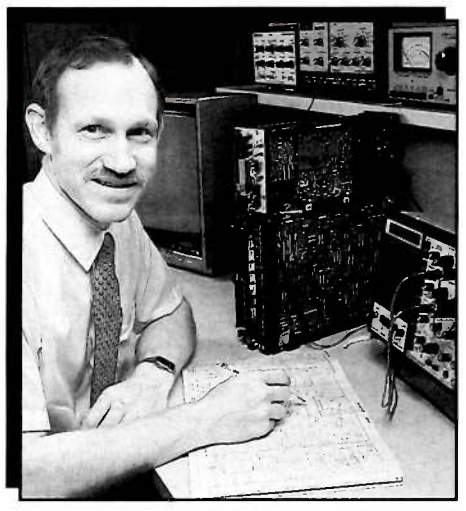
Quite certain that he had found the problem, the servicer grabbed a replacement 50 uF capacitor out of the parts bin. Just to be sure, he checked it on his AUTO-Z. It read the correct value, had low leakage, and low ESR.

The dielectric absorption test, however, revealed that the replacement capacitor also had about 50% DA. If he wouldn't have checked the replacement capacitor with his AUTO-Z, the TV's symptom would have been exactly the same as before. That probably would have caused him to believe the capacitor was not the problem, sending him on a wild goose chase.

Another 50 uF capacitor in the parts bin checked good on all four AUTO-Z tests. When this capacitor was put into the circuit, the set worked fine. The AUTO-Z came to the rescue again!

Need more information? Would you like to put an LC102 AUTO-Z on your bench and try it out? Call **1-800-SENCORE** and talk with your Area Sales Engineer. He'll work with you to end your capacitor testing problems for good! ❐

Sencore's Career Opportunities



Tom Schulte
Application Engineer

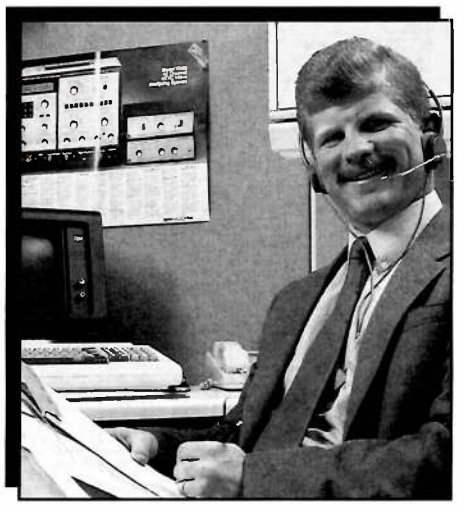
With the pace of technological advancement quickening, Sencore offers me a unique opportunity to play a leading role in the development of innovative electronic test equipment for a number of markets. In my position as a member of the Application Engineering department, I play a key role by providing the customer information necessary to make critical decisions in the equipment development process.

You've Seen Our Products, Experienced Our Service, So Now Join Our Team

Sencore, located in Sioux Falls, South Dakota, is expanding its operations in several areas and is seeking high-energy, goal-oriented individuals to help us leap into the 90s. Our success depends on our innovative products, as well as the many Sencore employees who always strive to achieve their best.

Sencore Offers:

- ✓ A proud tradition through our 40 years in the test instrument industry
- ✓ Continuing educational opportunities
- ✓ A competitive salary and benefit package to include:
  - Major medical and life insurance coverage
  - 401K, Flex 125, and Profit Sharing
- ✓ A professional, teamwork environment
- ✓ A modern facility, using state-of-the-art technology
- ✓ Technical and management advancement opportunities



Mike Pursel
Government Sales

With the increasing complexity of electronics, the 1990s look bright at Sencore. That's why I'm excited to be part of the Sencore team. I ensure everything is in place to make it as easy as possible for my customers to purchase and utilize Sencore products. This includes anything from technical sales presentations, informative discussions about competition, or field visits. Everyday is different depending on who I am talking with. It makes coming to work fun.

Present Openings

All positions require relocation to Sioux Falls, SD.

Test Equipment Sales

Combine your technical degree and communication skills to market our products directly to the customer via the telephone. As a Sencore Phone Sales Engineer, you will sell our products to a strong customer base within an assigned territory, while providing superior customer support before and after the sale. If you are an aggressive, self-directed individual, this is the career opportunity for you. Extensive sales and product training provided. Exceptional income potential is yours with our aggressive guaranteed commission draw program. Position requires:

- 1-2 years of proven sales experience or strong desire to enter sales
- Minimal travel
- Good understanding of test equipment applications

Application Engineering

If diversity is something you've always desired, our Application Engineering Department has all you want and more. As an Application Engineer, you will conduct market research, specialize in new product development, write technical support material and answer customer inquiries on the application and use of Sencore instruments. In addition, you will take our products directly to the customer by conducting seminars and attending trade shows. Position requires:

- 2 years of audio, video and computer troubleshooting experience
- Exceptional oral and written communication skills

New Product Development

Take our products from conception to market by becoming part of our design team. You will be a part of a group that received 5 patents in 1989 alone. As a team member, you will be responsible for conducting feasibility studies, planning and designing circuitry, developing and testing prototypes, and assisting in the transfer of new products to Manufacturing. Position requires:

- A mix of analog, digital and computer programming experience
- 2 years of similar work, with an emphasis in RF Design

Manufacturing Quality

Quality is an attitude, it's a commitment to excellence and something that our customers have always demanded. In our newly created Quality Assurance Supervisor position, you will have the opportunity to refine the qualities which have been instilled at Sencore. As Q/A Supervisor, you will be responsible for daily supervision, developing and conducting all finished product testing, auditing production and service Q-points, monitoring and improving yields, as well as special environmental testing. Position requires:

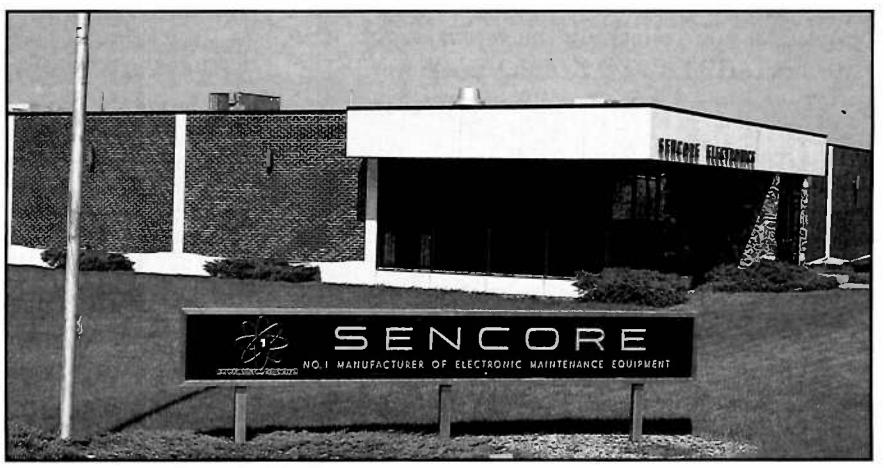
- Experience in a Q/A electronic test environment or related manufacturing experience
- Supervisory experience or potential

All positions require a minimum of a 2-year degree in electronics or equivalent (Bachelors preferred).

Finally, Sencore realizes that where you live is just as important as where you work. Our community of 100,000 offers a very healthy residential and business climate, four institutions of higher learning, a superior standard of living, low crime and affordable housing. Plus, South Dakota has no state income tax.

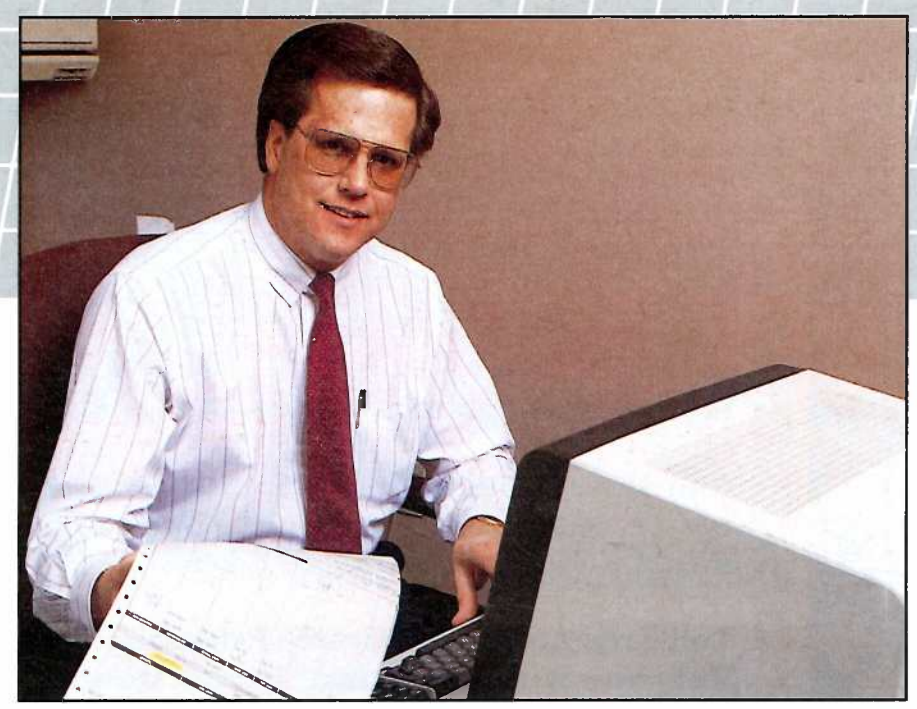
If Sencore and Sioux Falls is the winning combination you've been waiting for, give us a call at **1-800-SENCORE** or send a cover letter and resume to **Sencore, Inc., Human Resource Department (SN), 3200 Sencore Drive, Sioux Falls, SD 57107**

For Quick Response, Complete The Career Response Card And Mail Today!



Sencore, Inc., Sioux Falls, South Dakota

Customer Support



The Business Plan—Essential To Your Success

by Mark Ilse, Credit Manager

- **Helps You Zero In On Strengths And Avoid Weaknesses**
- **Simplifies Financial Decisions—Enhances Growth**
- **Guarantees A Better Return On Investment**

Your Business Plan Is Vital To Success—To Be Truly Effective It Should Be Put In Writing . . .

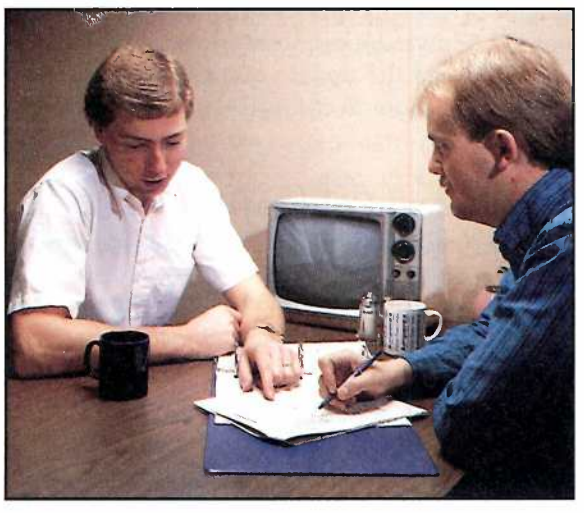
Do you know whether your service business is making or losing money? Does your accounting system monitor the money you spend, where you spend it, and for what purpose? Do you have an up-to-date business plan?

More often than not, a successful servicer will answer "yes" to these questions. Not because his shop runs "by the book", or he just happens to have a "knack" for making money, but because he has learned good business planning.

All businesses begin with a plan . . . some quickly outgrow or ignore it. Why do some businesses succeed and others fail? Planning has a lot to do with it. Let's review business planning and see why it is important to keep your plan up to date. Whether your business is new or ongoing, your plan should include, but not be limited to:

- ✓ Your company's "mission statement" and goals
- ✓ Marketing information
  - market size
  - market growth rate
  - pricing
  - competition
- ✓ Detailed internal plans
  - outline of goals
  - project management
  - personnel requirements and costs
- ✓ Financial data
  - costs needed to achieve company goals
  - expected profits
  - return on investment

When you make a business plan, the "mission statement" forces you to take the time to develop a clearly defined, well thought out overview of who you are, what business are you in, what you expect to accomplish, and how you are going to do it. Deciding exactly what business you are in is the most important step. It makes everything about your business fit into place, from setting up a training program, to purchasing equipment, to planning for profits. Do you need a pickup truck, or a van? Do you want test equipment for video, or for communications? Once you zero in on "your business", you'll find it easier to focus on your market and profit goals. Marketing information helps you determine which products to sell and what services to offer to satisfy the needs of customers defined in your mission statement. With an up-to-date business plan, you'll know how to use:



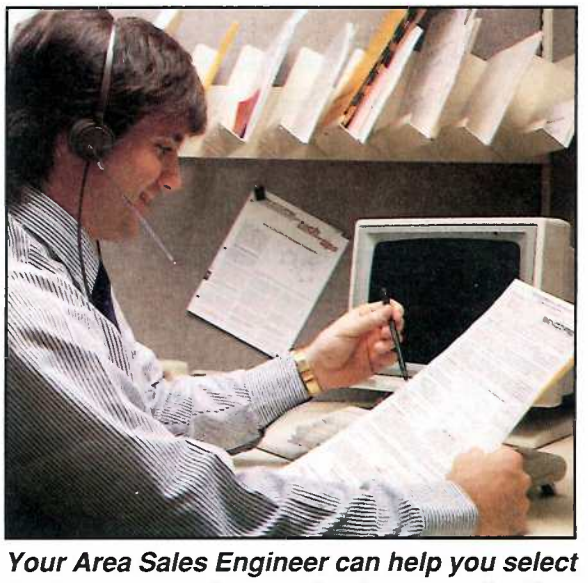
The Business Plan will help you zero in on, plan for, and purchase needed instruments . . .

- Market research to determine needs, trends, and competition
- Advertising to make the market aware of your company's products and services
- Project management to tailor your company's offering to known market needs
- Sales management/administration to maintain customer records and provide timely professional service

Detailed internal plans will keep your entire company focused on "your business", accomplishing your goals. Organization charts can be used to show all functions and how they relate to one another—guaranteeing that your business will stay on track.

Financial control, vital to the health and success of your business, should be tied closely to your business plan. Your accounting system must monitor the amount of money you spend, where you spend it, and for what purpose. Every part of your business plan should be monitored and the performance measured, to control costs, minimize expenses, increase profits, and guarantee return on investment.

Your business plan is a valuable asset, and is vital to your success. To be truly effective, it should be put in writing and updated at least once a year. For more information on business or instrument applications, call **1-800-SENCORE** and ask for your Area Sales Engineer. ❐



Your Area Sales Engineer can help you select the instruments for your business application.

Customer Support

Sencore Service — Dedicated To Keeping Your Sencore Instruments Working And Earning For You

by Bob Van Kirk, Service Manager

- **You Get Fast 72-Hour Service—No Extra Charge**
- **Your Instrument Is Updated With The Latest Safety, Protection, And Reliability Improvements — No Extra Charge**
- **Toll Free Access To Service Professionals, To Help You With Instrument Repair Questions — No Extra Charge**

Special VA62 Update Offer — Through February 28, 1990!

EXTENDED
CALL FOR DETAILS

The VA62 was first introduced seven years ago, and at that time it met all channel requirements. Since then, new cable channels have been added to TV sets and to cable systems. The VA62A now has cable channels 2 through 99. You can have the same channel capability with your VA62 if you send it in to be updated. For $295, your VA62 can have the new performance specifications of the VA62A. Besides having the same specifications, here is what you will receive in the update package.

Fig. 1: Your serviced instrument is refurbished and quality checked like new units—then returned in new packaging.

Shipping Arrangements Made For You — At No Additional Cost

Because shipping facilities may not be convenient for you, we will have UPS pick up your VA62.

Then after it has been serviced, UPS will deliver it back to you. Total shipping time both ways should be less than ten days and will be at no additional cost to you.

Three Day Turnaround Keeps Down Time To A Minimum

Your VA62 will receive top priority and should be back on its way to you within three working days after we receive it. This will hold down time to a minimum and allow you to schedule your workload accordingly.

Additional Channels Equip You For Today's New TVs

Your VA62 generates cable channels 2 through 73. With the EPROM update, the VA62 is transformed into a generator that produces cable channels 2 through 99. Most new TVs have the capability to receive these channels and the update allows you to test these 26 additional channels.

Repair And Calibration — Plus Circuit Repairs At No Additional Charge

As part of this update, the VA62 needs to be recalibrated. Calibration assures you the instrument is operating at peak performance. Also if we notice there is a defective circuit, we will repair the problem at no additional charge. ***NOTE**: All Sencore instruments are calibrated with standards that are traceable to the National Institute of Standards and Technology (N.I.S.T.).*

Product Improvements Added— At No Additional Charge

From time to time, our Engineering Staff releases notices on how we can improve the reliability of our instruments. If your VA62 hasn't been returned within the last year, we will add these circuit improvements at no additional cost.

New Literature And Front Panel Completes The Update To A VA62A

A new manual, schematic, and channel sheet will be included with your VA62. The front panel will also look new after we install new escutcheons and pull chart. These finishing touches will complete the update of your VA62 to a VA62A.

If you cannot be without your VA62, we do have a loaner program. These loaner instruments are available to you, for a small fee, while you have yours updated. However, if you are a member of the Sencore Key Customer Club, there is no loaner fee other than shipping.

Here's How To Order

Call your Sencore Sales Engineer Toll Free **1-800-SENCORE** for details on how you can become a Key Customer Club member. Ask for the Service Department to get the entire VA62 update for only $295. ❐

Fig. 2: Our standard 72-hour turnaround on service repairs and 48 hours on parts gives you maximum productivity from your test instruments.

Cut Your Video Troubleshooting Time By 54%* With The VA62A Universal NTSC Video Analyzing System

New And Improved!

VA62A Universal Video Analyzer
Patented

- *Identify tuner problems with All-Channel, VHF, UHF, and Cable RF Generators.*
- *Pinpoint IF Problems with modulated troubleshooting signal and exclusive programmable IF/RF generators.*
- *Isolate any video problems 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.*

** Based on a nationwide survey of users who reported an average time savings of 54% compared to their previous test equipment.*

Call 1-800-SENCORE
(736-2673)

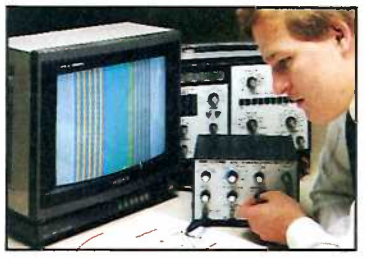
Update For New Technology With Exclusive Phase-Locked Accessories

VC63 VCR Test Accessory

Solve the VCR servicing challenge with substitute VCR signals, phase-locked to your VA62A.

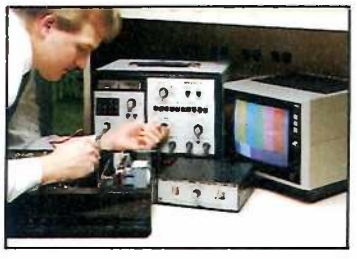
ST65 Video Analyzer Stereo TV Adder

Easily test and troubleshoot today's new MTS Stereo TVs & VCRs.



NT64 NTSC Pattern Generator

Meet all Warranty Requirements by adding the NTSC full-field and split-field patterns to your VA62A Universal Video Analyzer.



RG67 NTSC Video Monitor Adaptor

Expand into analog and digital video monitor service with phase-locked R, G, B and I signals.

SENCORE

Find The Defective Capacitors, Coils, Resistors, SCRs And Triacs That All Other Testers Miss . . . With The All New LC102 AUTO-Z™ Automatic Capacitor-Inductor Analyzer

- Dynamically tests capacitors for value from 1 pF to 20 F, leakage with up to 1000 volts applied, dielectric absorption and equivalent series resistance (ESR).
- Dynamically tests inductors, in-or-out of circuit, from 1 uH to 20 Henrys for opens, shorts, value, and detects even one shorted turn.
- Dynamically tests SCRs, Triacs, High Value Resistors, and locates the distance to within feet of an open or short in a transmission line for an added bonus.
- Automatically makes all of the tests, compares them to EIA (Electronic Industries Association) standards and reads the results as Good or Bad. Enter all information right from the component without look-up charts, calculations, or errors.
- Extends your testing capability to places where an AC cord won't reach, with rechargeable 9-hour battery or AC operation.
- An added feature alerts you that the fuse has opened, and that there may be residual high voltage on the component under test.

SENCORE LC102 AUTO-Z CAPACITOR-INDUCTOR ANALYZER

1.879 F GOOD

5.5 VOLTS

COMPONENT TYPE: ALUMINUM LYTICS, DOUBLE LAYER LYTICS, TANTALUM CAPS, CERAMIC CAPS, ALL OTHER CAPS, SPARE, COILS, YOKES & FLYBACKS, SWITCHING XFORMERS

COMPONENT PARAMETERS — NUMERIC INPUT: 1 2 3 4 5 6 7 8 9 0 • CLR

ENTER / RECALL: pF µF F + % − % V µH mH H

TEST: CAPACITOR VALUE, CAPACITOR LEAKAGE, DIELECTRIC ABSORP, CAPACITOR ESR, INDUCTOR VALUE, INDUCTOR RINGER

POWER: ON & BATT TEST / AUTO OFF / OFF — 115 VAC OR BATT.

TEST LEAD — 1 AMP, 3AG SLO BLO FUSE ONLY

LEAD ZERO: OPEN / SHORT

LEAKAGE: CURRENT / OHMS

⚠WARNING: Flashing light indicates 25-1000V applied to test leads when leakage button is pressed. STOP TESTING: Protection circuit or fuse is open. Capacitor being tested may be charged.

Pat Nos. 3990002, 4258315, 4267503, Others Pending

RANGES: 1pF to 20 F, 0.1uH to 20H

PULL CHART

CONSOLIDATE

SENCORE 39G219 LO CAPACITY TEST LEADS

New! And Improved!

THE Z STANDARD

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

IEEE 488 BUS-COMPATIBLE

RS232 Compatible

Five Patents

Call 1-800-SENCORE
(736-2673)

Form 4324 Printed in U.S.A.