

SENCORE NEWS

Issue #150 May/June 1990

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How To Service VCR Servos—page 7

Increasing Business Productivity—page 11

Buyer's Guide To Video, Audio And Component Testing—page 13

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**PM82 "POWER MAX" 5 kW
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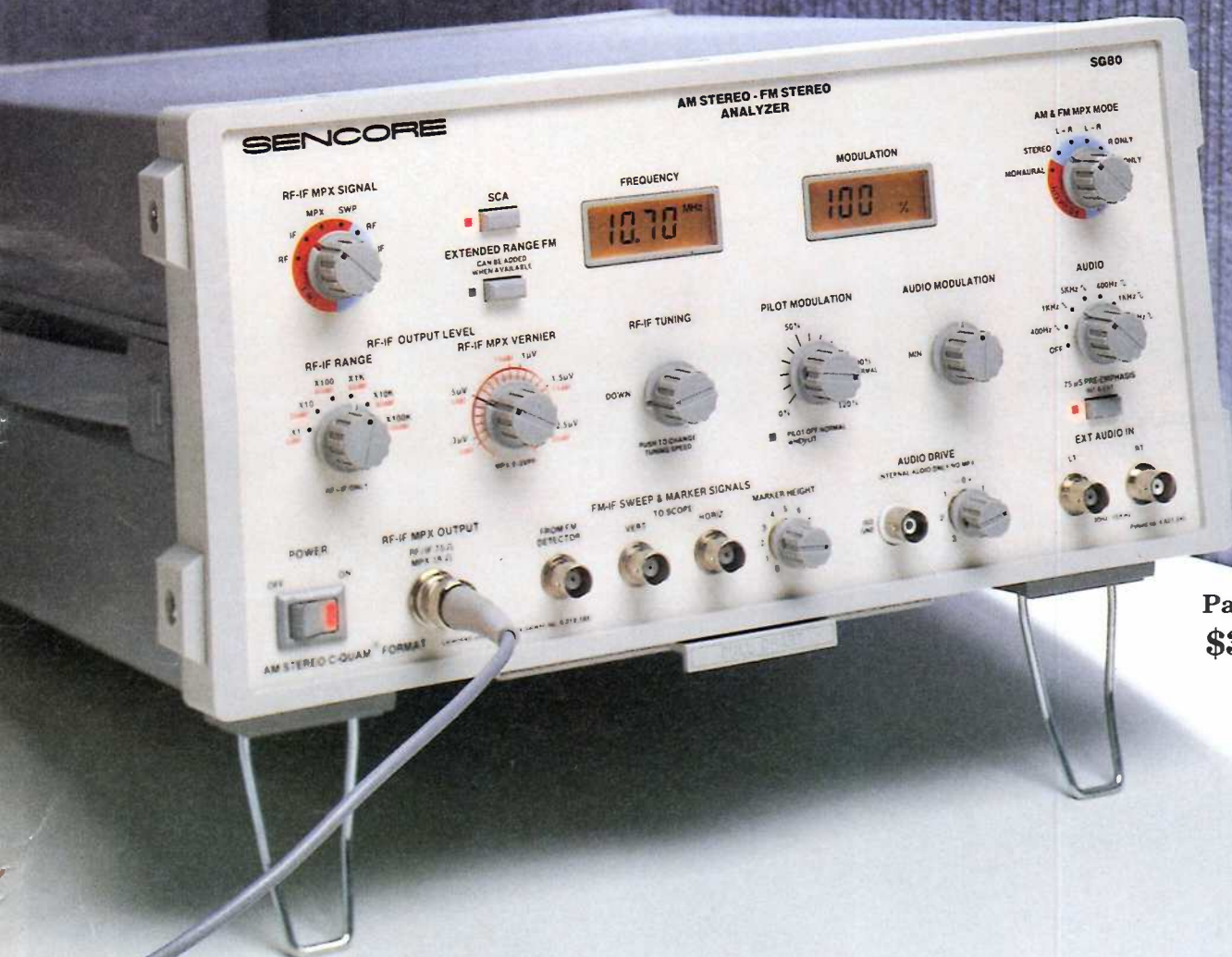
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Why Get Into Audio-Receiver Servicing

By Rick Meyer, Applications Engineer

- The profit potential for receiver servicing continues to increase—are you ready?
- Digital technology has merged with audio—creating the need for higher accuracy and increased servicing capability.

More than half the homes in America have some form of compact component audio system And 98% have radio—if you haven't seen the profit potential here, you'd better look again!

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Audio is booming. We, as consumers are purchasing and using more audio products than ever before. We listen to radios, record players and tape recorders in our homes, our cars, and at our workplaces. Audio has become a way of life for us. This has resulted in a steady and significant growth in the audio industry. The EIA (Electronics Industries Association) estimates that we will purchase nearly \$10 billion dollars of audio products in 1990 alone (See Figure 1). That's \$10,000,000,000.00!

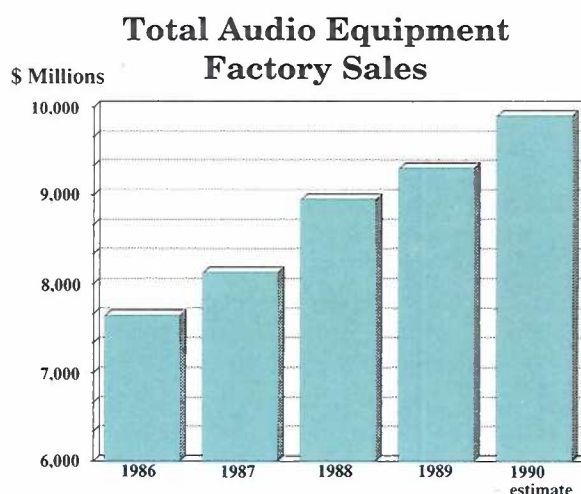


Fig. 1: According to EIA figures, the sales of audio products will approach \$10 billion in 1990.

A significant portion of the sales of audio products are for FM and AM receivers of one form or another. The EIA estimates that 98% of American homes have radios, and over half have some form of compact or component audio system (See Figure 2).

With this ever increasing quantity of radios, the potential for receiver servicing continues to increase. Are you ready to take your place in this growing service business?

The Quality Of FM Signals Continues To Improve

We continue to become more accustomed to higher and higher quality products. In the case of audio, we now are accustomed to and demand better quality sound than was previously possible. This is true of FM and AM receivers as well as amplifiers, CD players, tape decks and such.

The broadcast industry has recognized this trend and continues to advance towards higher and higher quality signals. With the advent of digital audio and the compact disk technology, new levels of quality have resulted. This same technology is entering into the broadcast studio. Broadcasters are replacing their records with compact discs. Mixing and audio distribution panels are being replaced with new, high-tech, high-performance, digital panels. Continued development of antennas and transmitting equipment are producing new highs in listening performance.

Estimated Household Penetration By Product

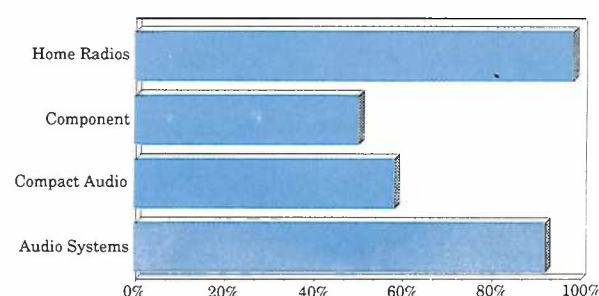


Fig. 2: The EIA estimates that 98% of all households have a radio and that 92% have an audio system.



Fig. 3: Even though the front panel display on the receiver reads the correct frequency, it does not prove that the receiver is tuned to the correct station.

The same is true with receivers. New IC technology has produced receivers with better performance than ever before. Stereo separation to 68 dB is now possible. MosFet technology is improving receiver sensitivity. Sensitivity as low as 1.6 uV is now commonplace. Internal receiver noise floors have been lowered with signal-to-noise ratios up to 98 dB.

What does this have to do with you, the servicer? Can you handle this new technology, or are you letting the service opportunities pass you by? The recent trends in audio point to an increased demand for service of this growing area. The technological advances, however, also point to the need to have high-quality, digitally-accurate test equipment to restore these receivers to their original high-quality standards. Is your shop equipped to handle these new receivers?

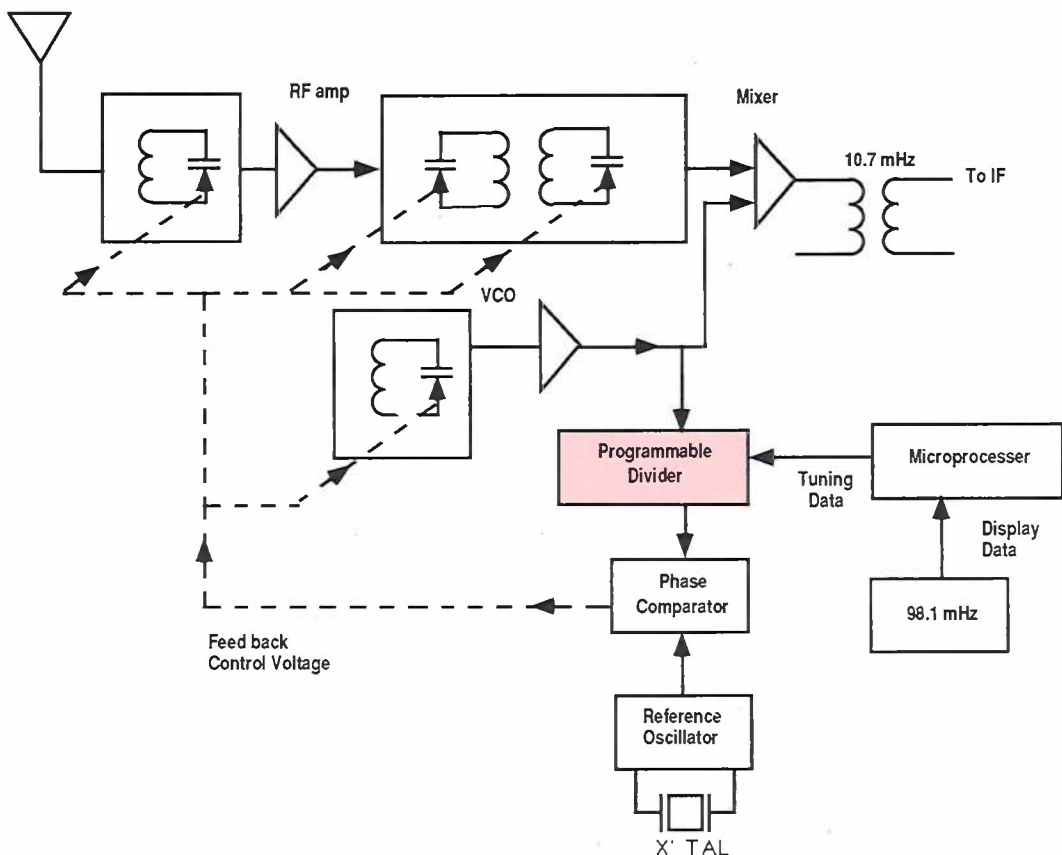


Fig. 4: The digital divider in the modern tuner is the digital connection between the front panel display and the tuned frequency.

The Digitally Accurate SG80 Meets The Needs Of Modern Day Receivers

The SG80 AM Stereo - FM Stereo Analyzer meets your needs of high-performance high-

quality receiver servicing. It is a high quality test and troubleshooting instrument that can handle today's demanding receivers. The SG80 has the digital accuracy needed to allow you to test the latest receivers faster and easier than ever before. Let's take a look at some of the demanding needs of modern receivers and how the SG80 AM Stereo - FM Stereo Analyzer can help you locate and repair these high-quality receivers faster and easier than ever before.

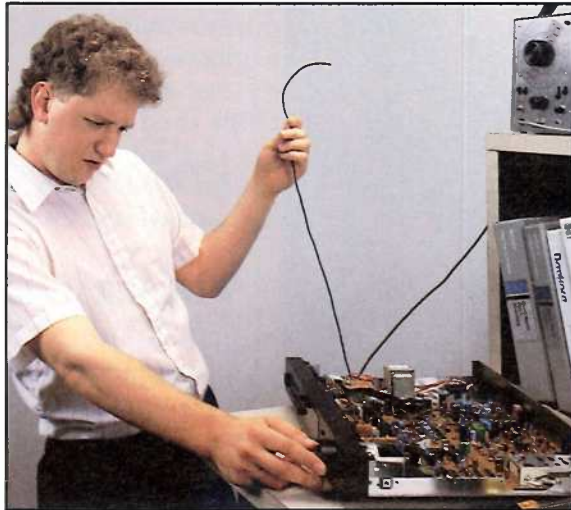


Fig. 5: Your lack of control of an over-the air signal often leaves you with doubt about the total operation of a receiver.

Modern Digitally Tuned Receivers Require A Signal Source Of Equal Or Better Digital Accuracy

Digital tuning is now commonplace in most receivers. Most customers think that if the

Digital tuners can fail in one of three ways: they can fail to tune through their full range, they can be off frequency, or the oscillator can die altogether. All three of these failures can still result in the receiver front panel functioning as if the tuner were working properly. The customer, however, will not be able to properly tune in a station.

A digital tuner actually refers to how the local oscillator is controlled. The local oscillator is an analog type oscillator that is controlled digitally. The local oscillator, often a VCO (Voltage Controlled Oscillator), is tuned by a voltage that is digitally derived. In order to obtain the control voltage, a sample of the VCO signal is fed to a digital divider which divides the frequency of the oscillator down to a lower frequency. The divided down signal is then compared to a crystal reference. By using a programmable divider, different frequencies can be obtained. This is where the digital tuning comes in. The connection between the frequency numbers on the front panel and the actual tuning is in the digital data supplied to the programmable divider.

As stated earlier, the signal out of the programmable divider is compared to a crystal controlled reference signal. If the frequency of the two signals are different, the voltage fed to the VCO changes to correct the frequency of the VCO. When the frequency of the VCO output signal is correct, the frequency of the signal coming out of the programmable divider is the same as the frequency of the crystal reference signal and the local oscillator is locked in.



Fig. 6: Analog tuned generators drift in frequency and often require periodic retuning of the generator frequency.

Several things can happen in this circuit to cause problems. First, the VCO can be defective and not oscillate. The symptom will be a dead receiver. The customer, however, will often still see the digital numbers change when he tunes the receiver.

Another problem is a failure in the divider or prescaler. The programmable divider receives digital data from the control microprocessor to tell it what station to tune to. If a problem occurs in the microprocessor, a data line is shorted, or the divider fails altogether, tuning control will be lost. The typical symptom of this type of problem is a receiver that appears dead, or is stuck on one station.

A third potential problem is a crystal reference oscillator that is either dead or off frequency. In either case, the customer will

digital number lights up on the front panel of the receiver, then the tuner must be tuning. But what happens when the customer can't pick up a station because something has gone wrong with the digital tuner? As we will see, the tie between the front panel display and the actual tuning oscillator may give the customer the false illusion that all is well.

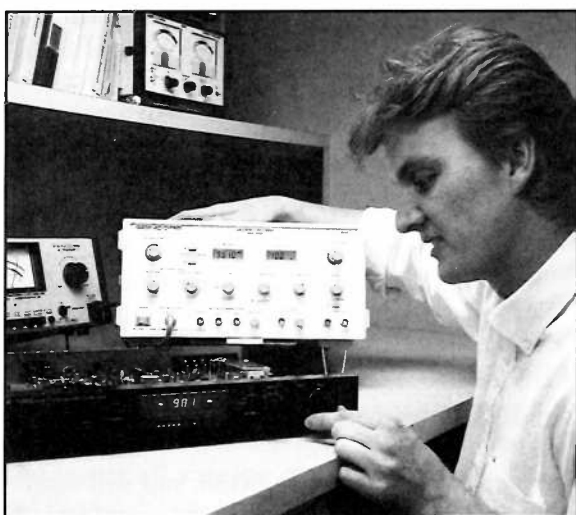


Fig. 7: The SG80 gives you confidence in knowing that the receiver either works or it doesn't.

still see the digital numbers tune to the correct frequency but he may not be able to tune in his favorite station.

The SG80 Allows You To Quickly Check The Operation Of Digital Tuners

The digital tuning of the SG80 AM Stereo - FM Stereo Analyzer allows you to quickly and accurately check for the problems we just looked at. You can quickly and accurately select a signal that you know is correct. It is locked on frequency and will not drift off during the course of your testing. You can also fine tune the SG80 AM Stereo - FM Stereo Analyzer to check for off frequency operation. The two speed digital tuning allows you to check each FM or AM channel, if desired, or zero in on a specific frequency. Your receiver testing is speeded up and you don't have to wonder if the signal is tuned in properly.

You may be presently trying to use off-the-air signals to check receiver operation. You may also feel that since it is a real broadcast signal it is the best that you can have. Your off-the-air signal may be of good quality, but it severely limits the ability to check the receivers your customers bring to you.

In the case of the digital tuning capability of a receiver, there are several problems with trying to use an over-the-air signal. First, unless you live in a large metropolitan area, you likely don't have a wide enough variety of AM and FM stations in your immediate area to cover the range of frequencies the receiver is designed to tune in to. Second, an over-the-air signal gives you no way to determine how well the tuner is locking in. Is the tuner centering in on the station, or does the AFT have to pull it onto the station? Third, you have no control over the broadcast signal. Its level, and signal quality are subject to affects you have no control over. You must time your troubleshooting for the best available signal level or signal type to do your test.

Analog RF signal generators are also of little help in checking or troubleshooting digital tuner problems. The main problem with analog tuned generators is that you don't know exactly what the frequency is of the generator. You can "tweak" the generator frequency to the receiver frequency, but it

doesn't prove that the receiver will lock onto a crystal locked broadcast signal. In addition, analog tuned RF signal generators drift in frequency. This forces you to retune the generator to ensure maximum performance.

The digitally accurate signals of the SG80 AM Stereo - FM Stereo Analyzer are a must for checking today's digital tuners. The SG80 uses advanced digital technology and a stable crystal reference to give you positive and

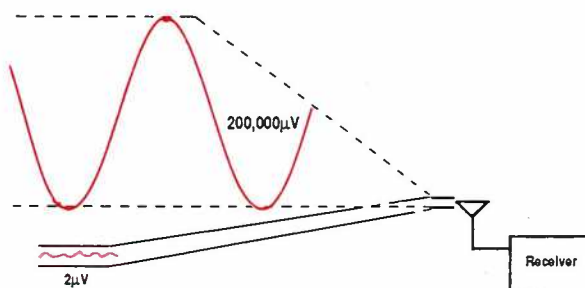


Fig. 8: The signals fed into a receiver vary over a wide range of signal levels.

precise tuning. No need to hook up frequency counters or to constantly "tweak" in the generator frequency as it warms up. The SG80's digitally accurate RF frequencies give you the confidence in knowing the signal you feed into the tuner is correct and that the receiver will work properly on all broadcast signals.

Let's look in a little more detail at how the SG80 AM Stereo - FM Stereo Analyzer can help you check digital tuners. First, you can check the tuning range of a receiver as follows:

First set up the SG80.

1. Set the RF-IF MPX SIGNAL switch to FM RF.
2. Set the RF-IF OUTPUT LEVEL to 65 dBf.
3. Tune the SG80 to one end of the tuning band, (88.1 MHz) for example.
4. Set the AM & FM MPX MODE switch to STEREO
5. Adjust the PILOT MODULATION control to its 100% NORMAL position.
6. Set the AUDIO switch to 1 kHz.

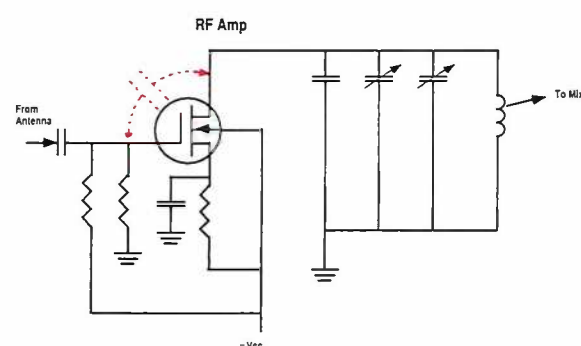


Fig. 9: Even a defective RF amp will pass a signal to the board and internal capacitances present.

7. Adjust the AUDIO MODULATION control until the MODULATION display reads 100%. Except for the frequency, this is the standard configuration for all of the FM receiver tests.

You are now ready to check the receiver.

1. Connect an RF cable from the antenna terminals of the receiver to the RF-IF MPX OUTPUT jack on the front of the SG80.
2. Tune the receiver to the same frequency the SG80 is tuned to.
3. Verify that audio is present at the output of the receiver.

Once you are sure the receiver can tune to and operate on this end of the FM band, you are ready to check the other end of the tuning range. The SG80 makes this test fast with its wrap-around tuning. Simply tune the SG80 beyond the normal FM broadcast band, (in this case, tune it down below 88.1 MHz). You will notice that the SG80 wraps around to the other end of the FM band. Do the same thing with the receiver and again check to see if

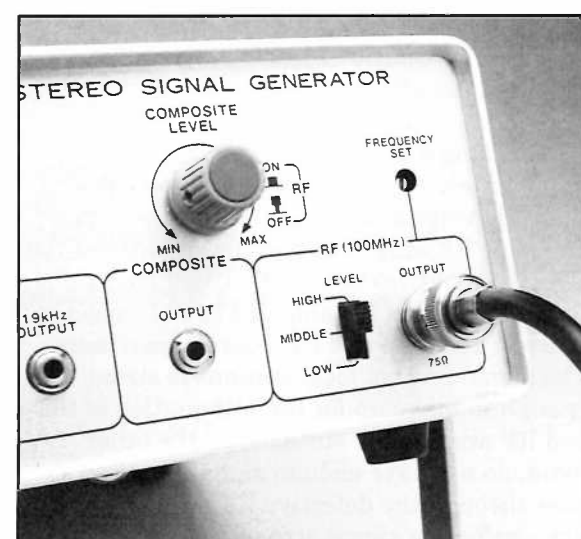


Fig. 10: Some signal generators give you very limited control of the RF level making sensitivity tests almost impossible.

audio is present at the output. If you can not get the receiver to tune to both ends of the band, you may want to step from one end of the band to the other to determine where the tuning stops.

The SG80 makes checking of the digital tuner a snap. The digital accuracy of the SG80 lets you have confidence when you return the receiver back to the customer that it is working properly and will tune in his favorite station.

Accurate Signal Levels Are Needed To Check For Proper Receiver Sensitivity

Many receiver failures do not result in a total loss of operation. Some problems, such as a defective RF or IF amp, affect the operation of the receiver only under certain circumstances. In order to understand how this type of failure affects the receiver performance, we need to look at what these amplifiers do.

One purpose of the RF amp is to amplify the weak signals received by distant stations. It must operate over a wide range of signal levels. A typical local signal may pump 20,000

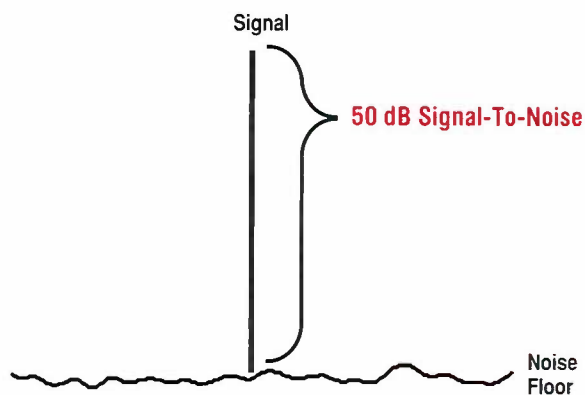


Fig. 11: The sensitivity test determines what level results in a 50 dB signal-to-noise level.

uV or more of signal into the RF amp. Weak signals, on the other hand, may be in the 1 to 2 uV range. The receiver RF amp must also take the brunt of signal spikes and surges that come in from the antenna. Local lightning strikes produce spikes of energy that must be absorbed by the RF amp. These spikes of energy take their toll and, as a result, the RF amp is one of the most susceptible and failure prone parts of the tuner section of a receiver. Typically, the RF amp will open up, although it can also short.

The effect of a defective RF amp may not be immediately apparent. Local stations, due to their high signal levels, will blast through a defective RF amp. The high frequencies of the FM RF signal, 80 to 100 MHz, will pass right through an open RF amp due to the capacitance in the amp and the board capacitance. The signal level of local stations is strong enough to make up for the attenuation of the bad RF amp. Weak stations, on the other hand, do not have enough signal strength to pass through the defective RF amp and still have sufficient signal strength to be processed by the rest of the tuner circuits.

Similarly, IF amps take the weak IF signals from the mixer and increase their amplitude so that the detector can properly extract the audio signal from them. A defective IF amp, though less likely to fail than an RF amp, will also allow strong signals to pass through and attenuate weak signals. In both cases, the result is that the receiver appears to work properly on local stations but rapidly degrades as the signal strength decreases.

You may be relying exclusively on over-the-air signals to check receivers brought in to you. As you can readily see, however, this method does not clearly identify tuners with RF or IF amplifier problems. Even if an RF or IF amp is bad, audio will still be heard from strong local stations. You can easily be fooled into thinking the receiver is working properly. The receiver will work for your customer but he still won't be happy with its performance.

Without a clearly identifiable and controllable signal level, it is difficult to determine if the receiver is working to its proper level. The difficulty with using off-the-air signals is that you don't know how large or small a signal you are feeding into the RF amp. In addition, many local conditions such as the weather, time of day, or even the traffic flow in the area can alter the signal strength of the over-the-air signals reaching your antenna.

Many FM generators, other than the SG80, will also lead you astray. Many generators have only roughly calibrated attenuators or they may only give you one or two RF levels. You don't know for sure what the level is with these generators. You waste time trying to determine the level or you must rig up attenuators to try to pad down the signal to check for sensitivity. Very likely, you won't waste the time and thus you may be missing a servicing opportunity.

The SG80 Lets You Quickly Identify Receivers With Defective RF And IF Amplifiers

The SG80 AM Stereo - FM Stereo Analyzer provides you with the accuracy you need to locate bad RF and IF amps. The RF level can be quickly and easily varied from a tiny 0.3 uV (0 dBf) to a whopping 250,000 uV (120 dBf). The microprocessor-controlled attenuators are factory calibrated to ensure that you get the signal level you want, the first time and every time.

The best test to check for a bad RF or IF amp is to perform a 50 dB quieting sensitivity test. This test determines the minimum RF input level that will still produce a 50 dB signal-to-noise ratio. A 50 dB signal-to-noise ratio is considered to be the minimum acceptable signal-to-noise level that will result in acceptable audio. A receiver will normally have a signal-to-noise ratio as high as 98 dB. As the level of the RF signal fed into the tuner section decreases, the resultant signal-to-noise ratio also decreases. The 50 dB quieting sensitivity test allows you to compare receiver to receiver and determine how small an RF signal the receiver can handle and still produce good audio.

In a receiver that has a bad RF or IF amp, the RF or IF signal is not sufficiently amplified. The resultant signal-to-noise ratio, for weak signals, is lower than for a normally operating receiver. The SG80 makes 50 dB quieting sensitivity tests quick and simple. Once you start using the SG80, you will find receivers with poor sensitivity that you previously would have sent back to the customer.

The SG80 Will Pay For Itself With Added Service Income

Once you start using the SG80, you will soon see how it can pay for itself. Some servicers charge a nominal charge to performance test the customer's receiver. This will add confidence in the eyes of the customer on the quality of his receiver and, therefore, the high quality of your work. Most customers will appreciate you doing this and will be willing to pay you to do it.

More importantly, the SG80 will quickly identify those receivers that are working marginally, and need your expert service talents. This will increase your service potential by bringing in additional service volume. By identifying and repairing only two receivers a week you can increase your income and pay for the SG80 in a year or less.

To get started on more profitable receiver servicing just contact Sencore by calling **1-800-SENCORE. □**

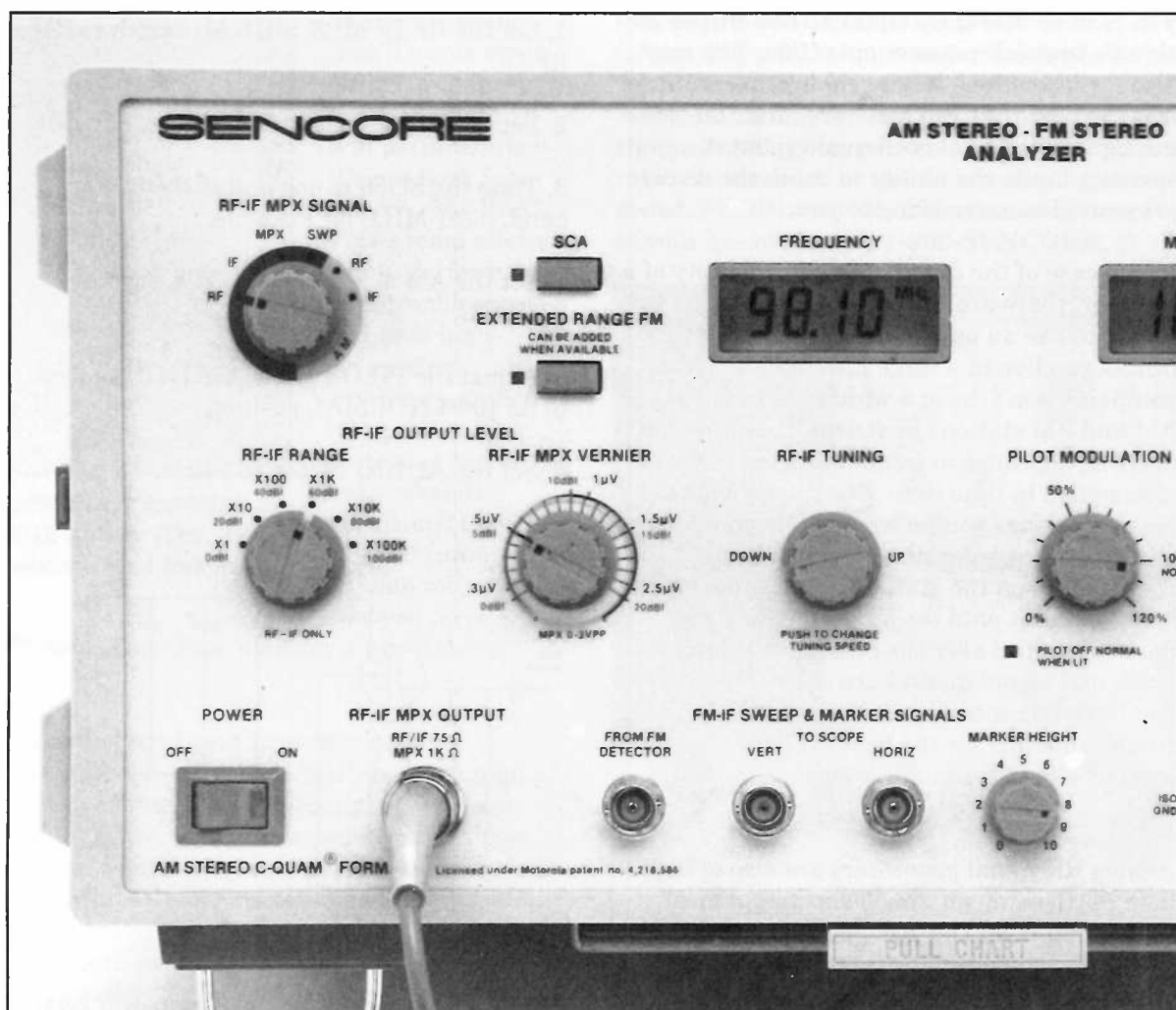


Fig. 12: The accurate attenuators on the SG80 make sensitivity tests a snap.



How To Service VCR Servos

By Greg Carey, CET

- Use your VA62A Universal Video Analyzer to substitute known good signals.
- Use your SC61 Waveform Analyzer to analyze Servo circuit performance.

It's common to spend time troubleshooting one servo loop, only to learn that the trouble is in another—you can avoid this pitfall . . .

Many technicians feel that VCR servos are tougher to troubleshoot than other circuits. A servo problem can often take so long to correct that you end up losing money on a repair. This doesn't have to be the case, however, if you have a good understanding of the circuits and an organized troubleshooting approach. Servos don't need to be more complicated than other circuits. And, servo servicing can be just as profitable as any other VCR servicing.

This article explains how to use the Sencore VA62A Universal Video Analyzer, the SC61 Waveform Analyzer, and a test tape recorded with VA62A signals to identify the source of servo troubles. The step-by-step procedures use a combination of signal tracing and signal substitution to quickly identify the bad circuits. If you need background on how servos operate, ask for a copy of Tech Tip #176, which takes you through servo circuit operation.

There are a few things to remember about servos, which can complicate your work if you're not ready for them. Servos have both

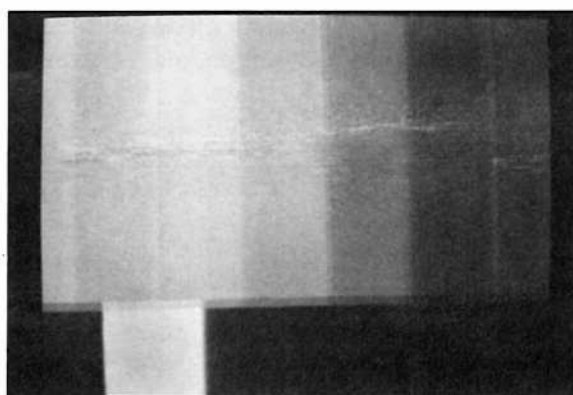


Fig. 1: Servo problems usually cause the picture to tear, or to change between clear and snowy. If the tearing remains stationary, or if the picture stays snowy all the time, the servos are not a likely cause.

electrical and mechanical components. Servos are self-correcting feedback loops. Most servos are dual-loops, and problems in either loop affect the signals in the other. There are two sets of servos, and symptoms from one may be similar to those of the other. Servo symptoms are often similar to symptoms from other circuits.

Organized Troubleshooting Methods

The main difficulty in isolating servo problems is the way several feedback loops overlap each other. It's common to spend time troubleshooting one loop, and to learn later that the trouble was really in a different loop. To avoid this, follow these steps (each is covered in detail later):

1. Confirm the symptom is really a servo problem by analyzing the symptoms with a test tape.
2. Separate problems in the capstan servo from those in the head (drum or cylinder) servo, also using the test tape.
3. Inject a control signal into the motor driver to isolate motor, motor driver, or mechanical faults.
4. Isolate the phase loop from the speed loop with a combination of signal substitution and signal tracing.
5. Narrow the problem to a particular component with signal tracing and component tests.

Probably Are Servo Related:

1. Linear (not Hi-Fi) audio is at wrong speed.
2. Linear audio is changing in pitch (warbling).
3. Picture alternates between clear and snowy at a regular rate.
4. A horizontal noise bar passes through the picture from time to time, either moving top to bottom or bottom to top.
5. Picture noisy, and tracking control has no effect

May Or May Not Be Servo Related:

1. Jitter, or noise near picture top or bottom.
2. Screen is blank, or audio is muted.
3. Tape loads, but does not play.
4. Machine begins to move tape, but then shuts down.
5. VCR plays tapes it recorded okay, but will not play tapes recorded on another machine.

Probably Not Servo Related:

1. Picture is always snowy or constantly noisy, but tracking control changes results.
2. Picture has a noise bar which remains in the same position on the screen.
3. Picture has a line running horizontally across the screen from left to right.
4. Color is intermittent (or missing) but black and white (luminance) signal is okay.
5. Picture changes in brightness as tape plays; especially on copies of tapes.

Fig. 2: Relating the general symptom to the likely causes prevent troubleshooting servo circuits when some other circuit is at fault.

Confirming Servo Symptoms

Most servo defects cause picture tearing, and may also affect the linear (non-hi-fi) audio. Some servo troubles may also blank the picture, hiding the true symptom.

Picture tearing may take several forms. Sometimes, the picture is clear for a while, gradually turns to noise, and then gradually returns to normal. In other cases, a noise bar intermittently moves through the picture, either from top to bottom or from bottom to top. In still other cases, the picture jumps up and down, or noise appears at the top or bottom of the picture.

Servo symptoms can be even more confusing when they combine with symptoms caused by problems in other circuits. Figure 2 breaks the common symptoms down to their probable causes.

Probably Are Servo Related

The following symptoms are usually caused by bad servos. Each has several variations, depending on the circuits involved and the type of failure.

Linear audio at wrong speed or changing pitch: Problems which affect the tape speed affect linear audio. These are usually caused by a bad capstan servo, and if not, they are caused by mechanical tape-transport problems affecting holdback or takeup tension.

Picture alternating between snow and clear: This symptom shows the video heads are not staying locked to the video signal recorded on the tape. The periods of snow show that the heads are 180 degrees out of phase with the signal on the tape part of the time. This symptom could be caused by either a drum or a capstan servo error. Use the audio on the test tape to tell if the capstan is at fault.

Noise bar passing through picture: This problem is similar to the previous symptom, except for the tape speed used. Since each recorded stripe of video overlaps adjacent video stripes at the slower tape speeds, the picture does not drop out completely when the heads are out of lock with the recorded signals.

Picture noisy, tracking control has no effect: A constantly noisy picture alone does not indicate a servo problem, unless adjusting the tracking control through its full range results in no change. If this happens, the servo's tracking adjust circuits are probably at fault.

May Or May Not Be Servo Related

The next group of symptoms may need more testing to confirm if they are servo related (Figure 3).

Vertical Jitter or Noise at Top or Bottom: This may show the head servos are barely locked to the video. The servo circuits may be operating marginally. If the servos are good, the tape may have been recorded on a VCR with excessive speed errors or may have been damaged. Use your known good test tape to see if the problem is machine-related.

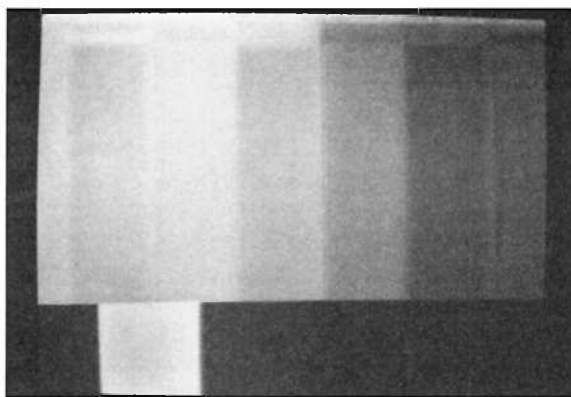


Fig. 3: Vertical jitter could be caused by servos which barely lock to the tape, or could be caused by mechanical problems like a bad holdback brake. Use your VA62A test tape to confirm the problem is not related to a damaged tape.

Screen blank or audio muted: Some VCRs mute the video or the audio when the servos are not working. However, the same muting condition happens if other circuits have a problem. For example, a system control problem may be muting the picture. Or, a video problem (caused by bad heads or problems in the luminance video circuits) could be causing a "no picture" condition, which you are confusing with muting.

Confirm the cause of a blank picture with a combination of signal injection and measurements. Inject the "Video Pattern" VA62A Drive Signal into the video circuits to see if the problem is caused by muting, or if the signal was interrupted in earlier circuits. If the picture comes through, use your VA62A and VC63 to move back toward the video heads to find the actual trouble.

Tape loads, but does not play: This could be a servo problem, or a problem in the loading or system control circuits. Some VCRs will load the tape, and then halt with the tape still in the machine, if a servo problem prevents one of the motors from turning. Use your SC61 to troubleshoot the safety sensors and system control circuits to confirm the problem's cause. See Tech Tip #159 for details on system control troubleshooting.

VCR moves tape, and then shuts down: If the servo motors are turning, but at the wrong speed, the system control circuit may shut the machine down or unload the tape to protect the tape from damage. Or, the problem may be strictly related to system-control circuits and have nothing to do with the servos.

Machine plays tapes it recorded, but not those from others: Compatibility problems are usually not related to the servos. Mechanical tape path alignment is a more common cause of compatibility problems. The exception is a speed selection defect.

Speed selection problems sometimes look like compatibility problems, because most pre-recorded tapes are recorded at the fastest speed (SP), while most customers use the slowest speed (XP or EP) when they record their own tapes. The compatibility problem is servo-related if the machine does not automatically switch to the correct tape speed during playback.

Probably Not Caused By Servo Problems

These last symptoms are often labeled as servo problems, but usually aren't unless the deck has multiple problems (Figure 4).

Picture always snowy: If the noise affects the entire screen, the most likely causes are a bad video head, a noisy video stage, or the head disk mounted backwards on the drum (causing the "A" head to follow the "B" tape track and vice versa).

Noise bar at fixed location: If a noise bar stays in a fixed location, the servos are working. The tracking control should let you change the position or the appearance of the noise, and if it doesn't you should troubleshoot the tracking circuits. Since the noise stays at the same place, you do know the problem is synchronized to the heads. Probable causes are dirt on the head drum, a bad rotary transformer, poor mechanical tape-path alignment, or a bad head selection relay.

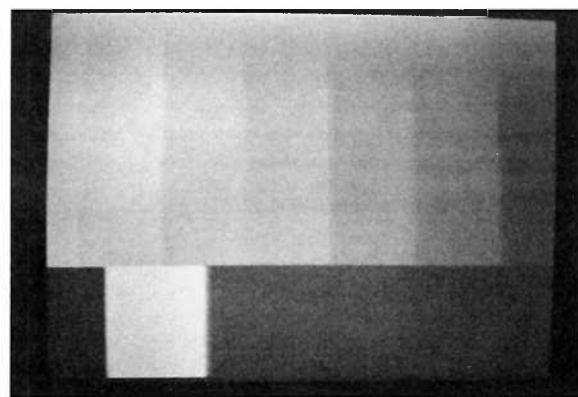


Fig. 4: If the picture remains noisy all the time, the problem is likely not in the servos. This photograph shows the symptom caused by a bad head, head amplifier, or A/B head switching IC.

Horizontal line: If you see a thin black or white line running across the screen, the tape is scratched. Check for an object in the tape path, or for a damaged tape guide or roller. Once a tape is scratched, it will always show the line, even after the problem is corrected, so correcting the problem will not eliminate the line on tapes already scratched. The problem could also be that a different deck scratched the tape before it was played in the questionable VCR (Figure 5).

Luminance okay, color affected: A good luminance (black and white) signal confirms the servos are working, even if the color is missing or intermittently flashing on the screen. Decrease the "color level" control on your TV receiver or monitor to observe the luminance signal without confusion from the color. Problems related to color are probably in the color circuits or caused by a weak color signal coming from the video heads.

Picture changing in brightness: If this only happens on copies of pre-recorded tapes, it is probably because of copy protection. The most common form of copy protection causes the brightness of copies made from the original tape to have extreme brightness fluctuation or intermittent loss of sync.

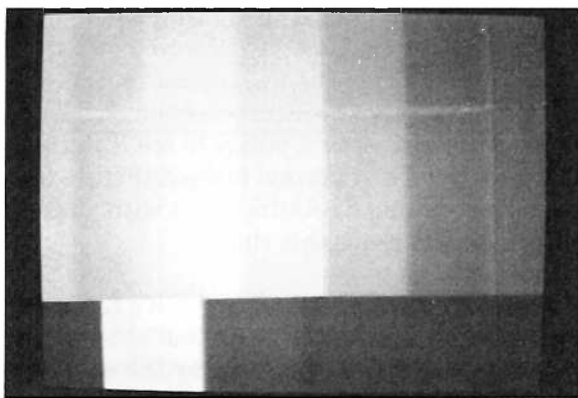


Fig. 5: A thin horizontal line at one location in the screen is not caused by a servo problem. The most likely problem is a physical scratch in the tape. If the suspect machine is scratching tapes, it will permanently place a line on every tape that passes through.

How to Separate Drum From Capstan Problems

After using symptom analysis to confirm the problem is related to the servos, the next step is separating drum problems from capstan problems. Both can cause video distortion, so use the linear audio track of your test tape to separate drum from capstan problems.

NOTE: Always use a working test tape you've recorded yourself for testing suspected servo problems. Only use the alignment tape for a final check of compatibility after repairing all problems.

If the audio plays at the wrong speed, or has speed fluctuations, the tape is moving past the audio heads incorrectly. Troubleshoot the capstan servo. If the audio plays correctly, work on the head (drum) servo.

Use test tapes recorded with a steady tone (such as supplied by the VA62A) and with voice or music at all three tape speeds to confirm the capstan circuits work for each speed. The tone lets you easily detect speed fluctuations which cause wow and flutter. Listening to voice or music, confirms if the tape is playing at a wrong (but constant) speed.

VCRs with hi-fi audio circuits need special procedures, because the hi-fi signal is recovered with heads on the same cylinder as the video heads. Before making audio servo tests, turn the hi-fi circuits off, forcing the deck to use only the conventional stationary head. You do the same thing by using a test tape recorded without a hi-fi track.

When you suspect speed compatibility problems, use a test tape with samples of each tape speed. Confirm that the servos properly choose each tape speed. If you recorded a test tape following the instructions on page 76 of the VA62A manual (or in Sencore Tech Tip #107), the first tape segment tests the speed selection circuits.

After using the symptoms to confirm a servo problem, and the test tape to separate the capstan from the head servo, you are ready to begin electrical troubleshooting. The first step will be to confirm whether the motor and its driver work correctly. This step isolates most of the problems which involve mechanical part failures, by separating the electrical driver circuits from the speed and phase feedback loops.

Testing the Motor and Motor Driver

Use the service literature to locate the DC input of the motor driver circuit. Set the VA62A troubleshooting power supply to the normal DC voltage found at the motor driver input test point. Substitute the DC and notice if the motor turns smoothly (Figure 6).

NOTE: Since you are injecting in the middle of a self-correcting system, the motor will probably not turn at the correct speed. You are only interested in whether the motor turns smoothly and that varying the DC properly controls the motor.

Vary the substituted voltage a few tenths of a volt from the normal setting, and see if the motor changes speed. You should be able to get the motor close to the right speed, and

replaced. Sometimes, the motor will turn freely, but one position has much higher mechanical resistance than the rest. A shorted winding or bad driver has probably caused one of the electromagnet pole-pieces to become permanently magnetized. The motor will have to be replaced.

NOTE: After installing a new motor, but before applying power, check all the driver circuits for a shorted driver output. If the output is shorted, it could damage the new motor.

If the motor turns freely, use the VA62A power supply to check its windings. Set the VA62A output voltage to near the motor's normal drive level, and momentarily touch the leads across each winding (Figure 7). **NOTE:** To avoid damage to the motor coils, only touch the lead for a split second. Do not leave it connected. The momentary DC pulse should cause the motor to turn part of a revolution. If

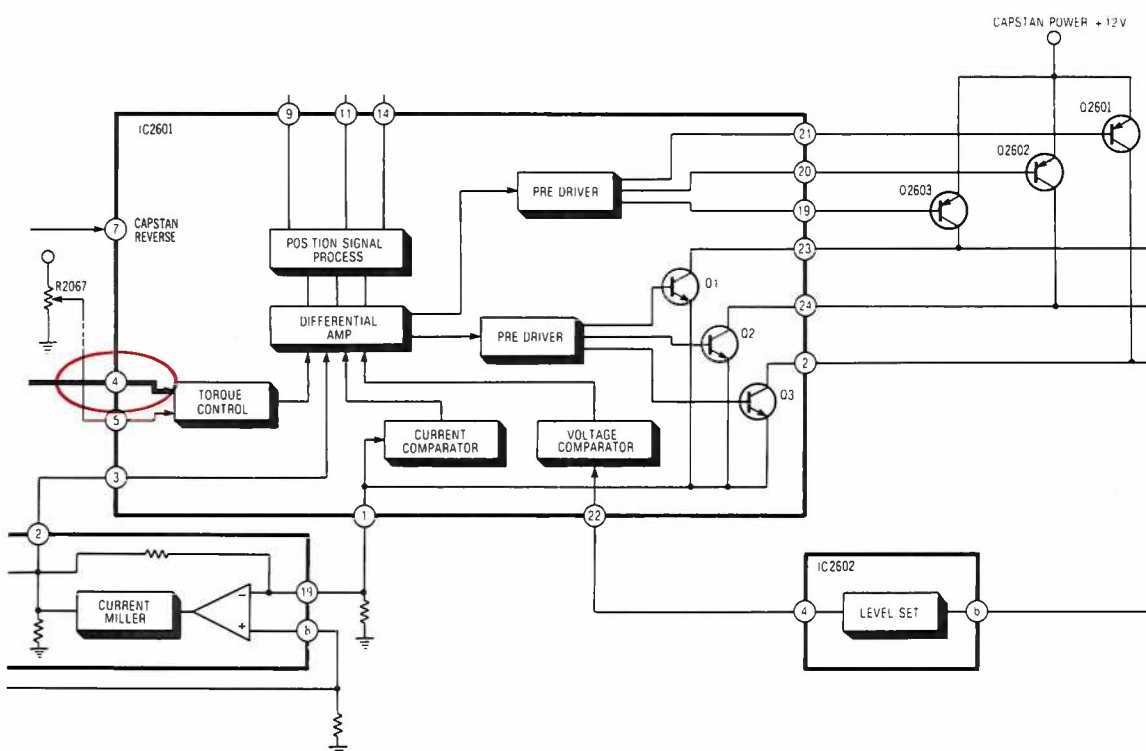


Fig. 6: Injecting substitute DC from the VA62A at the test point between the servo circuits and motor driver confirms whether the motor and its electrical driver circuits work correctly. You should be able to control the speed of the motor by varying the DC voltage.

have a wide range of speed control from nearly stopped to turning much faster than normal.

If you think the motor driver circuits are at fault, continue to feed the substitute DC voltage into the driver, while you trace the motor drive and feedback signals with your SC61. Confirm that each driving signal has the same frequency, peak-to-peak level, and DC bias by pressing the digital readout selector buttons one at a time. If one signal differs from the others, you know the motor has a shorted winding, or that the driver circuits are at fault.

Testing The Motor

If the motor fails to turn, or turns unevenly when injecting the substitute DC control voltage, your problem might be a bad motor. Check its operation with these two steps.

First, remove power and turn the motor manually to see if it turns freely. If the bearings feel rough or sticky, the motor must be



Fig. 7: You can confirm that each set of motor windings works by momentarily pulsing each with the VA62A power supply. If the motor turns part of a revolution, the coils are working.

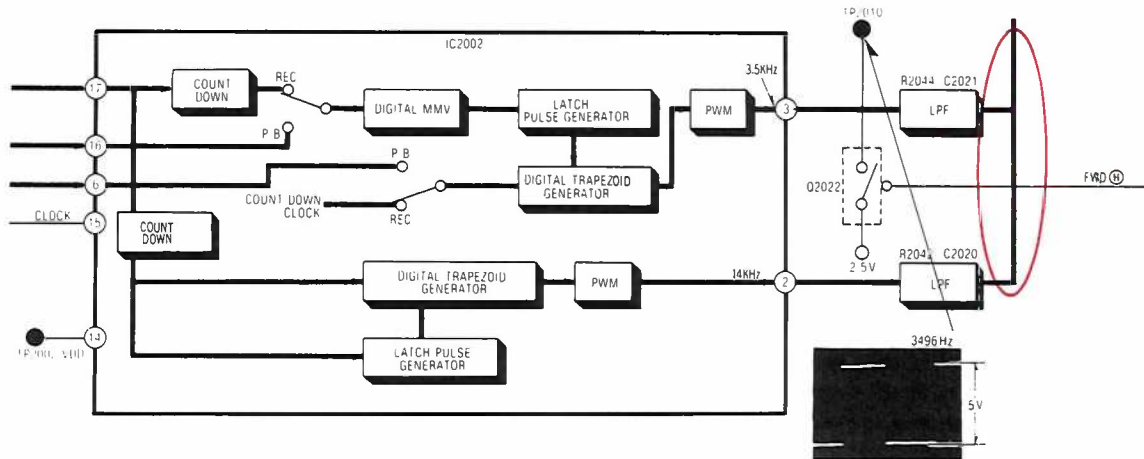


Fig. 8: The best place to begin troubleshooting is at the point where the speed and phase loops add their signal together, which happens to be the same test point used earlier to test the motor driver. Injecting DC at this point, while monitoring the response of the error detectors with the SC61, confirms whether the two correction circuits are responding to changing motor speed.

pulsing a winding does not cause movement, the motor is defective.

If the motor and its driver are working correctly, the next troubleshooting step is to separate problems in the phase loop from those in the speed loop. This halves the circuits which could be part of the trouble.

Separate Phase From Speed Loop Problems

Connect your SC61 to the output of the speed loop's error detector. Watch the error detector's response, as you vary the VA62A DC voltage controlling the motor speed (Figure 8).

The error detector should alternate between maximum and minimum correction values, as you vary the motor's speed above and below the normal speed. The variation depends on the type of error detector.

If you are testing an analog error detector, the output translates directly to a DC voltage. Press the DCV button for the SC61 channel you are using, and set the INPUT COUPLING switch to "DC" while you make the test. The

digital readout will show the actual DC value, and the CRT will show any instantaneous changes that happen as you change the motor speed.

If the speed loop's error detector does not produce a change with changing motor speed, the problem is in the speed loop. If the error detector's output changes, suspect the phase loop.

You can also substitute the VA62A's DC supply for each of the error detector outputs. Watch the rotational speed of the motor as you inject DC at one and then the other output. Monitor the error detector for the opposite loop (the phase detector, while substituting at the speed detector, and vice versa) to see if there is a change when you substitute the DC signal. If not, the loop has the defect, so use signal measurements or component tests to find the bad part.

Special Notes On Pulse Width Modulators

When troubleshooting VCRs that use pulse-width-modulators (PWMs), check for correction at the PWM output, ahead of the low-pass

filter (LPF). The PWM normally makes corrections by varying the duty cycle of the square wave when the VCR operates. Confirm normal correction by increasing the physical drag on the motor or a pulley to see if the duty cycle changes in a normal fashion (Figure 9). Lightly touching a rotating shaft with your finger should cause this change.

When connected ahead of the VCR's LPF, the SC61's digital DC voltage readout shows the average DC level represented by the square-wave, while the CRT shows the actions of the modulated pulse. Watch the digital readout and the CRT waveform for changes in the PWM signal as you make your servo tests.

When there is a servo problem, the PWM output will often be abnormally steady or vary rapidly from maximum to minimum width. The steady condition may cause a squarewave with constant duty cycle, or one at maximum or minimum width (Figure 10). Maximum width could be a narrow pulse, or a DC signal equal to the peak value PWM value. Similarly, minimum pulse width might be a narrow pulse of the opposite polarity, or a DC signal near zero.

When the PWM is changing quickly, the SC61 waveform might look like it's completely out of sync (Figure 11). This shows the PWM IC is trying to compensate for an erratic signal, or that the IC itself is defective. Use DC to try to control the circuit to test for correct IC operation.

Watch for a change (instead of an "improvement") in the signal displayed on the SC61, as you inject the various VA62A signals. This is an important distinction, because you are substituting signals into the middle of an error-correction loop. The substituted signals do not include the normal error, so it usually forces the error detector to maximum correction. When you see a change, you know that the circuits are responding to the substitute signal.

Do you have questions or need additional information? Give your Area Sales engineer a call, **1-800-SENCORE (736-2673)**. Be sure to ask for a copy of Tech Tip #176. □



Fig. 9: When the pulse width modulator normally corrects for variations in tape motion, the output shows horizontal movement. Loading a motor by lightly touching a pulley with your finger should cause the pulse width to change.



Fig. 10: Some servo problems will cause the PWM to go to maximum or minimum correction. If so, it may show pure DC, or a very narrow pulse, as shown here.

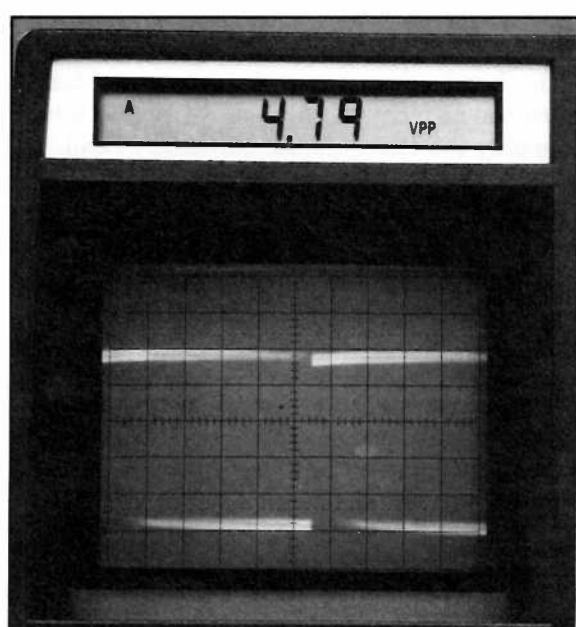
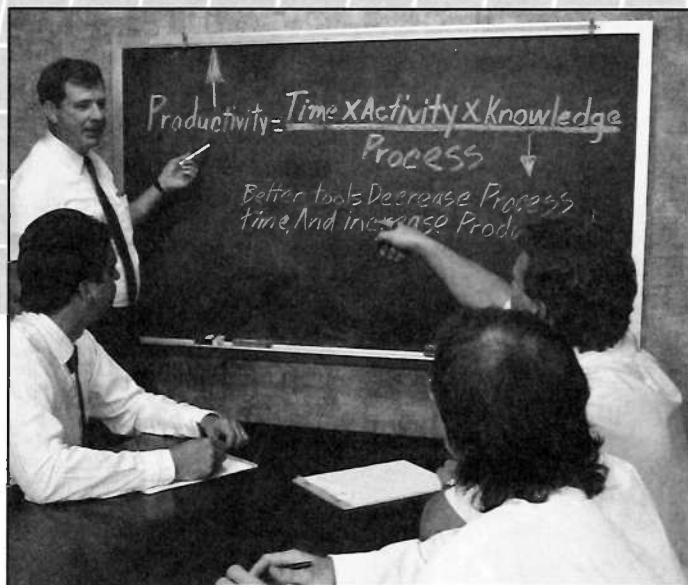


Fig. 11: Other problems may cause the PWM output to rapidly change from maximum to minimum pulse width. Injecting the VA62A signal should let you bring the correction under control, if the circuits after the injection point are working correctly.



The Components Of Productivity

by John Cummuta, president of Advanced Marketing Concepts, Inc., a broadcast management and marketing consulting firm.

As seen in Radio World, March 28, 1990

- The process is the place where you will find the greatest opportunity for productivity gains.
- The tools you use in the process will have more effect on overall productivity than any other element.

"Saving money by not buying the most effective tools for each process in the business is like saving gas money by not driving to work each day. The losses outweigh the gains."

Have you ever reached the end of a day feeling like you didn't get a thing done. You were there for eight hours, yet nothing of note was accomplished. Or, have you ever felt the same way about the people who work in your department?

Well, the measure of how much gets done — per unit of time— is called "Productivity" and increasing productivity is a good thing for managers to do. It causes your boss to smile, which causes you to continue getting paid—and that causes your creditors to smile. It can even get you a raise or promotion.

In fact, productivity is even more important than that. It's what the Japanese have been beating us at and it's what we had better improve at, or we'll need to start learning Japanese.

Easy For Engineers To Grasp

Increasing productivity should be a natural concept for engineers to grasp, because it's logical. It's a "systems" kind of problem. Let's start at the top.

Productivity (amount of work per unit of time) has four principle components: time, activity, knowledge and process. The relationships of these elements are shown as a formula in Figure 1.

You'll notice that, in general, productivity is directly proportional to time, activity and knowledge; it is inversely proportional to the process you use to accomplish whatever it is you're doing. That means that to increase productivity, we must either increase something above the division line or decrease what's below the line.

Let me use the example of baking a cake to demonstrate this relationship more clearly. You use a certain amount of time to prepare

and bake a cake, you have the activities involved, you have the knowledge necessary to either read and follow the directions or to do it from memory and you execute the process step by step.

Let's look at what's involved. First of all, there's time. Time is a constant. We can neither expand or compress it, so we might as well not worry about it. Let's concentrate on the things we can affect.

Activity And Knowledge

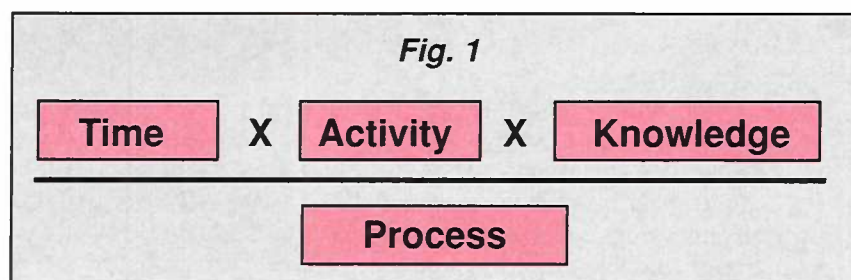
Activity is how hard you work, how fast you work and how efficiently you work. In the example of baking a cake it's how fast you mix the ingredients and put the mixture into a pan.

Obviously, if you mix twice as fast, that will increase productivity. If you doubled the muscle you put into whipping the batter, you'd increase, by some percentage, the number of cakes you could put out per day. That's why we show activity as directly proportional to productivity: more activity—more productivity.

Now, while everyone could generally be more effective in their use of time and could work a bit harder, it's usually difficult to get anyone to maintain a substantially higher level of energy. But, for short spurts, working harder is a straight-line way to get more productivity. Productivity is also directly proportional to your knowledge. The more you know about what it is you're doing, the faster and more efficiently you should be able to do it.

To go back to the cake baking example again, this would equate to your knowledge of how to

put the ingredients together and in what amounts. If you know everything by heart, you'll waste less time reading directions—and you'll just get more done. Productivity goes up.



In the reality of a high-tech world, however, a good deal of your knowledge capacity is used for just keeping up with the newest concepts. And it's usually not a great idea to do most technical tasks by heart. Using the manuals, the procedures and the specifications is the safer route to success.

But the principle still holds: the more you know, the better you are at a job. The better you are, the faster you'll get it done. The faster you get it done, the higher the productivity.

Process

That brings us to the process. The process is the way you do whatever you're doing and it's usually the place where you will find the greatest opportunity for productivity gains.

You'll notice that process is inversely proportional to productivity, and that simply means that the shorter the process the greater the productivity. So, anything you can do to reduce the process (speed it up) will increase productivity.

In order to better understand what factors control the size or time-span of the process,

we'll break the term down to its two principle component parts: steps and tools.

The steps in a process are usually fixed. In other words, if in baking our cake we first have to pour the mix in a bowl, then add two eggs, then add milk, then mix and so on, those steps cannot be eliminated without serious consequences to the outcome.

So like time, which cannot be altered, the steps in most processes cannot be removed—but they may be rearranged or sped up. Tools are usually a technician's greatest levers. You understand the concept of leverage: using minimal force to effect maximum change in the outcome. Well, the right tools give tremendous leverage in the execution of any process and therefore usually offer the greatest opportunities for dramatic productivity gains.

Let's use our cake baking example again. We acknowledged that we can't affect time, but we can work harder, meaning that we can increase our activity level.

Looking at the entire cake baking process, the mixing of the ingredients and placing them in the pan are relatively small parts of the overall time-span. We'll say that a third of the

total cake production time is actual human activity.

That means then that even if you mix twice as fast, you'll only have a one-sixth improvement in the process time. But what happens if we give you an electric mixer (a tool)? That could more than halve the mixing time—while actually requiring less work on your part.

Let's say that we gain the same one-sixth in overall process time. Now, what happens if we replace the conventional oven with a microwave? The oven is just another tool in the process, but look what it can do to overall productivity. The microwave could cut the process time in half or more.

That means that the addition of one tool could reduce process time by fifty percent. Another way to say that is that the introduction of the new tool could double productivity—again with no requirement for us to work harder.

We've seen the same results when computers are introduced into the bookkeeping or billing processes at the station: or when new, computerized test equipment is implemented. A task as simple as cutting a piece of wood can be dramatically affected by the choice of a power saw over a handsaw.

Putting It To Work

What does all this mean for you? If you're a manager, you manage people executing processes. In most cases, the productivity of those processes has a direct-line relationship with station profit. So, to increase profit you'll want to make your processes as productive as possible.

In doing so, just keep in mind the equation in Figure 1: and remember that, with few exceptions, the tools you use in the process will have more effect on overall productivity than any other element.

So, saving money by not buying the most effective tools for each process in the business is like saving gas money by not driving to work each day. The losses outweigh the gains.

For the record, this article was written on a word processor. Every process has its tools. □

John Cummuta is president of Advanced Marketing Concepts, Inc. a broadcast management and marketing consulting firm, and a regular RW columnist. He can be reached at 312/969-4400

Sencore Tech Talk

Direct Coupled Amp Failures

In an audio power amplifier, even a simple failure can take out a large number of parts—because the stages are DC coupled (to achieve good frequency response), the amplifier destroys itself as one overloaded component takes out another and so on (See Figure 1).

This is how DC coupled amplifiers self-destruct (a typical scenario): The disaster begins back at the power supply where a cold solder connection, shook by the "thump" of a deep bass note, momentarily causes a loss of the -45 VDC supply. With

the loss of B-, the bias transistor, Q8, is unable to hold the base of Q4 at the proper voltage, and it begins to raise towards B+. Within 0.10 second, the positive going voltage on the base has turned the NPN transistor, Q4, on to full saturation. Q4's conduction drives Q6 into saturation. The only factor limiting current through Q6 is R3 (.22 ohm) and the load (DC resistance of the speaker and wires—about 7 ohms). Thus, 6.14 amps ($44.3V / 7.22 \text{ ohms}$) surges through Q6. This transistor is rated to withstand 12 amps of collector current, but the resultant power of 272 watts far exceeds

the component's 100 watt power rating. Thus, Q6 goes into thermal runaway with the current and power quickly avalan- ching until the junction melts.

As soon as the base and emitter of Q6 shorts, a current path is created between B+ and ground through the saturated Q4. The current instantly exceeds Q4's power and current rating, causing it to short. The over current stress, caused by Q6 and then Q4 shorting, is too much for R3,

causing it to burn open or increase in value.

Just a second after the intermittent hits, 3 components lie in ruins, each having been destroyed by another. But the disaster is only half over.

When the B- supply is restored, a large current flows through Q5 to B+ through either the B-E short of Q4 and RL, or through a shorted E-C of Q4. This large current exceeds the power rating of Q5, destroying it and possibly destroying or damaging R2.

The positive voltage at the emitter of Q5 also biases Q7 into full saturation. Current flows through it and R4 to ground through the speaker. Like its counterpart Q6, its power rating is exceeded and the current avalanches until its junction melts down. The current may or may not destroy R4, depending upon its power rating.

This example shows how 5 and possibly 7 components in a DC coupled power amplifier can be destroyed within just a matter of seconds. Of course with an intermittent B- power supply, the amplifiers other output channel would also be destroyed.

Notice that opening the load the instant the amp became unbalanced could have prevented this massive failure ... that's what the PA81 Stereo Power Amplifier Analyzer's DC protection circuit is all about.

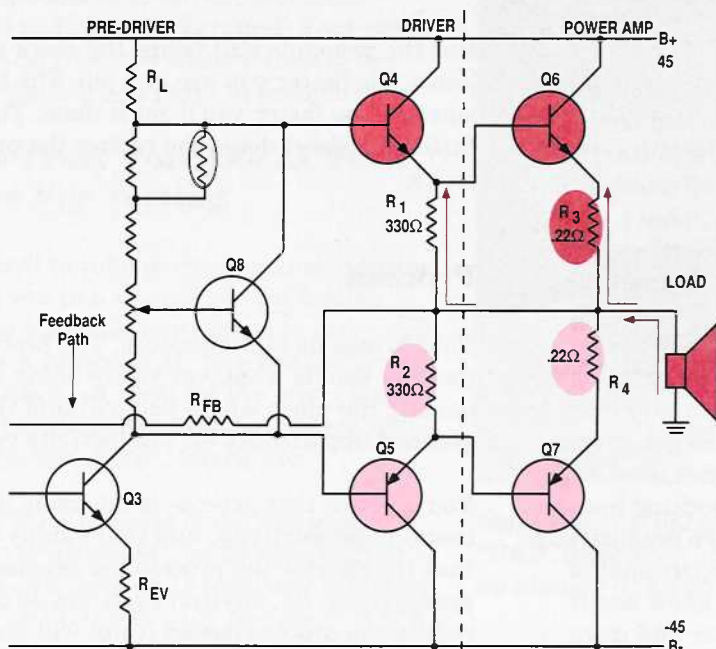
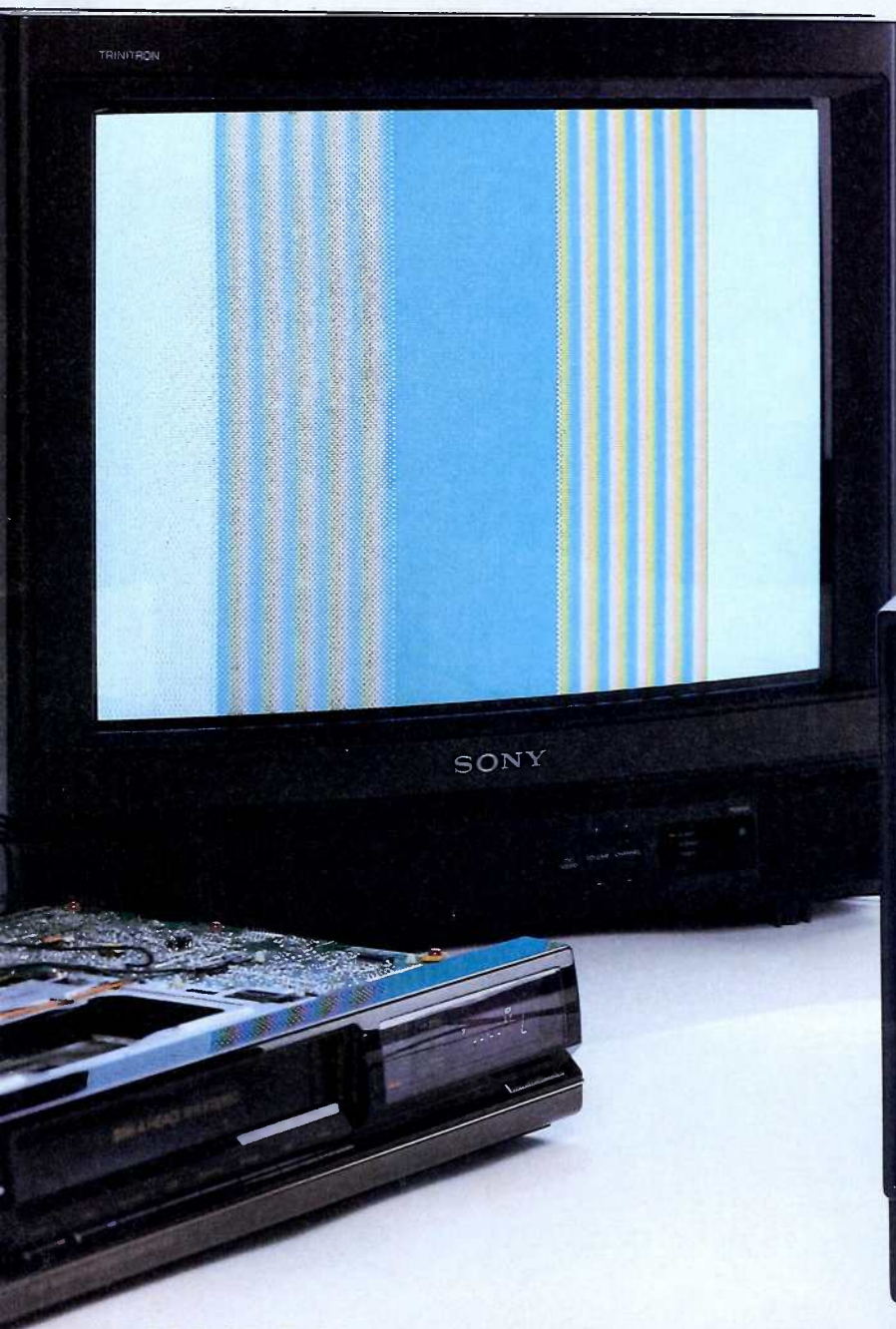


Figure 1: This audio power amplifier (simplified schematic), is typical of most amplifiers in use today. All DC supply and bias voltages must remain stable for proper operation (and to prevent self destruction).



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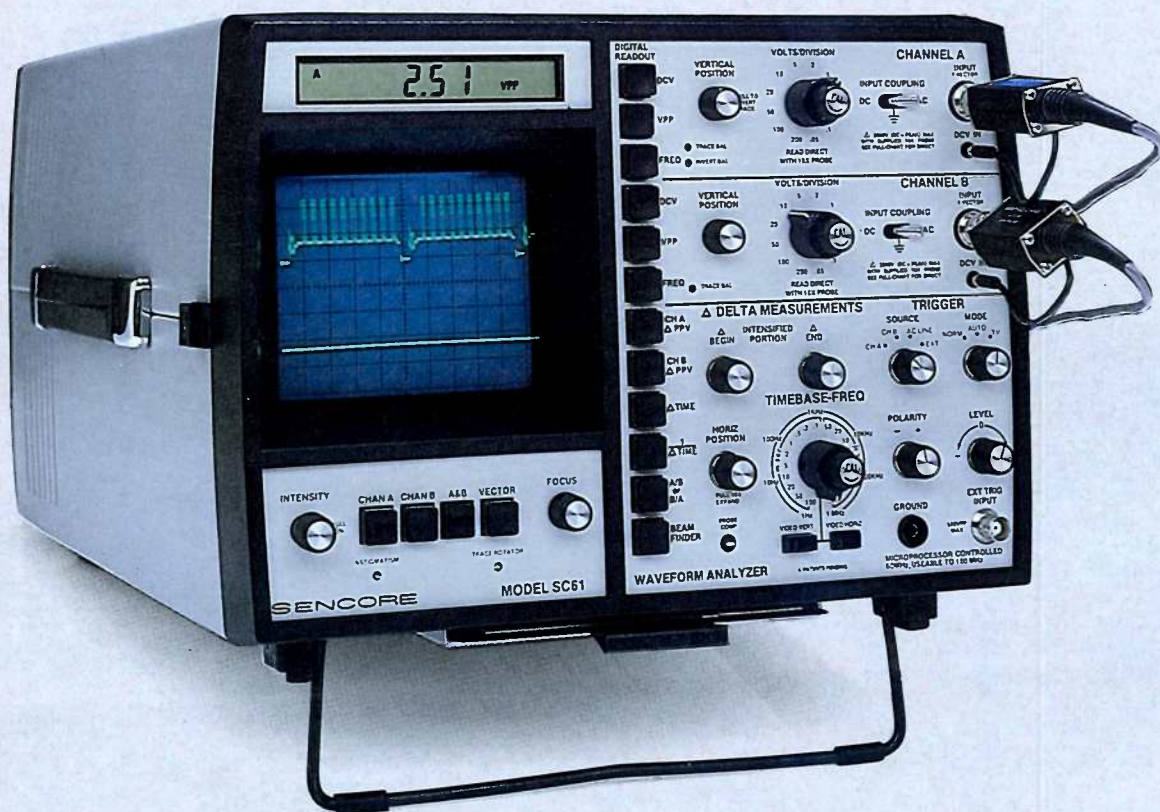


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- Updates Your VA48 Or VA62A Video Analyzer To An Integrated Multichannel Television Sound (MTS) Stereo TV Analyzing System
- Exclusive Phase-locked Generator Locks The ST65 To Your VA48 Or VA62A For Rock-Solid Analyzing
- Makes Stereo And Second Audio Program (SAP) Performance Tests On Any MTS Stereo TV System
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NT64 NTSC Pattern Generator™

Add The NTSC Full-Field And Split-Field Patterns To Your VA62A Universal Video Analyzer—Meets All Warranty Requirements



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- Produces EIA RS189 Standard Full-Field And Split-Field Color Bar Patterns
- Meets All VCR Manufacturers' Requirements For Color Bar Generator
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RG67 NTSC Video Monitor Adaptor

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



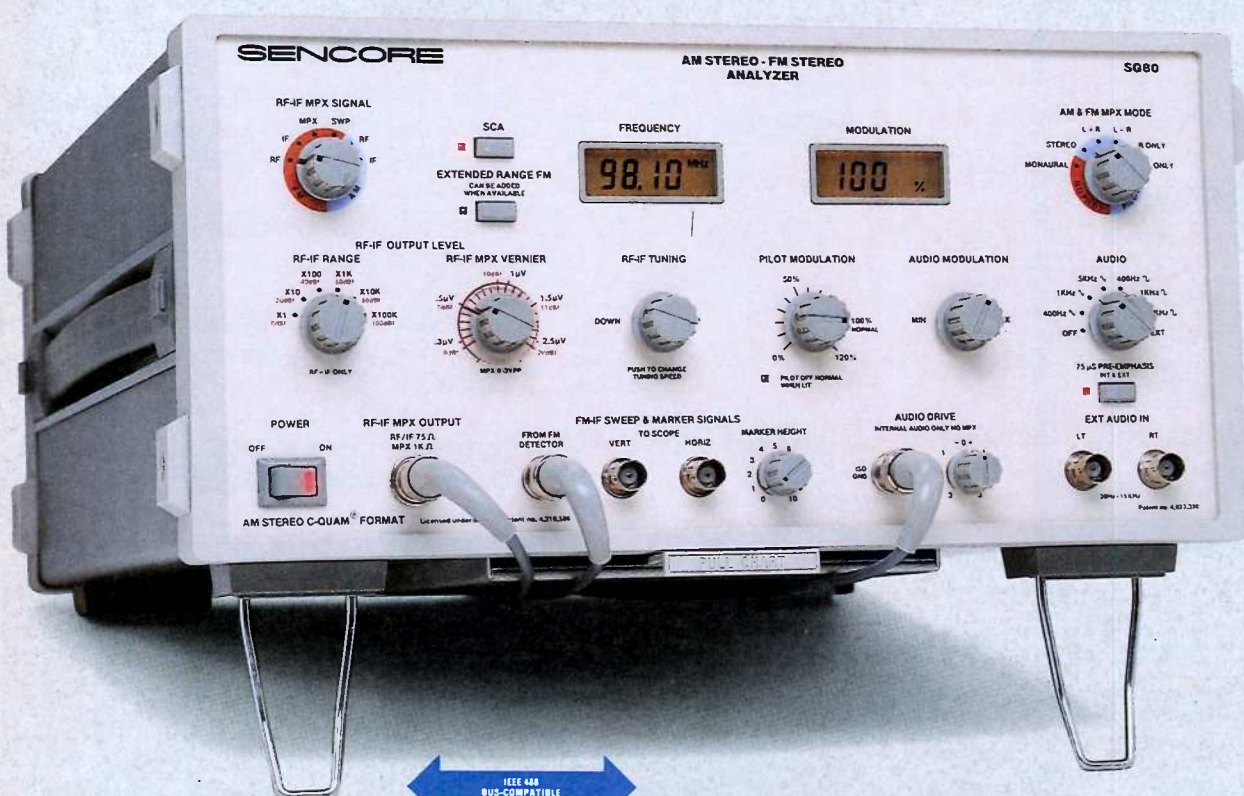
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- E-Z HOOK™ Leads For Fast Hookup To Separate R,G,B,I Inputs

SG80 AM Stereo-FM Stereo Analyzer™

New



\$3,995

**U.S. Funds
Patented**

- **Every signal you need** to troubleshoot and performance test any AM Stereo or FM Stereo receiver
- **Rock solid digital tuning** gives you fast, accurate, channel-by-channel control
- **Microprocessor calibrated attenuator** provides accurate signal levels for all your testing and troubleshooting needs
- **Patented analyzing signals** let you use the same troubleshooting techniques for both AM Stereo and FM Stereo receivers
- **Exclusive tuneable IF sweep system** allows you to dynamically analyze the latest FM IF stages
- **Isolated audio drive signal** lets you troubleshoot from the stereo decoder to the audio amplifier
- **High quality signals** give you confidence the receiver is operating at peak performance
- **Automate your testing** with optional IEEE 488 or RS-232 computer interface accessories

Pinpoint AM Stereo - FM Stereo receiver problems right from the antenna with the only fully integrated AM Stereo - FM Stereo Analyzer

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

- **Every signal you need to troubleshoot and performance test any AM Stereo or FM Stereo receiver.** You get every substitute signal needed to completely performance test (to the tightest specs) or quickly service the entire AM Stereo - FM Stereo receiver.
- **Rock solid digital tuning gives you fast, accurate, channel-by-channel control.** Digital accuracy reduces errors and speeds servicing. You get full tuning capability, wraparound tuning, and precision control for 100% confidence on every repair.
- **Microprocessor calibrated attenuator provides accurate signal levels for all your testing and troubleshooting needs.** Test receivers to manufacturers' specifications with precise and readable signal levels. The SG80 gives you microprocessor calibrated signal levels for exacting tests like sensitivity, separation, and 50 dB quieting.
- **Patented analyzing signals let you use the same troubleshooting techniques for both AM Stereo and FM Stereo receivers.** The SG80 lets you combine analyzing signals and troubleshooting techniques in one instrument. Most signals share the same knob and output jack meaning no more wasted time on lead swapping or setting controls.

- **Exclusive tuneable IF sweep system allows you to dynamically analyze the latest FM IF stages.** In just minutes, you can confidently analyze and align FM-IF stages for the proper bandwidth and shape, plus prove that you are using the correct replacement ceramic filters. Lets you pinpoint any FM-IF defect quickly and confidently.
- **Isolated audio drive signal lets you troubleshoot from the stereo decoder to the audio amplifier.** The SG80 lets you continue your dividing and conquering - even in the audio sections. You can safely inject a phase-locked audio signal anywhere after the stereo decoder to help you narrow the problem even further.
- **High quality signals give you confidence the receiver is operating at peak performance.** To keep up with today's high quality signals, Sencore had to develop an entirely new (patented) method to generate the signals necessary to quickly prove modern receiver stages good or bad. Low distortion signals and high separation levels (over 60 dB) make the SG80 your ultimate audio troubleshooting tool.
- **Automate your testing with optional IEEE 488 or RS-232 computer interface accessories.** You'll save valuable testing time by automating your receiver testing with either the IEEE 488 or RS-232 computer interface. Analyze a receiver's complete performance quickly and document the data for future use.

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

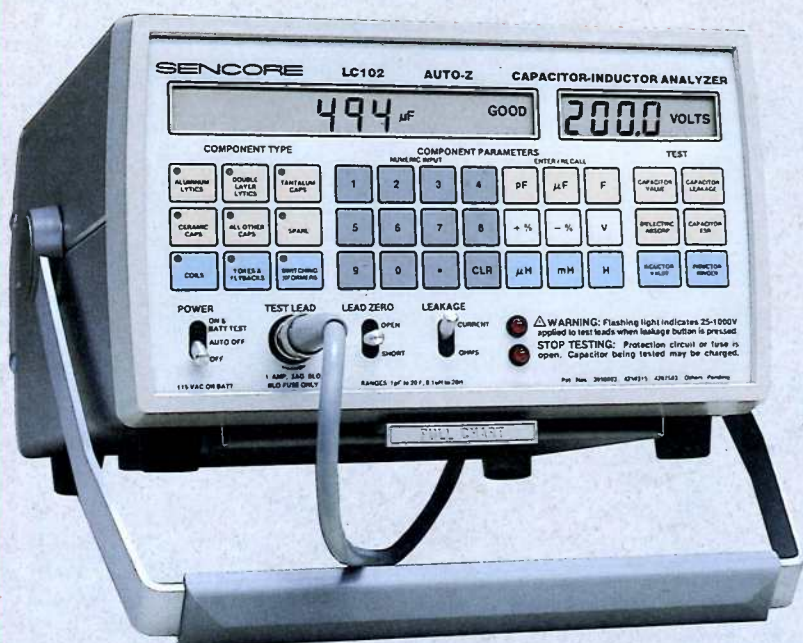
- **Fills The Missing Link In Audio Analyzing**
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- **Built-In EIA/IHF Filters And Loads**
- **Monitor Sound Quality Every Step**
- **Signal Tracer With RMS And/Or dB**
- **Automatic DC Balance Monitor For Intermittent Troubleshooting And Circuit Protection**
- **Standard Audio Line Tester**



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LC102 AUTO-Z™



RS232
Compatible

- New, Improved, Dynamic, Mistake Proof, LC Analyzer That Finds Defective Components That All Other Testers Miss

- Dynamically Tests Capacitors For: Value From 1pF to 20F Leakage With 1 kV Applied Dielectric Absorption Equivalent Series Resistance (ESR)

- Dynamically Tests Inductors From 1 uH to 20 Henrys For Opens, Shorts, Value, And Even One Shorted Turn

- Dynamically Tests SCRs, Triacs, High-Value Resistors, And Transmission Lines As An Added Bonus

- Automatically Makes All 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

- Extends Your Testing Capability To Places Where An AC Cord Won't Reach With Rechargeable 9-Hour Battery Or AC Operation



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



Call For A 10 Day
Tech Tape Preview

\$1,895

U.S. Funds—Patented (Five Patents)
On GSA Contract

LC101 Z Meter™ Capacitor-Inductor Analyzer



- Exclusive Dynamic Tests Analyze Capacitors For:

- Value
- Dielectric Absorption
- Leakage
- Equivalent Series Resistance (ESR)

- Dynamically Analyzes True Inductance Value And Effective Q (Quality) With A Patented Ringer Test

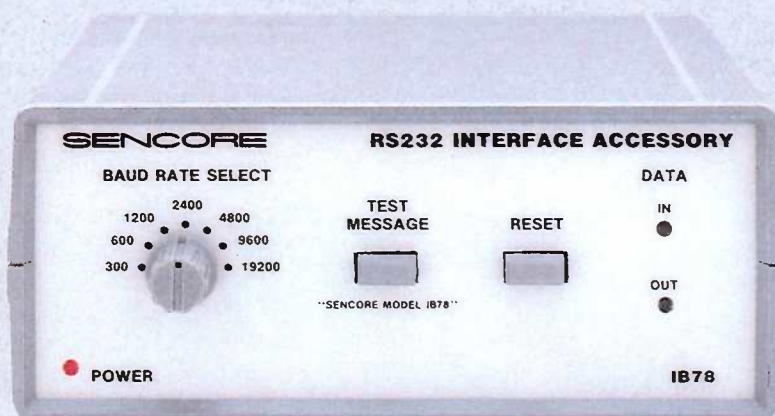
- Finds Distance To Within Feet Of Open Or Shorted Transmission Lines

- Checks Leakage As Low As One Microamp With Up To 1000 Volts Applied In Cables, Switches, PC Boards, And Connectors

\$995

U.S. Funds—Four Patents
On GSA Contract

IB78 RS232 Interface Accessory



- Adapts Your Interface-Ready Sencore Instrument To Any Personal Computer, Without Costly Modifications

- Allows You To Perform Computer-Accurate Analyzing And Storage For Permanent Records

- Lets You Modem Your Tests And Measurements, Eliminating Unnecessary Trips To Remote Locations

- Exclusive Automatic Setup And Test Message Simplifies Use With Any RS232 Compatible Computer Or Controller

- Selectable Baud Rates Along With Data, Parity, And Echo Settings Match Any RS232 Configuration

- Data Indicator Lights Inform You When Data Is Being Sent Or Received

\$395

U.S. Funds



New!

FS74A CHANNELIZER SR.™ TV-RF Signal Analyzer

New and Improved!



\$3,495

**U.S. Funds—On GSA Contract—Patented
NSN 6625-01-297-5604**



**RS232
Compatible**

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

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

Locate Problems Quickly And Accurately. Whether the problem involves abnormal signal levels, excessive hum, elusive ghosts, unwanted signal interference or some other system defect, the FS74A is guaranteed to help you pinpoint the trouble fast, accurately, and 100% automatically.

Tune All Standard Off-Air, Cable, And FM Channels Quickly And Accurately. The FS74A's microprocessor is a field strength meter exclusive. Quickly tune the FS74A to the exact carrier frequency. The LCD displays channel number and frequency offset to 10 kHz resolution. Select HRC, ICC or non-shifted cable systems with microprocessor speed and accuracy.

Bring In Weak Signals With The Best Sensitivity Available. Super sensitive, 5 microvolt (-46 dBmV) sensitivity on all frequencies means you can analyze signals all the way back to the receiving antenna. No more fiddling with attenuator inputs or undependable range switches either. The RF input to the FS74A is fully autoranged. Simply connect a cable to the input and measure signals to a full volt (+ 60 dBmV) automatically.

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

Exclusive Built-In Wide Band Monitor Makes Tough Picture Quality Checks In A Snap. The wideband monitor is an integral part of the FS74A. Just turn on the monitor and view any of the television channels in full detail on the CRT. Its full 4 MHz bandwidth helps you isolate problems that affect large-screen receivers, but will go unnoticed on portable televisions. Use the new Video Out Jack for bench testing and with other instruments for analyzing troublesome interference.

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

The FS74A CHANNELIZER SR. is guaranteed to pinpoint TV-RF trouble quickly. Call **1-800-SENCORE** for more information. Or send for a "10 Day Tech Tape Preview" on the FS74A.



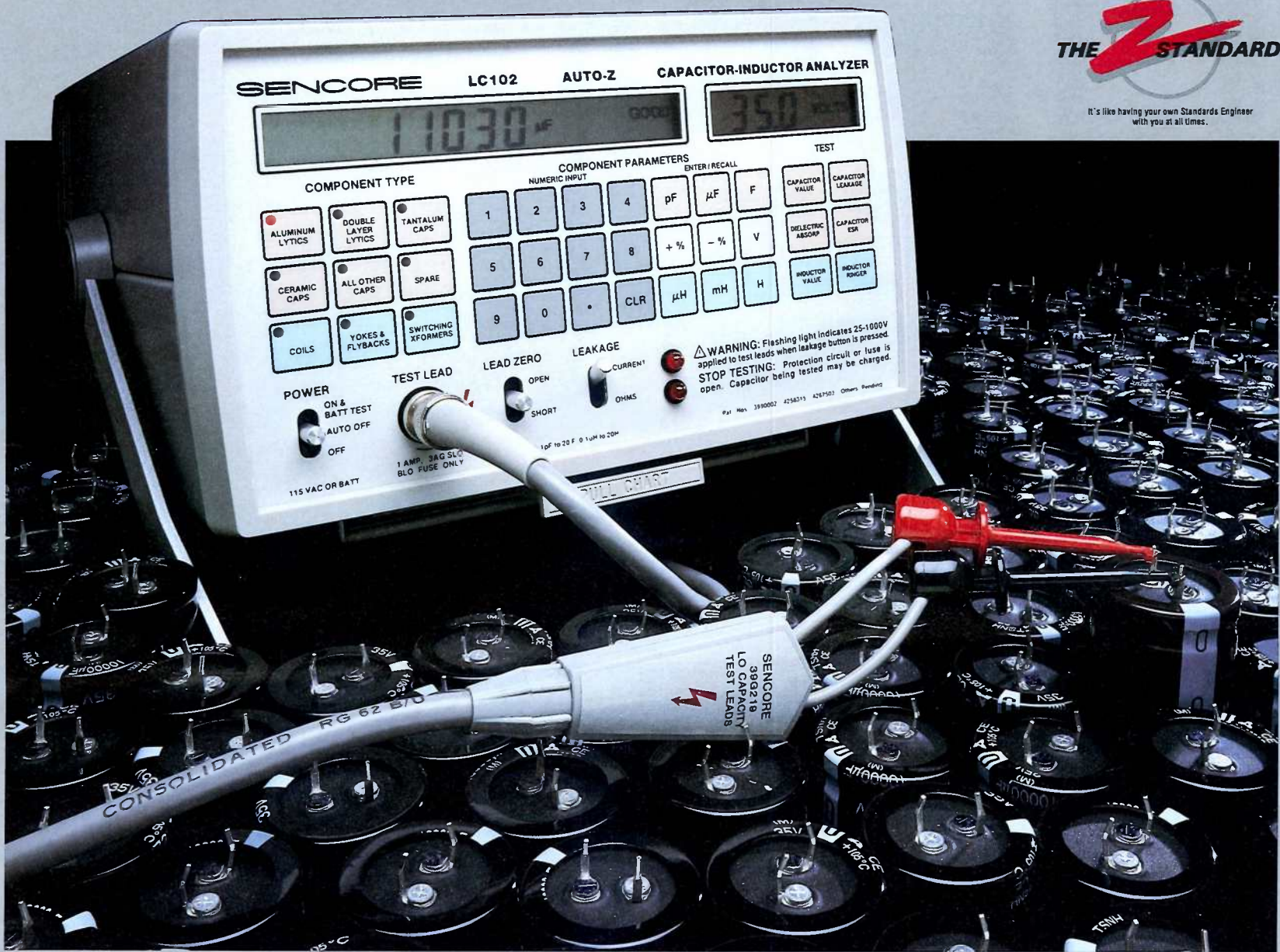
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Dynamically Find Defective Capacitors, Coils, Resistors, SCRs, And Triacs That All Other Testers Miss . . .



LC102 AUTO-Z™ Capacitor/Inductor Analyzer

\$1,895 U.S. Funds 5 Patents

Most LC and value-only testers have two things in common: they don't test capacitors and inductors completely and they're prone to interpretation and calculation errors.

The LC102 AUTO-Z changes all that.

Designed by servicers for servicers, the LC102 meets your most important component analyzing needs: **it finds bad components.** The AUTO-Z uses dynamic, yet easy-to-use tests to eliminate the guesswork and frustration that normally accompany cap/coil analyzing.

Catch all capacitor defects with the LC102's exclusive capacitor tests (with up to 1000 volts applied). Patented inductor tests find all bad coils, even coils with only one shorted turn. Tests for SCRs, triacs, transmission lines, and more make the AUTO-Z a bench standard.

Only the AUTO-Z tells you the condition of capacitors and inductors with the push of a button. The component's parameters are automatically compared with the LC102's internal memory of EIA and industry standards, and the results are displayed as GOOD or BAD.

The 100% portable AUTO-Z is mistake-proof. It's autoranged, autozeroed, and it has auto off circuitry to conserve its battery life. The AUTO-Z reliably checks components where you need it—at your side.

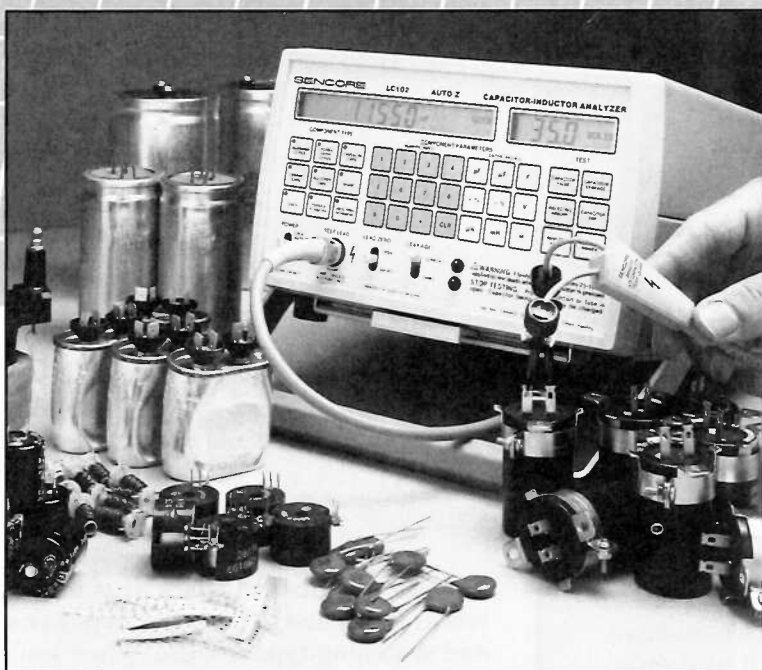
You won't find the patented and dynamic tests of the AUTO-Z anywhere else. For more information about the LC102 call 1-800-SENCORE.



LC102 AUTO-Z

- Analyzes capacitors for:
 - Value from 1 pF to 20 F
 - Leakage with 1 kV applied
 - Dielectric absorption
 - Equivalent series resistance
- Analyzes inductors from 1 uH to 20H for opens, shorts, value, and even one shorted turn
- Analyzes SCRs, triacs, hi-voltage resistors, and transmission lines
- Automatically analyzes caps and coils, and reads the results as good or bad
- Extends your testing capability with rechargeable 9-hour battery or AC operation

Call 1-800-SENCORE
(736-2673)



Increase Your Productivity With The New Bench Standard— The Z Standard

By Larry Schnabel, Marketing
Communications Writer

- You may be wasting a lot of time on problems you could solve quickly with your Z Meter.
- For the first time, anyone can tell if a component is "good" or "bad", by simply pushing a button and reading the digital display.

**The LC102 AUTO-Z helps you realize
*"there's no substitute for doing it right the first time."***

Electronic servicers have at least one thing in common when it comes to their test equipment needs. They need to be able to detect capacitor/inductor problems quickly and accurately with little or no chance of error. Without the proper equipment, testing capacitors and inductors can be a frustrating experience.

Since capacitors and inductors have such universal use, they are an integral part of almost every technician's life. The difference between a fast repair and a troublesome unit can be an inductor with a single shorted turn or a leaky capacitor. If your test equipment can't find these types of defects, you may be wasting a lot of time on problems you shouldn't be.

Since capacitor and inductor problems cannot be ignored, every technician needs a method of testing these components with a high level of confidence. A reliable capacitor/inductor analyzer has found a home on today's standard test bench along with the oscilloscope and digital multimeter. Once you have the basics of your bench built, you can add more specialized instruments depending on your application. But first, you need to cover the basics.

The LC102 AUTO-Z—Technicians Rely On It Every Day

If you're setting up your shop or just adding on to your bench, we've got an essential test instrument for you! The LC102 AUTO-Z has become a piece of test equipment that today's technicians rely upon for their component testing needs. The AUTO-Z analyzes capacitors and inductors with patented and dynamic tests so you are absolutely certain of the condition of the component you are testing. The AUTO-Z uses exclusive (patented) capacitor and inductor tests, yet they're simple and mistake proof. The LC102's quick, thorough, and accurate tests help you turn capacitor/inductor challenges into speedy repair jobs. The AUTO-Z is time tested and proven on the



Fig. 1: The LC102 AUTO-Z has become standard on any bench because of its exclusive and dynamic tests.

bench and in the field to find defective components that other testers miss.

Everyday Test Equipment For Everyday Problems

Through all the new technology and modern product changes, capacitor and inductor use hasn't declined, it has actually increased. And since capacitors and inductors still fail, technicians must have everyday test equipment that they can trust to find those defects. For maximum productivity, today's servicer can't afford to be slowed down by suspect capacitors or inductors. You need to verify the component's condition quickly and either replace the part or move on to troubleshoot other parts of the circuit.

The LC102 AUTO-Z has become an instrument technicians need on almost every repair job they perform. Since capacitors and inductors are used in virtually every electronic product, the AUTO-Z is a troubleshooting asset that has become an industry standard. When you have a suspect capacitor or inductor, you need to have a quick and reliable method of testing these components. The AUTO-Z answers this challenge with fast,

error-proof, and patented tests at your fingertips—and puts it within reach on your fully equipped bench.

Good/Bad Tests Eliminate Interpretation And Costly Mistakes

Not everybody who performs capacitor and inductor testing needs to understand the tests they perform. This non-technical approach works fine until the operator is left with some interpretations or conversions to make. Tasks such as converting formulas, interpretation of scope waveforms, and shifting decimal places leaves room for human error.

The only instrument that completely analyzes the condition of capacitors and inductors is the LC102 AUTO-Z. For the first time, anyone can tell if a component is "good" or "bad" by simply pushing a button and reading the digital display. The AUTO-Z gives you a GOOD/BAD indication of the component under test so there is absolutely no doubt about its condition.

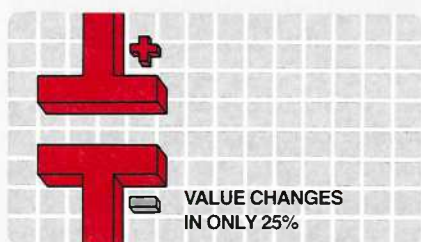
You simply enter the component's type and parameters then perform the appropriate tests. The LC102 AUTO-Z performs each test and compares the results to its internal memory of industry standards then displays the results as a simple "GOOD" or "BAD" on



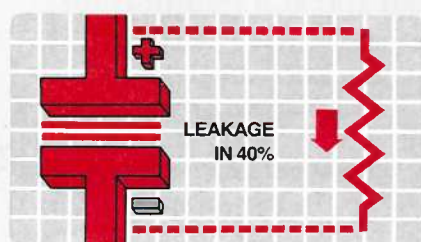
Fig. 2: The AUTO-Z helps you find the defective capacitors and inductors that other testers call good and are put back in-circuit.

How Do Capacitors Fail?

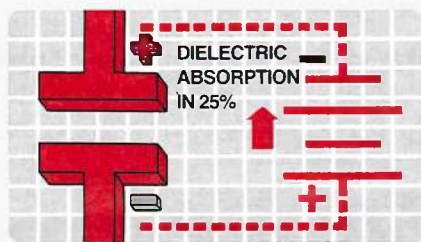
Capacitors can fail in four different ways. How do these defects affect your tests?



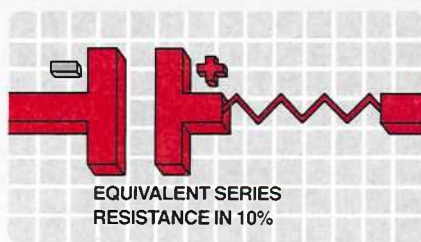
Value Change: All capacitors can change value over time, but some are more prone to change than others. Ceramic capacitors often change value 10-15% the first year as the ceramic material relaxes. Electrolytics change value from simply sitting idle as the electrolytic solution dries out. Only about 25% of all defective capacitors have a static value change, but value should be checked first to quickly eliminate this as a source of trouble.



Leakage: The most common capacitor defect representing more than 40% of all capacitor failures is leakage. Capacitor leakage is represented in-circuit by a resistance directly in parallel with the capacity. This parallel resistance effectively changes the value and will cause the circuit to malfunction. The capacitor's leakage should be tested at full potential to simulate in-circuit conditions.



Dielectric Absorption: Dielectric absorption (DA) happens mostly in electrolytics when they take on a charge but do not fully discharge during use. A residual charge often stays on the capacitor, much like a small DC battery placed internally, and changes the capacitor's effective value after the first few cycles of operation.



Equivalent Series Resistance: A resistance placed in series with a theoretically pure capacitance is called equivalent series resistance (ESR). A portion of the AC voltage is dropped across the resistance, reducing the amount of effective capacity in-circuit. This resistance has many sources (leads, plates, electrolyte, etc.), but is impossible to measure with an ohmmeter.

the alpha-numeric display. We call the LC102 the "Z Standard" because it's like having your own standards engineer with you at all times. With all the complicated electronics and standards inside the LC102, its operation is still simple on the outside so anyone can use it—regardless of technical background. Your costs for labor can be trimmed while reducing the chance of installing bad parts in good circuits.

Take The Truly Portable AUTO-Z Anywhere For Testing

It's pretty hard to take most capacitor/inductor testers with you to a remote site for testing. Many are too bulky for one person to carry and most require a source of AC line voltage for operation. That's not ideal for the many applications and locations you need to analyze capacitors, inductors, SCRs, triacs, etc.

Only the AUTO-Z lets you make component analyzing tests wherever you do your testing—including on-site tests away from any source of AC power. The LC102 is truly portable—it's lightweight, it comes with a convenient carrying handle, and it has an optional weather-proof padded carrying case. The rechargeable battery supply then gives you the power to use the AUTO-Z anywhere your testing takes you.



Fig. 3: The LC102 gives a decisive "GOOD" or "BAD" indication so any worker can use it with no chance of error.

The special switching power supply lets the AUTO-Z deliver up to 1000 volts, even under portable operation. The CMOS technology and auto-off circuitry help conserve battery life,

giving you the capability for a full day of testing between charges.

Portability gives you the flexibility to use your AUTO-Z to its fullest potential. Here are just a few places where portability can be a huge asset to your testing:

- Servicing projection and console TVs in the home
- On-site industrial machine repair
- Audio installations (auto, business, churches, etc.)
- Computer installations
- Production line work (where you move from bench to bench)
- Hospital installations and repairs

The AUTO-Z Tests These Special Components, Too!

The use of SCRs and triacs have increased in recent years due to their use in power supply and switching-type circuits. When you run across a suspect SCR or triac, however, you really don't need an engineering tool or diagnostic device to test the part. You just need to know if it's good or bad.

Along with the optional SCR250 SCR & Triac Test Accessory, the LC102 AUTO-Z tests SCRs and triacs for turn-on capability and leakage defects. The SCR250 provides the turn-on signal while the AUTO-Z supplies the leakage voltage up to 1000 volts. The AUTO-Z dynamically analyzes these components under in-circuit conditions so you don't miss a single defect or intermittent.



Fig. 4: Take the LC102 AUTO-Z wherever your troubleshooting takes you. It's cordless, lightweight, and analyzes all day without recharging.

Make Your Bench Complete—Add The LC102 AUTO-Z!

You'll be surprised how much you'll rely on the LC102 AUTO-Z for everyday testing duties. Your bench won't be the same—and you'll be more productive for it!

Put the LC102 to the test. Try it on your bench under your applications. Just call **1-800-SENCORE** and talk to your Area Sales Representative. He'll help put an AUTO-Z on your bench so you can start analyzing your component problems more effectively. □



The CR70 "BEAM BUILDER" — The Safest Way To Test And Restore Big Screen CRTs!

It's the rare technician that hasn't invested time and parts into a tough TV trouble only to find the picture tube bad. That's why most servicers test the CRT before repairing the set—quite often they find the CRT is the only thing wrong. Besides, it only takes a couple of minutes to completely analyze any CRT, from the smallest B&W to the largest color. But now, instead of wasting time troubleshooting CRT symptoms, you can add profits — 1) by eliminating the needless troubleshooting. 2) by restoring the CRT on the spot. 3) by being equipped to test every CRT on the market and restore a high percentage of the bad ones.

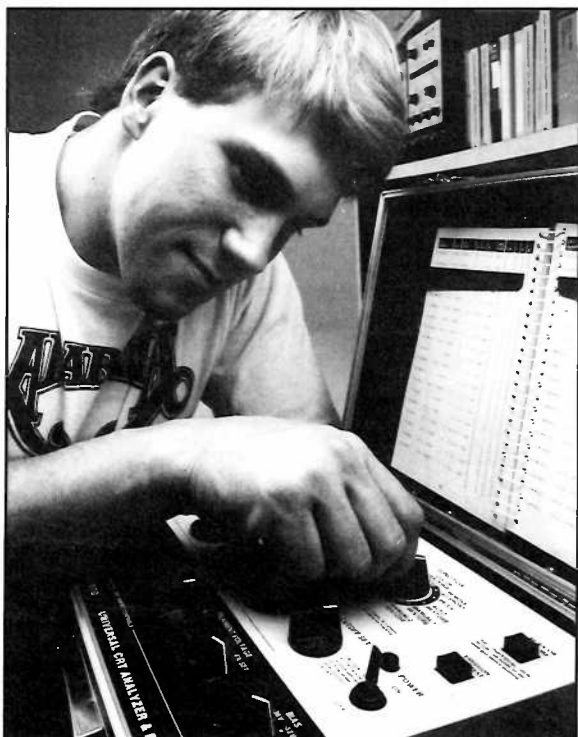


Fig. 1: The first six positions of the CR70 "Function" switch provide dynamic tests of the CRT gun.

Your CR70 "BEAMBUILDER" is designed to do just that. You can test more than 6000 CRTs (any CRT ever made, now and in the future), plus restore 90% of them, guaranteed. You'll never be caught short in CRT analyzing with your CR70. Let's take a closer look.

Your CR70 "BEAMBUILDER" and its progressive restoration, quickly corrects common CRT troubles. Dynamic tests positively determine the condition of the electron guns—if the CRT tests GOOD on each test (including the COLOR TRACKING test for color CRTs), it does not have a gun related failure. However, a BAD indication calls for restoration.

Use The Test Results To Determine Which Restoration To Use!

The CR70 provides five different levels of restoration and shorts removal to match the CRT gun failure. Use Table 1 as a guide to match the test result to the type of CR70 restoration to use on the CRT.

Progressive Restoration is The Safest Method Available!

The CR70 provides 5 levels of progressive restoration: • Remove G1 shorts, • Auto Restore, • Manual 1 Restore, • Manual 2 Restore, and • Rejuv. While over restoration can damage a CRT, progressive restoration will guarantee longer and greater customer satisfaction.

Remove G1 short: This function removes flakes of contamination that become lodged between G1 and cathode, or between G1 and G2. When REMOVE G1 SHORT is selected, the cathode and G1 are connected together inside the unit. The filament voltage is removed, and a capacitor which has been charged to 450 VDC is applied between G1 and K/G1 Fil. The capacitor discharges through the short, vaporizing it. This capacitive discharge technique is very effective in removing shorts, and will not damage the CRT since when the short is gone, the current stops.

Auto, Manual 1, and Manual 2, are similar in their operation and effect on the cathode. Restoration "boils" off the cathode contamination and allows fresh emitting material to be exposed on the cathode's surface. Auto, Manual 1, and Manual 2 differ only in the intensity of the restoring current.

Auto Restore: The least intense. The restore current is limited to 100 mA, and is cycled on and off 3 times. The cathode is heated to the point where restoration can occur, while keeping it from overheating. Auto restore is sufficient to restore most cathode-related problems.

Manual 1 Restore: The next highest level for use on CRTs which are not adequately restored by Auto Restore. Restore current is again limited to 100 mA, but the current is allowed to flow longer (as long as the REJUV OR RESTORE button is held in) to further heat the cathode's surface.

Manual 2 Restore: The highest level of restoration. This "last resort" level is used when several attempts of lower restoration fail to return the tube to acceptable performance. Like Manual 1, the restoring current flows as

long as the REJUV OR RESTORE button is held down, but the current is limited to a much higher level of 150 mA. This superheats the cathode to remove the contamination, but it can very quickly strip the cathode of all its emitting material.

In all three restoration functions, the filament voltage is increased and a positive voltage is applied to G1. The positive voltage on G1 pulls a much larger than normal amount of electrons through the cathode and brings fresh emitting material to the surface. (Normal beam current is approximately 300 uA, compared to as much as 150 mA of restore current).

As the cathode begins to restore, the current indicated on the CR70 meter will increase. If the cathode is totally encrusted, or stripped of emitting material, no current will flow when the restore button is depressed.

Rejuv: The rejuvenate function is used when the CRT cathode is so totally encrusted that no restore current can be drawn by the other restore functions. In the REJUV function, a charged capacitor is connected between the cathode and G1, similar to the REMOVE G1 SHORTS function. However, in REJUV the filament voltage is left on. This means the electrons under the cathode "crust" are active and want to be liberated. When the sudden positive voltage from the capacitor is applied to G1, they break free, cracking the layer of contamination. This allows normal Auto restoration to take place.

NOTE: Restoration will not damage the CRT if it is used properly. But remember, restoration is a subtractive process. Over-restoring a marginal tube (by using repeated Auto Restore on a tube having bad cutoff and good emission, or by using higher levels of restoration than shown in the table) may degrade the tubes performance or further damage it. Never "clean" a gun that tests good. The CR70 tests are dynamic, and if tube tests good on ALL tests it will provide acceptable performance.

Do you have questions or need additional information on CRT testing? Give us a call today, 1-800-SENCORE, you'll be glad you called. □

Test Results				
Cutoff	Emission	Life	Tracking	RESTORATION PROCEDURE
good	bad			Auto Cycle, then MAN 1 if still weak.
bad	good			Auto Cycle once.
bad	bad			Auto Cycle. REJUV if no restore current.
good	good	bad		Auto Cycle once.
good	good	good	bad	Auto Cycle lowest gun(s).

Table 1: Use the CR70 test results to determine which restoration procedure to use.

Why Aren't You Doing The Safety Leakage Test?

What Is The Leakage Test?

The leakage test assures that the TV set or other electronic device being returned to the customer does not have exposed metal parts that could give the customer an electrical shock.

Virtually all service literature lists a safety leakage test. This safety check applies to all consumer units connected to the AC line, but it is most important when the device has a hot chassis (does not have an isolation transformer).

- A Broken Safety Ground
- Using Long Metal Screws
- Adding An Earphone
- Foreign Objects
- Connecting An External Speaker

The list could go on and on. The key is that there is a shock hazard any time a person can come in contact with a hot chassis.

The PR57 Leakage Test: It's Fast And Simple!



Fig. 1: To make a safety leakage test with your PR57, simply plug the chassis into the POWERITE® and touch the probe to all exposed metal surfaces.

The PR57 simplifies the safety leakage test because all circuits are internally referenced to the isolated output of the PR57. First, the PR57 allows the leakage test to be made while the unit under test is still connected to the isolated output. Other procedures require a direct connection to the AC line.

The PR57 leakage test does not require earth ground reference because all the current paths are referenced back to the secondary of the isolation transformer. This allows you to make the test anywhere, including in a home that is not wired with grounded outlets.

The Safety Leakage Probe has a switch which places a current-limiting resistor in series with the test circuit. This resistor limits the amount of current when a test point with high leakage is contacted. This condition occurs when the point being tested is connected directly to either side of the AC line.

Any test point that reads close to full scale (800 uA) with the button in the "out" position is connected directly to one side of the AC line. If, for example, the meter reads full scale when the LO SIDE button is depressed, there is a direct connection to the common side of the AC line.

Leakage readings which are less than full scale indicate that there is a leakage path (but not a dead short) to the point being tested. Simply press the button on the Safety Leakage Probe to read the actual leakage current present.

How Much Leakage Is Bad?

Figure 4 shows the effect of electrical shock on the human body. You may be surprised to learn that the most likely range of fatal current is between 30 and 250 mA. This is the area where the breathing and heart are most severely affected. The chart is based on a person weighing 150 pounds. Smaller people, especially children, are much more susceptible to shocks at lower current levels. Underwriter Laboratories has established

guidelines for safe leakage currents. The maximum UL allowable limit (since 1972) is 500 microamps. Consumer electronic devices manufactured before 1972 were allowed 750 microamps. The leakage test on the PR57 is calibrated directly in microamps to compare with the appropriate standard.

Measuring Leakage At Lower Levels.

Some equipment must be kept at a leakage current which is considerably less than consumer products. For example, clinic and hospital equipment must have less than 100 or even 10 microamps.

This requires more resolution than provided by the PR57 meter. Simply place an AC current meter (such as the Sencore DVM37 or DVM56A) in series with the Safety Leakage Probe. This allows you to measure the leakage within 0.1 microamps with digital accuracy. □

Why Should You Perform The Leakage Test?

Even though you may find leakage on only one chassis out of a hundred, that's the very reason you need to safety test every chassis that leaves your shop. It only takes one leaky chassis to put you out of commission so you are unable to work, to damage your expensive test instruments and put them out of service, or, to zap a customer and bring on a lawsuit. It only takes one unsafe chassis before you realize that it costs you more *not* to make the leakage test on every chassis that goes out the door.

You can even add an extra charge for performing the leakage test. Your customers won't mind paying if it means added safety for themselves and their family.

What Causes Leakage?

Any path that will place the customer into either direct or indirect contact with the AC line is dangerous. There are many different ways in which this can happen. The most common causes of leakage are as follows:

- Shorted Antenna Bypass Capacitors
- Improperly Installed Tuner
- Conductive Knobs
- Defective Isolation Transformers
- AC Bypass Capacitors
- Bent Rabbit Ears
- Improper Installation Of Parts
- Foreign Objects Touching The AC Line

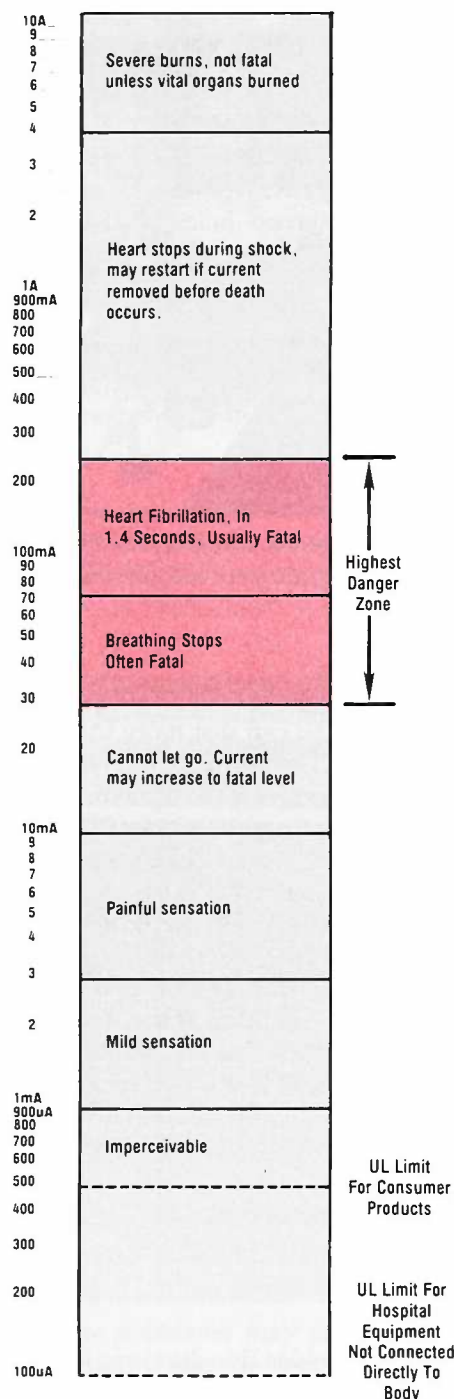


Fig. 2: The effects of electrical shock on a human being.

Customer Support



Pat Mohs, VA62A Service Technician

Why Sencore Factory Service?

by Bob Van Kirk, Service Manager

- Exclusive Loaner Instrument Program
- 100% Made Right Lifetime Guarantee
- 72-hour turnaround on service repairs
- 48-hour turnaround on parts



Every now and then a potential Sencore customer will contact me and ask this question, "How can Sencore factory service help me more than another brand or local instrument repair center?" I enjoy this question because it allows me to boast a little about what we have to offer. Since you may be considering more Sencore instruments, or just need to be reminded about service benefits, I want to share the reasons why Sencore customers can rely on Factory Service.

Loaner Instruments

By calling the Service Department you can arrange to have an instrument to use. These loaner instruments are available to you, for a small fee, while you have yours serviced. However, if you are a member of the Sencore Key Customer Club, there is no loaner fees other than shipping. Call your Sencore Sales Engineer for more details on how you can qualify for a Key Customer Club membership. Sorry, loaner availability is limited to those instruments listed in our current catalog.

Three-Day Turnaround

Over eighty percent of the instruments returned to the factory are repaired within 72 hours. During the 72 hours, your instrument is renovated, repaired, recalibrated, aged and tested. What is even more unbelievable is the fact that we don't charge you extra for the quick turnaround.

Toll Free Assistance

For those technicians that may want to try to service their own equipment, we offer Toll Free technical assistance. Trained service specialists troubleshoot or are prepared to help you with any service questions.

Warranty Coverage

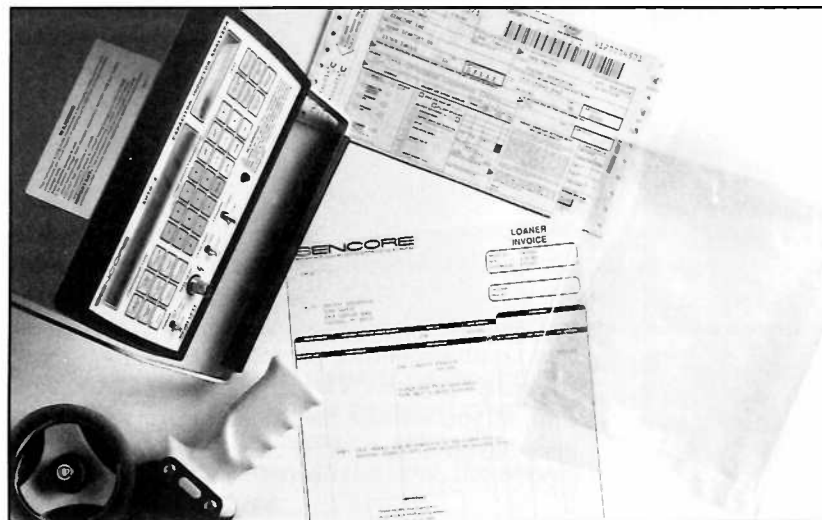
Occasionally an instrument will prematurely fail. We have a one year warranty on all new instrument purchases. This warranty means in the unlikely event of instrument failure, we will provide repairs at no charge to you.

Made Right Guarantee

As our 100% Made Right Lifetime Guarantee states, we cover all workmanship defects. This guarantee will continue to save you money throughout the lifetime of your instrument. All repair work done under this guarantee is done for free. If your instrument needs recalibration, that and shipping are all the charges you have to pay.

Product Improvements

From time to time our Engineering Staff releases notices on how we can improve the reliability or performance of our instruments. When your instrument is serviced, these improvements are installed for no additional fee. This is another benefit of our exclusive 100% Made Right Lifetime Guarantee.



Loaner instruments are available to you, for a small fee, while you have yours serviced. If you are a member of the Sencore Key Customer Club, there is no fee other than shipping.

National Institute of Standards and Technology (NIST) Traceable

We work with our factory quality department to verify NIST traceability. The Quality Department maintains a Primary Standards Lab in which a metrologist confirms the service procedures and equipment are traceable to the National Institute of Standards and Technology. All test equipment serviced is furnished a Certificate of Calibration to show traceability. Detailed incoming and outgoing test results on your instrument are available upon request.

Shipping Arrangements

If shipping facilities are not convenient for you, give us a call. We can have UPS pick your instrument up within five days. In a hurry? We can have Federal Express pick your instrument up and back to Sencore within two days. We can even have original packing materials sent to you for the return of your instrument. Then for the return trip, you have your choice of one, two or 5 day delivery. We usually ship regular UPS unless otherwise requested.

Return Authorization Not Required

Sencore's Service Department is unique among factory service centers in that we do not require return authorization. We are staffed to handle all peak periods, because when something needs servicing, it should be done at the customer's convenience, not the repairer's convenience. Simply pack the in-

strument in a box and return it to us. We do ask that you include a brief note explaining what services your instrument requires.

Genuine Replacement Parts

We use the same high-quality parts for repairs as we use in building new instruments. This means they are tested and handled with the utmost care. Genuine replacement parts availability is guaranteed for a minimum of five years after the last manufactured date of our equipment. However, we do have parts in stock for older

products, some are more than 15 years old. For do-it-yourselfers, we can even ship you parts within 48 hours from our Service Parts Department.

Centralized Service

Since we are under the same roof as our Engineering and Quality Departments, we have the opportunity to confer with them on service related issues. For example, if your test equipment doesn't operate properly in a certain application, we can work with Application Engineering to set up the same test you were performing. That way, when your instrument has left our service department, you can rest assured the problem was taken care of.

The next time you compare services, pull this article out and see if we provide the service you need. I think we will, if not, please let us know.

Service Questions

Please call Toll Free, **1-800-SENCORE**
(736-2673)

Tech Schools Teach Full Uses Of Sencore Instruments Day-Long Troubleshooting Workshops

How can you be sure you are getting full value out of your Sencore instruments? How can you decide whether investing in a new analyzer will help your business be more successful? Where can you meet other technical friends to learn how well their Sencore instruments are working for them? When can you get your hands on a unit and try it before you make a commitment to put one on your bench? How can you meet face-to-face with a Sencore Application Engineer to get answers to all your technical questions about using your test equipment correctly? Where can you get simplified explanations of some of the toughest circuits you face day after day?



information is based on Sencore's popular series of "Tech Tips" technical bulletins, so you can take the information home with you. Specially prepared Tech Tape video programs present background theory in clear, concise terms. You reinforce the learning immediately by completing pages in your own activity workbook. Then, each point is demonstrated by applying the test equipment to actual circuits containing defects typical of the products you repair each day.



All of these items and more fill each day of a Sencore Tech School troubleshooting workshop. Tech Schools are designed to teach you how to use Sencore test equipment effectively. They cover the latest circuits, give you simplified troubleshooting procedures—right from Sencore's popular Tech Tip technical bulletins, and let you see the instruments applied to real-life circuits and troubles.

What Topics Are Covered?

There are two completely different Tech Schools running. One covers video servicing, including digital tuners, VCR servos, and testing of VCR head and luminance circuits. The second program covers servicing of AM/FM stereo receivers and amplifiers. If most of your work involves TV and VCR service, the video workshop is best for you. If you specialize in audio servicing, register for the audio day. If you do both kinds of service, register for both days.

What Will I Learn?

Each day covers three main areas:
1. Understanding the circuits you are servicing,
2. Operating the special features of the Sencore instruments that apply to the circuits, and
3. Isolating any circuit problem in the fewest steps possible.

Tech Schools convey this information using all of the latest teaching methods. The

Since you are part of a limited-sized group of other servicing professionals, you also share in the opinions and experiences of others who use Sencore products.

If you still have questions at the end of the day, the Sencore Application Engineer is available to answer questions, or to help you apply the equipment in your own hands-on demonstrations.

What Do I Get?

The low Tech School fee covers your workbook binder, all literature, lunch, coffee breaks, and the program itself. You also receive a handsome certificate of achievement, suitable for framing.

Above all, you get a day packed with technical information. Information that will help you service circuits with higher effectiveness, starting the very next day. Let's see how by looking at what is covered in each workshop.

Video Troubleshooting Tech School

The video troubleshooting Tech School technical workshop provides information about the circuits that prove the most difficult to service, according to nationwide surveys. The information applies to the repair of both television receivers and video cassette recorders (VCRs).

Microprocessor Controlled Tuners

We start by looking at the microprocessor-controlled digital tuners found in most TV receivers and VCRs.

► Learn how to use tuning voltage charts, found in most service literature, to determine which channels need extra testing when confirming that the tuner properly tunes all channels.

► Discover how a three-minute tuner performance test, which you apply directly to the antenna terminals, confirms that the tuner and IF stages work correctly on all channels and under all viewing conditions.

► Find out how to test touchy automatic fine tuning (AFT) circuits, and how to re-tune them to peak performance.

VCR Luminance and Head Testing

Apply the special troubleshooting signals from the VA62A Universal Video Analyzer and its VC63 VCR Test Accessory to VCR video problems.

► Simplify troubleshooting in the tricky FM circuits with direct signal substitution.

► Separate VCR head problems from those related to rotary transformers or amplifiers.

► Combine with symptom analysis to positively separate mechanical or servo problems from those created by bad video stages.

VCR Servos

Then, we look at the circuits that cause major headaches for many video servicers—VCR servos.

► Learn how servos operate, including the reaction between speed and phase loops, and the effects of PWM error detectors. Build your own universal block diagrams and waveform notes in your activity workbook as you learn each step of servo operation.

► Practice Sencore's Really Fast Check (RFC) procedure, using the SC61 Waveform Analyzer and a test tape, which correctly identifies servo problems every time.

► Confirm the process by working as a group to narrow several difficult servo troubles down to the defective circuit in just minutes.

Audio Troubleshooting Workshop

Learn how to service the latest stereo receivers and amplifiers, whether part of a home system or an autosound system. Sencore's proven Tech School learning process takes you a step at a time to full understanding of profitable audio service.

FM Stereo/AM Stereo Receivers

Many receiver problems go unnoticed when tested with an over-the-air signal, yet your customer ends up with poor performance on some of their favorite stations. Learn how to turn these nagging troubles into profitable servicing opportunities.

► Learn how FM and AM stereo circuits should work, including "stereo blend", muting, and C-Quam AM circuits.

► Discover a 3-step performance test that identifies receiver problems, so you don't send marginal units back to your customer.

► Use signal substitution and unique test signals to isolate any receiver problem and

then return the circuits to peak performance in minutes.

Pre-amplifier and Power Amplifiers

Direct-coupled audio amplifiers provide top fidelity, when they are working, and troubleshooting challenges when they aren't. Learn how to turn the toughest amplifier problems into simple repairs for top income every time.

► Learn how direct-coupled amplifiers work and why they are so popular.

► Test amplifier performance in minutes to confirm the system is working.

► Find problems like DC unbalance, avalanching stages, crossover distortion, and improper power tracking in minutes; without backtracking or parts swapping.

Attendance Is Limited

Because of the high level of participation between the instructor and the audience, these workshops are limited to just 30 persons per day. This gives everyone a chance to get questions answered, and to work directly with the instructor.

How Do I Reserve A Seat?

Check the schedule on this page to see if there is a Tech School scheduled in your area between now and the end of October. If

there is, just pick up your phone, dial **1-800-SENCORE (1-800-736-2673)** and ask for "Tech School reservations."

If there is not a Tech School scheduled in your area now, there soon will be. Clip out the coupon at the end of this article, and mail it to Sencore. We will notify you as soon as a Tech School is scheduled.

Upcoming Tech School Locations

AL	Birmingham	Oct. 22
AR	Little Rock	Oct. 29
CA	Oakland	Sept. 24
CA	Sacramento	Oct. 8
CA	San Jose	Sept. 10
GA	Atlanta	Oct. 8
KY	Louisville	Aug. 20
LA	New Orleans	Oct. 2
NC	Raleigh	Sept. 24
NJ	Newark	Oct. 2
NJ	Paterson	Oct. 15
NY	Long Island	Oct. 29
OH	Cincinnati	Oct. 22
OR	Portland	Oct. 22
PA	Harrisburg	Sept. 3
PA	Philadelphia	Sept. 17
PA	Pittsburgh	Aug. 20
SC	Greenville	Sept. 3
TN	Memphis	Oct. 15
TX	Dallas	Aug. 20
TX	Houston	Sept. 17
TX	San Antonio	Sept. 3

Call 1-800-SENCORE to reserve a seat.

✂ *Clip and Mail Today!*

Tech School Reservation Coupon

Please notify me when Sencore schedules a Tech School in my area.

Workshop Topic

☐ Video ☐ Audio ☐ Both

Name _____

Company _____

Address _____

City _____

State _____ Zip _____

Daytime Phone _____

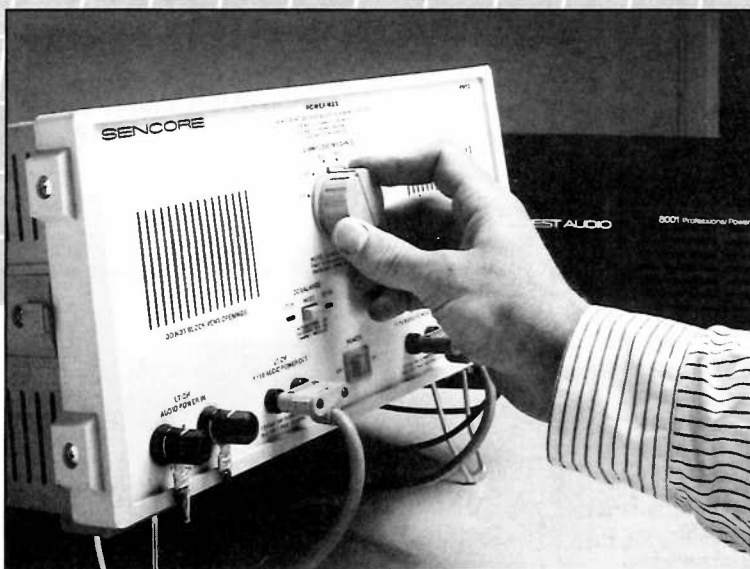
I would like to see the following topics covered: _____

I own the following Sencore instruments, which I would like covered: _____

I would like to learn more about the following Sencore instruments, which I do not own at this time: _____

Mail to:

Sencore Tech Schools
3200 Sencore Drive
Sioux Falls, SD 57107



The PM82 "POWER MAX"TM 5KW Decade Audio Power Multiplier

By Paul Nies, Applications Engineer

New!

Expand the capability and utility of your PA81 to dynamically and accurately analyze stereo audio power amplifiers to 5000 WATTS!

Not too many years ago, if someone mentioned a 500 watt amplifier you could be sure that he meant the driver or power stage of a transmitter. Not anymore. Numerous audio manufacturers market audio amps that deliver 500 watts per channel (See Table 1).

Extends PA81 Features

The PM82 is designed to be used with your PA81 Stereo Power Amplifier Analyzer. As an accessory to the PA81, it extends all of the exclusive PA81's testing and troubleshooting capabilities to high-powered audio amplifiers.

Load inputs of the PA81. Connect the output of the amplifier to the PM82 using heavy gauge leads and set the PA81 and PM82 "Dummy Load" switches to the output impedance of the amplifier. To read the actual power, set the PA81 function switch to "RMS Watts" and multiply the power reading on the PA81's meters by 10.

To measure power levels greater than 2500 watts/channel, simply connect the left and right PM82 inputs in parallel with each other, and connect the outputs to the PA81.

Protects Amplifiers From Damage

Thermal leakage in a transistor, a dirty bias pot or an intermittent solder connection can wipe out every transistor in a DC coupled power amp in a fraction of a second. To protect against such impending problems, the PM82 DC Balance circuits constantly monitor the DC voltage across both Dummy Load inputs. If at any instant the DC voltage at either input exceeds 1 volt, the Dummy Loads are opened within a split second—and stay open until you reset them.

Fully Protected Loads

The PM82 "POWER MAX" is designed to dissipate a total of 5000 watts (5 minutes on followed by a 10 minute cool down time). A fan provides proper air circulation across the loads. A thermal sensing circuit monitors each channel and disconnects the loads if the power rating is exceeded or the air circulation impeded. For detailed specifications or answers to your questions, call 1-800-SENCORE. □

Sweat Out Thermal Problems

You'll never again be left wondering how an amplifier will perform when it's put back into service. The PA81/PM82 team allows you to performance test, troubleshoot and cook high-power stereo amplifiers at their rated power. Is a transistor becoming leaky when it warms up? Does a thermal cutout activate too soon? Now you have a way

to stress test those monster amps right in your shop.

Includes All Load Impedances

A complete range of EIA/THF specified high-power, non-reactance, dummy loads allows you to test at specified impedances. For comparison to manufacturer's rated specifications on all amplifiers, new and old.

An "Open" position allows you to easily perform the testing and alignments called for by some manufacturers without needing to unwire the PM82 from the amplifier.

COMPANY	MODEL	POWER (watts)	LOAD (ohms)
Accuphase	M-1000	1800	4 (bridged)
BGW Systems	Tri-Amp	900	4
Carver	Silver Seven	900	4
Carey Audio Design	DH-1000	1000	8
Crest Audio	8001	1200	4
Crown International	Delta-Omega	1300	4
Macro-Tech	10K	1850	4
JRM Power Tower	B Pro	900	4
Sound Craftsman	Pro-Power Ten	900	4
Threshold	S/1600	1492	4
VTL	Manley	1000	8 And 4

TABLE 1: These are the highest-power audio amplifiers reported by "Audio" magazine in their 32nd Annual Equipment Directory (Oct. 1989). (Sencore makes no claim to the completeness or accuracy of this list).

Increased Power Measuring Capability

The PM82 "POWER MAX" connects in parallel with the PA81's Dummy Loads, as shown in Figure 1, and provides the proper, high-power load for the amplifier. The unique design of the PM82 absorbs 9/10 of the applied audio power, increasing the power handling capability of the PA81 from 100 watts/channel continuous 250 watts intermittent, to 1000 watts/channel continuous 2500 watts intermittent.

To use the PM82 you simply connect the "1/10 Power Out" jack of the PM82 to the Dummy

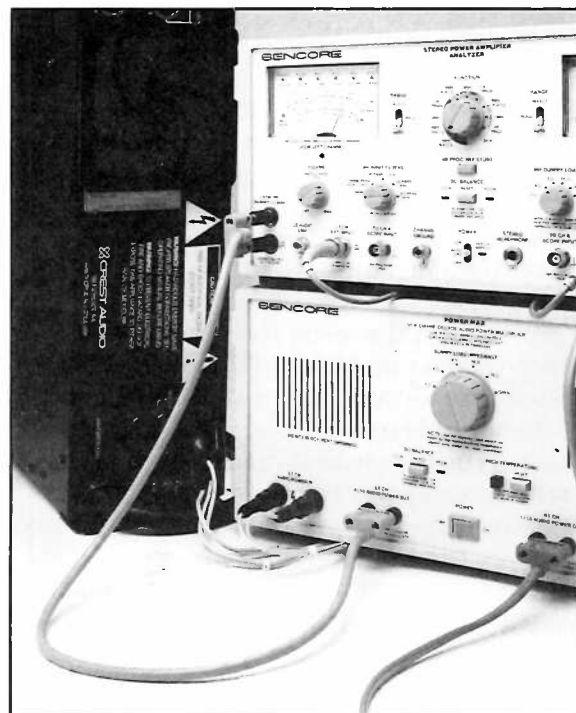


Fig. 1: The PM82 connects in parallel with the PA81 Dummy Load input and absorbs 9/10 of the applied power.



Leon Brumbaugh

Audio Techs Speak Out On The PA81 Stereo Power Amplifier Analyzer

by Paul Nies, Applications Engineer

"You've almost got to make a profit on every job you do. I've already paid for the PA81 based on the quickness of it."

Leon Brumbaugh,
Walt's Mobile TV

In this issue, we thought we'd let some of our owners/users tell how the PA81 Stereo Power Amplifier Analyzer is helping them become more effective and profitable in audio servicing.

Leon Brumbaugh, owner
Walt's Mobile TV
Las Vegas, NV

Last year, Leon's shop grossed over \$200,000 with less than a 1% recall rate. Walt's Mobile TV is at home on the VCR service bench. Leon explains why:

"People complain that their audio playback [on a VCR] is different than what they recorded it at. What we do, is take the VA62 Analyzer and inject a tone; we monitor the record level at different tone levels with the PA81 hooked up. Then we play it back and measure it again. That way, we can prove instantly to the customer that there's no problem—or, if there is a problem, we can do our alignment. Some of these Matsushita (Quasar), Magnavox, Philco, and Sylvania, have a little problem—there's no adjustment. So, there's a resistor value you have to play with. Using the PA81, we can determine the value we need."

"Now my technician, he l-i-v-e-s on that PA81. Oh, he loves it. We have two of them now. We keep one over on his (tech's) bench, which he uses on stereos, TV, and everything, and then we have a PA81 on the VCR bench."

Chuck Daniels is one of Leon's technicians. He uses the PA81 to service CDs, phonographs, and tape decks ... setting levels on VCRs, and "Just about anything audio that I can think of to do with it. It's my tool of preference," Chuck explains, "how I got along without it I'll never know."

"I use the audio line input feature a lot because we have a service contract with one of the rental companies here in town. They have the separate phonographs, and CD players and the separate audio tape decks. I do a lot of servicing on those, and the PA81 is just ideal. I can check everything without running

everybody out of the shop. We do a lot of rack system repair. We've also got one on the VCR bench that we use for setting audio levels. Just about anything audio, it's the first tool that I reach for. I just strap [connect] it up and go with it."

What Did You Do Before You Had The PA81?

"Well, what everybody else did—we used an old junk amplifier and strapped everything up and had a quagmire of wires running all over the bench with two, three sets of speakers and stuff like that. The PA81 is the greatest convenience I can think of."

"It saves me time. We work on a cart system—we have a bench setup and the test equipment stays stationary. All our work comes to us on carts. Consequently, on one end of my bench I've got this PA81 and I strap all my audio up there. If I want it to cook and heat check and all the rest, it can do that while I'm doing something else ... I've got the scope hooked up to it too, so I can watch for clipping. It's just a great aid to me."

"The main thing about that piece of equipment is that even if you're strictly a video tech like I basically am, all video techs service audio somewhere along the line. It's your right hand."

John Vildosola, owner, technician
Stereo Components
Fullerton, CA

"The part I like is that it does just about everything for us. For example, when a customer would bring in a power amplifier (mainly Orion, Pyle and those types), and on some of these amplifiers, sometimes the installers will set the gain at too-sensitive

levels. So when they turn their units on, a tremendous amount of noise is sent into the amplifier only at turn on. (Switching noises, turn on switching noises, etc.) Our problem was that we would sometimes rebuild an amplifier (replace all the transistor outputs), and we would charge the customer, and take it for granted that he had understood that we had actually repaired the unit. But sometimes the customer would come back to us and the unit would not work. It still was noisy, so now what we do is this: we have written up a procedure to install the amplifier—what to connect 1st, 2nd, 3rd so that there are no problems. Now we can show them, rather than explain to them, what the unit is doing."



John Vildosola

"We can show them the performance at lower volume. To us, that is very important. We actually have the customers connecting the amplifiers on the bench, so they convince themselves that the amplifier works. When they go to their home and do their installation, they can judge for themselves rather than blaming the problem on the store." This has eliminated about 80% of the problem."

"A function we use a lot is the audio line and the external input. It is very nice that we are able to monitor an RCA line for instance. There are times the customer will say 'the amplifier was not repaired because we have noises on one channel.' So we take the unit to the car, and we show the customer that sometimes the noise will come from the RCA terminals of the head unit rather than the amplifier itself. They convince themselves to repair the other unit next. So that's very useful to us. We like that. The unit is basically increasing our business. As long as we can get the customer satisfied, with the problem they are encountering, we are happy."

What Did You Do Before You Had The PA81?

"We went through a lot of explaining. We were spending as much as an hour with a single customer, explaining the entire system, because they really don't know. The problem is, these people were spending \$1,000, \$2,000, \$3,000 on their system and they didn't know what is what. We had to explain too many of the technicalities, and we had to procrastinate the next job. Now they can see and hear for themselves what the system is actually doing. And no one can tell them any different when they see this. That's a very powerful tool, and that's basically why we purchased the PA81."



Todd Caraway

Todd Caraway, audio tech Wright Electronics Kirkville, MO

"I use the PA81 on tape decks, receivers, amplifiers, car cassette decks and car amps. The feature that helps me the most is the fact that it detects the DC voltage. In my experience, you can have an amplifier that seems to be working fine, but after running it for two or three days, your speakers are bad. Well, as soon as your speakers go bad, if they short out, the amp has problems again."

"You may have an amplifier hooked up to the speakers and it will work fine—at least it will appear to work fine. But, a lot of times, if you've got a smaller amplifier and you're running a bigger set of speakers, that DC balance may not hurt those speakers for a long period of time. Eventually, the speakers are going to be damaged—the amp is going to be damaged because the speakers are damaged. The PA81 helps sense that."

What did you do before you had the PA81 in these situations?

"I spent a lot of time checking test points. With the PA81, I can make sure the amplifier is working to specs. We do what we call a 'Performance Test' on the piece of equipment and in turn we charge the customer \$5. Even if we have a piece that is under warranty, we push the performance test. I just talk to the customer and say, 'well this is just \$5 and it assures that your equipment is working fine. We will not warranty a piece of equipment that we have worked on unless it has had a performance test. That way, it kind of kills a couple of birds with the same stone; it's an extra \$5 for the equipment and everything gets tested so we know it is working. We have very few returns here."

"I've never had an unfavorable reaction to the performance test. Not even on the phone; not even somebody that has had a piece of equipment in here and had an expensive repair and had to fight with themselves on whether or not they were going to put the money into that piece of equipment. They would rather pay an extra \$5 and have the performance test done than to miss something."

Gill Foley, owner Dunn-Rite TV Glendale, AZ

Gill does video and audio servicing. His shop does authorized service on Technics, Panasonic, Quasar, and RCA high-end Dimensia.

"One thing that I will do once in a while, is if I get a VCR in, and somebody has messed with the audio head or control track head, I will hook it up and use the RMS volts—hook up the left and right audio output to the PA81 and roughly adjust the head until I get the highest indication and both meters reading equal."

"On a stereo VCR, you've got to be critical to get both left and right separation, plus you've



Gill Foley

got to be critical for the control tracks. I just had one last week where somebody fiddled with the head. Well, it was quicker to hook up the PA81, look at the needles, and set the left and right for maximum."

"DC balance is a big feature for me; when I want to check at full power output, I just run a couple of leads up to the scope."

"There was an amp that, believe it or not, had a leaky transistor and if you ran the volume control up and down too fast, it would trip the DC balance on one side. It would still play ok ... if you moved the volume control very slowly up and down, she wouldn't trip. I went back in and found a transistor that was leaking and changed it. Then I realized that the amp had a decent output, but just a little DC sneaking down there. I would have never caught that. It would have taken out the speakers or the outputs."

"The PA81 is priced right. Just look around at what you are buying today. Test equipment is expensive! You have to look at it this way: you go out and buy your load resistors, buy your dB meters and all the rest of it, and put the amplifier in, and the filters, and then add it up..."

Loren Bennet, service tech Dunn-Rite TV

"The PA81 does one thing that I think is really impressive—it cuts down the cost of outputs. You know that if you replace everything and don't variac it up, there are moments when your amp is just going to go ahead and smoke again. But, with the PA81, it disconnects the outputs so fast that I save the outputs ... that's one thing that I really appreciate."



Loren Bennet

"I finally got it down to where I use the PA81 as a total substitution on my bench for everything from repairing CDs, to the amps... everything. I use it as an amp substitute and I just leave my scope hooked up to it constantly. It's very useful. Plus, it's neat and portable. I can run out to a bare counter with the PA81 and let the customer check out his unit and make sure that it is working."

"Those filters are real useful for CD applications, to remove that 44 kHz clock noise. On some of the old stuff, the clock noises bleed through on the D to A and there is no way to sample that out. But with those filters on the PA81, you can sample that right out of there. The PA81 gets rid of those clock noises like a champ." □

Completely Analyze And Troubleshoot Audio Power Amplifiers To 5,000 Watts And EIA/IHF Requirements, While Preventing Costly Component Damage!*

Exclusive Amplifier Analyzing Team!

PA81 Stereo Power Amplifier Analyzer™

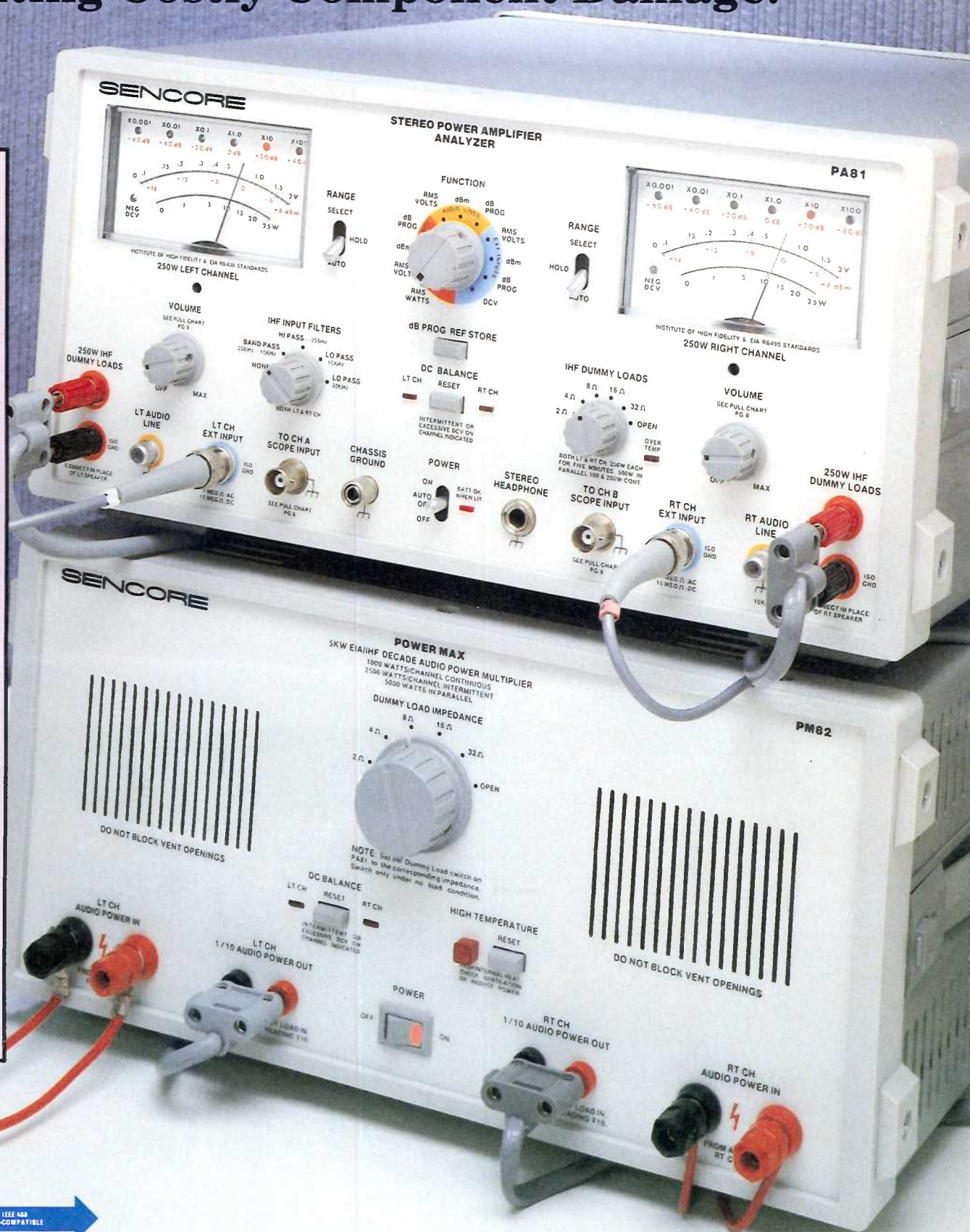
- Twin frequency compensated autoranged wattmeters
- Built-in EIA/IHF components:
 - 2,4,8,16,32 ohm-zero reactance loads
 - All specified bandpass audio filters
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- * • Built-in DC balance test protects outputs
- Audio line level tester
- Monitor stereo separation to 126 dB

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PM82 POWER MAX EIA/IHF Decade Audio Power Multiplier™

- Increase the PA81's power analyzing capability to 5,000 watts
- Sweat out thermal amplifier problems
- EIA/IHF load impedances
- * • Protects amplifiers from expensive component damage
- Provides load resistor cooling and high temperature protection
- Portable enclosure for full power testing at the job site

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Just press a button to test . . .

The Waveform Analyzer locks solidly onto

any waveform and lets you read DC volts, PP volts, and frequency at the push of a button.

You can measure signals from 5 mV all the way to 3000 VPP so you can analyze even the most powerful circuits. Plus, the innovative sync circuits allow you to quickly lock onto any waveform, and keep it locked.

The SC61 Waveform Analyzer also lets you:

Analyze Waveforms Easily:

- Accurate waveform display
- Rock solid sync for fiddle free operation
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AUTOTRACKING™ Digital Readings Analyze The Whole Signal:

- Autoranging DC volts through a single probe
- Automatic peak-to-peak volts
- Automatic frequency measurements

Delta Digital Tests Analyze Any Part Of The Signal:

- Delta peak-to-peak volts of any part of the signal
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- 1/Delta time - frequency of any part of the signal

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* Limited quantity offer—the SC61 Waveform Analyzer's normal price is \$3295.

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