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Issue #141 October/November 1988

Walter Fiscuss Summed It Up This Way:

"If I had to do it over, I'd buy the FS74 again." Page 3

Update '88

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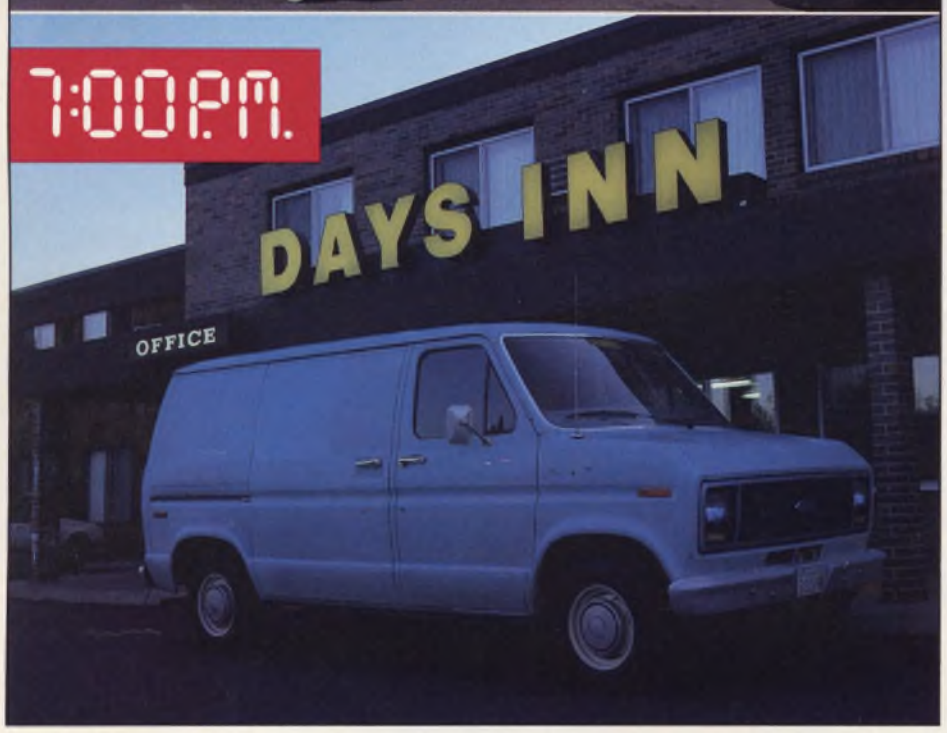

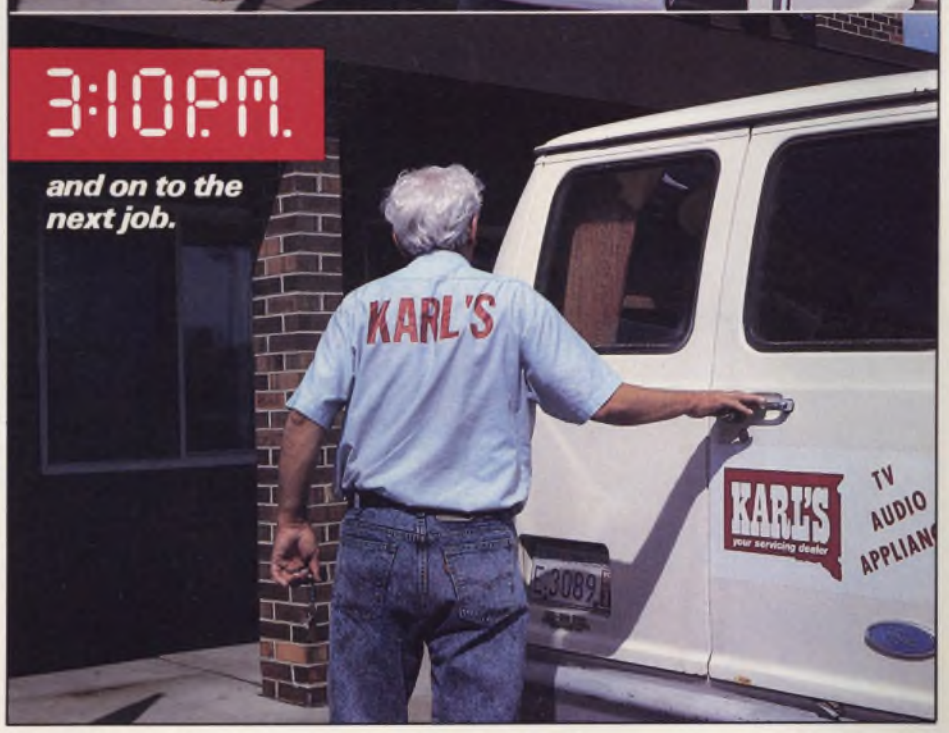

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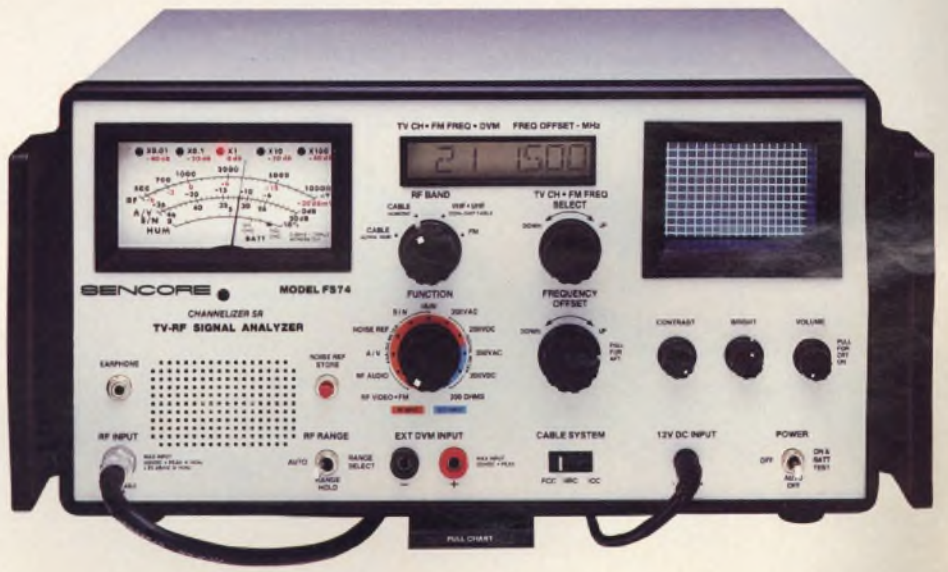

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MATV Service — A Business Builder For Any TV Shop

by Greg Carey, Application Engineer, CET

> "If I had to do it over, I'd buy the FS74 again."

Walter Fiscus is the owner of Audio Video Service of Granville, Inc. in Oxford, North Carolina. In July of 1988, he had just received a Sencore FS74 CHANNELIZER SR.™ Signal Strength Analyzer. He was becoming familiar with its operation, when the phone rang.

Walt recognized the voice of Mr. Balkrishna Patel, the manager of the new King's Inn Motel, which had been under construction on the southeast part of town for the past six months. The voice had an unusual edge to it, as Mr. Patel explained that the grand opening was less than one week away. There was still much to be done — too much. It looked as though all 40 brand new televisions would be working from rabbit ears when the first guests checked in. The master antenna television (MATV) system was far from finished. Mr. Patel asked if Walt might be able to come over and take a look at the maze of wires poking through the walls.

Walt decided there was no time like the present to find out what his CHANNELIZER could do. He threw it into his 1985 Dodge Ram service van, and drove to the motel construction site.

When Walt surveyed the motel, he found that cables had been pulled from the headend room to each room by the company who had originally promised to install the system. That was all that had been done. Walt explained, "They hadn't even gotten in the headend system, hadn't put the jacks in the walls, hadn't stripped the cable, or anything."

Walt placed the first priority on installing the headend. He arranged for antennas and a 50 dB distribution amplifier to be shipped in overnight. There was about a 60 foot run from the antennas to the headend, so Walt also ordered an antenna preamplifier. They arrived the next day. He had the antennas up by Saturday, and the headend was finished by Monday morning. He thought that the toughest part of the job was finished, but soon found there was much work to be done.

FS74 CHANNELIZER Comes To The Rescue

The next three days involved some pretty long hours. As Walt explained that week, he said, "If

Contents

◄ *Fig. 1: After the phone call from the motel manager, Walter loaded his FS74 into his service van . . .*

▼ *. . . to find the Grand Opening less than a week away, and 40 rooms without television.*

Fig. 2: Nearly half the rooms were dead until Walter found the service hallway in the back. His CHANNELIZER SR. let him fully analyze the MATV signals in the cramped quarters.

it weren't for the FS74, I think I'd still be out there trying to figure out what's going on."

Walt and Mr. Patel spent some time the first two days trying to get the company that had installed the wires to come to the construction site to show him what they had done. Walt remembers, "We'd call them, and they said they'd come out. I wouldn't see them, so I'd call them again, and they said they'd be there at a certain time. Finally, I figured out what they had done by myself by the time they arrived."

Deciding he couldn't wait any longer, he started to find out how the wires had been routed through the building. He couldn't trace the wires directly, because they had been run up through the ceiling of the two-story building. There were about 13 feeder wires coming into the headend room, so he started by connecting them. After some time he found that these trunk cables looped from room to room with each cable feeding four rooms. Walt connected one trunk at a time, and used his FS74 to find out which rooms were part of which feed line. He installed isolated taps in the rooms to tie the cables together.

After installing the jacks, Walt took his FS74 from room to room to adjust the signal levels and confirm each outlet worked correctly. He found that only half of the outlets worked. After much searching, the manager suggested that he inspect a narrow service hall running between the rooms on the backside of the building. He found the feeder cables for each room, coming through the walls into the hall. Adding splitters to these cables got the rest of the rooms operating.

Now that signals were where they were supposed to be, it was time to balance the levels in all of the rooms. Things went fine, until he got to two rooms which had a strange symptom. The FS74 came to the rescue here, as the ribbon cutting ceremony drew closer and closer.

CHANNELIZER Finds A Bad Part

Walt explained the problem: "In one part, there was good reception in two rooms, but the other two rooms had a loss of color on channel 5."

Walt called the problem a hair-puller. The two bad rooms had no color on channel 5, and the channel 4 audio came through on channel 5 as well. He said, "Here, the room adjacent to it has perfect color and video on [channels] 5 and 4. The next room over was bad, and all there was between them was a short stub of wire going from this jack over to that jack."

Walt was glad that his FS74 could give him a meter reading, a video picture, and detected sound all simultaneously. Walt's FS74 proved that the problem was in one of the isolating splitters. It was supposed to tap off different signal levels by clipping out resistors. He said, "I clipped out all of the resistors, which should have been a zero [dB loss]. I was still losing it. I showed a minus 37 dB, so I changed it."

The problem was solved. He said of the FS74, "I was able to tell where the loss of signal was taking place [because] I could read [signal level] and see the video on the monitor."

When the ribbon was cut on Wednesday morning, every room in the motel had television. The FS74 let Walt balance the system so that, "Even the farthest room from the headend was within a couple of dB of every other room."

Good Work Earns Future Business

The motel manager was impressed with Walt's performance. He realized the problems associated with coming into a partly installed system, figuring out the intended design, and then working all the problems out in less than a week. Since Walt was equipped to make the needed tests, he finished the job in time—even under extraordinary pressure.

The same company plans to build another motel in the future. They have asked Walt to design and install the entire MATV system from the ground up. They know that Walt will provide a solid design, and that he has the equipment to ensure that the job is done right.

Treating A Sick Hospital System

After a well-deserved rest, Walt took his FS74 to another MATV system he works with. This is in an 80-room hospital in Henderson, about 10 miles to the east of Oxford. The original MATV system had been installed several years earlier. Walt had upgraded the headend a few years back. He had installed strip amplifiers and converters to move UHF channels to VHF.

He checks and adjusts the system every 6 months to be certain it's working correctly. He had used an older field strength meter to adjust levels on the strip amps, but was never quite satisfied with the results. He found out why when he connected his FS74.

He found that some rooms farthest from the headend, which had 200 to 300 feet of cable between, were down nearly 10 dB from normal. Walt said, "When I put on the FS74 meter, and

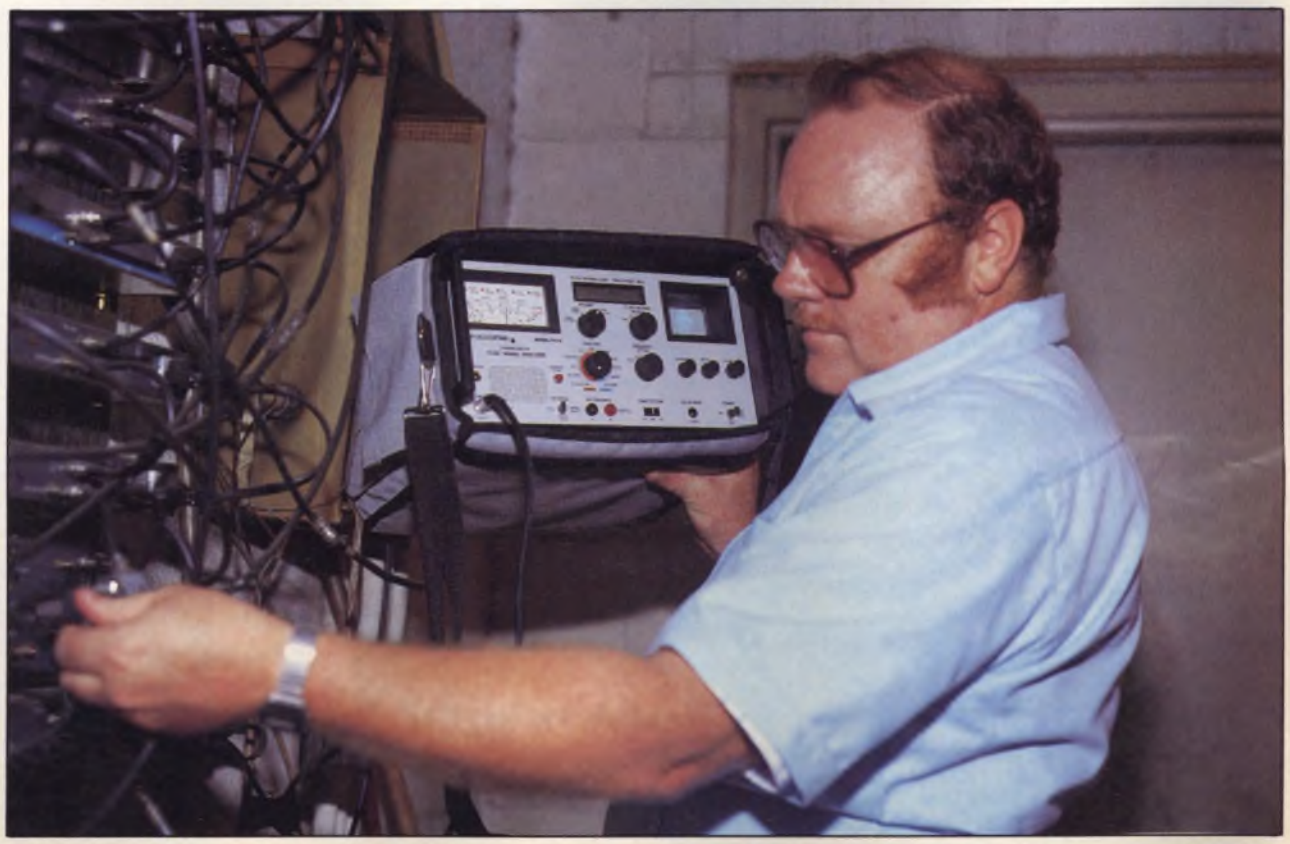


Fig. 3: Balancing the strip amplifiers in the hospital headend restored clear pictures, even in the most distant room.

Fig. 4: Mr. Patel, the manager of the King's Inn Motel, watches as Walter runs through a 6 month system checkout to keep every room's picture at top performance.

used the digital [tuner] and the automatic attenuator, I had to increase the gain of the strip amps to get a good signal. I had them set too low. Having both the CRT as well as the digital readout itself at the same time really helped."

MATV Brings Added TV Service

Walt's MATV work helps build his TV service business too. During his six-month MATV system check, he picks up TVs that have failed since last time. His MATV work locks in the TV business, since most people prefer working with one service company.

He believes six months is a good interval. He can keep the MATV signals right continually. He explained, "The FS74 simplifies it so I can make a maintenance run every 6 months to keep things up because I watch it for the maintenance. I don't feel like the thing [MATV system] should be left there to run and run and get worse."

A few of the other motels in the area don't have a regular MATV maintenance program. They've had their MATV system in for several years, and just keep hoping that they keep working. They have Walt's card if they suddenly have problems. He said, "I don't know whether they really have someone to check it [MATV system], or whether they just leave it to die and go its way—and hope that they don't have any problems." He added, "But they've got my card in case they do."

Billing By The Job

One question Walt had to answer was how to bill for the service on both the MATV system and the TVs connected to it. The motel and hospital managers suggested a flat rate monthly fee per set. Walt decided it would work better to charge for work done. A monthly contract looks good at first, but can cost profits later. He said, "Two dollars or even $2.50 a set looks fine when there's nothing to be done. But if I go there, and the sets start getting some age and they start failing 3 or 4 a month, I feel I'll take a loss."

Walt would rather settle for a little less income at first, than face a sudden rash of problems that could eat up all his profits a little later. Other institutional TV servicers have learned this lesson the hard way when, for example, dozens of picture tubes of the same age fail simultaneously. Walt says, "Later on, if I charge 40 or 50 dollars a set labor, I'll come out better than charging 2 dollars a month all that other time."

Part Of Home TV Service, Too

Walt finds his FS74 is also important in his normal TV servicing business. He finds it helpful to check the customer's cable tap or antenna system, because a problem is often caused by a bad RF signal instead of the TV receiver. He said, "You know how these customers say, 'Look here, I've got bad reception.' So I take it [FS74] with me to confirm that it's not the cable. I've seen times when there's a negative 15 or negative 20 dB signal coming in, and the customer's TV is really working just fine."

The FS74's video monitor is especially helpful when explaining a test to the non-technical customer. The FS74 impresses the customer, as it sits on top of their TV with the cable hooked to it. It lets the customer see exactly what each meter test and each automatic reading is showing. Walt calls the monitor a real customer convincer. He said, "You can prove to the customer that it's in the cable if they're seeing the same thing on the FS74 that they are seeing on their TV."

The Video Monitor — The Most Important Feature

Walt said that he couldn't think of a single feature he would take off the FS74—every one is good. But his favorite feature is the wideband video monitor. Without it he'd have had a much tougher time troubleshooting the motel system, and have trouble showing results to non-technical customers as well. He says, "I think that the monitor is the greatest thing about it."

In one case, the monitor helped him track a noisy picture caused by an off-frequency cable channel. He found that the fine tuning on a 25" console TV had to be offset, even though a 19" TV seemed to pick up the channels normally. The FS74 monitor let him duplicate the symptom on the TV to confirm that the TV itself was not defective.

Walt and his son Wayne currently operate Audio Video Service together. The FS74 they have will cover their MATV work in the foreseeable future. When we asked him whether he thought a second meter should be the FS73 junior model, or the FS74 senior model, Walt said, "If it really grew to that point, and I needed another one, I'd go with the senior."

He elaborated, "Every time I've turned the field strength meter on, I've turned on the monitor with it. I like to be able to see visually, plus what's being shown on the meter. . . All the other [features] have their own little advantages that they're worth. But, if you have a visual picture there—if you see a hum bar going up through it then, of course, you can put it into the hum test and be able to go with that. Whereas otherwise, if you didn't have that, you'll go searching to see what's causing it."

He added, "I think that for anyone that is going to do *any* MATV, or is just checking behind cablevision for troubles in the customer's home, it's well worth having for the hair pulling and frustration of wondering what's going on without the field strength meter."

Then, he summed it up this way: "If I had to do it over, I'd buy the FS74 again." ■

Fig. 5: Walter explains the FS74 to his son, Wayne, on their modern Sencore-equipped TV service bench.

Answers To Often-Asked Questions About Audio

by Paul Nies, Applications Engineer

What exactly is audio? What does the power rating of an amplifier mean? How can I be sure that today's high-powered audio systems really work when they leave my bench?

These are very good questions that we hear almost daily at Sencore, and the answers to them may be very important to your future success in a growing service market. In this issue we'll cover some questions about the audio market, and a few general theory questions. In upcoming issues we'll talk about more specific amplifier troubleshooting methods, plus answer questions on how you can more effectively troubleshoot audio systems.

> "The power amplifier stage is the most asked about and most difficult section of an audio system to test and troubleshoot . . ."

1. How Will I, As A Servicer, Deal With Audio?

When we hear "audio", we naturally think of hearing sounds. Those sounds could be music, conversation, news, or some other information. We could be listening to "live" audio or to "recorded" audio. But rather than try to cover all these areas let's simply consider an audio system to be any system which electronically delivers the sound (live or recorded) to the listener (Figure 1).

Such a complete audio system has three major parts; 1) the pickup or source device (phonos, CD's etc.), 2) the amplifying device, and 3) the loudspeakers. Of course in some audio systems the amplifying device and source device, and maybe even the loudspeakers are in the same unit. Some examples are: receivers (which include an AM/FM tuner and an amplifier), ghetto blasters (which include an AM/FM tuner and cassette deck), and stereo television systems.

The power amplifier stage is common to all audio systems. This is the most asked about and most difficult section of an audio system to test and troubleshoot because of the exacting signals and large power levels it must handle. For example, CDs now tax the amplifier with the largest dynamic range of signal levels ever needed to be reproduced.

2. How Do Today's Audio Systems Compare With Systems Of Several Years Ago? Isn't Audio Just "Audio"?

The trend in audio today is toward quality and increased output power. The 1987 EIA Electronic Market Data Book states that "The principal consumer appeal of a component [audio] system is sound quality. Components offer the best sound attainable today."

Since sound quality depends on the total system, consumers are updating their whole system when they purchase a new component such as a CD or

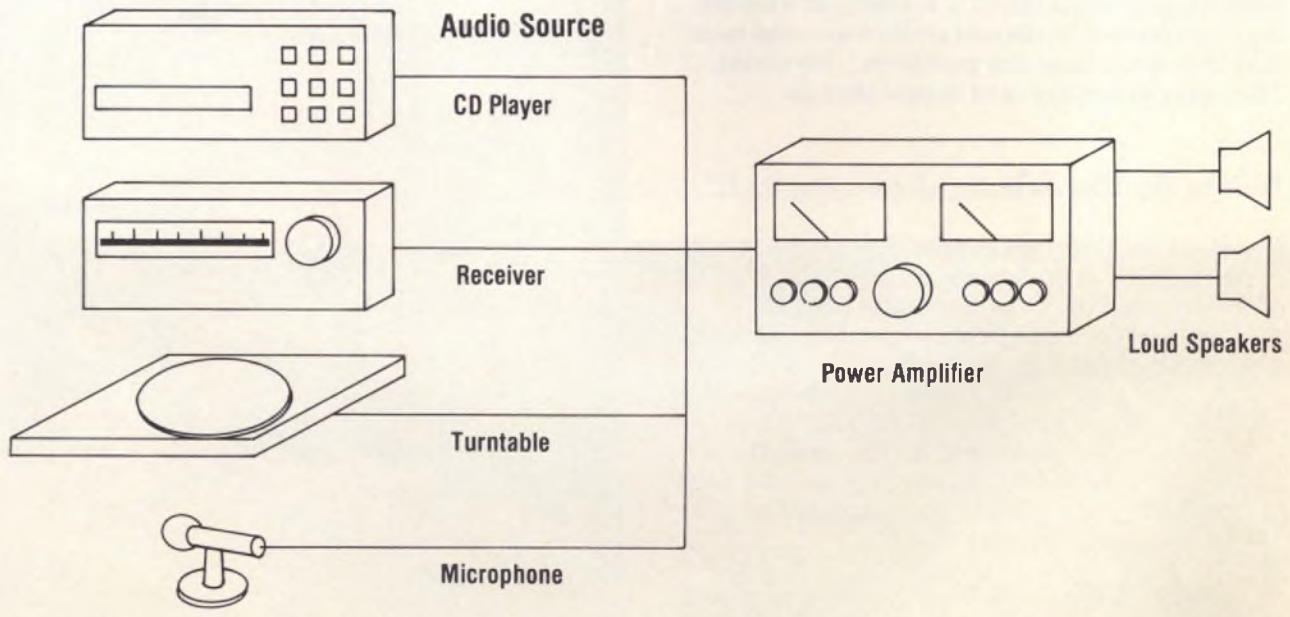


Fig. 1: A complete audio system consists of 3 main parts: 1.) the audio source, 2.) the power amplifier, and 3.) the loud speakers.

Hi-Fi VCR. "You can't play a CD on cheap equipment," says Richard Ozaroff, a Value Line Securities Inc. Analyst as quoted in an article entitled "High-Tech Music Has The Audio Market Rocking" (BUSINESS WEEK, June 2, 1986), "It would be like driving a Mercedes with retreads."

And what about more power? Well, if you live in a house with a teenager, or listen to cars driving down the street, you'll soon realize that many of today's audio consumers also want sound power. In fact, there are several sanctioning organizations in the United States that have contests to see who has the loudest car audio system. One group, The National Autosound Challenge Association . . . has 20,000 competing members and expects to draw 500,000 spectators at its events this year.

Perhaps the following excerpts also taken from the BUSINESS WEEK article best summarizes today's audio systems:

"Compact Discs and stereo VCRs are rousing the industry out of a long sleep. . . The audio market matured about ten years ago. Sales stayed flat because no new products were introduced and the consumer got bored."

"Now consumers are buying audio equipment again. A stronger economy is one reason. But most of the credit goes to new technology - compact discs and televisions and video recorders with stereo sound . . . These products give audio consumers a reason to buy - something they lacked for years . . . "

"Audio companies plan to continue to introduce yet more new products. Now that they have recaptured the consumer's attention, audio equipment makers seem determined not to let them get bored again."

Audio systems, (two or more audio components connected together) are now in 89% of all U.S. households. This is exceeded only by the radio and television receiver. Sales figures from the EIA indicate that well over 22 million complete audio systems have been sold over the past five years. These are audio systems that are purchased all together at one time and do not include items such as CDs or cassette decks which are added later, or system upgrades such as speakers. There is a tremendous income potential for servicers who are able to cash-in on this growing market.

The largest, and fastest growing area of audio is autosound. The EIA states that "Second in popularity only to air conditioning as an optional extra among new car buyers, and a major aftermarket purchase item is the automotive stereo system. Autosound systems, known rightly as 'Highway Hi Fi' are enabling millions of owners to enjoy their libraries of recorded tapes while on the go."

3. Can You Give Me A Quick Review Of Audio Theory? What Exactly Is Audio?

The sounds we hear are the result of an air movement that our ears transform into nerve impulses and pass on to our brain. Clapping our hands causes a mass of moving air to strike our eardrum making it vibrate. Our vibrating eardrum converts the movement into the sensation called hearing.

In a typical audio system, a "transducer" called a microphone converts sound waves into electrical signals which can be recorded. Another transducer, the loudspeaker, converts the electrical signals back into air movement. A microphone is the very first stage in every audio system (although perhaps located back at the recording studio) while the speaker is the very last stage. Stages in between the microphone and the loudspeaker are used to store, playback, and amplify the electrical signals.

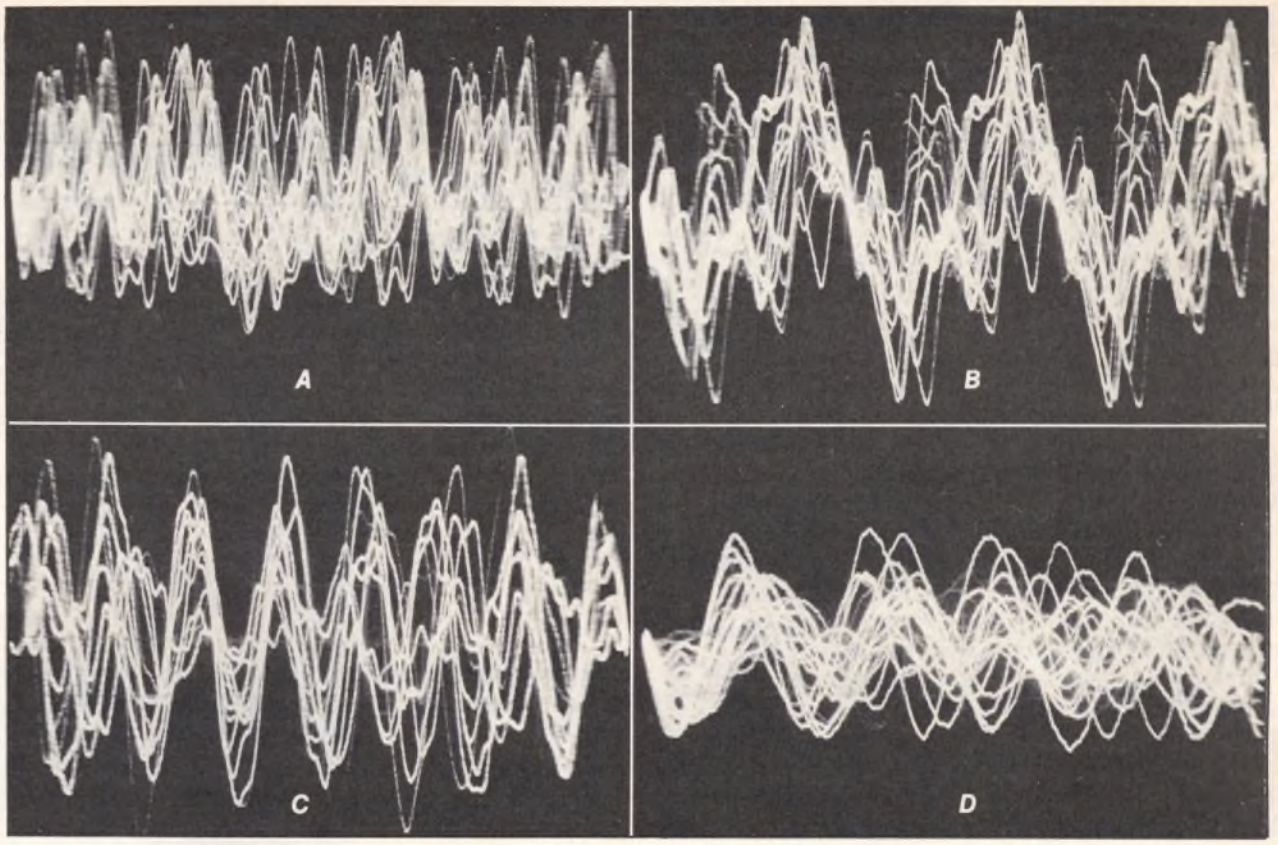


Fig. 2: Here are some other waveshapes produced by some common sounds: a.) Church organ; b.) Violin; c.) Flute trio chord (note sinewave harmonics); d.) Speech.

4. What Waveshapes Make Up Audio?

Each sound has a unique waveshape (Figure 2). The waveshapes vary from those produced by a flute (a waveshape closely resembling a sinewave) to those produced by a saxophone (a waveshape which looks more like a squarewave). Other instruments and audio sources produce waveshapes that are somewhere in between. The sound you hear during an orchestra concert is the instantaneous sum of all the unique waveshapes produced by the different instruments.

5. How Do The Sounds We Hear Correlate With Waveshape?

Basically two characteristics of the audio waveshape determine what "sound" we hear. We've already seen that the waveshape produced by a flute and a saxophone look different. This difference in waveshape is called "tone" and it is what distinguishes a flute sound from a clarinet sound.

The second characteristic of the audio waveshape is its frequency. How fast the waveshape repeats determines what "pitch" or note we hear. This is what makes a "C" note sound different than a "B" or a "D" note on a piano. The faster the waveshape repeats (the higher its frequency), the higher the pitch we hear. Most audio sounds are between 100 Hz to 15 kHz.

Relative Sound Level		Power at Ear (watts/cm²)	Relative Height		
	140dB			140dB	
Jet Take-Off	130dB	10^{-3}	Distance From Earth To Moon	130dB	238,875 Miles
Threshold of Pain	120dB	10^{-4}		120dB	
	110dB	10^{-5}		110dB	
Subway	100dB	10^{-6}		100dB	
	90dB	10^{-7}		90dB	
Heavy Street Traffic	80dB	10^{-8}	Mount Everest	80dB	29,141 Feet
Loud Music	70dB	10^{-9}	Empire State Building	70dB	1,250 Feet
Conversation	60dB	10^{-10}		60dB	
	50dB	10^{-11}	Sony Building	50dB	50 Feet
Average House	40dB	10^{-12}	Person	40dB	5 Feet, 9 Inches
	30dB	10^{-13}	Curb Height	30dB	6 Inches
Quiet Whisper	20dB	10^{-14}		20dB	
	10dB	10^{-15}	Thickness of a Dime	10dB	0.05 Inches
Threshold of Hearing	0dB	10^{-16}	Thin Piece of Paper	0dB	0.0012 Inches

Courtesy: Sony

Fig. 3: The dB is used to express a logrithmetic ratio between two numbers. The human ear can hear a tremendous range of loudness levels. Here is a comparison of our hearing range to some distances which are also expressed in terms of a logrithmetic ratio.

6. What Is The Range Of Loudness That We Can Hear?

The loudness of a sound corresponds to the force of the air that strikes the eardrum and is called Sound Pressure Level (SPL). The softest sound you can hear is called the "threshold of hearing" and corresponds to a sound pressure level on your eardrum of .0002 dyne/sq. cm (A dyne is the force equal to 1/980th of a gram. The loudest sound your ears can normally tolerate is called the "threshold of pain". It is a level approximately 1 trillion times greater than the threshold of hearing (Figure 3).

Because of the tremendous ratio between the loudest and softest sounds, sound intensity is expressed in decibels. The dB was first used by Alexander Graham Bell to express the dynamic range of the human ear. He found that the ear responds logarithmically to sound pressure according to the formula dB = 10 log P1/P2. Thus, calling the threshold of hearing the 0 dB reference, the threshold of pain is a sound pressure level of +130 dB.

Moving farther away from a sound source makes the sound softer, since less air strikes your eardrum. Because the ear responds logarithmically to sound pressure, a doubling or halving of the distance from the sound source results in a 6 dB change in loudness (approximately 1/3 as loud), and a 10 dB change in level corresponds to a sound that is twice or half as loud.

It is now common to express a logarithmic ratio between any two like quantities in dB. Another common dB ratio is used to express voltage gain. The formula for dB voltage gain is: dB = 20 log V1/V2.

7. How Do You Measure The Amount Of Audio Output From A System?

The amount of audio output from a system is often called "volume". However, volume is just a layman's term and has no real quantity, other than one listener says "it's too loud", and another says "it's too soft".

The output of an audio system is measured in terms of electrical RMS power delivered to the speakers. However, the loudness of the sound you hear depends on several things, such as 1) the distance between you and the speaker, 2) the frequency of the sound, 3) the room acoustics, 4) how well your ears work, and 5) how efficiently the speakers transfer the electrical signal back into sound waves.

Saying that an amplifier produces "100 watts" does not specify an exact "loudness". However, you can get a relative idea of the difference in potential loudness by comparing amplifier RMS wattages. For example, if identical speakers are connected to a 100 watt and to a 10 watt amplifier, the output from the 100 watt amp will be approximately twice as loud as the 10 watt amp.

An "RMS" watt is the industry standard measurement of audio power. RMS watts are "effective" power and relate directly to doing work (moving the loudspeaker voice coil). RMS power readings are only accurate when measuring a good sinewave.

8. What Exactly Does An Audio Power Amplifier Do?

An amplifier is a device that makes small signals larger. Often an amplifier is thought of only in terms of voltage amplification. For example, applying a 1 VPP signal into a voltage amplifier with a gain of 10 produces a 10 VPP signal at the output.

Audio power amplifiers also amplify signals, but they amplify the signal current, rather than the voltage. In fact, the peak-to-peak signal amplitude at the output of a power amplifier is often lower than the peak-to-peak signal at the input. This is because power amplifiers have a much lower output impedance than input impedance. Audio amplifiers provide the power needed to drive a loudspeaker by increasing the signal current that is delivered to the load (Figure 4).

Here's what happens. Let's start with a signal that has an amplitude of 10 VPP. If this signal is delivered into an impedance of 10 kohms (the typical impedance of a voltage amp) the resulting power, according to ohms law ($P=E^2/R$) is .01 watt. But if we decrease the impedance to 8 ohms (a common impedance of a loudspeaker) and maintain the 10 VPP signal level across the load, the power increases to 12.5 watts.

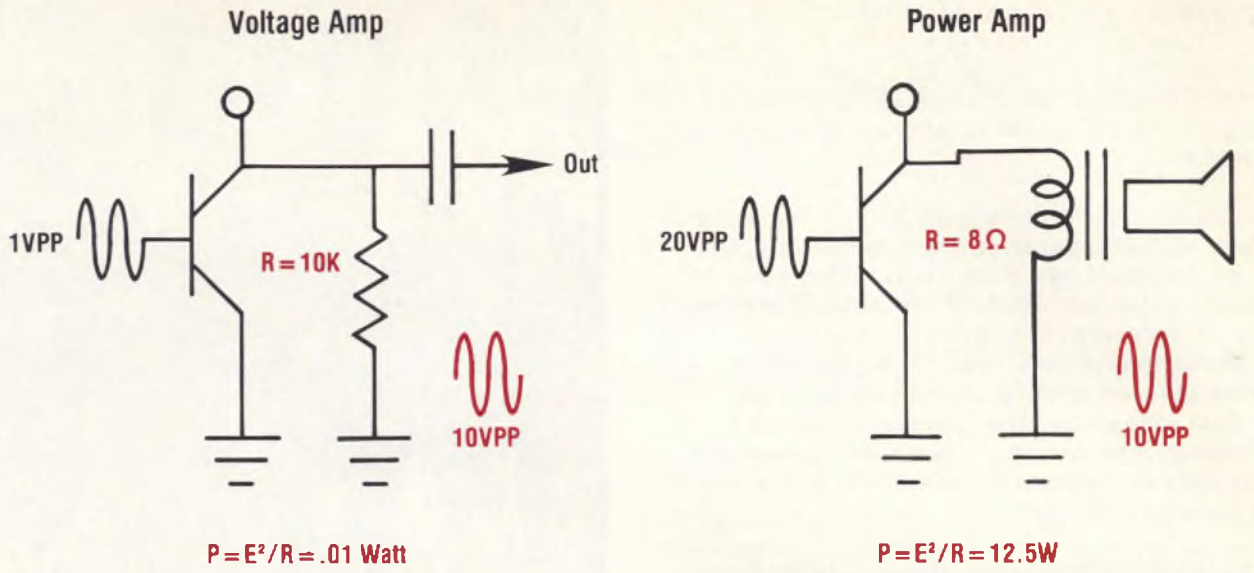


Fig. 4: A voltage amplifier delivers its output into a high impedance load which causes the applied signal to be increased in amplitude. A power amplifier has a much lower output impedance than input impedance which actually reduces the voltage amplitude but greatly steps up the current.

9. Isn't Power Sometimes Measured Other Ways Besides RMS Watts?

Yes, sometimes the manufacturer of an audio system may specify "peak power", or "music power". Either of these terms relate to the maximum short term output that the audio system can reproduce. Peak power occurs at the largest peak of the reproduced waveform. However, unless a sinewave is applied, there is no way to relate peak power or music power to RMS power (Figure 5). An audio system that is properly operating within its RMS power rating will be able to handle the peaks normally encountered in sound reproduction. Many systems today contain audio amplifiers that are rated at an output of 100 watts per channel or greater into an 8 ohm load.

10. Some Audio Specs Are In dB. Are dB And Watts Related? Why Not Always Use Watts Directly?

Wattage ratings allow you to quickly compare systems, and match speakers to amplifiers. Wattage readings specify a known amount of signal delivered into a known resistance. But, many times in audio work you are more concerned with the relative difference between signal levels, as when making signal-to-noise and frequency response tests, or making distortion measurements and determining stage gains. This is where the dB (decibel) is used.

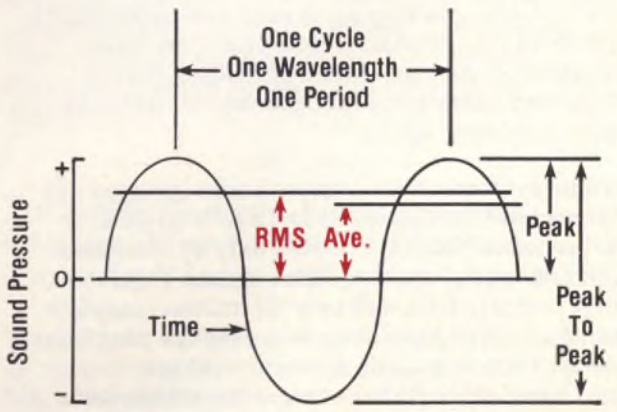


Fig. 5: The characteristics of a sinewave can be expressed in several ways. However, the relative RMS and average levels shown here are only valid for a pure sinewave.

As we learned earlier, the dB expresses a ratio between two power or signal levels. A number stated as a dB does not specify an absolute level as a watt does, but regardless of power, the ratio of signals expressed will remain the same. Therefore an 8 dB signal to noise ratio means the same thing (noisy sound) whether the output power is 10 watts or 100 watts. Since audio systems deal primarily with RMS power gain, the power formula, dB=10 log (P1/P2), is often used in audio work.

In the early stages of an audio system the signals are very small. Once again, the absolute signal level is not as important as the gain of the amplifying stage. But these are voltage amplifying stages, rather than power amplifying stages, so voltage gain is desired. Voltage gain is determined using the formula dB=(20 log (V1/V2).

Because the dB gain of a stage (either power or voltage) is independent of absolute level, dB's are often very useful in troubleshooting. ■

Understanding Functional Analyzing With Your VA62 Universal Video Analyzer ™

by Tom Schulte, Application Engineer, CET

There are generally two ways to test a TV; you can signal trace or signal inject.

Signal tracing is the age old method of connecting a scope to a test point and comparing the waveshape to the waveform on the schematic (if you have a schematic). The idea is to move from one end of the circuit to the other until you spot a waveform, or reading, that doesn't match those on the schematic.

The success of this approach depends on your ability to analyze just what that waveform is telling you. This presents several problems. First, you must use a schematic. On many schematics the waveforms are small dark photos that are difficult to read, and often don't show much detail. Second, your success can be hampered by the small changes in a waveform that can completely change a circuit's operation! Third, you could be led astray, since the DC, peak-to-peak, and general waveshape can all *appear* to be correct.

> "Once the problem is isolated to one circuit block, you can find the defective part in minutes. The key to success is finding the defective block . . ."

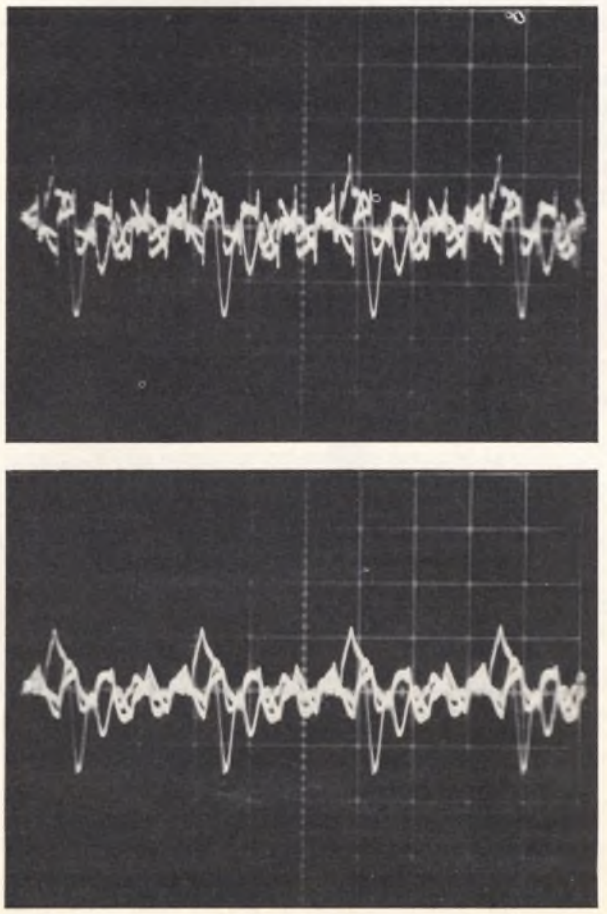


Fig. 1: The problem with signal tracing is that waveforms may have slight differences that are not readily noticed but can cause problems in the circuit.

A far more successful troubleshooting method is "functional analyzing", where you simply test the *function* of the suspected stages. If they work, they're good—that's it; there's no need to measure voltages or check waveforms.

Functional analyzing eliminates the need for detailed measurements and concentrates, instead, on checking the functional operation of the circuits in the TV. To use functional analyzing, you break the total TV into functional blocks. Your goal is to test the function of each block and isolate the problem to the defective block. Once you have the problem isolated to one small circuit block, you can find the defective component in minutes. The key to success is finding the defective block . . .

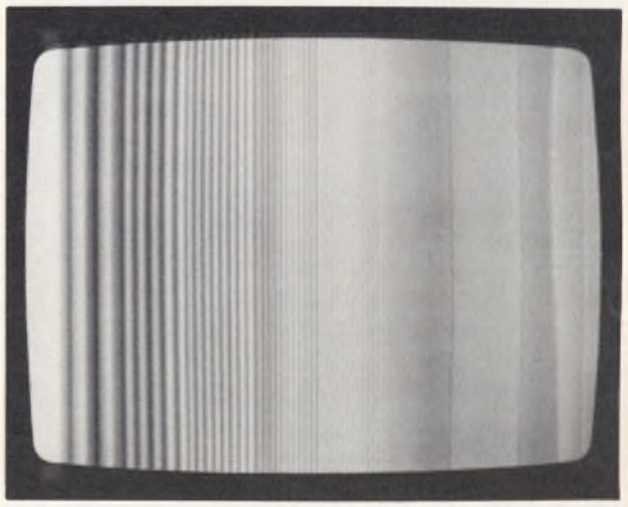


Fig. 2: The original symptom was a washed out picture without good contrast. This problem could be in the tuner, IFs, or video circuits.

How do you test each block? You need a known good substitute signal. Your VA62 Universal Video Analyzer supplies all the basic signals needed to troubleshoot TVs and VCRs. You inject the same type signal from the VA62 Universal Video Analyzer as the block normally receives for an input and monitor for proper operation. To see how this works, let's look at an example.

You have a television with a video problem. You first connect the VA62 up to the TV's antenna terminals and select the MULTIBURST BARSWEEP pattern. Normally you would expect to see crisp, clean, vertical white and black bars. Instead, you see a washed out picture with a loss of detail (Figure 2).

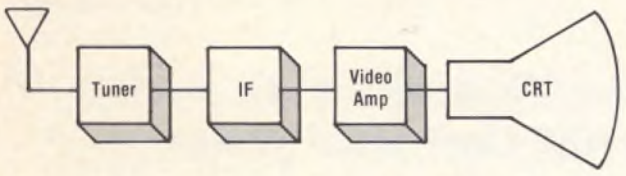


Fig. 3: To isolate the problem shown in Figure 2, we can break the TV receiver into 4 blocks, any of which could be causing the problem.

The problem could be anywhere from the antenna to the CRT. Before you start looking for components, you mentally break the overall TV up into blocks (as large as possible). For example, you can look at the TV as being composed of 4 functional blocks: the tuner, IF, video stages and CRT (Figure 3).

There are three places you could inject a test signal in these blocks: 1.) Between the tuner and IF. 2.) Between the IF and the video stages. 3.) At the CRT. Let's start by injecting between the IF stage and the video stage. A good place to start, as you will see later, is at the output of the video detector. The signal at this point is a video signal. Leave the VA62 Universal Video Analyzer connected to the antenna terminals and select a video pattern. This signal is now identical to the signal that should be seen at the output of the video detector. Injecting this known good signal at the output of the video detector, you see a clear, sharp picture with good contrast (Figure 4). Do you suspect a soft CRT? No! Do you need to do any more testing in the video circuits? No! Have you had to do any guesswork or make detailed measurements? No!

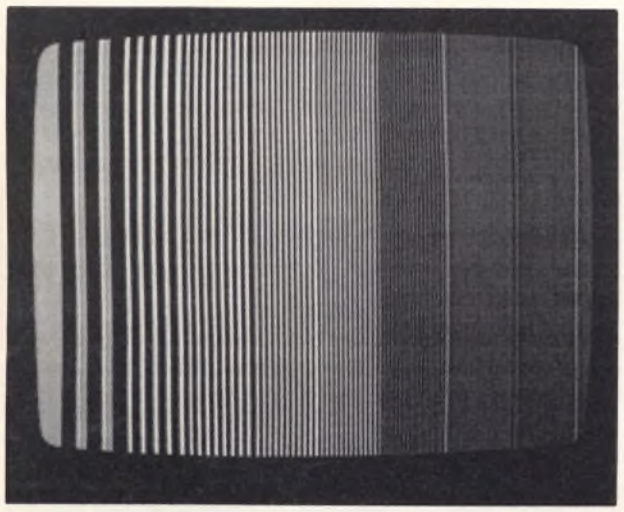


Fig. 4: When we inject into the video circuits, we get a good picture ensuring us that all circuits after this point are good.

Let's move back one more step and inject a signal into the input of the IFs. Select the 45.75 MHz VIDEO IF signal on the VA62's RF-IF SIGNAL switch and connect the RF cable from the tuner input to the input of the IF block . . . there's no improvement.

What does this tell you? You know the circuit works from the video amp out to the CRT, yet the circuit doesn't work from the IF to the CRT. Conclusion: something in the IF is defective. It's that simple. When you analyze this block you see that there are only three major components in the block, the IF buffer transistor, the SAW filter, and the IF amp/video detector IC (Figure 5).

Checking the IF buffer, you find that it is open. Changing it restores the picture to its proper contrast and sharpness. You have done this without waveform interpretation and without analyzing the operation of the circuit.

Functional analyzing leaves nothing to interpretation. The only variable is in the signal selected, which is clearly labeled on the VA62 Universal Video Analyzer. You simply dial up the signal in question and inject it.

You may ask what happens to the signal already present in the TV circuit? The answer is that the VA62 Universal Video Analyzer drive signal "swamps" out any signal that is present at the injection point. The result is that you only see the VA62 signal.

How is this possible? The VA62 Universal Video Analyzer has a lower output impedance than the impedance of the circuit. The VA62 Universal Video Analyzer takes control of the circuit, eliminating the need to disconnect components to substitute signals.

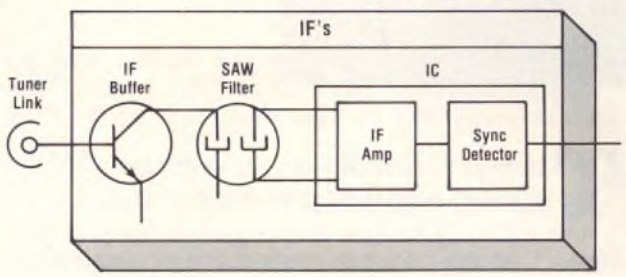


Fig. 5: Once the problem is identified to a major functional block, it can be divided into smaller functional circuits for more detailed testing.

With rare exception, you will find that functional analyzing is at least twice as effective as signal tracing. In addition to requiring less interpretation, functional analyzing makes all TV receivers look alike. It lets you get back to the basics. No matter what type of components are used, tubes, transistors, or ICs, you use just one universal troubleshooting approach.

Many servicers feel that the biggest benefit to functional analyzing, however, is that when you inject a substitute signal into a circuit, and the set operates, you know conclusively that every circuit is functioning from that point on.

Signal Substitution, The Only Way To Troubleshoot ICS

Signal substitution is a super timesaver in any circuit. But it doesn't stop there. Signal substitution solves one of the toughest problems of today's service technician - checking ICs. Signal substitution is the only sure way to confirm the operation of ICs and to isolate problems associated with them. The only other alternative is expensive and time-consuming chip swapping. Here's why:

How do you tell if a chip is good? Many servicers measure the voltages on the various pins. That means using a meter or scope to look at 14, 24 or even 48 IC pins. But, what if one of the voltages is slightly different than the voltage shown on the schematic? Chances are very good that you'll end up swapping ICs. You will have to carefully unsolder and resolder every pin on the IC. And, you have no guarantee that a new IC will fix the problem.

That's why signal substitution is so important. ICs are complete circuits. Each IC performs one or more functions. In fact, many of the chips used in television sets today perform many functions. Signal substitution, using your VA62 Universal Video Analyzer, confirms that the IC produces the correct output when a known good signal is injected into it.

Divide And Conquer Makes Signal Substituting Even More Efficient

Let's take signal substitution one step further. If you aren't careful when choosing injection points, you can end up jumping all over in your attempts to find the problem. By attacking the problem in a logical systematic approach, called divide and conquer, you become much more efficient.

Each functional block (Figure 3), is composed of several smaller functional blocks as shown in Figure 6. You could have started at the driver transistors at the CRT and worked your way back, one functional block at a time. This would have required 7 signal injections instead of three. By cutting the problem into halves, you cut your troubleshooting time by much more.

With the divide and conquer technique, you divide the problem in half, then in fourths, then in

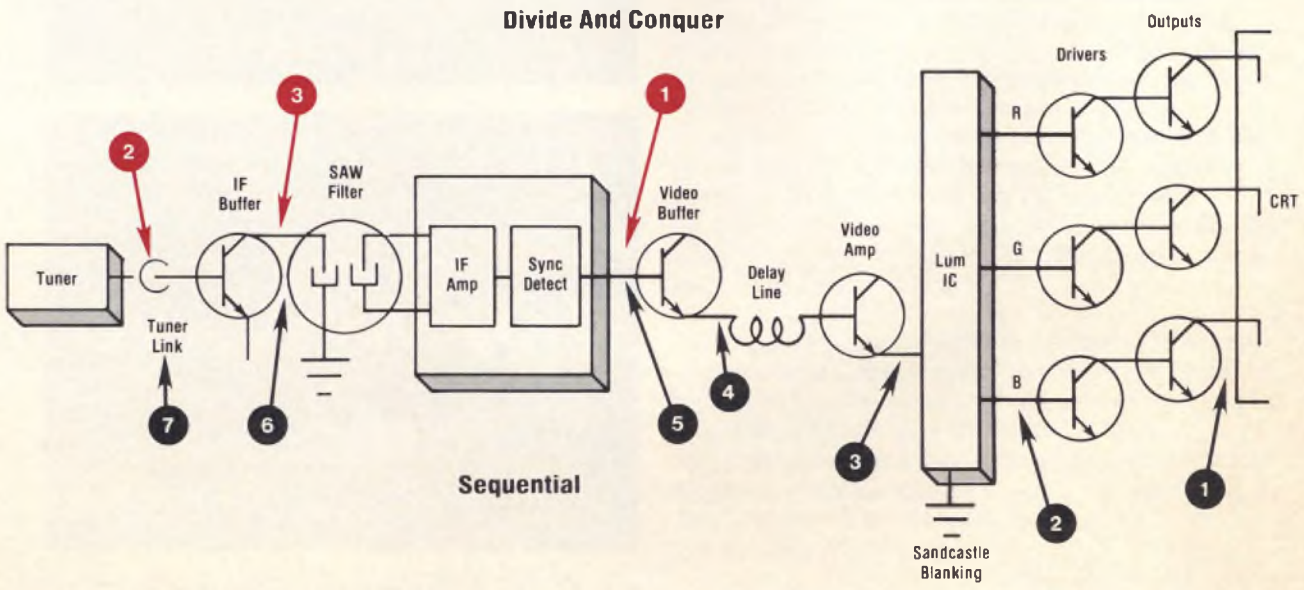


Fig. 6: Divide and conquer functional analyzing minimizes the number of signal injections needed to find the defective stage.

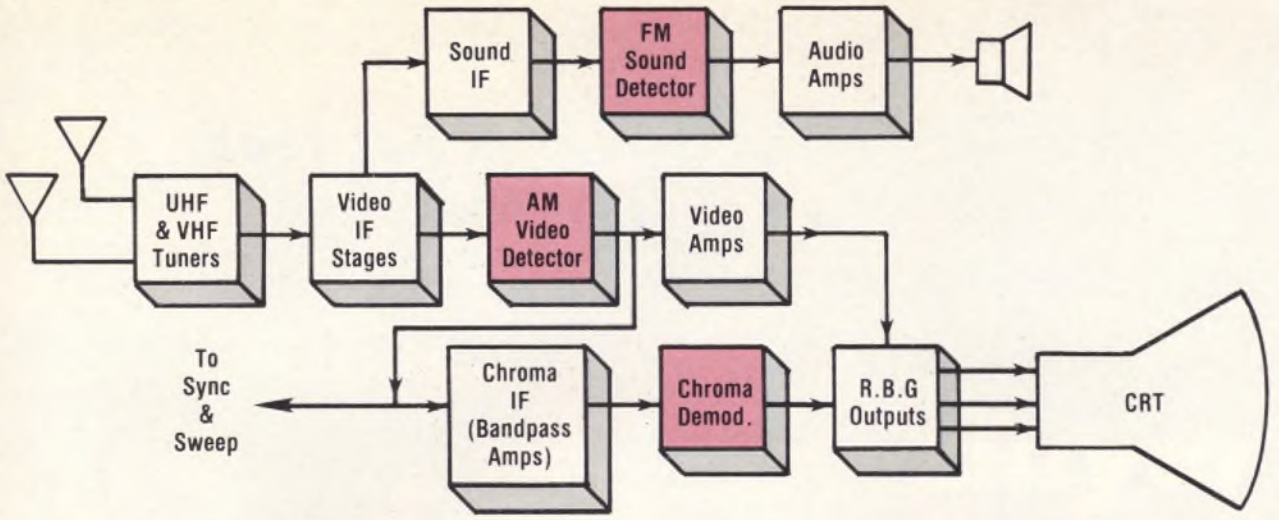


Fig. 7: The detectors are the best place to start divide and conquer signal injection because they cause the greatest change in the signals.

eights, etc. You quickly eliminate large sections of the television from suspicion and zero in on the defective block, and finally, the defective circuit.

The Detectors Are Your Halfway Points!

The final way to make troubleshooting most efficient is to make the first injection in the right place. Take a look at Figure 7. The detectors cause the greatest change in the signals. The circuit before the detectors process the signals much differently than the circuits after the detectors. Because of this, detectors are the best place to start the divide and conquer process. Injecting at the detectors cuts the number of signals that can cause a problem by at least half.

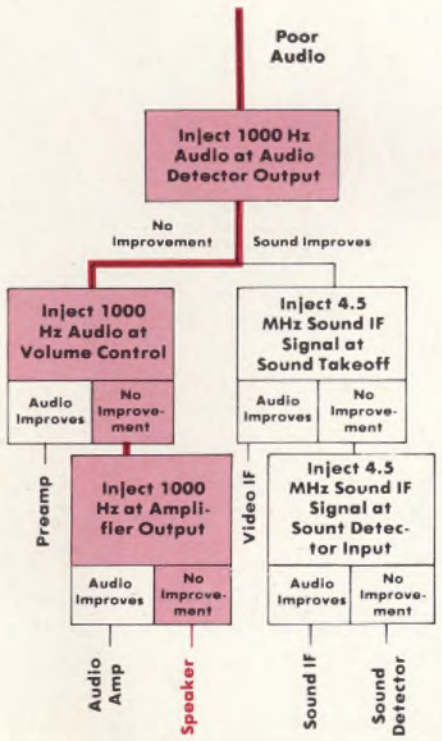
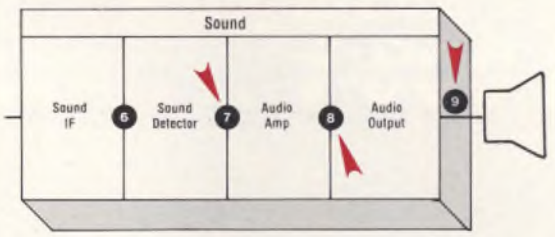


Fig. 8: The TV Functional Analyzing/Troubleshooting Guide gives a systematic method of quickly locating the defective stage.

There are three types of detectors in a television receiver: the video detector, the audio detector, and the chroma demodulators. The video detector changes the amplitude-modulated IF signal into video, the sound detector changes the FM sound IF signal into audio, and the chroma demodulators change the phase-modulated color signals into the individual red, green and blue drive signals.

Sencore's proven TV Functional Analyzing/ Troubleshooting Guide, along with the TV Functional Block Diagram gives you some helpful points to start your troubleshooting.



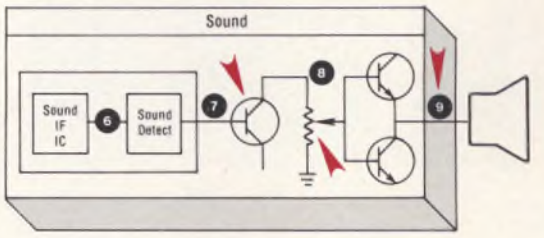


Fig. 9: The TV block diagram has injection points keyed to the troubleshooting guide to help identify key injection points.

Figure 8 shows the audio troubleshooting section of the the Functional Analyzing/Troubleshooting Guide. It shows you what to look for, based on the symptoms, and where to start your divide and conquer signal injections based upon the problem. The numbers on the troubleshooting guide correspond with the numbers on the Universal TV Block Diagram (figure 9).

How To Use The Analyzing/Troubleshooting Guide

The TV Functional Analyzing/Troubleshooting Guide begins by telling you to inject an RF signal from the VA62 into the antenna terminals of the TV receiver. In this step, you look at the entire TV as one complete functional block and confirm that the receiver is truly defective. If it is defective, you will observe one of the symptoms. Once you identify a specific symptom, you have already narrowed the problem down to about 1/6 of the total circuits.

Next, you determine the detector or other major circuit point that is involved with the general symptoms. For video and sound problems, inject at the video or sound detector output. For chroma problems, inject at the chroma demodulator input. If the receiver operation returns to normal, you know that the problem is somewhere before the detector. If the operation remains bad, you know that the problem is somewhere between the detector and the output.

Using Divide And Conquer To Find A Problem

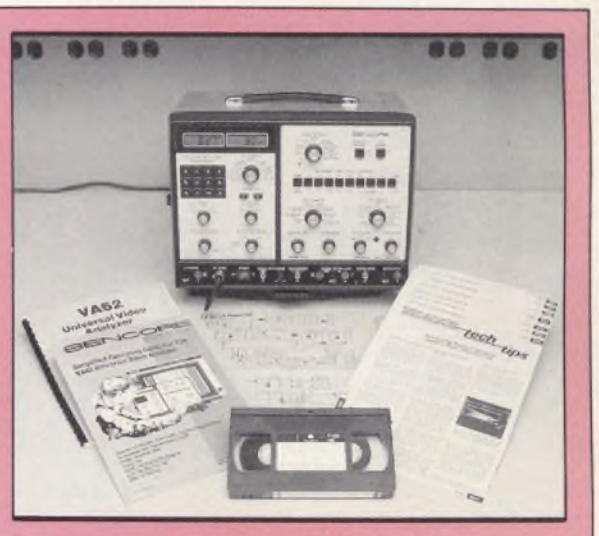
Let's look at one more example, a television with distorted sound, to see how divide and conquer functional analyzing is simplified using the TV Functional Analyzing/Troubleshooting Guide and Universal TV Block Diagrams (Figures 8 and 9).

The first thing you need to do is confirm the symptom. When you inject an RF signal from the VA62 into the receiver, you confirm that the sound is, indeed, very distorted. Look at the TV Analyzing/Troubleshooting Guide and find the symptom "Poor Audio". (A portion of the guide shown in Figure 8.)

As the Analyzing/Troubleshooting Guide shows (Figure 8), you need to find out whether the problem is before or after the sound detector. Do this by selecting the AUDIO drive signal on the VA62 and injecting the drive signal at the output of the sound detector (point 7 in Figure 9). The sound is still garbled. This proves that the problem is between the detector and the speaker.

When you follow the "no improvement" path of the TV Analyzing/ Troubleshooting Guide (Figure 9), you are instructed to inject the same VA62 audio signal into the volume control (point 8 in Figure 9). When you do this you find that the sound is still garbled. Following the "no improvement" path further, you inject the VA62 audio drive signal at the output of the audio amplifier (speaker leads). The sound is still distorted . . . you have narrowed the problem down to the speaker.

There are many examples of how to use functional analyzing to find problems. This article has shown you a few. Using your VA62 Universal Video Analyzer, you can troubleshoot any video system by simply getting back to the basics. ■



Do you have a question on the function of the VA62, and how functional analyzing can boost your troubleshooting ability? If so, call 1-800-843-3338 and ask your Phone Sales Engineer about our all new VA62 familiarization tape, and technical application literature. Or, simply ask for additional information on the response card on page 28.

Countdown To Tax Savings For 1988, And Save Up To 47% On Your Sencore Investment!

Randy Koepsell, Vice President Of Finance

The end of the year is right around the corner, and once again, now is the time to make some business decisions that can significantly impact your 1988 tax return. I know that this might seem a little early, since the tax filing deadline is still over 6 months away, but I wanted to take this opportunity to "clue you in" on what's happening with the 1988 tax laws, and show you how you can save thousands off your taxes by making some smart business decisions - now.

Plus, you can update your test equipment for about half of what you would expect to pay - with a little help from Uncle Sam.

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Tax Saver Number 1:

$10,000 WRITE OFF. Uncle Sam allows you to write-off up to $10,000 of business equipment purchases as an expense. That means that your investment in Sencore Test Equipment now, in 1988, can mean saving thousands on your tax bill!

Let's assume that your taxable income falls between $17,850 to $43,150, you are filing a single return, and your business income is at least as much as the net equipment cost.

Here's a few examples showing what you can save:

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STEP 1: Fill in the catalog price of the equipment you are interested in purchasing:	_____	$2,572.90	$10,813.00
STEP 2: Write in the amount of savings shown in our specials.	_____	$677.90	$1,890.00
STEP 3: Subtract **Step 2** from **Step 1** to find your net cost of the equipment.	_____	$1,895.00	$8,923.00

This is what Sencore saves you by acting now. Let's see what Uncle Sam can save you.

STEP 4: Enter here the savings on your taxes versus what you would have had to pay if you did not invest the amount in **Step 3.** (For example - use 28% if you made from $17,850 to $43,150)	_____	$530.60	$2,498.44
STEP 5: Subtract tax savings in **Step 4** from net cost in **Step 3. This is your final cost!**	_____	$1,364.40	$6,424.56
You Save	_____	$1,208.50 OR 47%!	$4,388.44 OR 41%!

Tax Saver Number 2:

DEPRECIATION: Uncle Sam lets you depreciate your business investments, even if you have used up your $10,000 capital equipment write-off. This allows you to still update your equipment and write-off some of the expense, even though you have already written off your $10,000. Tax Saver Number 2 is as easy as A, B, C.

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STEP A: Take your first year's depreciation of 20% on the amount in **Step 3** above. (Step 3 x 20%)	_____	$379.00	$1,784.60
STEP B: Take this times your tax bracket. (Assume 28%, as above)	_____	$106.12	$499.69
STEP C: Take the savings you calculated in **Step 2** above, and add **Step B** to it. This is your FIRST YEAR savings! Plus, you still get to depreciate the remainder over the next five years!	_____	$784.02	$2,389.69
	Your First Year Savings	**Your First Year Savings**	**Your First Year Savings**

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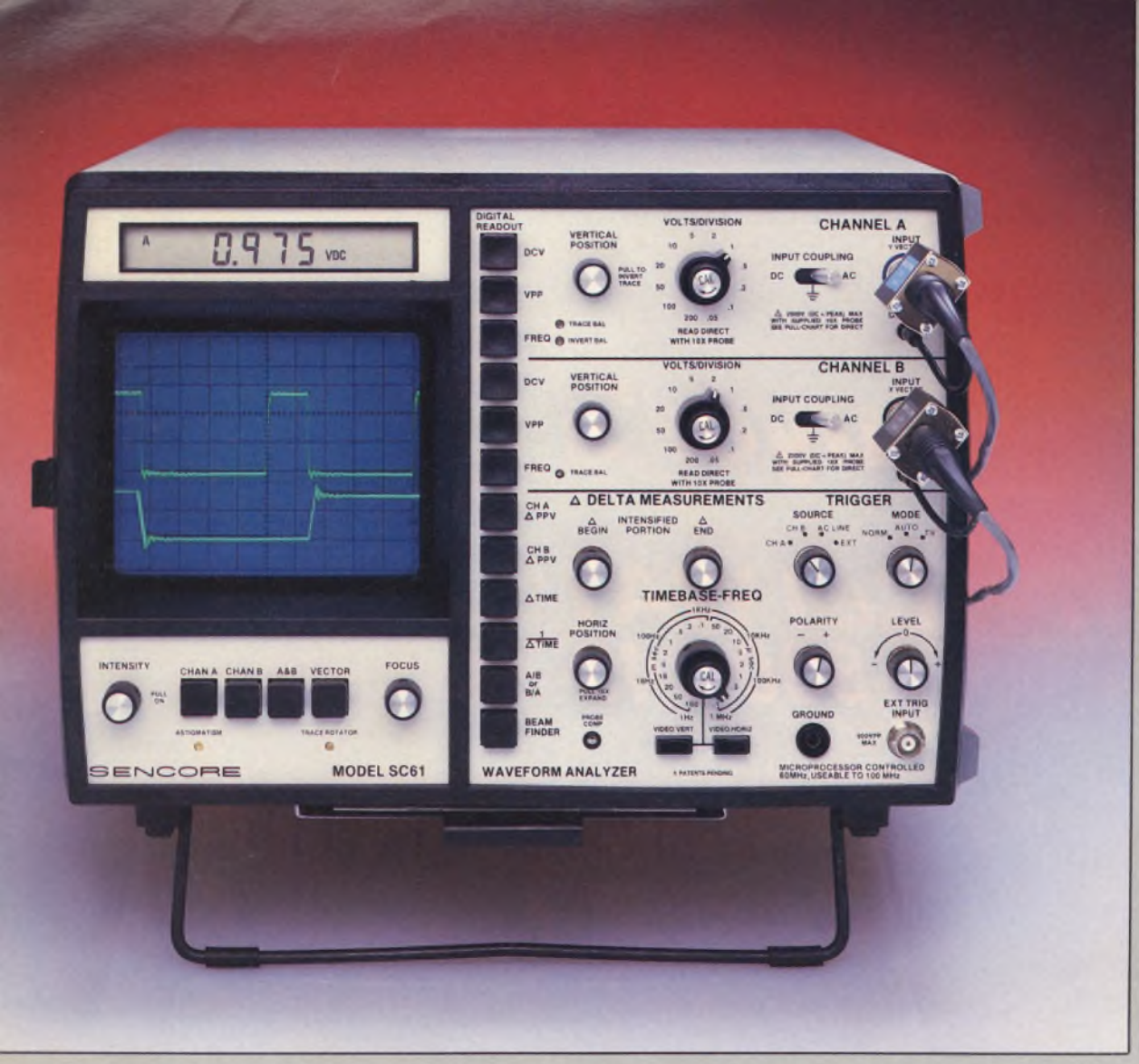

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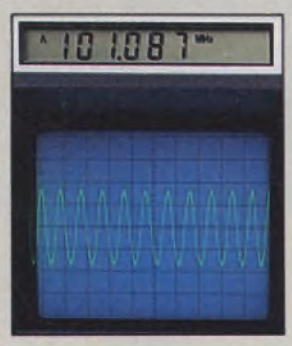
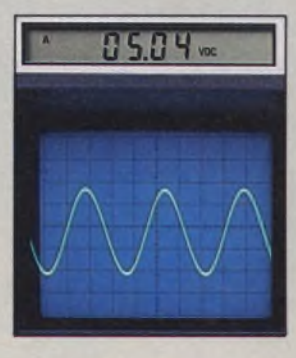


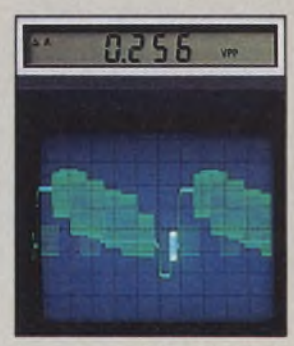
AUTOTRACKING™ Digital Readings Analyze The Whole Signal

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

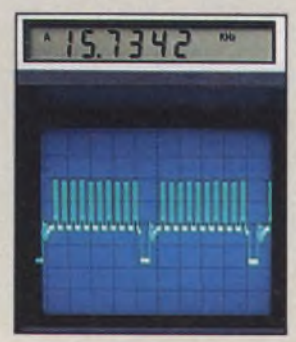


Delta Digital Tests Analyze Any Part Of The Signal.

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

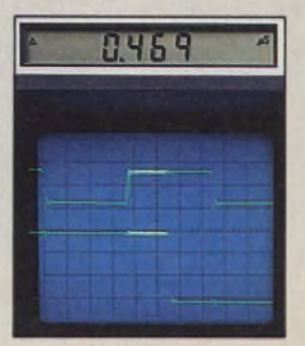


Rock-Solid Sync - ECL Logic Circuits And Differential Amplifiers Give Fiddle-Free Operation. Lock onto tough video waveforms and other evasive signals easily. The SC61 gives you complete control over even the hardest to trigger signals.

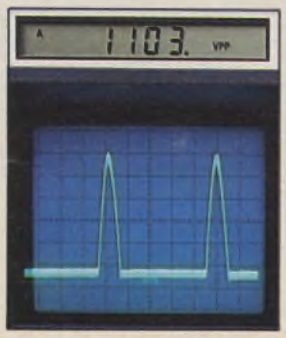


Automatic Peak-To-Peak Volts - Even If Variable Control Is "Out Of Cal". Now, eliminate the errors that are common to conventional scopes. The SC61's Automatic Digital Readout will tell the EXACT level, even if the attenuator is left "Out Of Cal".

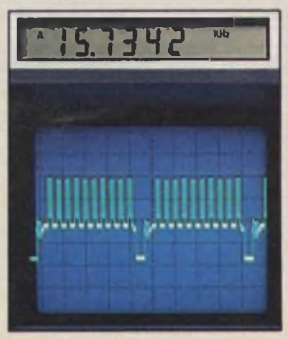
Delta Time For Any Time Reading - Including Delay Between Traces. An easy way to determine the time of any waveform segment or between two waveforms.



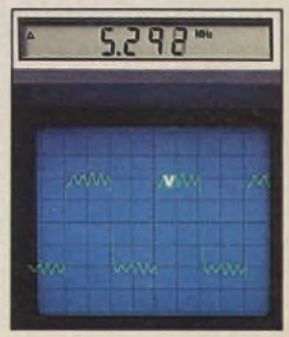
Four Times The Measuring Range - Measure from 5 mV To 2000 Volts (3000 Volts Protection) For Expanded Signal Handling. Now you can confidently measure the pulse on the collector of a horizontal output transistor without the fear of damaging your instrument. Only the SC61 gives you this peace of mind.



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



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



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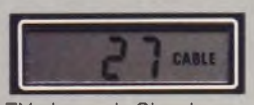
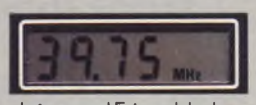


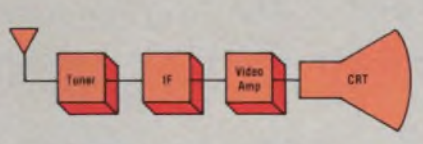
Identify Tuner Problems With All-Channel, VHF, UHF, And Cable RF Generators. The VA62 lets you completely test every TV channel. Simply select "STD TV" for VHF and UHF channels, and "STD CABLE" for all cable channels. Select "PROG CABLE" to duplicate HRC, ICC or any cable carrier shift to test lock-in range.



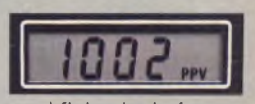
Pinpoint IF Problems With Modulated Troubleshooting Signal And Exclusive Programmable IF/RF Generators. Isolate any IF trouble by simply injecting a signal and watching the picture tube. The fully modulated, crystal referenced, 45.75 MHz IF signal is preset to match the 1st, 2nd or 3rd IF input.

Cable ready TVs and VCRs require accurate IF trap adjustments — the VA62's patented IF trap setting signals allow you to set any IF trap by simply looking at the CRT.

Isolate Any Video Problem With Patented Video And Standard Color-Bar Patterns. Do a complete system check without even taking the back off the TV or cover off a VCR. Exclusive video signals let you dynamically test for video resolution, color circuit response, synchronous detector linearity, and IF performance, plus standard color generator patterns make it easy to learn.



Find Defective Stages, Without Disconnecting Parts, Using Exclusive Phase-Locked Drive Signals. Special drive signals quickly isolate defective stages by injecting into any circuit, and watching the response. No need to disconnect components. The VA62's output circuits automatically "swamp out" the circuit's signal, and replace it with a known good substitute signal.



Test Yokes and Flybacks, Plus Measure Signal Levels With Autoranged Digital Meter. Reliably test expensive yokes and flybacks before replacing them with the patented ringing test. Plus, measure DC volts, Peak-to-Peak Volts, and monitor drive signal levels with the built-in digital meter. Dynamically test IHVTs, too.

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

Expandable: Update For New Technology With Exclusive Phase-Locked Accessories.

VC63 VCR Test Accessory $495

The VC63 Solves The VCR Service Challenge With Substitute VCR Signals, Phase-Locked To Your VA62.

- Isolate Problems In VHS, Beta, and U-Matic Formats
- Find Defective Heads Without Expensive Substitution
- Pinpoint Defective Stages With Exclusive Substitution Signals
- Troubleshoot Color Problems With Special Reference Signals

NT64 NTSC Pattern Generator $495

Add The NTSC Full-Field And Split-Field Patterns To Your VA62 Universal Video Analyzer - Meets All Warranty Requirements.

- Produces EIA RS189 Standard Full-Field And Split-Field Color Bar Patterns
- Meets All VCR Manufacturers' Requirements For Color Bar Generator
- Fully Phase-Locked To All Other VA62 Signals

ST65 Video Analyzer Stereo TV Adder $995

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

- Updates Your VA48 or VA62 Video Analyzer To An Integrated Multichannel Television Sound (MTS) Stereo TV Analyzing System
- Exclusive Phase-Locked Generator Locks The ST65 To Your VA48 Or VA62 For Rock Solid Analyzing
- Makes Stereo And Second Audio Program (SAP) Performance Tests On Any MTS Stereo TV System
- Exclusive Adjustable RF/IF, COMPOSITE SIGNAL and AUDIO Levels Match And Isolate Troubles In Any Stage — Including The Decoder
- The Only Tester Guaranteed To Tie Troubles Down To Any And All Stages

RG67 NTSC Video Monitor Adapter $890

Updates Your VA48 Or VA62 Video Analyzer To Expand Into Analog Digital Monitor Service

- Phase-Locked R, G, B And I Signals Drive Any NTSC Analog/Digital Monitor
- Selectable Signal And Sync Polarity With Adjustable Amplitude To 5 VPP; Matches Any Input
- E-Z Hook™ Leads For Fast Hookup To Separate R, G, B, & I Inputs

E-Z HOOK is a registered trademark of E-Z HOOK, Division of Tektest, Inc.

LC77 AUTO-Z ™

Automatic Dynamic Portable Capacitor And Inductor Analyzer

$1895 Four Patents And One Applied For U.S. Funds

THE Z STANDARD

For The First Time In Electronics Servicing History, You Can Take The Numbers Right Off The Part And Prove, Once And For All, That The Part Is "Good" Or "Bad", To Industry And EIA Standards — Anywhere, Anytime, Without Look Ups, Calculations, Or Error.

IEEE 488 BUS-COMPATIBLE

On GSA Contract NSN #6625-00-557-0399

Automatic Microprocessor Controlled For Accurate Error Free Cap/Coil Analysis

Exclusive Advanced Digital Technology Completely Analyzes Capacitors From 1 pF to 20 Farads And Inductors From 1 uH To 20 Henrys. Test Method (Patented), Dielectric Absorption (Patented)

Automatic Ranging Of Capacitance And Inductance Value, Percentage Calculator, Lead Zero, And Good/Bad Determination

Exclusive Leakage Readings In Current Or Ohms To 1000 Volts And 1000 Megohms

Exclusive Equivalent Series Resistance Test Measures 0.10 Ohms To 2000 Ohms (Patented)

Exclusive Automatic Inductor Ringing Test With Good/Bad Determination (Patented)

100% Battery Operated Portability Lets You Do All These Exclusive Tests Where 115 VAC Is Unavailable Or Hard To Get At

LC76 PORTA-Z™

Portable Dynamic Capacitor And Inductor Analyzer

$1,395 U.S. Funds Four Patents On GSA Contract

Battery Operated, Patented Capacitor/Inductor Analyzer Designed To Locate Defective Caps And Coils Other Testers Miss

Exclusive Capacitor Tests Analyze Value, Leakage At Rated Voltage To 1000 Volts, Dielectric Absorption (Patented), And Equivalent Series Resistance (ESR) (Patented)

Exclusive Inductor Tests Analyze True Inductance Value (Patented) And Ringing (Patented).

100% Battery Operated Portability Lets You Do All These Exclusive Tests Where 115 VAC Is Unavailable Or Hard To Get At

Finds Distance To Within Feet Of Open Or Shorted Transmission Lines

Tests SCRs, Triacs, Hi-Voltage Rectifiers, Diodes, With SCR250 Accessory

Hi-Pot Test Checks Leakage As Low As One Microamp Up To 1000 Volts In Cables, Switches, PC Boards, Connectors, Etc.

LC75 Z METER 2 ™

Dynamic Capacitor And Inductor Analyzer

$995 U. S. Funds Exclusive Four Patents

Patented Cap/Coil Analyzer Designed To Locate Defective Capacitors And Coils That Other Testers Miss

On GSA Contract NSN 6625-01-250-9554

Exclusive Capacitor Tests Analyze Value, Leakage At Rated Voltage, Dielectric Absorption (Patented), And Equivalent Series Resistance (ESR) (Patented)

Exclusive Inductor Tests Analyze True Inductance Value (Patented) And Ringing (Patented)

Finds Distance To Within Feet Of Open Or Shorted Transmission Lines

Tests SCRs, Triacs, Hi-Voltage Rectifiers, Diodes, With SCR250 Accessory

Checks Leakage As Low As One Microamp Up To 600 Volts In Cables, Switches, PC Boards, And Connectors

SCR250

SCR And Triac Test Accessory

$168 U.S. Funds On GSA Contract

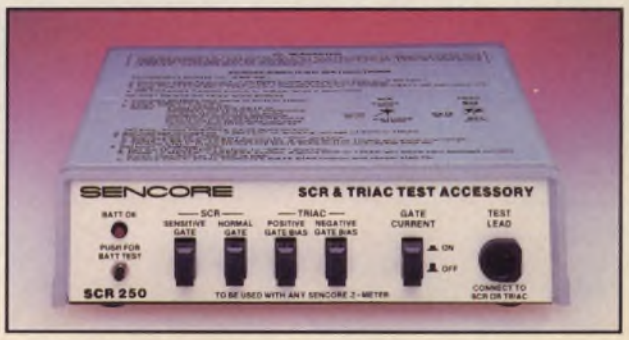
Dynamically Test All SCRs And Triacs For Leakage And Turn-On With 100% Reliability, With Any Sencore Z Meter

Tests All SCRs And Triacs

Exclusive Dynamic Leakage Test At Applied Voltage

Easy To Use, No Set Up Or Specifications Needed

Tests Industrial And Protected Gate SCRs And Triacs, Too



FS74 CHANNELIZER SR.™ TV-RF Signal Analyzer - $3,495 U.S. Funds Patented

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.

IEEE 488 Bus Compatible
On GSA Contract

IEEE 488 BUS-COMPATIBLE

All Channel Digital Tuner — Tunes In Any Cable, HRC, ICC, VHF, UHF, and FM Channel. The FS74's digital tuner lets you tune in all sub-band, cable, VHF, UHF, and FM frequencies from 5 MHz to 890 MHz. The FS74's unique circuits test the carrier frequency and displays the carrier offset with 1 kHz resolution. HRC and ICC offset lets you confirm correct shifts at the flip of a switch.

Exclusive 5 Microvolt (–46 dBmV) Sensitivity With Automatic Attenuation and Ranging For Fast Hands-Off Operation. Troubleshoot from the head-end or antenna to the subscriber tap with full range from –46 dBmV to 60 dBmV. The FS74 automatically selects the proper attenuator range for instant measurements.

Exclusive Automatic Tests, Even On Fully Modulated Channels. Microprocessor technology now lets you fully test each channel without dropping modulation or carrier. Perform these tests automatically:

- Audio-to-Video Carrier Ratio Test - Direct meter reading confirms the required 15 dB A/V.
- Hum Test On Any In-Use Channel - Measure percentage of hum on any channel, automatically.
- On-Channel Signal-to-Noise Test - Exclusive, patented signal-to-noise tests WITHOUT tuning to an unused channel.
- Digital Readout Of Frequency Offset - Determine the exact location of your carriers.

Exclusive Picture Quality Check With Integrated Wide Band Video Monitor — Isolates Problems Meters Can't Show. No other Field Strength Meter gives you this unique

problem locator. The FS74's monitor gives you 4 MHz (320 horizontal lines of resolution) response to track down problems that regular meters and portable TVs miss.

Exclusive ACV/DCV Measurements Through RF Input Or Special DVM Input — No Need To Carry Additional Test Instruments. Leave your volt-ohm-milliamp meter at the shop, because the FS74 gives you complete voltage measurements, even through the RF input! Plus, the FS74 has a special low level ohmmeter to test for contact resistance.

FS73 CHANNELIZER JR.™ TV-RF Performance Tester - $2,395 U.S. Funds Patented

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

On GSA Contract
IEEE 488 Bus Compatible

IEEE 488 BUS-COMPATIBLE

All Channel Digital Tuner - Tunes In Any Cable, HRC, ICC, VHF, UHF, And FM Channel. The FS73's digital tuner lets you tune in all sub-band, cable, VHF, UHF, and FM frequencies from 5 MHz to 890 MHz.

Exclusive 5 Microvolt (–46 dBmV) Sensitivity With Automatic Attenuation And Ranging For Fast Hands- Off Operation. Troubleshoot from the headend or antenna to the subscriber tap with full range from –46 dBmV to 60 dBmV.

Exclusive Automatic Hum And Signal-To-Noise Tests On Any In-Use Channel. The FS73 lets you perform these dynamic tests on any in-use channel. No more need to tune off of a used carrier.

Microprocessor Controlled Fine Tuning With Readout Of Frequency Offset. Test for HRC, ICC, or any carrier offset with the FS73. The FS73 lets you easily determine where your carriers are - quickly and accurately.

IB72 IEEE 488 Bus Interface Accessory $625 U.S. Funds

Interface Selected Sencore Instruments To Personal Computers And Instrument Controllers For Automatic Testing And Time Savings

Interfaces Selected Sencore Instruments To The IEEE 488 Bus For 100% Automatic Testing.

Selectable Address, External Reset, And Data Indicator LED Aid Program Development And Debugging.

Meets IEEE Standards 488-1978 (Electrical) And 728-1982 (Data).

IEEE 488 BUS-COMPATIBLE

CR70 "BEAM BUILDER"™

Universal CRT Analyzer and Restorer - $1,295.00 U.S. Funds Patented

For The First Time Ever, Test Every CRT On The Market — Now And In The Future — Plus Restore 90% Of All Weak Or Shorted CRTs, Guaranteed, Or Your Money Back

On GSA Contract NSN #6625-01-187-4395

Test Every CRT (Old Or New) On The Market — No Need To Buy Additional Sockets. The CR70's setup switches and universal adaptor eliminate the need to continuously buy additional sockets to update your tester. Test every type of CRT in use today:

- All Black and White and Color Video CRTs
- Projection CRTs
- Computer Display CRTs
- Closed Circuit Video CRTs
- Camera Pickup Tubes — Broadcast, Industrial and Surveillance
- Even Scope, Radar and Other Industrial CRTs

Exclusive Tests Cover CRT's Full Dynamic Range, From Cutoff To Peak Emission — For Highest Test Reliability. The CR70 gives you test results you can trust. The CR70 measures true beam current over the full operating range of the CRT from black (cutoff) to white. Plus, the CR70's patented color tracking test gives a direct Good/Bad comparison of all three guns of a color CRT, or all three CRTs of a projection system to confirm proper balance. Pinpoint shorts instantly with the CR70's sensitive H-K and G1 short tests.

Guaranteed To Safely Restore 9 Out Of 10 Weak or Shorted CRTs — Or Your Money Back. Profitably restore 90% of all weak or shorted CRTs — which would otherwise need to be replaced. Our "AUTO RESTORE" and progressive restoration eliminates the worry about "Zapping" the tube too hard and losing the CRT.

Guaranteed To Be Totally Protected From Damage From Charged CRTs — Keeps Your Investment Working For You. The CR70 is fully protected against high voltage kick backs from charged CRTs that damage other CRT testers.

PR57 AC "POWERITE" ®

Variable Isolation Transformer And Safety Analyzer - $495 U.S. Funds Patented

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

NSN #6625-01-124-6296

Variable Isolated 470 Watt Power Transformer To Isolate Your AC Line And Vary Your Output Voltage From 0 To 150 Volts. Lower the AC line voltage to pinpoint tough startup and shutdown problems. Raise the line voltage to sweat out intermittents.

Voltage, Current And Wattage Power Monitor To Determine That The Equipment Under Test Is Not Drawing Excessive Current (Or Wattage) At Any Voltage Setting. Determine problems before they happen by monitoring current and power. Monitor voltage and identify AC line problems like width, sync and intermittents in the customer's home.

AC Line Leakage Safety Tester To Assure That Excessive Leakage Current Is Not Present On Any Exposed Part On The Equipment Being Tested. Protect your customer and yourself. This exclusive AC leakage test is required by many manufacturers, and is an inexpensive way to avoid potential liability suits from shocks received from a "Hot" set. Plus, since you provide a service for the customer, you can charge extra and make a nice profit on this quick, but vital test.

CG25 Little Huey ™

Portable Digital Color Bar Generator - $198.00 U.S. Funds

Rock Solid Digital Patterns In A Small, Portable, Battery Operated Package

On GSA Contract

Built Rugged For Field Use — With Built-In Test Leads.

Big Generator Features With Variable Dot And Adjustable Channels.

Automatically Shuts Off After 20 Minutes So Your Batteries Don't Run Down.

ST66 Stereo TV Analyzer™

$1,395 U. S. Funds Patented

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

On GSA Contract

It's A Completely Portable, Battery Operated MTS Stereo TV And VCR Analyzer. Completely test and troubleshoot MTS and SAP audio in any TV or VCR, plus you can performance test the video circuits, too. Portable features let you test hard to move MTS ''Big Screen'' TVs in the customer's home.

All The Special Signals You Need To Performance Test And Service MTS Stereo TV — Stereo Decoder, SAP And Audio. Test all the special audio circuits in MTS with provided signals. Test for separation, threshold level, and frequency response.

Quickly Eliminates The RF/IF Section As A Source Of Trouble — Test From The Antenna To The Speakers/CRT With One Simple Connection. Special RF, IF and drive signal outputs let you use signal substitution to easily track down and isolate defective MTS stage.

Exclusive Video Patterns To Service The Entire Stereo TV From The Antenna To The CRT. The ST66's special video patterns let you diagnose video problems from the tuner to the CRT.

Surpasses All Others On The Market In Performance, Price, Portability, And Reliability. No other MTS generator gives you all these features, and no one gives you the ability to troubleshoot MTS circuits like the ST66. The best price/performance value on the market today.

SR68 Stereo TV Readout

$595 U.S. Funds

Dual Meters And Loads To 100 Watts Solve Stereo TV Servicing Challenges

On GSA Contract

Analyze Stereo TV Audio Line Or Speakers In dB Or Watts. Confirm both stereo channels are matched and working correctly. Dual meters read out in watts in two ranges (0 to 10 or 100 watts).

Loads To 100 Watts For Dynamic Tests And Speaker Substitution. Keep your shop peaceful and quiet by replacing your monitor speakers with special non-inductive dummy loads. 20 watt continuous, 100 watt cycled ratings let you dynamically test at rated output. 4, 8, 16 and 32 ohm loads match any system. Special line-level (10 kohm) input for VCRs and TVs with line outputs, too.

Measure Channel Separation To –40 dB Without Calculations. Separation test, calibrated in dB to –40 dB confirms stereo decoder is set for best performance.

Battery Operated - Use In The Shop Or In The Field. Take the test right to the job for projection systems and built-ins. Audio-off circuits save your battery if you forget to turn unit off.

SG165 AM/FM Stereo Analyzer

$1,295 U.S. Funds

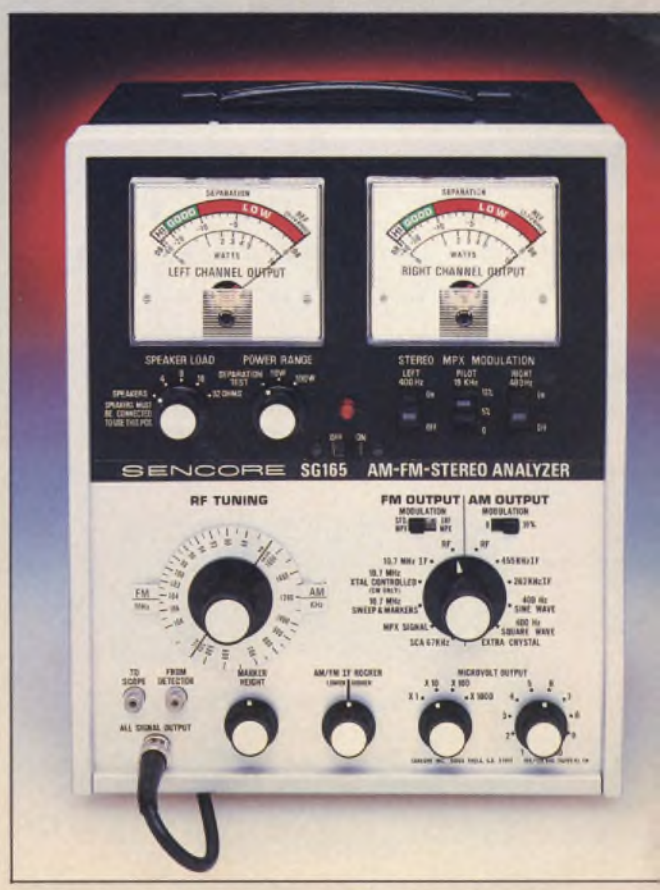
Designed To Boost Your Audio Troubleshooting Efficiency — Everything You Need To Completely Analyze/Service An AM/FM Stereo Receiver

On GSA Contract

Provides Every AM/FM Stereo Signal Needed For Efficient Analyzing. The SG165 supplies signals needed for efficient analyzing. Sencore's unique signal substitution technique lets you pinpoint defective stages anywhere in the stereo for fast troubleshooting.

It's Five Generators In One — RF/IF, Audio, Stereo MPX, Sweep/Marker, And SCA. Completely test and troubleshoot the tuner, IF section, stereo decoder for separation, and audio circuits, from the antenna to the speakers.

Dual dB, Watt, Stereo Separation Meters With Built In 100 Watt Speaker Loads For Complete Amplifier Testing. Two meters read dB, Watts, and stereo separation with built-in 100 Watt speaker loads for complete amplifier testing. Loads eliminate annoying howl from shop speakers. Easy to read meters let you test for separation quickly and accurately.



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

FC71 Portable 10 Hz To 1 GHz Frequency Counter

$1,295 U.S. Funds Patented

The Only Portable, Battery Operated Counter Especially Designed With An Exclusive Microprocessor Controlled Timebase To Measure 10 Hz To 1 GHz To 0.5 PPM Accuracy In High RF Environments

On GSA Contract NSN #6625-01-076-2595

Five Times More Accurate Than FCC Requirements, Even On The Toughest Job; 0.5 PPM. The FC71 is more accurate than FCC requirements, even on the cellular telephone system; 0.5 ppm. Plus super stable .5 ppm/year aging from 10 Hz to 1 GHz; reads to .01 Hz resolution in 1 second.

Exclusive Microprocessor Timebase For Super Stability From – 12 F to 122 F. Microprocessor compensated timebase gives 9.5 hours of accurate readings on every charge, so you make FCC accurate readings all day long.

Measures All Signals, Even Complex And Noisy Signals, With Exclusive Sensitivity Control. Exclusive snap action amplifier input allows you to count signals like AM, FM, Digital signals with ringing, and noisy signals that cause other counters to give random readings.

Super 5 mV Average Sensitivity Over Full Range. Measure the smallest signals with the best sensitivity on the market.

Double Shielded For Interference-Free Frequency Measuremnts Anywhere. Measure in high RF environments, even right next to the transmitter.

Automatic Crystal Check Tests The Fundamental Frequency Of Any Crystal. Test any crystal as ''good'' or ''bad'' to eliminate guesswork in oscillator circuits.

Frequency Ratio Test Compares Two Frequencies And Displays The Ratio Directly. Simplifies troubleshooting in digital counter and RF multiplier circuits.

Automatic Readings With IEEE 488 Computer Interface, IEEE 488 Bus Compatible. Record any reading with a computer.

TF46 ''Super Cricket''

Portable Transistor/FET Tester $495 U.S. Funds Patented

Automatically Tests Any Transistor Or FET With 99.9% Reliability In Less Than 15 Seconds — In Or Out-Of-Circuit

On GSA Contract NSN #6625-01-058-9564

Portable Battery Operation So You Can Completely Analyze A Transistor Or FET Anywhere.

Needs No Set-Up Book Or Instructions. Connect the 3 leads in any order and rotate the permutator switch to dynamically test any transistor or FET. The TF46 identifies transistor type, polarity, and basing if you need to identify leads.

Automatic Power Shut Off After 20 Minutes' Use; Saves Your Batteries.

DVM56A ''MICRORANGER''

Automatic 4 1/2 Digit DVM. $995 U.S. Funds Patented

100% Automatic, Microprocessor Controlled, 3, 4, or 4 1/2 Digit DVM, Designed To Save You Time With The Fastest Measurements On The Market Today

100% Error Proof, You Can't Make A Mistake, Even If You Operate Everything Backwards.

The DVM56A Makes Tests For You That No Other Single Meter Can Make. The only meter with all 5 types of AC: PPV, average RMS, decibels and programmable dB. Plus, DCV to 2 kV, both high and low power ohms and AC or DC current.

Tough, Fully Protected To 10 kV; Better Than Any DVM On The Market. With input protection like that, you're guaranteed that your DVM56A will be with you for a long time to come.

DVM37 3 1/2 Digit, 0.1% Bench/Portable Digital Multimeter

$395 U.S. Funds Patented

Fully Protected, Super Rugged Digital Multimeter You Can Use Anywhere

An Indestructible DVM For Both Bench And Field. With the DVM37 you can drop it, kick it, carry it by the test leads, and it will keep on performing for you, anytime, anywhere.

0.1% Lab Accuracy In A Portable Meter For Measurements You Can Count On.

15 Megohm Input Impedance For Least Loading Error Especially In High Impedance Circuits.

Protected Inside, Too, Better Than Any Other DVM On The Market To 2 kV DC With 8 kV Transient Protection And To 10 kV With TP212 Probe.

Customers Rate Sencore Service Department "Number One"

by Bob Van Kirk, Service Manager

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 rate our Factory Service number one.

Return Authorization

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

Wats Free Assistance

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

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. Downtime can be held to a minimum with these flexible arrangements.

Three-Day Turn Around

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 turn-around.

▲ *Your serviced instrument is refurbished and quality checked just like new units. Then returned in new packaging — at no extra cost.*

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.

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

Made Right Guarantee Coverage

As our 100% Made Right Lifetime Guarantee states, we cover all workmanship defects. That 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.

NBS Traceable

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

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.

▲ *72 hour turn-around on service repairs and 48 hours on parts is only a phone call away.*

The next time you compare services, pull this article out and see if we fit the title of the Number One Service provider. I think we will.

Service Questions

Please call **Wats Free, 1-800-843-3338.** ■

Career Opportunities At Sencore

"Where You Make The Difference . . ."

Garrett Carter
Sales Manager

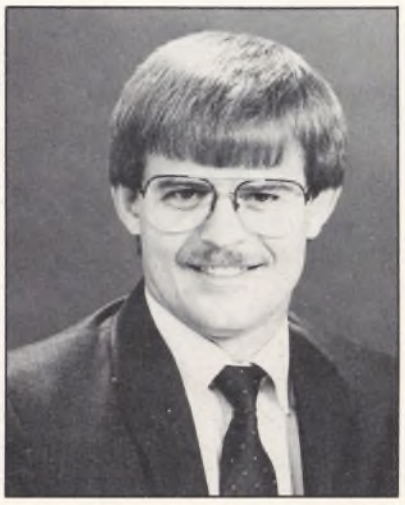
As we move towards the 1990's, marketing opportunities and competitive challenges have never been greater. Sencore believes that PEOPLE make the difference in helping us maintain our competitive edge. People like Garrett Carter, Sales Manager; Tom Archer, National Accounts Manager; Rob Barden, Merchandising Manager; Hank Moser, Team Manager; Mike Pursel, Government Sales Manager; and Rick Bertrand, Phone Sales Engineer, have met exceptional challenges in the Sales and Marketing Division through their own personal initiative and professionalism. We're looking for others like them - originals - and there aren't very many. If you think you might be one of them and would like a chance to have a profitable career opportunity in Sales, we'd like to hear from you. We offer an aggressive draw commission program with the potential for unlimited income and an impressive benefits program.

At Sencore, only exceptional people will help us meet exceptional challenges.

Call our toll-free number **1-800-843-3338** and ask for Barbara Streemke or send your resume and salary requirements to: Sencore, Human Resources Department SN, 3200 Sencore Drive, Sioux Falls, South Dakota 57107.

Tom Archer
National Accounts Manager

Rob Barden
Merchandising Manager



Hank Moser
Team Manager

Mike Pursel
Government Sales Manager

Rick Bertrand
Phone Sales Engineer

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2. _____ Serial # _____

Additional: _____

☐ **YES,** I plan on investing in the following Sencore instruments, please send me my free subscription. _____

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☐ **YES,** I would like a subscription to the Sencore News, but I do not plan on investing in Sencore instruments in the next 12 months. Enclosed is $20.00 for my 12 month subscription.

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MAIL TO: Sencore, Inc.
ATTN: Promotion Dept.
3200 Sencore Drive
Sioux Falls, SD 57107

How To Troubleshoot VCR Sensor And System Control Problems With Your SC61 Waveform Analyzer™

by Rick Meyer, Application Engineer

> "We often suspect the microprocessor as the cause of a system control problem — in most cases the problem is in the safety circuits . . ."

VCR servicers tell us that system control problems are one of their most frequent VCR servicing problems. The microprocessor is the heart, or mind, of the VCR system control. Failures, however, are more often associated with circuits external to the microprocessor (attested to by servicers who have replaced the micro unnecessarily). The VCR safety circuits are often the culprit in the dead or non-functioning VCR. Many of these safety circuits use sensors that either fail entirely or appear to be intermittant. In this article we will show you how to troubleshoot some typical system control problems using your SC61 Waveform Analyzer.

The Microprocessor Is The Mind Of The VCR

The microprocessor controls all of the functions of the VCR. It receives data from the front panel keys identifying what the customer wants the VCR to do. It uses this information to tell the various motors, servos, and electronic circuits when and how they should operate.

The microprocessor also collects data from various safety circuits which monitor the operation of the VCR and the status of the video tape. These safety circuits use sensors to monitor what is happening inside the VCR. You could say that these sensors are the "eyes" of the microprocessor. The sensors interface between the mechanical world of the video tape and the electronic world of the microprocessor. If any one of these sensors fails, the microprocessor receives incorrect data about the functioning of the VCR. In most cases, the program in the microprocessor takes the safest course of action; it shuts the VCR off.

Seven Key Safety Circuits Tell The Microprocessor How The VCR Is Functioning

There are seven basic safety circuits that monitor the operation of the VCR.

1. CYLINDER LOCK - Checks for rotation of video heads.
2. CASSETTE SWITCHES - Verifies the position of the cassette.
3. END SENSORS AND LIGHT TOWER - Checks for end of tape.
4. REEL SENSORS - Checks for rotation of take-up reel.
5. MODE SWITCH - Makes sure tape is properly loaded around drum.
6. DEW SENSOR - Checks for excessive moisture.
7. RECORD SAFETY SWITCH - Prevents recording on protected tapes.

An incorrect signal, from an operational problem in the VCR or a defective sensing circuit, will cause the microprocessor to turn the VCR off.

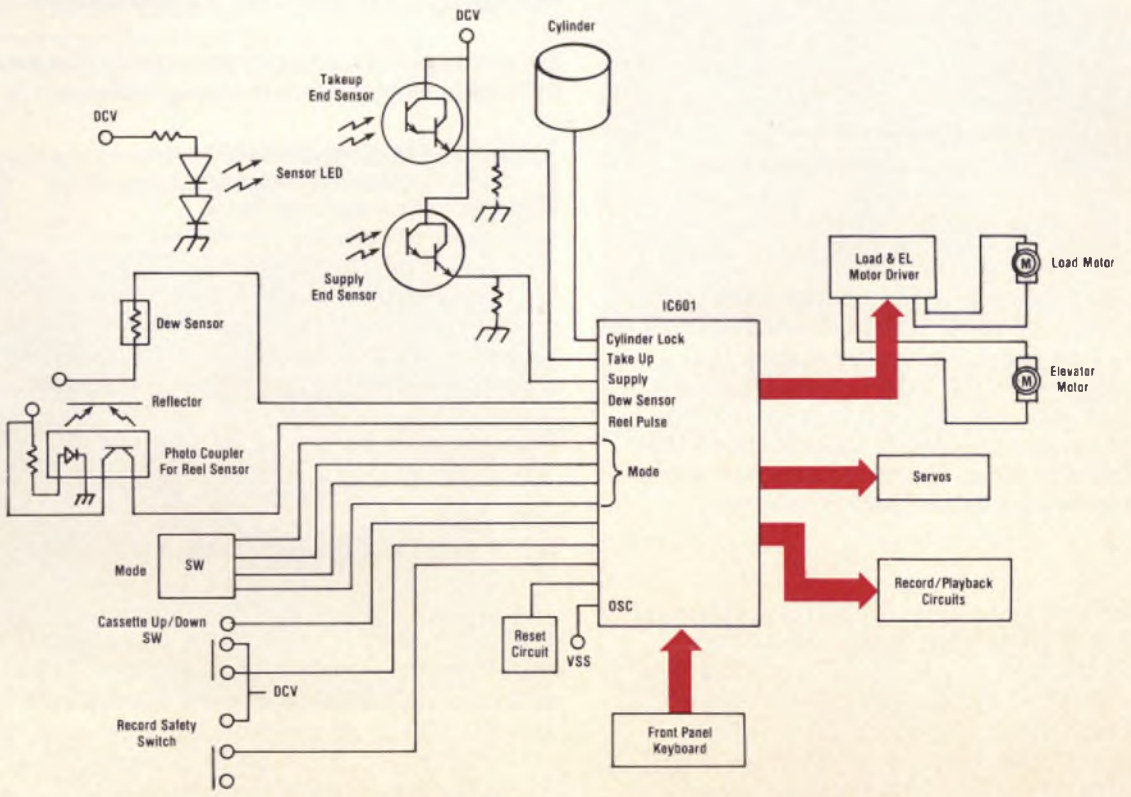


Fig. 1: The system control microprocessor takes data from the safety circuits and front panel controls and uses this data to control the operation of the VCR.

A Five Step Process Verifies If The Problem Is In The Microprocessor Or In The Safety Circuits

System control problems cause the VCR to either malfunction, or more often, not function at all. We often immediately suspect the microprocessor as the reason for a system control problem. In most cases, however, the problem is associated with the safety circuits.

There is a fool-proof five step process for troubleshooting microprocessors to determine if a microprocessor is good or bad. These five steps are:

1. Check the power supply
2. Check the clock
3. Check the data in/data out lines
4. Check for a reset pulse
5. Check for bad grounds

A more detailed description of how to do these five steps is found in the Sencore Tech Tip #109. You can get this tech tip by calling our toll free number 1-800-843-3338.

In many cases, the cause of the system control problem will be found in step three of this five step microprocessor troubleshooting method. Steps 1 and 2 should be done first, however, since a properly operating power supply and correct clock frequencies are essential for any operation of the microprocessor.

The Symptoms Can Often Identify Where The Problem Is

If the VCR functions, at least in part, its operation can often give important clues to the cause of the problem. For instance, a VCR that loads the tape, begins to play, and then shuts off again, often has a reel sensor problem. The reason it does this is that the microprocessor senses that tape is not being taken up on the take-up reel and assumes that it is therefore piling up inside the VCR. Its best course of action is to shut off. Of course, the microprocessor can not distinguish between a reel that is not turning and a sensor that is no longer working. In either case, the microprocessor assumes that something is wrong.

As another example, a VCR that loads the cassette, but won't wrap the tape around the video drum, may have an end sensor problem, or the cylinder may not be turning. The specific symptoms that occur may be somewhat different from one VCR to another. By looking at the symptom and doing some reasoning, we can usually get a good idea of where to look.

The cause of a specific symptom can often be identified by looking at a system control timing chart or a flow chart. These charts show the actions taken when the VCR is placed in each mode. Each action in the VCR is preceded by a testing of various sensors. If the test shows that everything is in order, the microprocessor sends the appropriate signals to perform the next operation.

Troubleshooting of a system control problem can be speeded up by testing the sensor inputs preceding the next step to be accomplished. For instance, if the VCR loads the cassette but won't load the tape, we should check the data line telling the microprocessor that the video heads are rotating. If this signal is good, we should look up the flow chart and check the output from the end sensors. We continue this process until we locate the defect.

The Microprocessor Must Have The Correct Logic Levels To Operate Properly

Digital circuits, and in particular microprocessors, operate with logic high and logic low signal levels. These logic levels must be distinct or the microprocessor will confuse one for another (see page 28).

The characteristics of a defective sensor can often result in an output that is in the questionable voltage area (neither high nor low). In the case of mechanical switches, high contact resistance can cause a voltage to either not go to ground or not come completely up to the power supply voltage, depending on the design of the circuit. If the voltage fed to the switch is low, the voltage output from the switch will also be low and a logic high may fall in the questionable area. In the case of photo-coupler and hall-effect sensors, the power supply voltage may be low, the sensor may be leaky, or the sensor may not completely turn on. In any one of these conditions, the output voltage can end up in the questionable area.

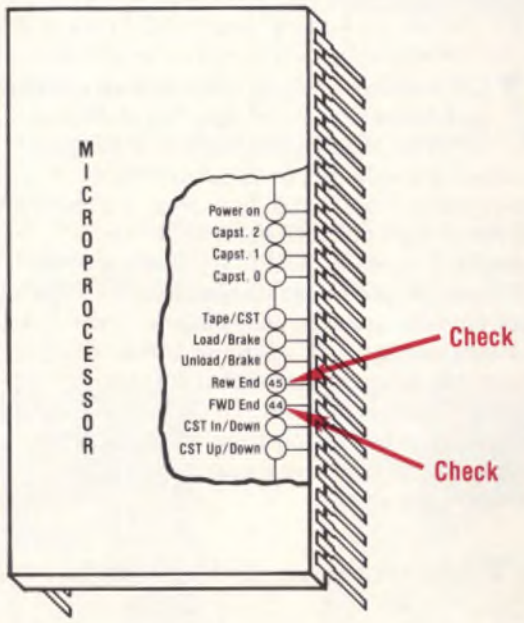


Fig. 2: The input signals were tested at the microprocessor control pins to check for proper level as well as their presence.

Your SC61 Waveform Analyzer Can Speed System Control Troubleshooting

Several types of measurements need to be made to troubleshoot system control problems.

1. DC voltage measurements
2. AC voltage measurements
3. Frequency measurements
4. Viewing of complex waveforms

With your SC61 Waveform Analyzer you can make all of these measurements with one probe hookup. Let's look at a couple of examples of actual VCR system control problems and see how fast they were troubleshot using the SC61 Waveform Analyzer.

The Case Of The Ejecting VCR

One day we were setting up our equipment for a Sencore Update 88 TV/VCR Seminar. After the equipment was set up, we checked everything out to make sure it was properly set up and working correctly. When we pushed a video cassette into our demonstrator VCR, an RCA model 625, it loaded the cassette and then immediately unloaded it again. We didn't get too concerned because this often happens. Our demonstrator had all the covers removed and often exhibited this condition due to stray room light hitting the sensors. We confidently placed a box over the sensor to cut out the room light and pushed the video cassette back in. The VCR loaded the tape and promptly unloaded it again. Our confidence immediately turned to deep concern. There was only an hour before the seminar was to start and the success of the seminar depended upon the use of our demonstrator VCR.

Whatever we were to do at this point had to be done fast. We immediately reached for the SC61 Waveform Analyzer and a schematic. Since this was a system control problem, we decided to practice what we teach. We went through the five step microprocessor troubleshooting method.

We first checked the power supply. The SC61 Waveform Analyzer gave us all the tools we needed to completely and quickly analyze the power supply. We placed the SC61 test probe on the power pin of the microprocessor, and pressed the DCV button on the SC61. The digital LCD display promptly read out 10.30 volts. We had power to the microprocessor. We looked at the CRT on the SC61 and observed a straight line. Visually, it looked like the power supply line was clean. Just to be sure, however, we pressed the SC61's VPP button; the display now read 0.067 VPP. This verified to us that there were no high frequency spikes on the power supply that we could have overlooked by simply observing a CRT trace. Both the DC voltage and peak-to-peak voltage readings were well within limits and we could rest assured that the microprocessor was not being upset by power supply spikes.

We next checked the clock. We moved the SC61 test probe to the clock pin on the microprocessor and pressed the FREQ button. The display read out 479.541 kHz, well within the normal frequency range for this VCR. Step two of the five step microprocessor troubleshooting procedure passed with flying colors. Less than a minute had passed.

Our next step, in the five step troubleshooting procedure, was to check the data in/data out lines on the microprocessor. We suspected that one of the safety circuits was causing the eject problem. Since the symptom looked identical to the symptom of too much light on the end sensor, we decided to check these sensors first. A quick review of the schematic showed that the forward end sensor was connected to pin 44 of the microprocessor and the rewind end sensor was connected to pin 45 (Figure 2). We connected the A channel probe to pin 44 and the B channel probe to pin 45. We pressed the A channel DCV button on the SC61 and the digital display read out 9.91 volts, a good healthy logic high. When we pressed the B channel DCV button, the digital

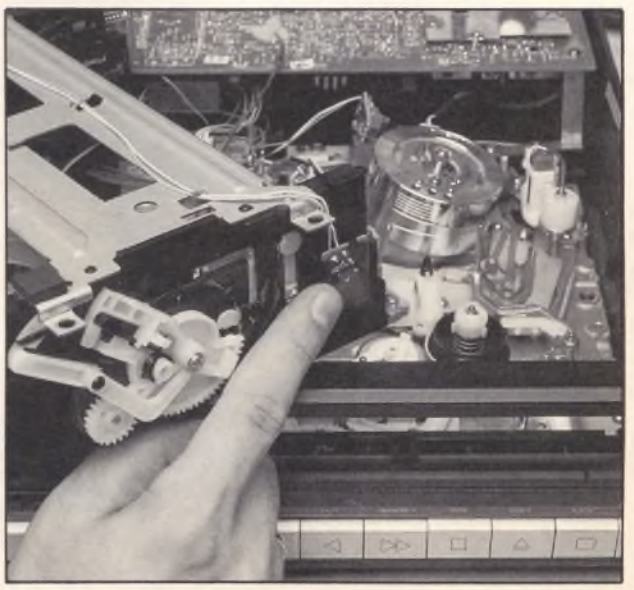


Fig. 3: A quick check of the VCR circuits using the SC61 Waveform Analyzer showed that one end sensor was leaky.

meter quickly displayed 9.89 volts, again, a good healthy logic high. This made sense. The VCR was on, and the cassette was out. Both sensors were receiving light from the light tower and should be at a logic high level.

We covered the forward sensor so that no light could strike it. The A channel trace immediately dropped to a lower level on the CRT. But was it low enough? Was it below the questionable area for a logic low? We quickly found out by using the digital DC voltmeter on the SC61. We simply pressed the A channel DCV button and read 0.06 volts; well below the questionable logic level.

We next covered the rewind sensor and looked at the CRT on the SC61. The logic level did not change. When we pressed the B channel DCV button, we found that the voltage was still over 9 volts. Aha!!! The culprit! We unsoldered the wire from the rewind end sensor and grounded it. When we now inserted the video cassette into the VCR it stayed in. Pressing the play button confirmed that all other functions were working properly.

We gave our seminar that night with the rewind sensor line grounded. The next day we stopped by a parts house and got a replacement sensor. Thanks to the SC61 Waveform Analyzer, this system control problem was quickly solved. The day, or rather, the night was saved.

Another VCR, Another End Sensor?

A few weeks later we were setting up for another VCR seminar. We set up our Panasonic PV-1330 VCR which we used to show video tapes. When we inserted the video cassette, the VCR loaded the tape and then unloaded it again. We had just fixed a similar problem in our demonstrator VCR a few weeks ago and expected this to be a quick fix. We'll just go in, find the bad end sensor and jumper it out.

We took the cover off the VCR and looked for the end sensors. We weren't sure which one was defective so we simply hooked up the SC61 test probe to one of the end sensors. We observed the CRT and found digital pulses on the end sensor output signals. A digital voltmeter wouldn't work here. We looked at the schematic and found that the LED light tower was being modulated with pulses. The light hitting the end sensor should have a similar pulse; it did. This verified that the end sensor was working. Just to be sure it was good, however, we checked the amplitude of the pulse using the peak-to-peak meter on the SC61. We pressed the VPP button and the LCD display read out 2.91 VPP, a good healthy pulse. We next placed our finger over the sensor and the output dropped to 0.19 VPP. The sensor was definitely good.

Aha!! The other sensor must be defective. Just to be sure, however, we hooked the SC61 probe onto the other sensor. That's strange? This sensor also had a healthy pulse on it. We covered up the sensor and the pulse disappeared. What!!! It was good, too. Maybe this won't be so simple after all, we thought to ourselves. Time to regroup.

We went back to our five step troubleshooting procedure and checked the power supply and clock on the microprocessor using the DC volts, peak-to-peak volts and frequency functions of the SC61. Everything was working as it should be.

We were, again, to step three of our five step microprocessor troubleshooting procedure. We needed to check the data in/data out lines. What, besides the end sensors, could be causing the cassette to eject? A review of the block diagrams for the VCR showed that the only other sensors that were operating when the video cassette was pushed in were the cassette in, cassette up/down and dew sensors. We monitored these switches as the cassette went in and out and everything looked normal. What could the trouble be?

The only other signals to the microprocessor were the front panel switches. This type of VCR used a scanning method of checking the front panel switches. Data was output on 4 scan lines and received back on 6 data lines. With no buttons pushed, there should be no activity on the data input lines. We pressed the VPP button on the SC61 and quickly probed the 6 data lines with the SC61. When we got to data input line 2, the digital meter suddenly displayed 3.2 VPP. Slowing down the timebase on the SC61 verified that there were pulses on the data line. But there shouldn't be any? We left the probe hooked onto data input line 2 and probed the 4 scan lines with the other probe. When we got to scan line 3, the pulses lined up. Looking at the schematic, we followed scan line 3 and data line 2 back to the switches and they came together at the eject switch. Obviously!!! A careful examination showed a shorted eject switch. So much for symptom/cure this time!

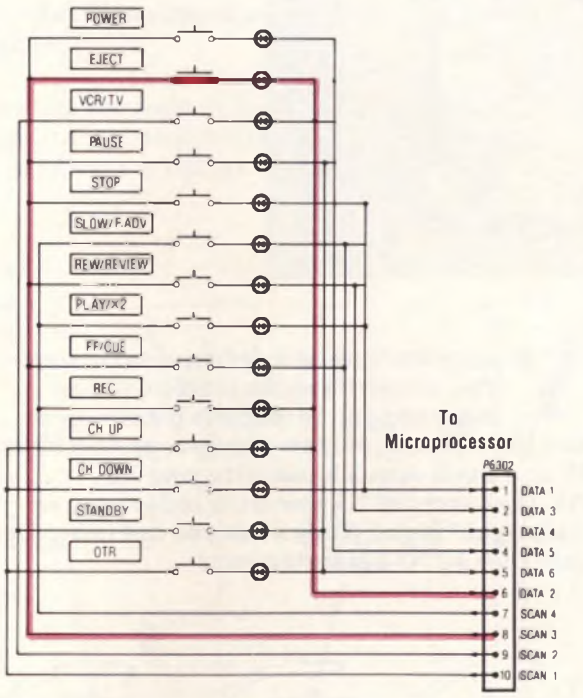


Fig. 4: A pulse on one of the data lines with no buttons depressed indicated a problem in the front panel keyswitches.

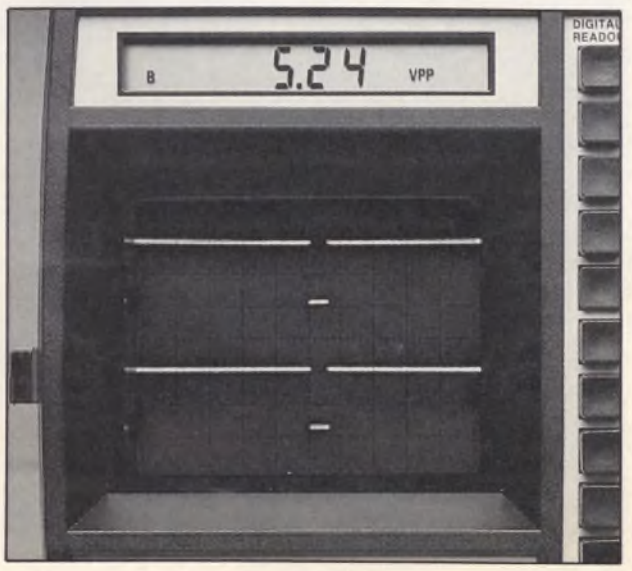


Fig. 5: The scan lines for the front panel switches were checked with the SC61 to find out which line was being fed through a switch. It was then a simple matter to verify that the eject switch was defective.

Troubleshooting An Intermittant VCR

An employee brought in a Marta model MVR2000 VCR that would play for a while and then unload the tape from the video drum and quit. No one, in particular, was excited about working on it! Oh well, everyone needs a challenge now and then.

We first hooked the VCR up to a television, inserted a tape and pressed play. Sure enough. It played. We let it play and after about a half hour passed, it unloaded the tape from the video drum and quit. Well, we had confirmed the symptom anyhow.

We decided to again start with the five step troubleshooting procedure. We hooked up the SC61 probe to the power supply pin and quickly checked for both DC voltage and ripple. The DC voltage was good and the ripple was minimal. We next started checking the data in/data out lines. The output of the end sensors was good. They both read below 0.2 volts giving a definite logic low as they should. We next looked at the reel sensor output. A pulse was observed on the output of the reel sensor. But wait! It looked pretty small. We stopped the VCR and placed it in fast forward.

When we selected the VPP function we found that the reel sensor pulse was just slightly over 2 volts, quite close to the questionable logic area. A quick check of the DC voltage going to the reel sensor showed a healthy 4.8 volts. The photosensor used to sense rotation of the reel was not completely turning off. We removed the sensor and checked it with the TF46 Super Cricket. Sure enough. The sensor was leaky. Replacement of the sensor brought the reel pulses back up to 4.2 volts.

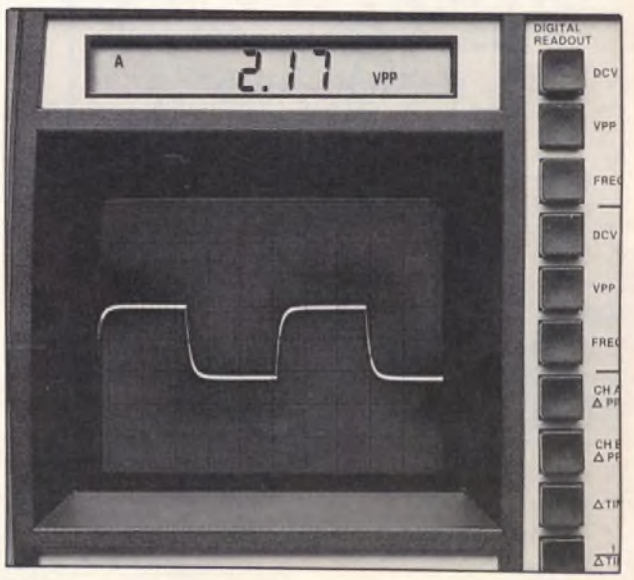


Fig. 6: The SC61 quickly verified that the pulses from the takeup reel sensor were too small to be identified by the microprocessor.

You have just seen how to troubleshoot several typical sensor type system control problems. Sensor problems are not difficult when you understand how they work, and use modern troubleshooting equipment like your SC61 Waveform Analyzer. Do you have questions about this article, or need information on successfully expanding your VCR service? Call your Area Sales Engineer, 1-800-843-3338. ■

How To Interpret The Coil Readings You See On Your LC77 AUTO-Z™

by Larry Schnabel, Applications Engineer

You're working on a defective television. You've narrowed the problem to one stage and you're ready to pounce on the bad part. There's only two suspect parts left, an IC and a coil. A quick test with your LC77 AUTO-Z and you'll know if the coil is good or bad, right? Right. ***(Only when you can interpret all that your AUTO-Z is telling you.)***

> "Many of the toughest troubleshooting challenges are caused by bad inductors . . ."

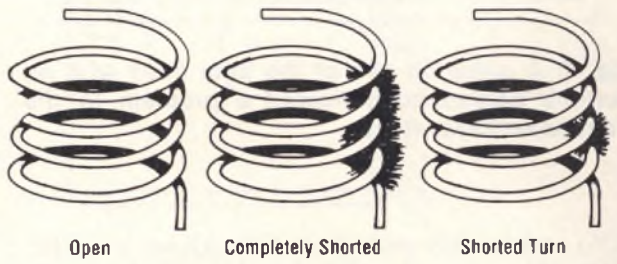


Fig. 1: The three most common inductor failures: Open, short, and shorted turn.

Inductors are one of the few components that haven't been incorporated inside of ICs. Today's smaller, more capable entertainment systems contain more ICs and coils than ever before. In fact, EIA reports that factory shipments of ICs for 1987 totaled $11.9 billion, up 14% from 1986; transformers and coil shipments were up 6%. As IC use continues to increase, the number of inductors used will also increase.

With more inductors being used, there are more that fail. Many of the toughest troubleshooting challenges are caused by bad inductors. Without a reliable test method, servicers have to "second-guess" and find themselves stocking parts for substitution. Two things that today's servicers don't need are a lack of confidence and a profit-eating inventory of parts.

You Can Test All These Coils With The LC77 AUTO-Z

The LC77 tests inductors for the three most common failures: open coil, completely shorted coil, and a coil with shorted turns (even a single shorted turn is detected).

An inductor with high internal resistance is effectively an open circuit. Whether it's an RF oscillator coil or a transformer winding, the circuit will not function until you replace the defective coil. The LC77's inductance value test will tell you whether the inductor under test is open or has changed in value.

Shorted turns reduce the "Q" of an inductor. The LC77's patented ringing test detects these shorted turns by applying a pulse to the coil and counting the resultant ringing cycles. If the ringing cycles don't meet or exceed 10 at a preset level, the "Q" of the inductor is bad, therefore the inductor is bad. The entire test is done automatically, all you need to do is push the INDUCTOR RINGER button, and read the results on the LC77's digital display.

There are many different types of coils used in consumer equipment today. They range from transformers, to RF coils, to speaker coils. A few coils have exclusive characteristics which must be taken into account when testing, even with the LC77.

Why Is It Most Of The Power Transformers I Test Have Low Ringing Readings?

Transformers such as power transformers and audio transformers contain laminated iron cores. The iron core acts like a shorted turn (see figure 2) resulting in ringing readings of less than 10. If you have a known good replacement, you can ring it and use it for a comparison test.

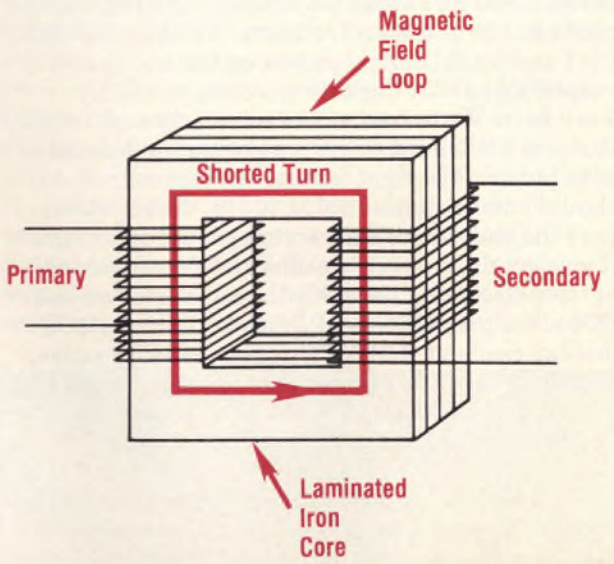


Fig. 2: The power transformer's iron core acts like a shorted turn which absorbs the LC77's ringing pulse.

The best way to test these types of transformers is to apply the normal working voltage to the primary, and measure the secondary(s) voltages with a voltmeter (figure 3). You can also measure a power transformer's current draw under a no-load condition. If the current draw is almost zero, there are no shorts in the transformer. If there is a heavy current draw, there is a short in the transformer.

Fig. 3: The best test for power transformers is to measure the voltage of each of the output windings.

Other types of iron-core inductors include isolation transformers, power chokes, filament transformers, motor coils, and speaker coils. The iron core material in all of these coils dampens the surrounding magnetic field and causes the ringing readings to be low.

Note: Powdered-iron core transformers and inductors do not dampen the pulses, therefore they will ring normally with the LC77.

Can I Use The Ringing Test On The Smallest Inductor Values?

The LC77 rings coils as small as 10 uH. Smaller coils may ring less than 10, even if they're good, because they are below the LC77's ringing range. In this case, compare the ringing results to a known good coil. These smaller coils can be tested for inductance value, however, down to 0.1 uH.

Some flyback transformer windings may only have a couple of turns which results in a low inductance. In these cases, use a winding with more turns to conduct the ringing test. A good ringing reading on any winding proves there are no shorted turns in any of the flyback's windings.

You Can Test Inductors In-Circuit

The inductance value and ringing tests can be performed in-circuit if the coil does not have a parallel low impedance path. If there is a low impedance path present, lift one side of the coil for proper test results.

You can ring the flyback transformer in-circuit, too. If the flyback doesn't ring good in-circuit, disconnect loads until it does ring good. The most common flyback loads are the CRT filament, the horizontal yoke, the horizontal output transistor, and scan-derived power supplies. Fortunately, many of these loads are easily disconnected by pulling a plug or socket.

Special Considerations When Ringing Yokes

Both the vertical and horizontal yokes should ring 10 or above like other coils. However, the vertical yoke windings often have damping resistors which act like a shorted turn. They must be disconnected before the yoke will ring accurately.

Note: If the vertical and horizontal yoke windings both ring good, but you still suspect a bad yoke, check for a short between the two windings. A good yoke will have infinite resistance between the windings.

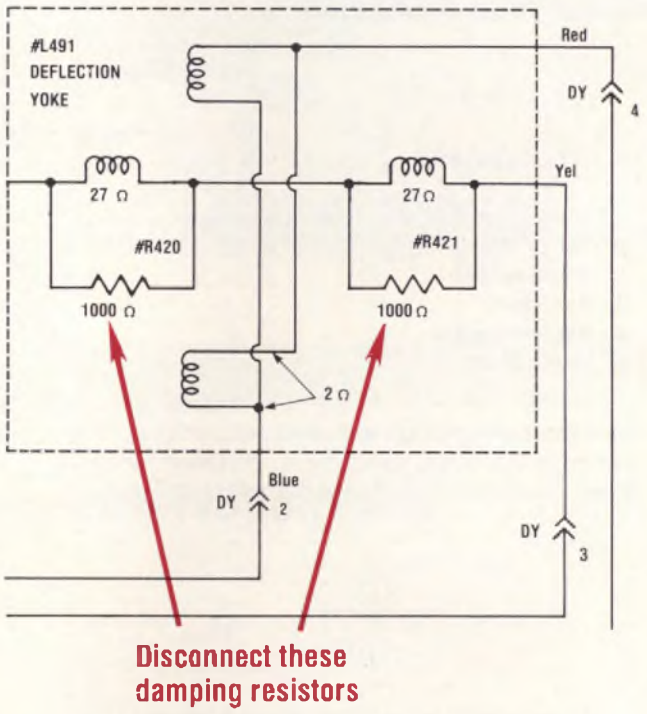


Fig. 5: Disconnect the damping resistors if the vertical windings of a yoke ring bad. The damping resistors are low impedance paths that act like shorted turns.

How Do Metal Shielded Coils Ring?

Some coils, especially IF transformers may be placed inside a metal shield to reduce interference. These shielded coils may not ring good when tested with the ringing test because the metal shield acts like a shorted turn and absorbs the ringing energy.

A shielded coil is good if it rings 10 or more. However, if it rings less than 10, remove the metal shield, if possible, and test the coil again. If it now rings 10 or more, the coil is good. If you are unable to remove the metal shield, make a comparison test using an identical, known good component.

The Best Test For VCR Video Heads

Figure 6 shows the basic construction of a VCR video head. A core of "soft" ferrite material has a coil of insulated wire wound around it.

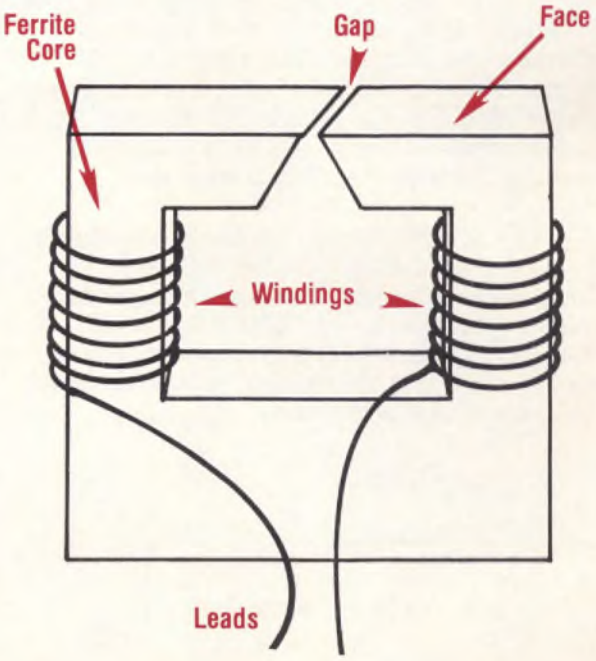


Fig. 6: A VCR video head is a coil of wire wound over a ferrite core, like regular coils, except the indiuctance value is so low it won't ring on your LC77. The best test for video heads is to prove the supporting circuits work using your VC63 VCR Test Accessory.

You can check the inductance of the heads with your LC77. However, it is almost always less than 10 uH. This reading will tell you if the heads are open. Worn or shorted heads are harder to narrow down. Since heads do not always wear the same way, the inductance value of worn heads is not predictable. If a video head has shorted turns, the inductance value may change so little that an inductance test may be inconclusive.

The best test for video heads is substitution with a known good signal using your VC63 VCR Test Accessory. If the substitute signal proves the remaining circuits good, the heads, along with the rotary transformers, are suspect.

Do you have questions on testing a particular coil? Want to get an LC77 on your bench for a trial run? Call toll-free, 1-800-843-3338, today and ask for your Area Sales Engineer. ■

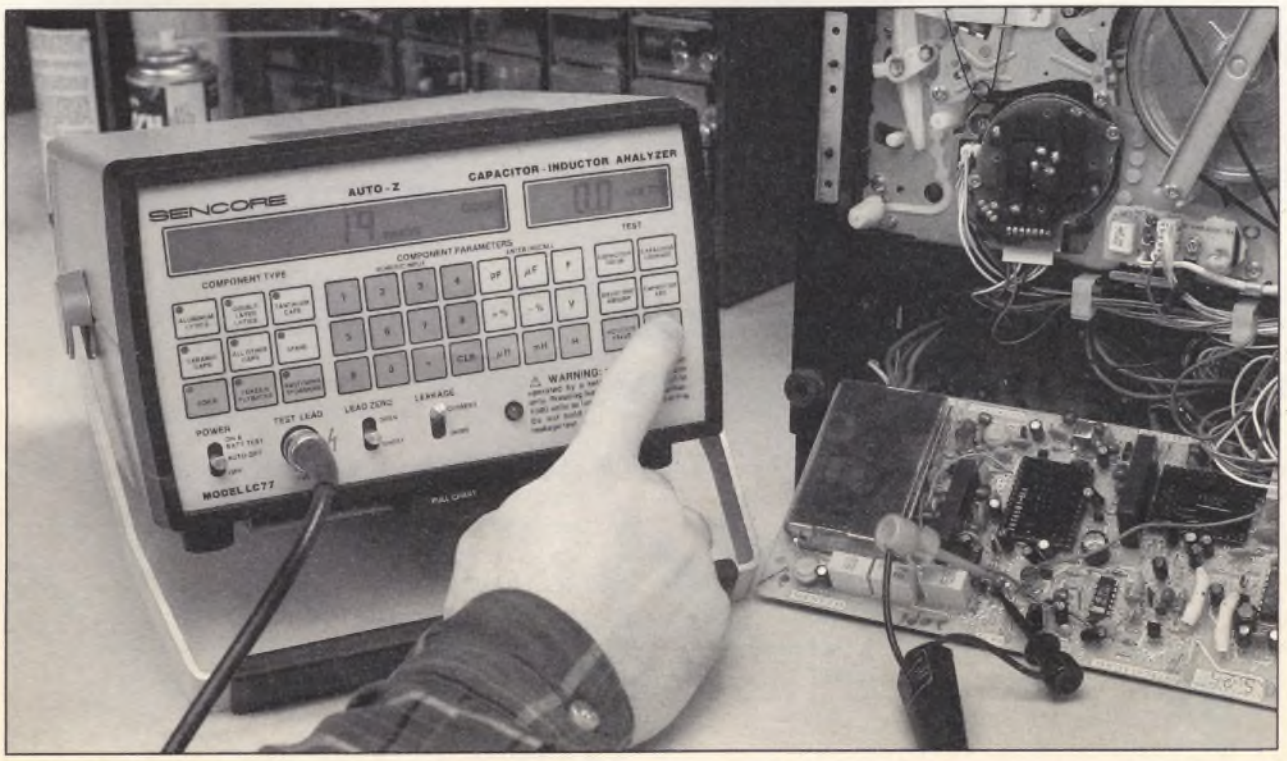
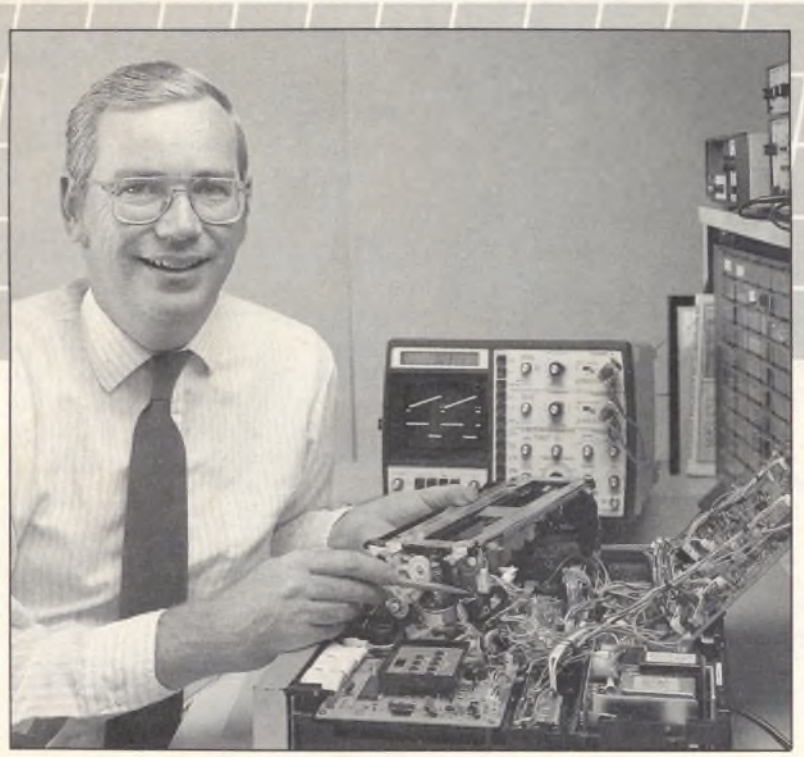


Fig. 4: The LC77 lets you test coils in-circuit with either the inductor value or ringing test.

Tech Talk

Understanding How Sensors Work Takes The Mystery Out Of VCR System Control Troubleshooting

by Rick Meyer, Application Engineer



Digital circuits process logic high and logic low level signals. Due to the characteristics of different types of logic circuits, these logic high and low levels must be well defined. A region exists where digital circuits can not determine if the signal is supposed to be high or low. The size of this region depends upon the type of logic circuits used. TTL circuits operate at 5 volts and have a region of uncertainty of from 0.8 to 2.0 volts(Fig. 1).

CMOS devices operate over a wider power supply voltage range and often have the region of uncertain operation stated as a percentage of the power supply voltage. For CMOS, this region is between 0.2 Vcc and 0.7 Vcc. For a 5 volt power supply, for example, this questionable area would be between 1 volt and 3.5 volts.

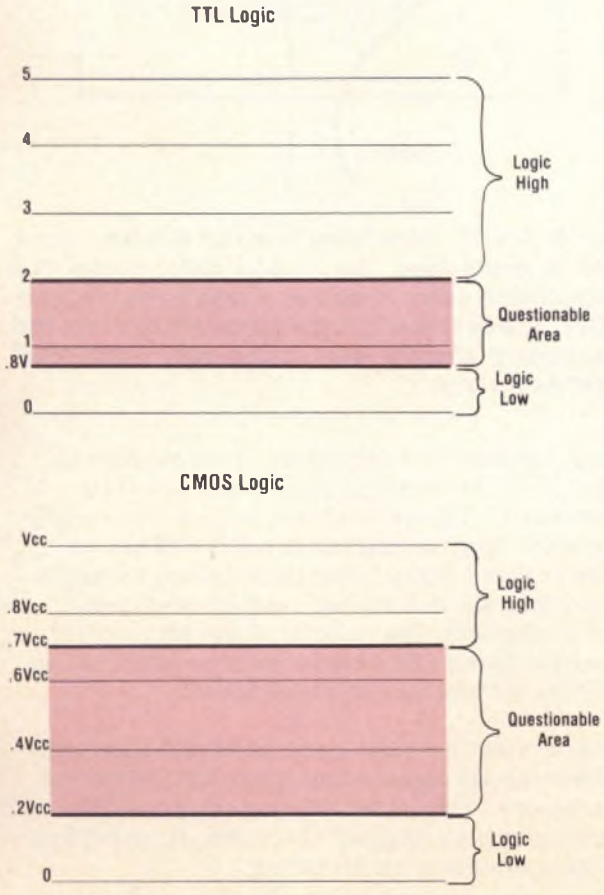


Fig. 1: Digital circuits operate correctly only when the digital pulses go from Logic high levels to Logic low levels. Erratic operation occurs if these logic levels fall in the questionable region.

VCR Sensors

VCR sensors fall into four categories:

1. ***Mechanical***
2. ***Resistive***
3. ***Photocoupler***
4. ***Hall-effect***

Mechanical switches are used primarily as the cassette up/down, cassette in, and mode switch. They consist of simple mechanical contacts.

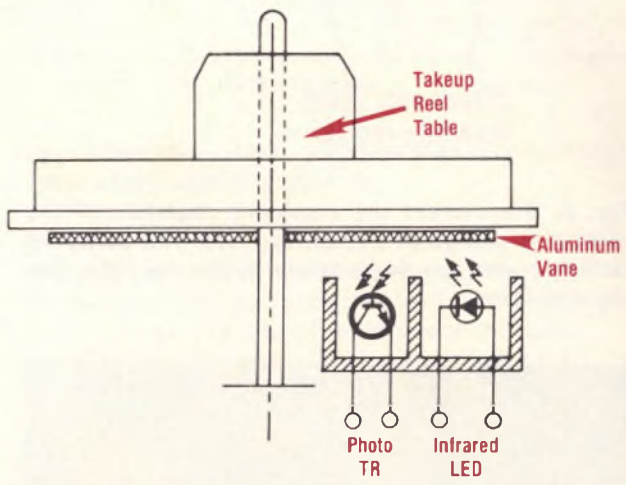


Fig. 2: In one type of reel sensor, the light beam from the LED to the phototransistor is alternately cut off as the reel rotates.

Resistive sensors are used to check for excessive moisture in VCRs. It consists of a resistive strip that increases in resistance as the moisture on it increases.

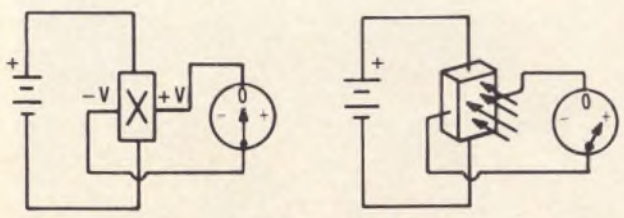


Fig. 3: A hall-effect sensor produces a voltage when in a magnetic field.

Photocoupler sensors are always used for the end sensors and sometimes for other actions such as takeup reel rotation. These sensors are really in two parts: the light source and the sensor itself. The light source may be either an incandescent lamp or a light emitting diode. The sensor consists of a holder containing a semiconductor substrate that is sensitive to light. When light strikes it, the resistance of the material goes down. The sensor then allows current to flow through it. When used to check for takeup reel rotation, an LED and the phototransistor are often contained in one case. Light from the LED shines on a disk of alternating dark and mirror services. When the reel turns, the light is alternately reflected or absorbed by the disk on the reel (see Figure 2).

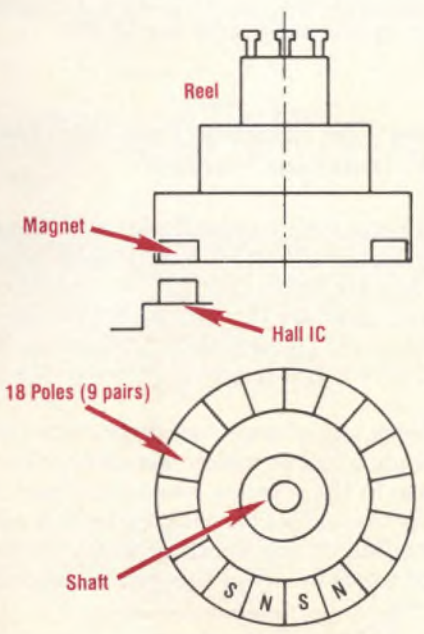


Fig. 4: The alternate changing of the magnetic poles in this type reel sensor causes the voltage from the hall-effect IC to turn on and off as the reel turns.

Hall-effect sensors are often found in the servo circuits and are sometimes used for takeup reel sensor(Figure 3). A hall-effect sensor consists of a small sheet of semiconductor material. A voltage is applied across the sheet and a constant bias current flows. There are plates on two other sides of the semiconductor material. In the absence of a magnetic field, no voltage exists across these plates. When a magnetic field is applied at right angles to the plate, a current is produced inside the semiconductor material that then appears as a voltage difference on the plates. A hall-effect sensor must have a voltage source to work. In addition, the magnetic field must be correctly oriented with the sensor. In the case of a takeup reel sensor, a magnet rotates with the takeup reel and allows current to flow through the sensor when the magnet comes in close contact with the sensor as shown in Figure 4. ■

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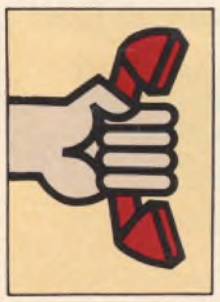

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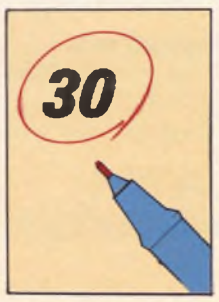

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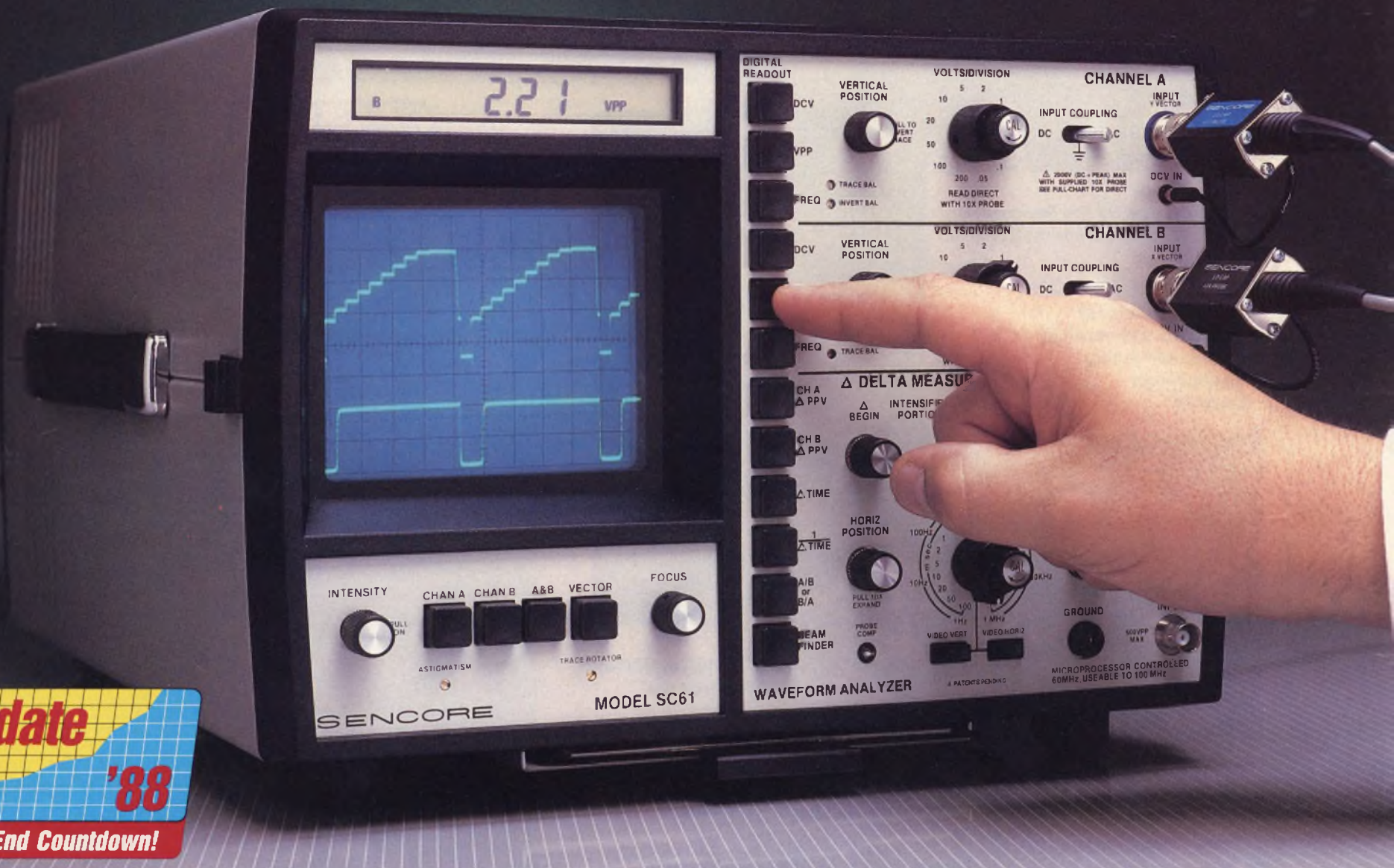

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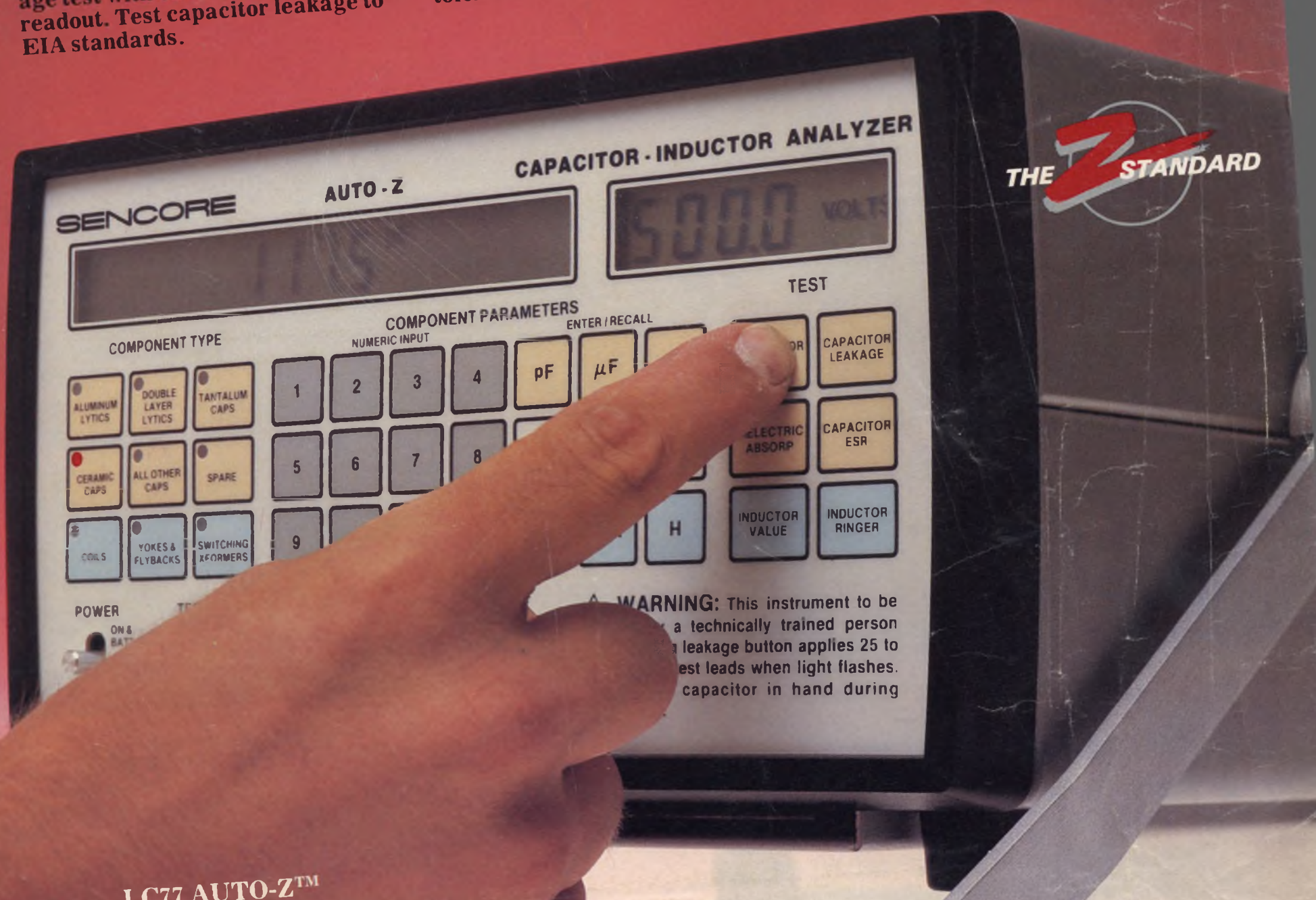

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