

# SENCORE

# NEWS

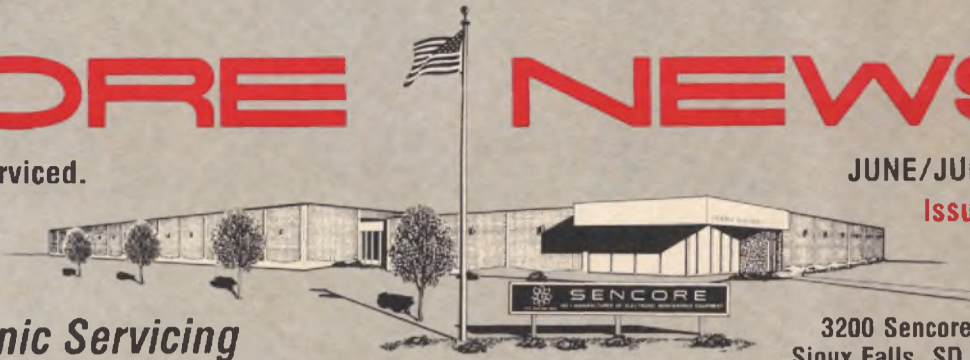
All American designed, produced, sold and serviced.

JUNE/JULY 1987

Issue #132

WATS Free 1-800-843-3338

*Sencore Means Success In Electronic Servicing*



3200 Sencore Drive  
Sioux Falls, SD 57107

*Dedicated To Successful Troubleshooting In The Video, Audio, Communications,  
Industrial Electronic Repair, And Educational Markets*

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**SENCORE**

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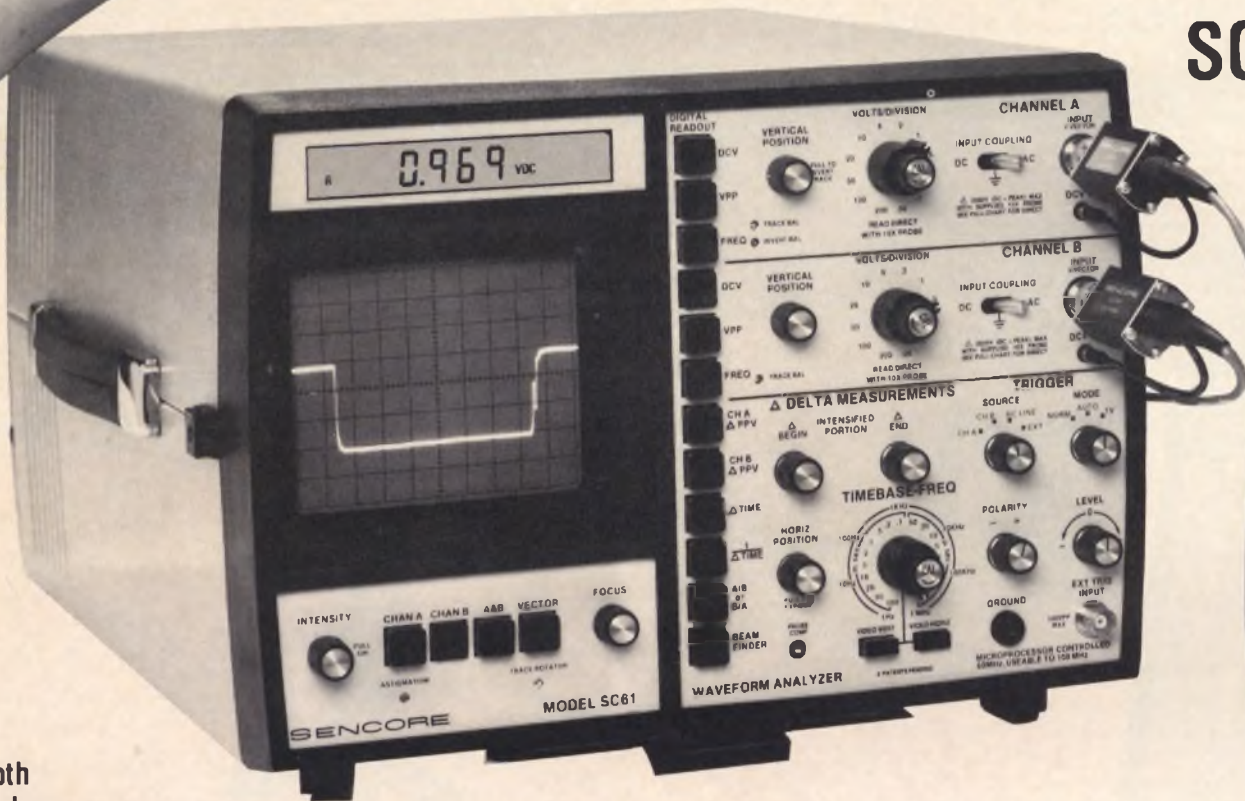
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# PUSH

# Your Way To Success In Electronics Servicing

1 Saturday August 1987  
Price Increase Aug. 1, 1987  
Act Now & SAVE \$300

## with the Sencore SC61 Waveform Analyzer



Analyze any waveform in seconds, with digital accuracy. All automatically at the PUSH of a button. Get your index finger ready. Make only one circuit connection for all tests. Here's how easy it is:

Use both channels or only one as shown here.

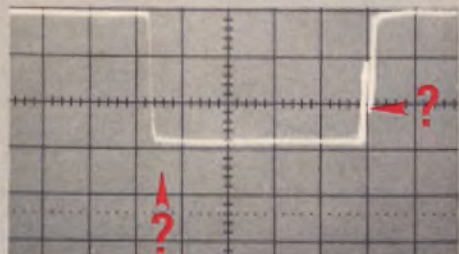
Triple Patented \$2,995 Price Increase Aug. 1, 1987 — \$3,295

10 times faster, 10 times more accurately, Zero chance for error.

### View The Waveform And Read DCV, VPP and FREQUENCY Automatically — In Just Seconds

Prepare by setting the SC61 TIMEBASE — FREQ to the same frequency of the waveform and watch it pop on the CRT with rock solid sync.

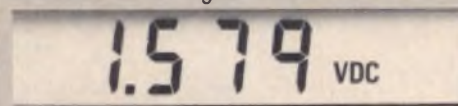
#### Success Step No. 1



Compare the waveform to your schematic. Note questionable areas.

#### Success Step No. 2

READ VDC on digital meter.

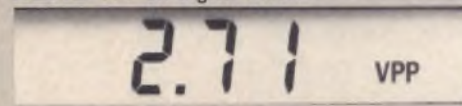


PUSH DCV

Compare to DC voltage reading shown on your schematic.

#### Success Step No. 3

READ VPP on digital meter.

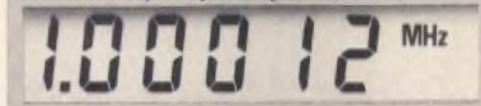


PUSH VPP

Compare to VPP volts shown on your schematic.

#### Success Step No. 4

READ frequency on digital meter.



PUSH FREQ

Compare to frequency shown on your schematic.

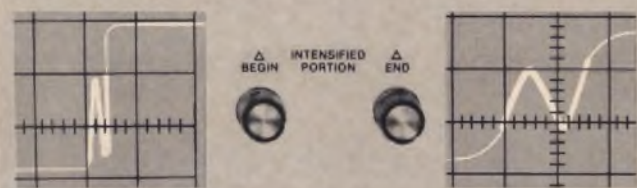
### Measure A Part Of The Waveform For Glitches, Interference, Rise Time, Duty Cycle, Time Duration, Etc.

#### Success Step No. 5

Adjust brightness so the portion of the waveform that you want to read is brighter.

Adjust controls until brighter part of the trace fits the portion of the waveform you wish to read.

Pull HORIZ POSITION switch to 10X EXPAND for accuracy.



#### Success Step No. 6

Read intensified portion, for all DELTA measurements, by simply pushing the desired pushbutton and reading the same digital meter.

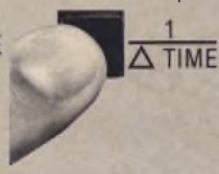
PUSH to read  $\Delta$  PPV directly.



PUSH to read  $\Delta$  TIME in  $\mu$  Sec.



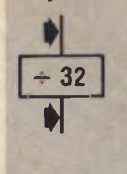
PUSH to convert time to freq.  $f = \frac{1}{t}$



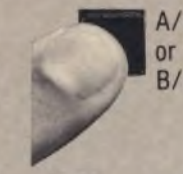
#### Success Step No. 7

Read frequency multipliers or dividers directly to speed up troubleshooting, to eliminate graticule counting, or to reduce costly calculating errors.

Connect probes to chip either way.



PUSH "A/B or B/A" pushbutton



Read divide or multiplier number directly. A/B indicator tells you how chip is connected.

OK, can you see how easy it is to quickly PUSH your way to success in electronic servicing? If your answer is YES and you still have that tingle in your index finger and can't wait to start pushing your way to success, pick up your telephone and help that index finger dial WATS Free 1-800-843-3338 for your first step! Give the Sencore phone operator your Area Code and she will immediately put you in contact with your friendly area Sales Engineer to answer

any other questions or discuss additional applications. We are ready when you are. How about now? Start pushing your way to success today!

## Call WATS Free 1-800-843-3338



# Business Building Bulletin

## You Are Probably Already Paying For Test Equipment You Don't Own

by Herb Bowden, President and CEO, Sencore, Inc.



nothing of added customer satisfaction and reduced callbacks. Very simply, they are saying that you can select the instruments, in the Sencore line that are the most appropriate for you, come up with a low down-payment and update your shop for the 90s and at basically no net cost to you.

They say that the time they save, and extra receivers they service (and invoice for) the very first month the equipment is on your bench, is more than enough to make the first monthly payment to Sencore. Naturally, subsequent monthly payments are even easier to make as equipment familiarity and efficiency improves. This amounts to getting your equipment for nothing. It pays for itself and proves that you are already paying for the test equipment you don't own every day in every way. When all payments are made, the difference goes in the profit till.

They will all tell you that this is where their success begins and why Sencore means success to them. Sure, they say that customer good-will is important, and that callbacks cost money, too, but basically, they are saying that the analyzing time saved alone will bring in enough extra bucks to pay for the equipment. Most say they use the new found time to show their new potential customers their new servicing tools, how they have updated their shop to serve them and assure them that they are equipped to do their work more efficiently and more thoroughly than anyone else in the neighborhood. Sure, this is tough on competition, but what's wrong with that?

Does this work? You bet it does. I stopped writing this article just long enough to walk into our Business Manager's office, Mr. Chris Kirkus, and asked him a good question, "Chris, realizing that it is technicians who start out being the least wealthy and least successful, who use Sencore's "Pay As You Grow" finance plan the most (mostly those who can't qualify for open account for the full purchase), what percentage of these people fail in business to the point where we have to repossess our products?"

What percentage would you guess? Don't forget, these are the technicians who often are struggling and need Sencore financing to help them. One out of five? One out of

10? One out of 15?" I was pleased to hear Chris say "Less than one out of 20 have any trouble with their time payments after purchasing Sencore equipment, to the point where we ask that our equipment be returned." The actual number, only 4.8 percent, is less than the national repair shop turn-over closing rate, meaning that 95.2 percent remained or became successful after purchasing Sencore equipment with our "Pay As You Grow" finance plan.

Did Sencore make them successful or did they make themselves successful by stopping their doubting and procrastination by taking the first step which is simply picking up the phone and dialing WATS FREE 1-800-843-3338 and finding out how little they would have to pay monthly to update their shop? That's where we think success began for this 95.2 percent who

became successful by doing just that. Don't forget, you can't buy wrong with Sencore because you have a full 30 days to return any or all equipment for a full refund regardless of how you are paying. Sencore assures you that you will become more prosperous right off the bat or you can return the equipment, no questions asked. Try before you buy. Sencore takes all the gamble! You simply have to pick up the phone and dial, at no cost to you, 1-800-843-3338.

Here is one of those success stories direct from the pen of one of our technician friends who says that he doesn't know why he waited so long. Maybe he can motivate you to make that call. You are already paying for the test equipment you don't have, every day in every way, so why not listen to our friend Vance Knight of Statesboro, Georgia, as he tells his recent success story.

**Y**ou are already paying for the test equipment you don't own", was the slogan of the Electronic Industry Association (EIA) for years. Sencore Application Engineers echo this truism at over 600 seminars a year, as they hold "how to" seminars from coast to coast. They demonstrate, over and over, just how simple it is to save at least 50 percent of a technician's time if he will simply use the new divide and conquer servicing methods made possible by Sencore's latest state-of-the-art functional analyzers.

Most recently, our Application Engineers have been asking our customers to give testimony by rising at these seminars and telling the others attending just how much time they have saved with their Sencore analyzers and automatic equipment. We have no trouble getting volunteers to speak at every session, and believe you me, they are our best salesmen as they also tell others how they have whipped tough dogs that no one else could repair and still save a lot of time on regular repairs.

Most say that their greatest savings on every repair, is a good receiver performance test afterwards, with Sencore standard signals and/or testing patterns. They say that a good solid performance test satisfies the customer, increases customer good-will, and vastly reduces expensive call-backs. It is easy for these people to say "we were already paying for the test equipment we didn't own", and mean it.

What are all of these people trying to tell you? In the most direct way possible, they are saying that you are either losing money, or not making the income you should be, by continuing with your old fashioned troubleshooting methods or by not having equipment to check the latest receivers. They are saying that the analyzing time, with these unique analyzers alone is reduced far beyond the cost of the monthly payments of the instruments, to say



### Letter From Vance L. Knight, C & W. Sales & Service, Statesboro, G.A:

“ Around the 23rd of February, I received a shipment of Sencore equipment that I had recently purchased. It was late that day by the time I had the SC61 Waveform Analyzer, PR57 "POWERITE" & DVM56A Digital Multimeter unpacked and set up.

The next day I tried out the equipment, hooked to my NTSC generator. The SC61 triggered and

locked up with the greatest of ease. The DVM56A is phenomenally accurate! The ohms zero function enabled me to zero out my test lead resistance thus facilitating measurement of less than one ohm very easily, which was important to me in my applications. In addition, the PR57 provides a very stable isolated AC output. At the same time you can read the AC current and the watts the unit under test is consuming... pretty handy!

I had a Sharp TV (model 19H74) in the shop for a couple of weeks with a vertical problem. I don't know why it is, but I have more trouble with vertical problems, (even simplistic ones) than any other circuit in TV's. So, I decided to use my new Sencore equipment on this "dog". Being the skeptic I am, I wondered how long it would take to repair this TV with this new and expensive equipment.

The problem was a vertical shrinkage type, this is to say: The vertical gradually pulled in from the top over a period of time. This TV was looked at on two previous occasions for about 4-5 hours total time.

I proceeded to hook up my SC61 to the vertical output transistor and set the digital readout for VPP. After about 10 minutes, I could see the VPP starting to deteriorate, from 38.8V slowly going down a tenth at a time to 38.4 V, etc. Having already replaced the output transistors, I concluded I had an output problem, probably a leaky/bad capacitor. After checking the schematic, I saw two likely suspects. I removed them and replaced both. (Would have been nice to have a Z METER here to show what the fault was). The problem simply disappeared! All of this in 30 minutes time! My skepticism towards Sencore

(continued on page 20)



## The SC61 Waveform Analyzer Takes The Guesswork And Frustration Out Of VCR Service, With Six Profitable Steps

by Stan Warner, Application Engineer

Listen: If the audio sound is too fast or slow, the problem is in the capstan servo circuits (Figure 3).

Look: If the sound is okay but the picture is bad, put the VCR into the PAUSE mode. If the picture doesn't stay stationary and upright, the problem is in the cylinder circuits.

Now that you can separate cylinder servo symptoms from capstan servo symptoms, it's time to look at six time saving checks you can make with your SC61 Waveform Analyzer.

Sencore's SC61 Waveform Analyzer is the answer for VCR service. It's faster and more accurate than any scope you've ever used. With the SC61, you'll conquer servo problems in seconds. Here's just a few of its exclusive features:

- 60 MHz usable to 100 MHz puts confidence in waveform analyzing.
- Input protection to 3000 Volts protects your investment and lets you make measurements others can't.
- 100% automatic "AUTO-TRACKING"™ digital readout lets you make error free measurements.
- Gives error free readings of DC Volts, PP Volts, and Frequency at the push of a button. Measures any increment of a waveform in amplitude, time, or frequency and calculates frequency ratio.
- Rock solid sync circuits latch onto the most elusive signal.
- 10 times faster and 10 times more accurate than conventional oscilloscopes.

**M**any technicians find that servo circuits are the most difficult of all the VCR circuits to troubleshoot. So, some fail to reach their true VCR service potential. With the proper test instruments and an understanding of VCR servo fundamentals, you can begin to service VCRs profitably. Let's start with a quick review. Are you familiar with these important facts?

- Servo systems are closed loop systems with control information fed from the output back to the input. Can these systems be tested without breaking the closed loop?
- Separate closed servo loops control the speed of the capstan and cylinder motors. How do you know which loop to troubleshoot?
- Each set of servos contains two loops - one inside the other. What are the symptoms of failure in one of these loops?

You'll find answers to these questions, plus learn to isolate servo problems and make circuit adjustments quickly and accurately in the discussion below. First, let's get a little more familiar with servo loops.

### Knowing What Servo Loops Are All About Is The Key To Success In VCR Service

In servo systems, the inside "speed" loop causes the motor to turn at nearly the correct speed. The outside loop provides additional control. Problems in either loop cause the signals in both loops to shift away from the normal values as the automatic circuits try to correct for the defective stage. This corrective action forces every component in the loop to appear defective. (Figure 1).

Separating cylinder servo problems from capstan servo problems is the first step in troubleshooting. A simple "look and listen" test tells

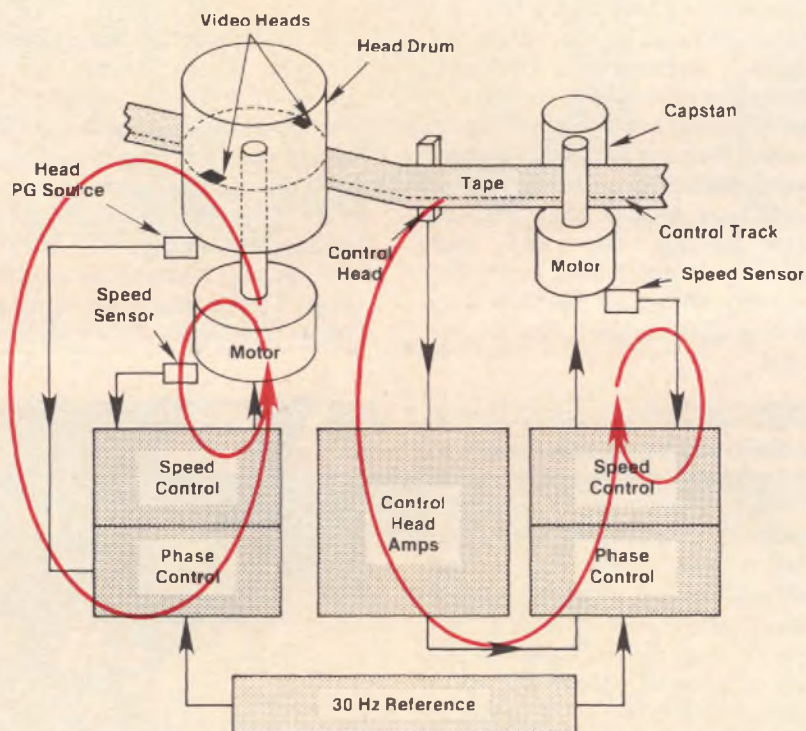


Fig. 1: The servos are tough to troubleshoot because they form two closed loops, one inside the other. A defect in any part of either loop causes all voltage measurements to be wrong.

which servo is causing the problem. What should you look or listen for?

**Cylinder Servo:** The cylinder motor drives the video heads at the proper speed and position to the tape. Except for new HI-FI machines which use spinning audio heads, cylinder servo problems affect only the picture. (Figure 2).

**Capstan Servo:** The capstan motor controls the speed of the tape moving past the heads. Because VCRs use stationary audio heads, capstan servo problems affect the sound and the picture. If the picture is affected and the sound is not, we have a cylinder servo problem. But, if the sound is also affected, we have a capstan servo problem.

Before you even open a schematic or grab a test probe, divide and conquer the problem by listening and looking for the symptom. Here's how:

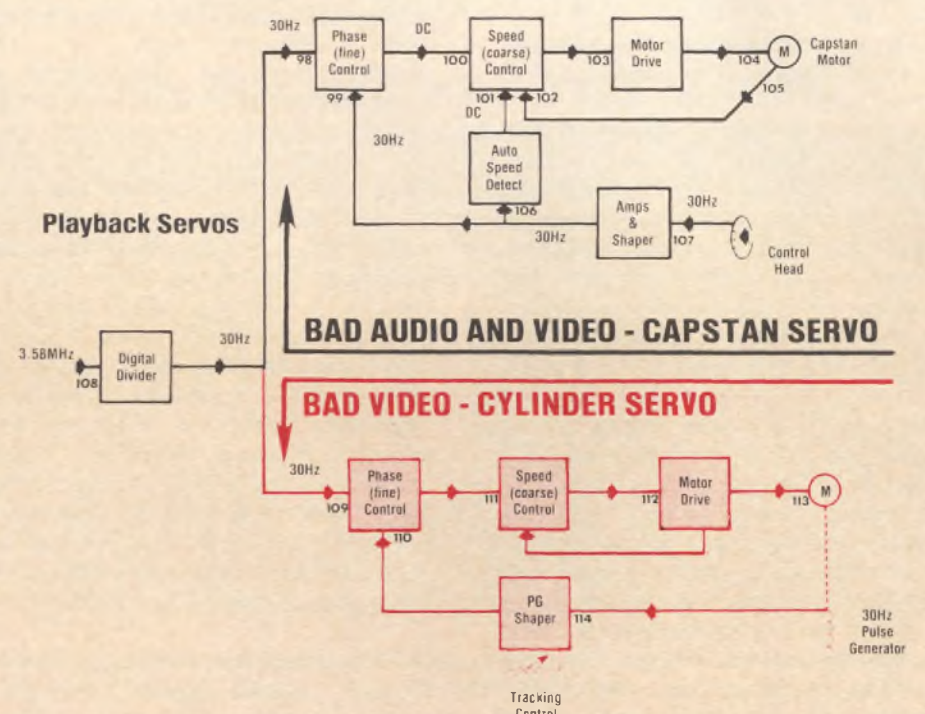


Fig. 2: Divide and conquer the playback servo circuits by looking and listening for symptoms that point to the capstan or cylinder circuits.



**Fig. 3: Servo problems cause the picture to randomly tear. Use the audio to determine whether the problem is in the capstan or cylinder servo section.**

## Six Easy Steps With The SC61 Waveform Analyzer Let You Conquer VCR Servo Troubleshooting And Alignment Problems

When you can solve servo problems in six easy steps, you've conquered the tough part of VCR service. Follow these steps with your own SC61 and a good VCR and you are on your way to success.

### Step 1: Check The Pulse Width Modulator (PWM) Waveform First.

The PWM controls the speed and phase of the capstan and drum. It is the first measurement you should make when troubleshooting servo circuits.

(a) Connect the SC61 to the PWM test point and verify the correct waveform on the CRT.

(b) Check for correct DC and peak-to-peak voltages with a push of the SC61's buttons.

(c) Press the FREQ button to verify the proper frequency.

(d) As a last check, apply finger pressure to the pinch roller or drum head. The duty cycle of the signal changes to compensate for the load but the frequency remains stable.

### Step 2: Make The "TRACKING FIX" Adjustment With Digital Accuracy.

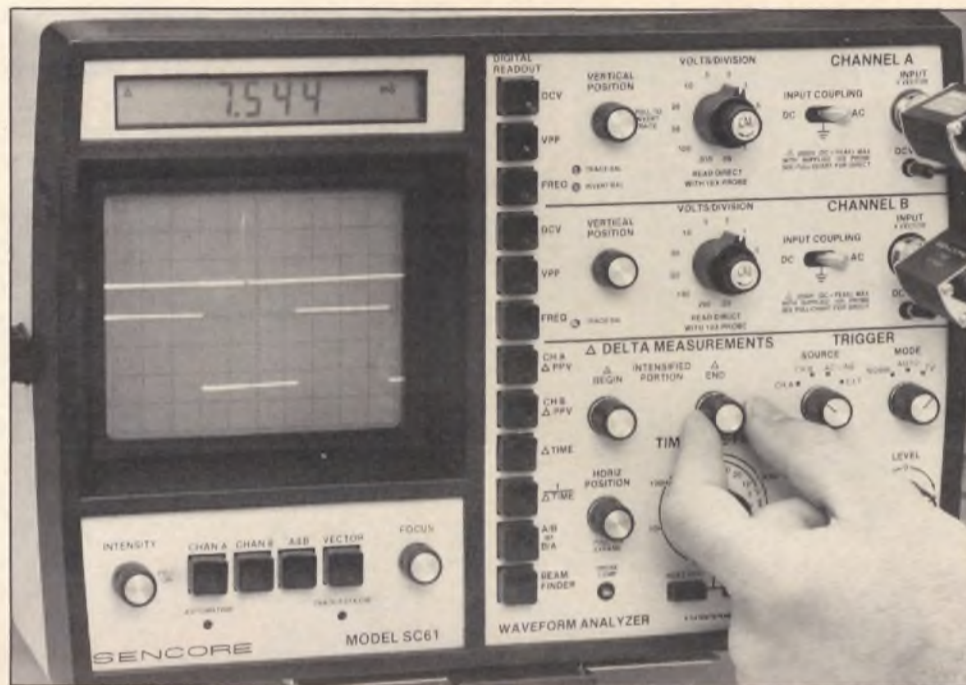
The "Tracking Fix" or "Tracking Centering" adjustment insures that the front-panel "Tracking" control produces the best picture when set to its center position. Adjustment procedures vary, according to the specific VCR. Most call for a precise delay between a 30 Hz switching pulse at one test point and a generated pulse at a second test point.

Use the SC61's "DELTA TIME" function to read the time delay between these signals directly on the SC61's digital readout. No need to multiply switch settings or count CRT graticule markings. And, interpretation errors between the two signals can't cause problems

because the DELTA TIME test marks the waveform itself, instead of requiring you to position the waveform segments with CRT graticules.

To measure the time between two signals with the SC61:

(a) Press the DELTA TIME button. This enables the controls called the DELTA BEGIN and DELTA END. These two controls position an intensified zone (Delta Bar) anywhere you want it on the waveform. The SC61 measures the



**Fig. 4: Use the Delta Time function for error free measurements of the time between pulses, to complete the Tracking Fix Adjustment successfully.**

time duration of the Delta Bar and displays the time on the digital readout (Figure 4).

(b) Simply adjust the beginning of the Delta Bar until it just touches the transition in the first waveform.

(c) Then adjust the end of the Delta Bar until it just touches the transition in the second trace.

(d) The time you see on the digital readout is the time delay between the two signals.

By simply adjusting the Delta Bar, you are measuring the time between the signals, although they come from separate test points.

What if we wanted to set the circuits for a specified time delay, let's say 0.4 msec? It's easy; just follow these three steps:

(a) Adjust the beginning of the Delta Bar until it just touches the transition point of the reference square wave.

(b) Adjust the end of the Delta Bar until the digital readout shows the delay called for in the alignment instructions. In our case you would adjust the DELTA END until the digital readout showed a value of 0.4 msec.

(c) Then simply adjust the circuit until the pulse in the second trace

touches the intensified part of the trace.

No need to worry about the effects of playback jitter, the Delta Bar remains referenced to the stable square wave. Watch the intensified area and center the moving signal over it.

### Step 3: Make The Head Switching Adjustment In Seconds.

All VCR alignment instructions call for an adjustment of the head-

servicers will tell you that since the SC61 was introduced, there's no need for a delayed sweep. We're sure you will agree (given a few minutes with the SC61 on your bench).

Here's how to use the SC61 to adjust the head-switch timing to manufacturers' specifications:

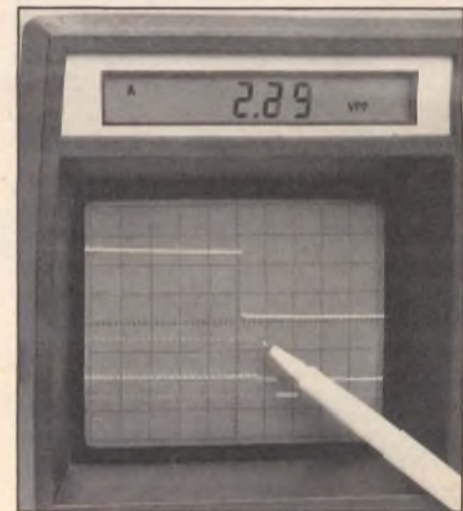
(a) Connect the CH A probe to the 30 Hz video head switching pulse and the CH B probe to composite video. Trigger on the head switching pulse (CH A).

(b) Set the time base frequency to the 1 msec position.

(c) Press the "A & B" (dual trace) button under the CRT and adjust the VOLTS/DIVISION and the VERTICAL POSITION controls until both waveforms appear on the CRT.

(d) Pull the HORIZ POSITION control to expand the waveform ten times.

The waveform will look like the one in Figure 5. Notice that you can easily see the horizontal sync pulses ahead of the vertical sync interval. Adjust the VCR Head PG or Head Shifter control for the correct timing between signals (according to the manufacturers' specifications).



**Fig. 5: Making the head-switching adjustment using the SC61's TIMES TEN EXPAND increases accuracy and saves time.**

switching signal. Before we talk about aligning head-switching circuits, let's be sure we understand the head-switching signal.

VCR circuits produce a visible horizontal noise bar when they switch from one video head to the other. If the circuits were to switch the heads half way between vertical sync pulses, the picture would have a noise bar right in the middle of the screen. If the circuits switched heads during vertical sync time, the TV receiver would show rolling or vertical jitter.

To prevent these problems, the circuits switch the heads during the last few lines of each vertical field. This places the noise at the very bottom of the screen, below the viewable picture. Head-switching occurs three or four horizontal lines before vertical blanking. This prevents vertical sync problems. The "Head-Switch" adjustment changes the timing of the head-switch square wave relative to vertical sync. What is needed to check and adjust this important switching point?

First, servicers struggled with delayed-sweep oscilloscopes to adjust critical VCR circuits like the head switching control (sometimes called the "Head PG" or the "Head Shifter"). Early VCR service manuals even referenced a delayed-sweep scope. Successful

The SC61's ADD function makes it even easier to compare the timing of these important signals. To add the two input signals together, press the CHAN A and the CHAN B CRT selector buttons simultaneously (Figure 4). Now, the head-switching square wave causes a "jog" to appear in the composite video signal (Figure 6). Many technicians find this makes comparison easier than placing one waveform next to another.

### Step 4: End Tape Path Problems With Informative SC61 Signal Check.

Mechanical misalignment can look like servo problems. A quick check of tape path alignment, with the

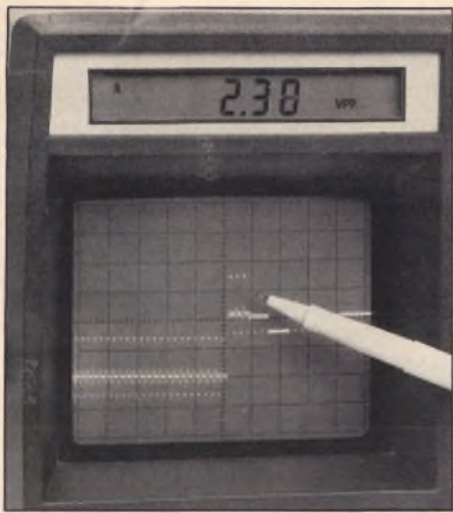


Fig. 6: The head switch adjustment is made easier yet when you use the SC61's ADD function.

SC61, will separate mechanical problems from electrical problems.

Here's how to use the SC61 Waveform Analyzer to isolate tape path problems:

(a) Connect the CH A probe to the 30 Hz head switch pulse. Connect the CH B probe to the point after the video signal passes through the head switcher. Here, you should see a 3 MHz luminance signal.

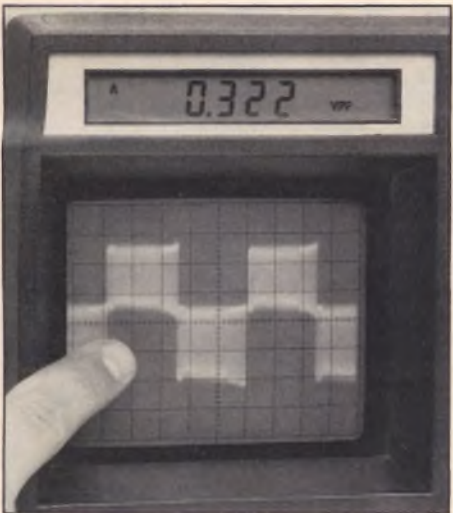


Fig. 7: Use the SC61 to divide a tape path problem from a servo problem. Notice how the video information is squared off at the switching pulses; this indicates a properly aligned tape path.

(b) Add CH A to CH B by pressing both CHAN A and CHAN B buttons in simultaneously (Figure 9). This will add the head A and head B information. Your trace on the CRT should look like the one in Figure 7.

If the beginning and ending, of each block of video information, is squared off, there is good tape alignment. If there are "bullet noses" on the beginning or ending, the problem is a misaligned tape guide on the tape path (Figure 8).

### Step 5: Check The FG Pulse To Solve Speed Problems.

The cylinder frequency generator (FG) pulses are developed by small magnets located in the cylinder

rotor. When the cylinder rotates, the magnets create a field which is converted into an electrical pulse at the stator detection coil. This pulse is looped back into the pulse width modulator where it is used for coarse speed control. The capstan FG pulse is generated in the same manner and is used for coarse speed control in the capstan servo circuit.

Frequency and amplitude changes, in both capstan and cylinder FG pulses, can cause frustrating servo problems. Checking the FG pulses calls for three instruments: one to measure the peak-to-peak voltage

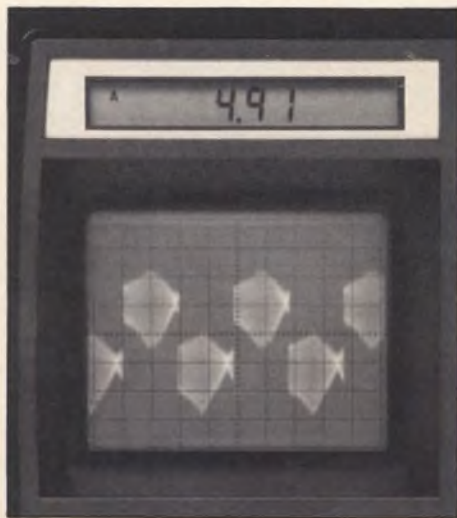


Fig. 8: Notice how the video is rounded off at the switching pulse transitions, in a VCR with a misaligned tape path.

value, one to look at the waveform, and one to measure the frequency. A faster and better way, however, is to analyze the FG pulse with the SC61 with a simple one probe hookup (Figure 9). Here's how:

(a) Hookup the SC61 probe to either the cylinder or capstan FG pulse. From the CRT, verify that the waveform is correct.

(b) Press the PPV and FREQ buttons to check the peak-to-peak voltage and the frequency.

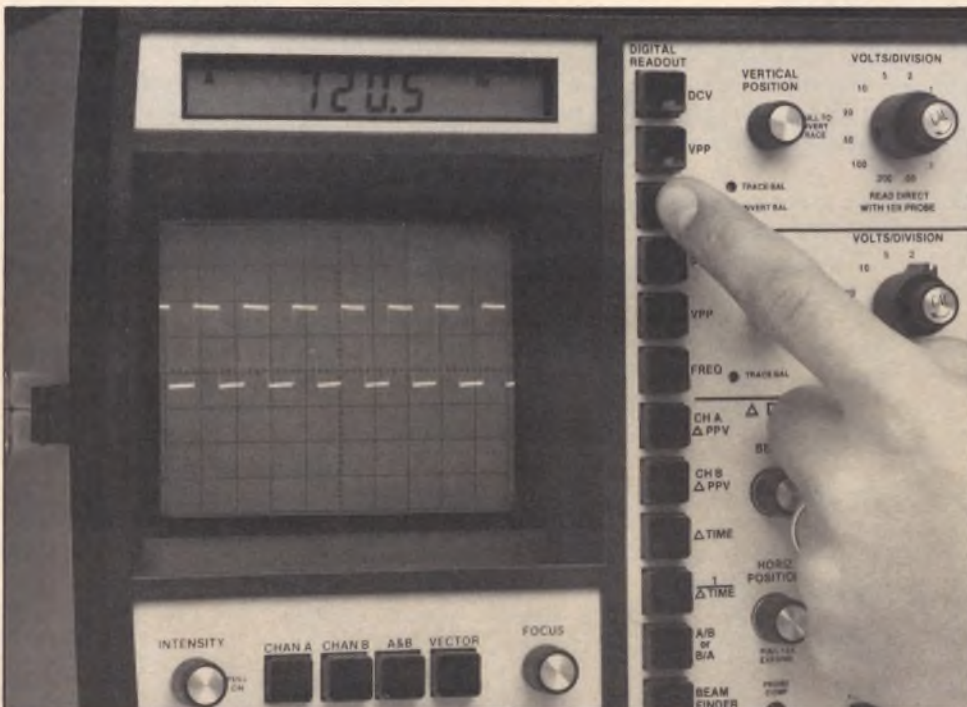


Fig. 9: With just one probe hookup you can completely analyze the capstan FG pulse waveform's important parameter: DCV, PPV and frequency.

(c) Connect the second probe to the PWM and compare this to the FG pulse. Apply your finger to the capstan or the drum (lightly).

The change in the FG pulse should produce a corresponding change in the PWM and the DC output.

### Step 6: Adjust The HI-FI Audio Head-Switching To Prevent Audio Dropout And Noise.

HI-FI audio heads are switched, during playback, similar to the video heads. The same switch rate, 30 Hz derived from the PG pulse (PG shifter), switches the audio heads. The audio heads are offset from the video heads, therefore, the 30 Hz has to be delayed by that offset in degrees to switch the audio heads on and off at the correct time (Figure 10). If this alignment is not precisely made, dropout will happen. This results in noise in the audio. If alignment is very far off, there may be a total loss of HI-FI.

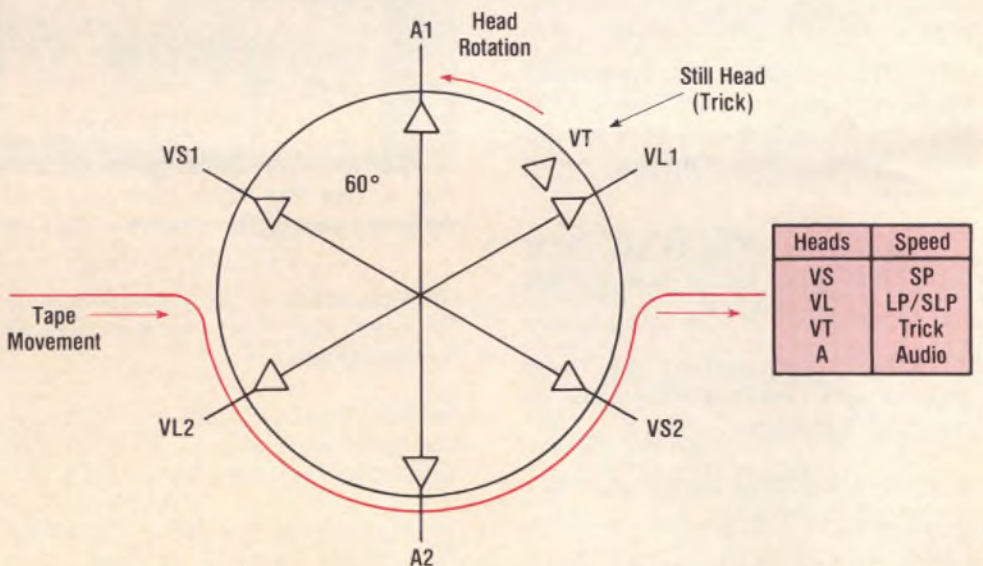


Fig. 10: Note that the HI-FI audio signals come from the rotating cylinder drum (in the same manner as the video). Proper switching prevents dropout.

Correct HI-FI alignment is verified by comparing the 30 Hz video head switching pulse to the 30 Hz audio delayed head-switching pulse. The audio switching pulse must be delayed by the phase angle that the audio head is behind the video head on the drum.

Let's look at a practical example. On a six head machine the video head and the audio head are separated by 60 degrees. Since the heads rotate at 30 Hz, the video and audio information is always 5.6 msec out of phase. If the two 30 Hz switching pulses aren't set 5.6 msec apart, dropout occurs in the HI-FI audio. With the SC61, this adjustment can be done in seconds. Here's how:

(a) Connect the CH A probe to the 30 Hz video switching pulse. Connect the CH B probe to the 30 Hz audio switching pulse. Trigger off CH A.

(b) Press the DELTA TIME button and adjust the DELTA END control until the intensified part of the trace lines up with the rising edge of the 30 Hz video switching pulse.

(c) Adjust the DELTA BEGIN control until the proper delay time appears on the LCD (for our example, see Figure 11, the time is 5.6 msec).

(d) Adjust the audio phase shifter until its rising edge lines up with the end of the intensified part of the trace.

There is a second test that can be done to get a more complete understanding of the workings of the HI-FI audio circuits. To complete this test:

(a) Connect the CH A probe to the 30 Hz audio switching pulse. Set the TRIGGER SOURCE to CH A. Connect the CH B probe to the output of the A/B audio head-switching circuit. Adjust the scope until you see, on CH A, the 30 Hz audio square wave switching

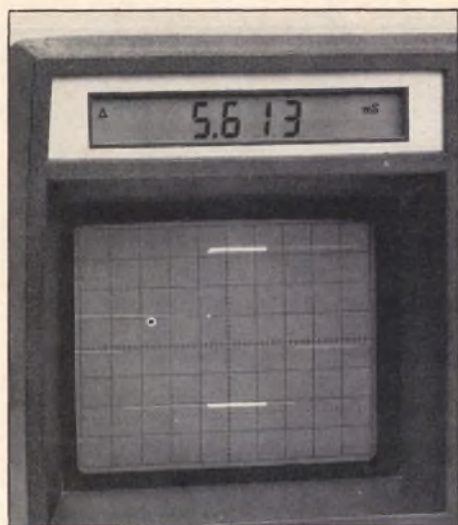


Fig. 11: Use the SC61's DELTA TIME function to accurately set the timing difference between the 30 Hz video switching pulse and the 30 Hz audio switching pulse.



Fig. 12: Aligning the servos properly prevents audio information drop off, as the head switches to the next channel.

pulse and, on CH B, the A & B FM audio information.

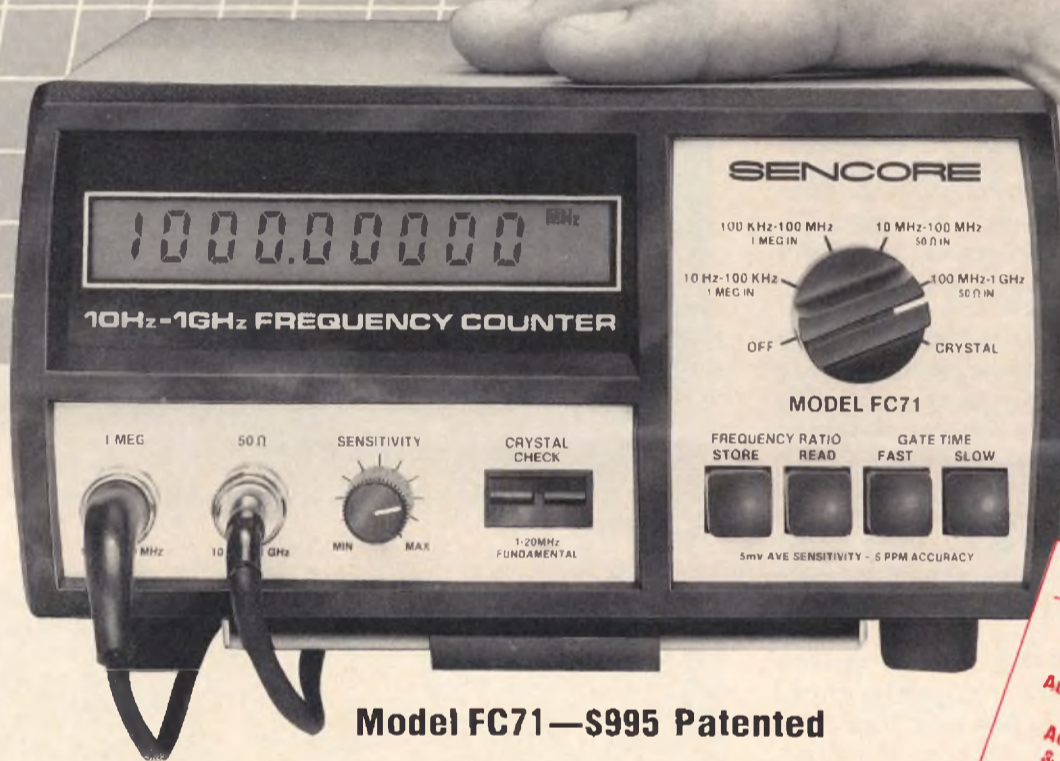
(b) Adjust the phase shifter and watch the response on the audio envelopes. The phase shifter adjustment eliminates dropout when the VCR is switching between CH A information and CH B information (Figure 12).

You've seen how six simple servo checks with the SC61 Waveform Analyzer can make VCR troubles easier to find. And, you've seen how all the important parameters of a waveform can be measured 10 times faster and 10 times more accurately than any other method. You get these advantages at the push of a button, with just one probe attached. These are just a few of the

SC61's exclusive profit making features.

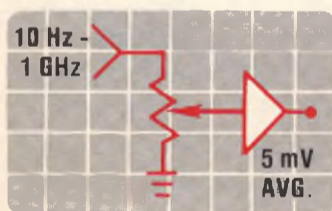
There's only one way you'll be convinced that you can increase your service potential. You've got to try the SC61 before you buy, on your service bench, on your own challenges. Give us a call WATS FREE 1-800-843-3338 for a 15 Day Self Demo at our expense. You're always sure you've "bought right" when you say yes to a Sencore investment. ■

# Absolutely Tops All Other Counters In Performance, Portability, And Value . . . Guaranteed Or Your Money Back!

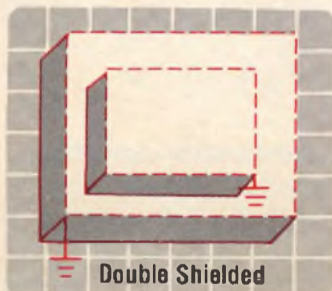


Model FC71—\$995 Patented

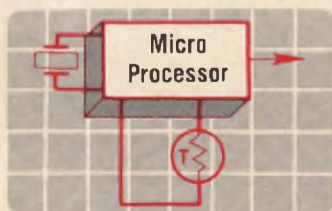
Price as of Aug. 1, 1987—\$1,295



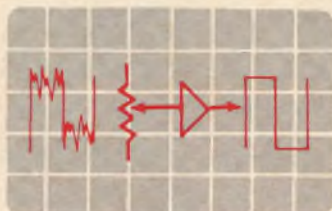
**Super Sensitive With Variable Input**—The FC71 is the most sensitive 1 GHz truly portable counter on the market with an unmatched sensitivity of 5 mV; you can measure signals with your FC71 that other counters just won't.



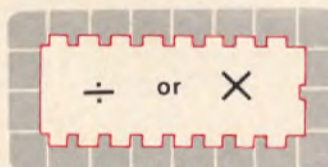
**RF Immune**—The FC71 is the most interference free counter on the market; no line cord to pick up interference, and it is all double shielded; guaranteed to operate where others won't, even at the most powerful transmitter site, or your money back.



**FCC Accurate-Plus**—The FC71 is the most accurate counter in this price range, with .5 parts per million FCC accuracy from 10 Hz to 1 GHz; the counter stays accurate in use, as temperature correction is done by an exclusive, patent pending, special microprocessor controlled circuit. You can rest easy that you are FCC accurate year in and year out.



**Exclusive SNAP-ACTION™ Input Amplifier**—toggles only during signal transitions, unaffected by noise; means the fiddle-free sensitivity control is simply left at maximum over 90% of the time. You will operate your FC71 on noisy signals, such as in digital circuits, where others won't stop dancing.



**Automatically Checks Divide And Multiply Circuits**—Just store the input and read the divider output, or vice versa; this feature alone will nearly pay for your frequency counter.



**Exclusive IEEE Universal Bus Compatibility**—Monitor frequencies for documenting purposes or intermittent troubleshooting. You will pay less for Sencore's IB72 IEEE 488 Bus Interface and you will still be able to use it with other Sencore equipment; it is universal.

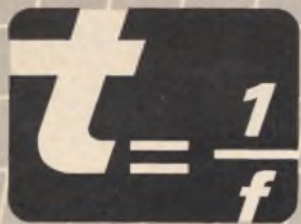


**Exclusive Crystal Check**—The FC71 is the only frequency counter that checks crystals to be sure that they are "putting out" at the right frequency.



**Highest Value, FCC Accurate, Portable Frequency Counter On The Market**—Before you pay at least two-thirds more and get less, you owe it to yourself to put the FC71 to the test on your bench or test site first. HERE IS OUR OFFER: Try an FC71 for 15 days at no obligation. Put the FC71 through its paces and see for yourself just what a breakthrough in counter design it really is. If you're not 100% satisfied, simply return your FC71 and owe nothing. If you're ready to buy instead of trying it, you can save

big by acting before July 4. You will receive the BY234 Heavy Duty Battery (\$60 value) at no charge. So, call us **WATS Free at 1-800-843-3338**, TODAY to say "YES" to a 15 Day Self Demo of the affordable counter you can rely on.



## Tom's Teaching Tips

### Teach Students To Analyze And Understand Complex Waveforms With the SC61 Waveform Analyzer.

by Tom Schulte, Technical Advertising Writer

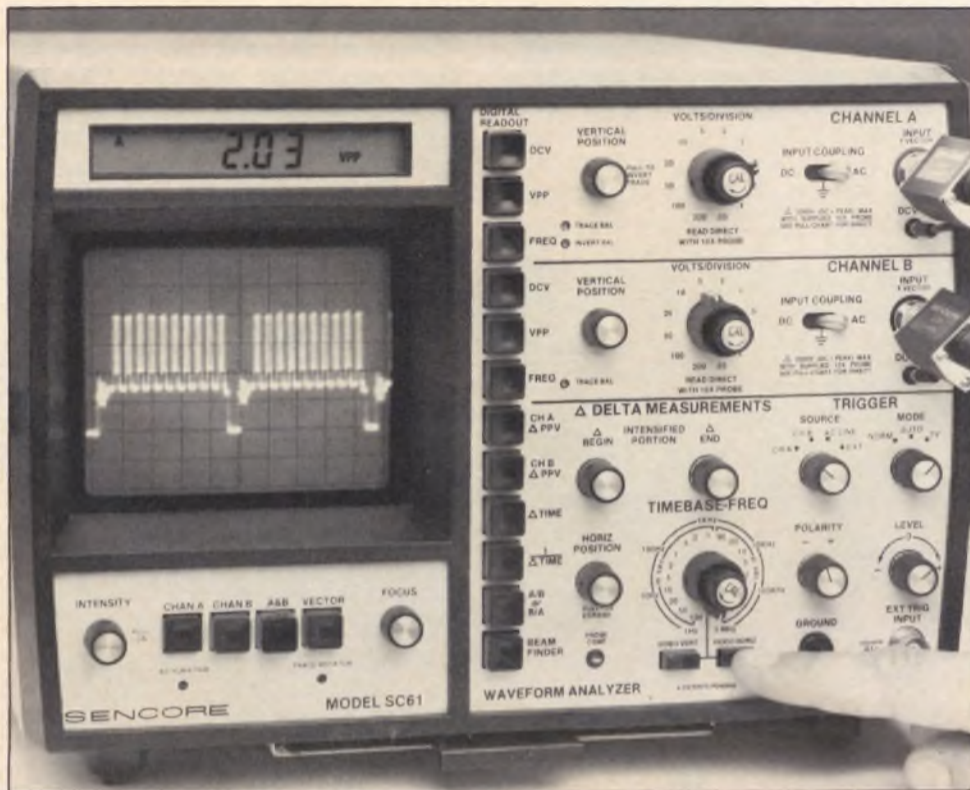


Figure 1: The preset video positions allow you to lock in even complex video signals rock-solid.

Teaching complex waveform analysis can be easy. In the last issue, I offered some techniques for teaching waveform fundamentals more successfully, using the SC61 Waveform Analyzer. Now, let's use the SC61 to show your students how to eliminate the guesswork in complex waveform analysis.

One of the most complex waveforms you and your students deal with in electronics is composite video. This signal includes many different parts. It includes: video (which can be very complex itself), sync pulses at both the horizontal and vertical rate (including vertical equalizing pulses), blanking pulses at the horizontal and vertical rate, chroma sync (burst), VITS (vertical interval test signal), VIRS (vertical interval reference signal), and digital closed caption signals. If your students are able to analyze this complex waveform easily, you know they'll easily analyze other waveforms. Let's see how easy it can be...

#### The SC61's Preset Timebase Helps Students Analyze and Understand Complex Waveforms

Connect the SC61 Waveform Analyzer to view the composite video waveform at the output of a TV's video detector. (Connect to the output of a color bar generator if a TV isn't convenient.) Set the SC61's trigger polarity switch to match the polarity of the sync pulses and set the timebase control to the VIDEO HORIZ preset position (Figure 1). This setting gives you two important benefits:

1. It activates internal video sync separators that lock in rock-solid on the signal.
2. A special SC61 vertical blanking circuit is activated which eliminates the vertical blanking and vertical sync pulses while you are viewing the video signal at the horizontal

rate. That means your students won't be seeing the confusing "ghost" line linking the horizontal blanking levels.

#### Automatic Timing Analysis—No Counting Or Calculations

Now that you have a rock-solid video signal on the display, you can show your students how to quickly analyze its various parameters. For example, simply push the DELTA TIME button, and adjust the DELTA BEGIN and DELTA END controls to intensify one horizontal cycle. The digital display shows your students that the time for one horizontal line is, in fact, 63.5 microseconds (Figure 2).

Press the SC61's VIDEO VERT button, and adjust the DELTA BEGIN and DELTA END controls to intensify one vertical cycle. The digital meter now shows the time for one vertical cycle. Push the 1/DELTA TIME button and the display shows the equivalent vertical frequency (Figure 3). This allows your students to see that the repetition rate of the vertical fields is really 59.94 Hz (If you are using a non-interlaced color bar generator, the frequency will be 60 Hz). NOTE: The same result is obtained by simply pushing the FREQ button, but using this method first is more educational for your students.

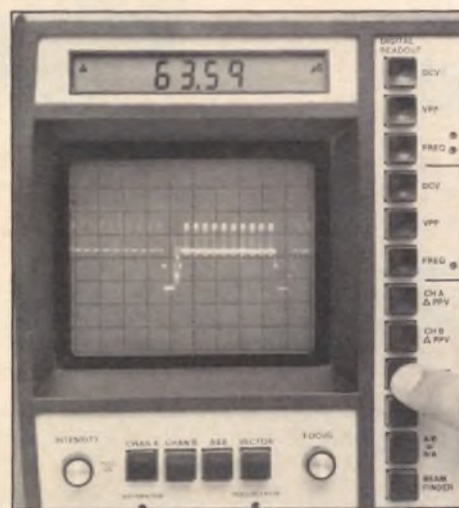


Figure 2: The DELTA TIME function is used to check timing in any part of the waveform.

#### Automatic Frequency Analysis of Signals Within The Signal Clarifies the Complex Video Waveform

Demonstrate to your students that they can analyze signals that are contained within other signals just as easily. Set the SC61's timebase control to .5 microseconds and switch to 10X expand to see an expanded view of the chroma burst. Push the 1/DELTA TIME button and adjust the DELTA BEGIN and DELTA END controls to highlight one cycle of the burst signal. The

digital display immediately shows your students the frequency of just the burst signal, while ignoring the rest of the complex video waveform.

#### Automatic Amplitude Analysis Of Part Of The Waveform Verifies Critical Levels

Also, demonstrate to your students that they can analyze the peak-to-peak amplitude of individual parts of the waveform with the SC61 Waveform Analyzer. With the burst signal still highlighted, push the CH A DELTA PPV button and read the digital display for the amplitude of the burst signal. A properly operating TV receiver delivers composite video with burst amplitude of approximately 25% of the overall signal. They can use this method to analyze the amplitude of any part of a waveform.

#### Automatic Analyzing Ends Student Frustration

Your students are now able to analyze complicated waveforms by using the SC61's automatic analyzing features to break the waveform into "bite size chunks." They simply analyze the individual parts of the signal for time, frequency, and peak-to-peak amplitude—automatically, with no guesswork.

Try this waveform simplification system in your classroom by calling WATS Free 1-800-843-3338. Ask for Sencore's exclusive "Try before you buy" 15 Day Self Demo. ■

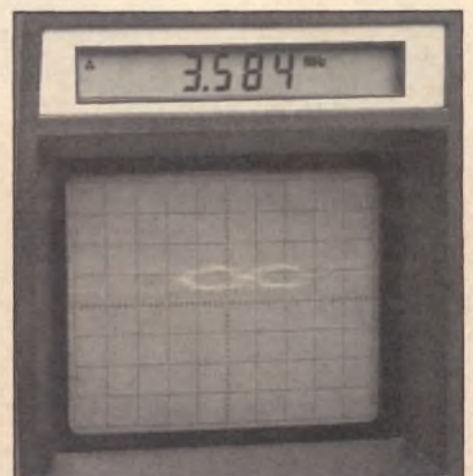


Figure 3: Automatically analyze the frequency of signals within signals with the automatic 1/DELTA TIME function.





## What The VA62 Universal Video Analyzer Does For You That No Other Instrument Can . . .

by Norm Tipton, Application Engineer, Field Sales Engineer

**C**an you remember how often you thought, "I have to take a coffee break from this set," but didn't . . . because you had to get it out? And through frustration and a whole lot of luck the trouble finally emerged? But, before it did, it took its toll in valuable time, customer relations and to say the least, your sanity? The feeling comes back now doesn't it? "Boy," you thought, "I need something to change the odds, to give me the edge."

Chances are that you've wished you could get a TV set out of shutdown so you could troubleshoot it. Or, you've found yourself staring at an IHVT and wondering how to test it with 100% certainty. Would you be more successful if troubles with tuners, VCR video heads, high voltage transformers, color circuits, etc. were positively identified?

Sencore's VA62 Universal Video Analyzer (industry recommended) answers these tough challenges and many more. It takes the guesswork out of video servicing and lets you isolate troubles 54% faster than ever before. Let's take a look . . .

### Cuts 54% From Your Servicing Time On Any Set, Including Tough Dogs . . . Guaranteed!

What's it worth to get those tough sets repaired and out of the shop? How much time can you save over conventional troubleshooting methods by using the VA62 Universal Video Analyzer? We went right to the user with a survey conducted by professionals. The answer? In this nationwide survey, users reported an average time savings of 54% compared to their previous test equipment. You know what that's worth in profit!

### Use The VA62 With The VC63 Accessory To Positively Identify Bad Heads In Any VCR

This easy to use and understand test proves beyond doubt whether video heads are good or bad. Video heads have been a problem for technicians from the day they were introduced. Their output signals are too small and complex to analyze with conventional test instruments. Now VCR heads can be tested with 100% confidence (Figure 1).

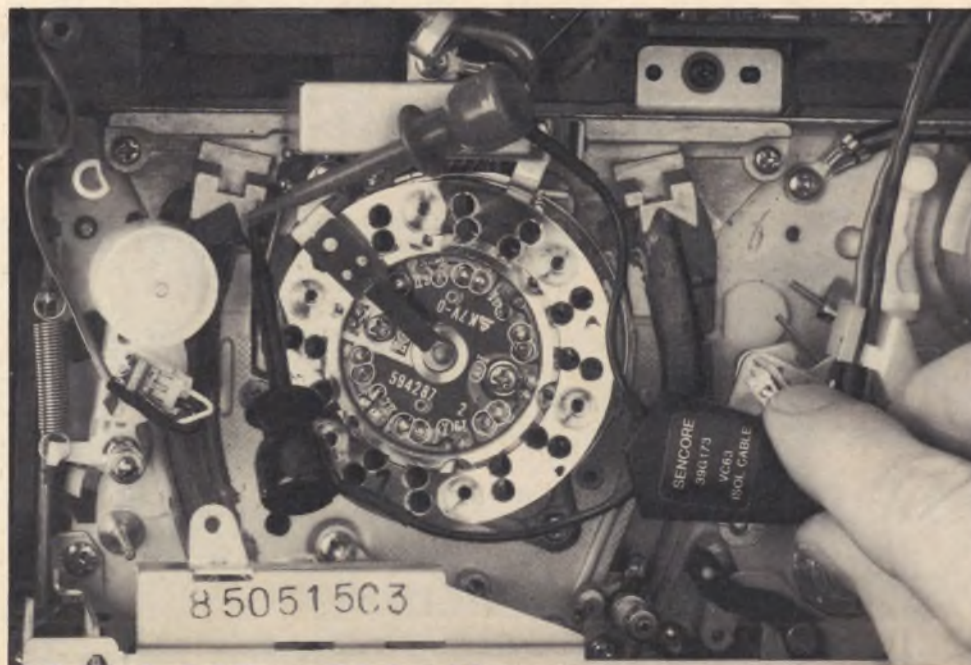


Fig. 1. Defective VCR heads can be identified with 100% confidence using the VA62 Universal Video Analyzer and the VC63 VCR Test Accessory. Here, a simple snoop loop (formed by clipping the VC63's leads together) is used to check the rotary transformer.

In Sencore workshops, customers are invited to bring tough dog sets in, to see for themselves why we say Sencore instruments save time and build success.

Here's a tip from Hank Melton, Alameda, California. He's convinced that testing with the VA62 and VC63 brings results that are "All

right!" Hank had read about the VA62 and promptly took us up on the invitation to put the VA62 to the test. He wanted to see it perform on a tough VCR problem. He brought the VCR to Sencore's workshop.

Hank placed the VCR in playback and pointed to the noisy picture. It was in sync but had high background noise. Hank commented, "With so much noise it's hard to tell if it's the video head, the head relay, or the luminance circuits."

Using the VA62 and the VC63 VCR Test Accessory, Hank made a "snoop loop" by connecting the two short leads of the VC63's test lead together. He held it over the head (very close *without touching the moving head*). The loop radiated the FM luminance signal into the rotary transformer and the video pattern appeared on the screen. Hank (referring to the simplicity of the test) remarked, "Say, that's all right!"

### The VA62 Simplifies Solutions To Startup And Shutdown Problems

The shutdown circuits in a TV set are activated by circuit failures like a shorted CRT, voltage regulator, HV diode, power supply diode, defective IHVT, or even the X-ray protect circuit itself.

The screen and sound give clues that lead you to the problem area. The catch is, that while the TV is in shutdown, there are no symptoms to see or hear except for the familiar "tic-tic" sound of a set in shutdown.

### Clues Are Found By Checking On Critical Circuits While The Set Is Forced Out Of Shutdown With The VA62 Drive Signals

Bring the set out of shutdown with the VA62 drive signal and watch for these tell-tale symptoms.

**The X-ray protect circuit:** When the X-ray protect circuit or the horizontal oscillator is at fault, the set can be restored to normal operation by driving the horizontal output transistor base with the VA62's exclusive drive signals. Why? Because the normal horizontal oscillator drive had been disabled by the X-ray protect circuits.

**A shorted CRT:** An extremely bright picture with retrace lines could mean a shorted CRT or trouble in the automatic brightness limiter circuit. The color of the picture shows which gun is shorted. If the picture and retrace lines are white, the CRT is probably not shorted.

**A shorted voltage regulator (SCR):** The result is a distorted picture with a squeal coming from the IHVT (Figure 2). Lowering the AC line input to about 45 VAC, allows you to examine the regulator without damaging the receiver.

**A shorted horizontal output transistor:** Operation will not be restored with the drive signals. The VA62 HORIZ XISTOR DRIVE signal will be shunted to ground by the shorted transistor and the VA62's digital meter will read near zero.

Leading manufacturers have disclosed that over 50% of the heads returned under warranty were good. That means, if you change a head on an educated guess, you have a 50% chance of being wrong. If you order 100 heads for replacement during the year, 50 of them could end up as stock. When you have to guess, it's easy to lose. Think about that . . .

Inject the VA62 HORIZ XISTOR DRIVE signal at this test point.

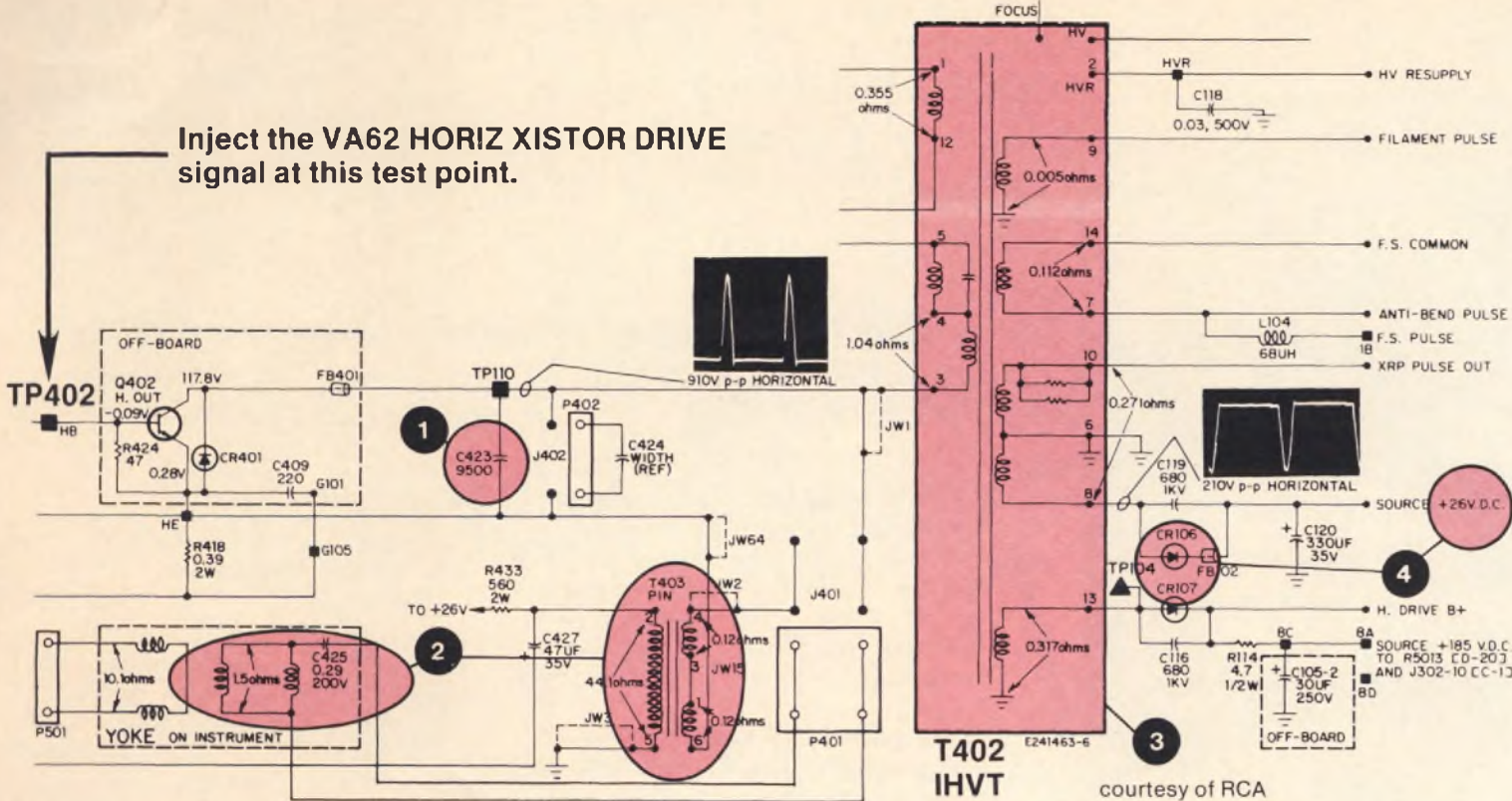


Fig. 2. The normal waveform at TP110 above changes in predictable ways when failures occur. The waveforms in Figure 3 below show up when defective sets are powered up at reduced line voltage (about 45 volts).

**A shorted IHVT:** If the IHVT is shorted it will cause immediate damage to newly installed horizontal output transistors. Always reduce the applied AC to about 45 volts and bring the set to full operation slowly. Monitor the horizontal output collector waveform when powering up after changing parts.

**Shorted turns or a cracked core in the IHVT:** The cracked core causes distortion of the horizontal output retrace pulse. Repeated output transistor failures are often caused by a cracked core or shorted turn. A good clue is a "deep saddle" or "hump" on the trailing edge of the horizontal pulse (Figure 3).

Waveform	Suspect
 800V p-p	1 Open C423
 220V p-p	2 Open Yoke, C425 Pincushion or Linearity Circuit
 220V p-p	3 Shorted turns in T402
 70V p-p	4 Shorted CR 106 or + 26V Load

courtesy of RCA

Fig. 3. Checking the waveform at the collector of the horizontal output transistor (TP110 Figure 2) gives important clues.

DRIVE RANGE to 30VPP, and the DRIVE LEVEL for 15 volts peak-to-peak on the DIGITAL METER.

3. Lower the AC input to the receiver under test to 75 VAC.

4. Inject the VA62 Horizontal Output Transistor Drive Signal at the base of the horizontal output transistor (Figure 2).

5. The IHVT CRT filament voltage will be applied to the CRT and the picture will slowly appear. Make

minor adjustment to DRIVE LEVEL for best picture.

Now that the TV is out of shutdown, you can troubleshoot the most likely circuits.

### The VA62 Isolates Defective Tuners In Minutes In The Shop Or In The Home

Manufacturers are completing plans to make a summer and fall introduction of completely "module-less" chassis. That means no more easy-to-change tuners. The tuner is destined to become an integral part of the chassis (Figure 4).

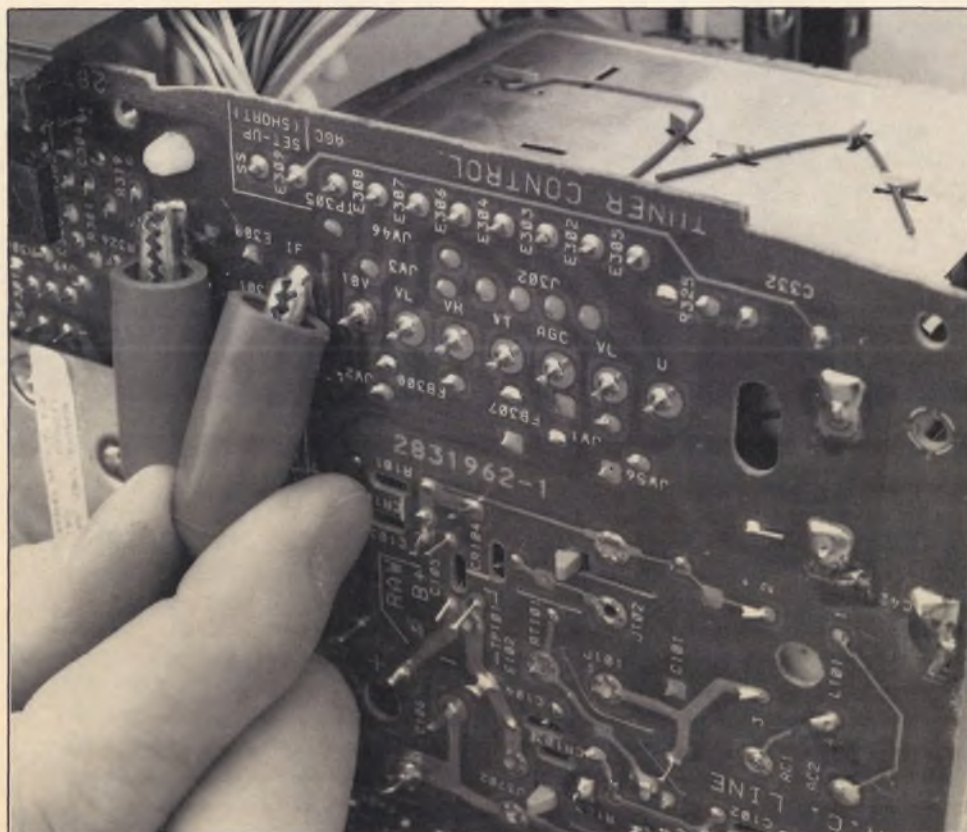


Fig. 4. Proving the tuner "good" or "bad" with the VA62 Universal Video Analyzer saves time, especially when the tuner is built into the main printed circuit board.

What does this mean to the servicer? More than ever before, you're going to need a way to substitute the IF signal in these chassis to isolate problems to the tuner circuitry with confidence. An integral tuner has no convenient "IF link" to remove and substitute external IF signals. Now, only a signal source that you can connect to the tuner's IF signal path *without interrupting it*, will let you check IF stages and isolate tuner problems 100% of the time.

When tuner circuits are included on the chassis circuit board, or the tuner itself is soldered to the chassis board, use the following procedure to successfully inject VA62 IF signals that prove which circuits are bad in only minutes.

1. Connect the balun transformer, supplied with the VA62, directly to the tuner IF signal path. The supplied balun has DC blocking capacitors for isolation and may be used to inject signals without fear of damaging any circuit.

2. Set the RF-IF SIGNAL selector on the VA62 to 45.75 MHz VIDEO IF, and select a video pattern.

3. Set the RF-IF LEVEL selector to 1ST IF and the RF-IF LEVEL VERNIER to 1 (NORM). This supplies 1000 microvolts to the first IF and should produce a snow free picture.

The VA62 is now swamping out the existing IF signal and replacing it with a known good one.

The new integral tuner's IF signal is the easiest to substitute with the VA62. Without the VA62, testing this circuit becomes very difficult.

### CAUTION

The horizontal output pulse will damage many oscilloscopes. Before measuring the horizontal output pulse, be sure that your oscilloscope inputs are protected. Sencore's SC61 Waveform Analyzer is protected to 3000 V and is recommended for these tests.

### A TV Set In Shutdown Can Be Restored To Operation In Five Easy Steps With The VA62 Universal Video Analyzer And PR57 "POWERITE"®

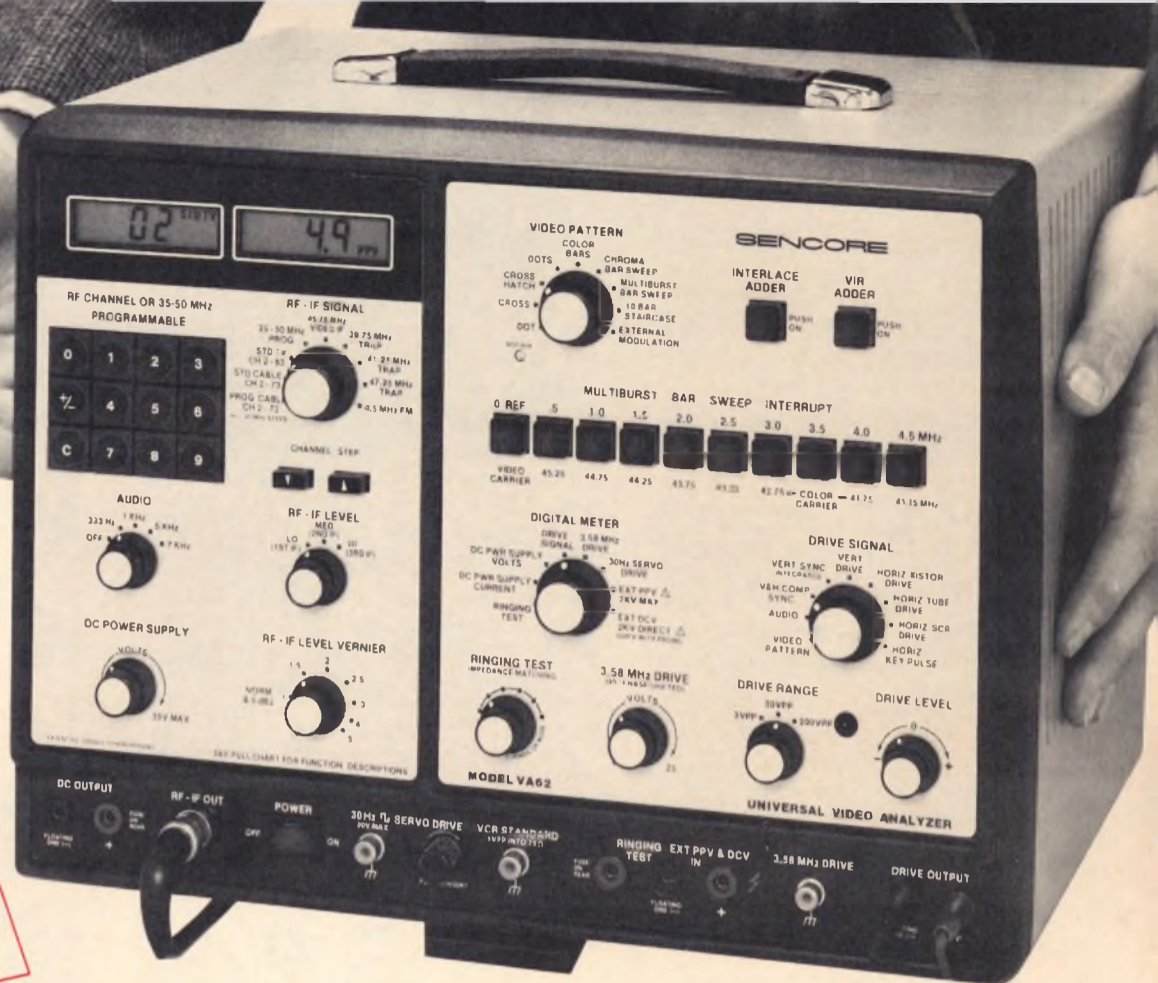
To bring the TV out of shutdown, simply follow these five exclusive troubleshooting steps:

1. Set the VA62 DIGITAL METER selector to DRIVE SIGNAL.

2. Set the VA62 DRIVE SIGNAL to HORIZ XISTOR DRIVE,

# Walk "Tough Dog" Troubles Out Of Any TV, VCR Or MTS Stereo Chassis—In Less Than Half The Time — Guaranteed.

**1** Saturday August 1987  
**Price Increase Aug. 1, 1987**  
**Act Now & SAVE \$200**



**Exclusive, industry standard VA62 Universal Video Analyzer . . . \$3,295 Patented Price as of August 1, 1987. . . . . \$3,495**

**Reduce your analyzing time** by isolating any problem to one stage in any TV or VCR, including MTS Stereo, in minutes, without breaking a circuit connection, using the tried and proven divide and conquer signal substitution method of troubleshooting.

**Cut costly callbacks and increase customer referrals** by completely performance testing TVs & VCRs before they leave your shop. Own the only analyzer that equips you to check all standard and cable channels with digital accuracy. Check complete RF, IF, video, traps dynamically right on the CRT too. Simplify alignment with exclusive multiburst pattern.

**Reduce costly inventory** (from stocking yokes, flybacks, and other coils and transformers, for substitution only), with the patented Ringing Test. Run dynamic proof-positive test on any yoke, flyback, and integrated high voltage transformer . . . in- or out-of-circuit.

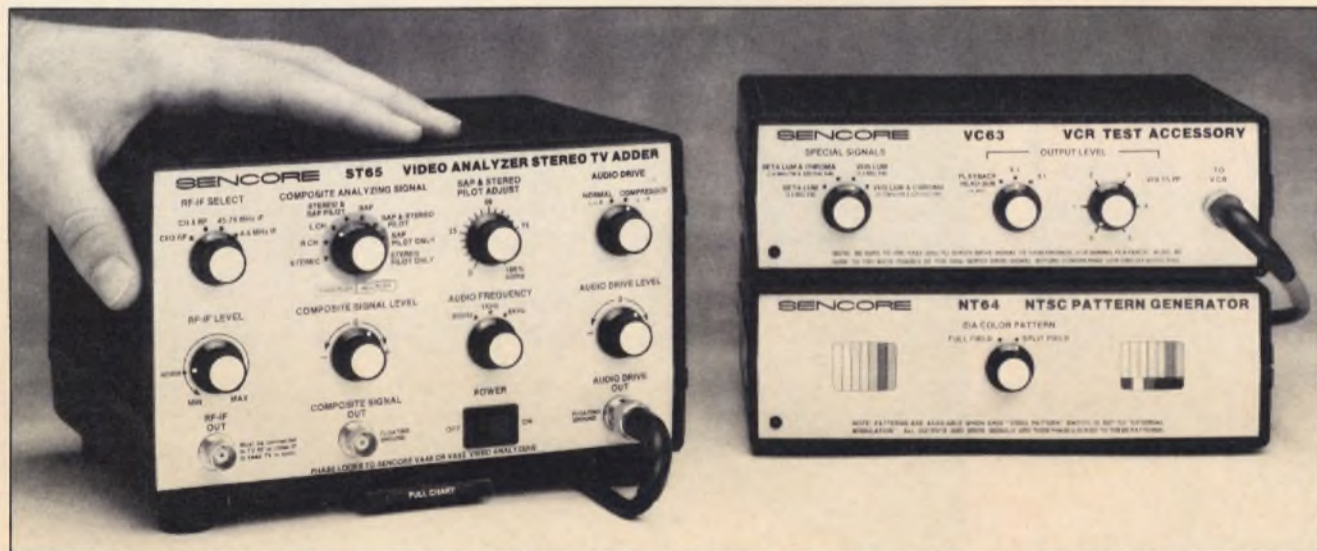
**Increase your profits by servicing stereo TV** while decreasing the number of "tough dogs" due to inadequate test equipment. Performance test all aspects of stereo operation right from the antenna terminals. With the ST65 Stereo TV Accessory troubleshoot any stereo problem right to the defective stage. Service stereo TVs quickly, without any hassles.

**Increase your business** by meeting all TV, VCR, and MTS Stereo manufacturers' requirements for profitable warranty service work with this one universally recommended analyzer. Adding the NT64 gives you an EIA standard sync-locked NTSC Pattern Generator for an additional \$395.

**Cash in on the profitable VCR servicing market.** Add the VC63 VCR Test Accessory and you'll be analyzing VCRs like an expert in no time. You'll isolate service problems fast. Identify head problems with confidence. Substitute for every major stage after the heads to find problems in minutes that take other techs hours.

**Can you afford not to have it?** Don't think that the VA62 is expensive. Written off over 5 years, the VA62 costs only 50¢ a working hour. Isn't that a small price to pay to double the productivity of your \$10, \$15, or \$20 an hour technician.

**Your guaranteed successful servicing results by calling WATS Free 1-800-843-3338 today.** Call us today at 1-800-843-3338 and let us put the VA62 Universal Video Analyzer on your bench for a 15 Day "try before you buy" Self Demo. Use it for 15 days to simplify your servicing and tame your former "tough dogs". You'll see why VA62 owners are so excited about its profit-making performance.



## VA62 Accessories:

**ST65 Video Analyzer Stereo TV Adder. . \$895**  
**Price as of August 1, 1987. . . . . \$995**

**NT64 NTSC Pattern Generator. . . . . \$395**  
**Price as of August 1, 1987. . . . . \$495**

**VC63 VCR Test Accessory. . . . . \$495**

**Call 1-800-843-3338 today.**

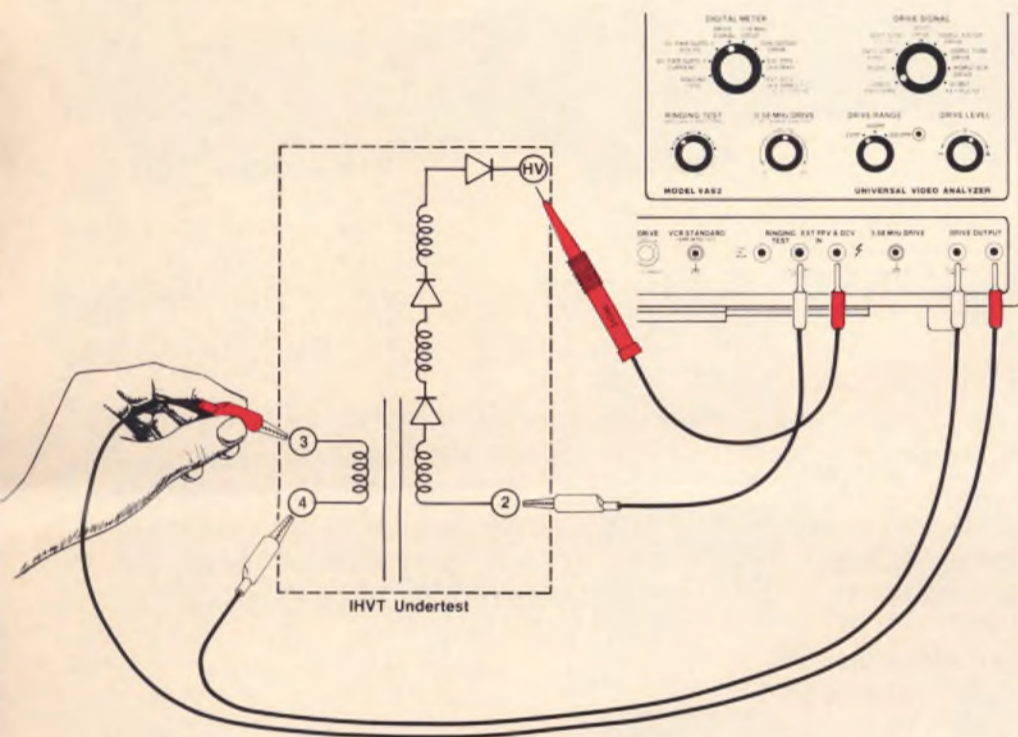
## Exclusive IHVT Test Procedure . . . Gives 100% Confidence — And Saves Time

Have you been looking for a way to tell, with confidence, if IHVTs are good or bad? Here's how Joseph E. Kramer Jr., of Oakland, California identified a difficult IHVT problem at a recent seminar.

Joe took in a TV receiver, a few months ago, that had black noise lines running horizontally through the picture. After making extensive checks, he decided the IHVT was defective. Anxious to get the set out, Joe picked up an IHVT at the local distributor and installed it. His good nature was just beginning to be tested!

bring the defective IHVT in (he had found nothing wrong with it) to see if the VA62 could show proof-positive that it was bad.

The following evening, at the seminar, Joe tested the IHVT with the VA62. He injected a 25 volt peak-to-peak HORIZ KEY PULSE into the primary (Figure 5), and read the resultant DC voltage at the high voltage output lead. The measured voltage was less than the minimum DC acceptable (Figure 6). According to Sencore's test, the expected value was 690 VDC. However, this IHVT produced just 453 VDC. The reduced DC output and the lines Joe saw in the picture could be caused by a leaking internal HV diode. The measured voltage obviously supported this conclusion.



**Fig. 5.** To perform a full dynamic test on IHVTs that you suspect to be bad, simply drive the primary with a 25 VPP HORIZ KEY PULSE and measure the resulting DC.

Joe turned on the receiver and watched disappointedly as the lines reappeared. "Now what?" he thought.

He began making checks on every component in the horizontal output stage. Nothing seemed to be wrong . . . except for the lines. Like other servicers, Joe just couldn't afford to spend all his time on that one receiver. He set it aside until he could find time to work on it.

Later, Joe made the decision to change the IHVT again. He turned on the receiver expecting to see the lines return. The picture was clean and beautiful. Joe was ecstatic that the set was finally repaired, but frustrated because he wasted so much time. And, it was because of a defective new IHVT! "If only I had a way of checking IHVTs," Joe thought, "substitution sure doesn't work!"

Joe told this story when he attended Sencore's week long seminar in Oakland. He said he would like to

Use this dynamic IHVT test procedure for fast positive proof of IHVT failures.

### WARNING

Before working in the high voltage circuit, discharge the high voltage to chassis ground.

This dynamic test sorts the good from the bad by actually driving the suspected IHVT with a known pulse and measuring the output voltage (Figure 7).

1. If the IHVT is to be tested in circuit, disconnect the collector of the horizontal output transistor by removing the transistor mounting screws. Disconnect the high voltage lead and filament leads from the CRT. Disconnect the scan derived voltage supplies.

2. With the VA62 off, place the

Collector PPV	CRT High Voltage			
	20	25	30	35
500	1000	1250	1500	1750
700	700	890	1000	1250
800	550	690	830	970
1100	450	560	680	790

**Fig. 6.** The Collector PPV of the horizontal output transistor and the normal CRT HIGH VOLTAGE determines the DC voltage obtained in the VA62's dynamic IHVT test.

DIGITAL METER selector to DRIVE SIGNAL.

3. Place the DRIVE SIGNAL selector to HORIZ KEY PULSE.

4. Connect the negative side of the EXT VPP & DCV input to the low side of the high voltage windings.

5. With the TP212 10KV, 1%, Transient Protector Probe, connect the positive side to the IHVT's HV output lead. (The TP212 probe prevents loading of the high impedance secondary circuit.)

6. Connect the DRIVE OUTPUT to the primary winding of the IHVT: the positive lead to the point connecting to the collector of the horizontal output transistor and the negative lead to the low side of the primary winding.

7. Set the DRIVE OUTPUT selector to 30 VPP and the DRIVE LEVEL control for a 25 volts peak-to-peak reading on the DIGITAL METER.

The approximate voltage output can be found in the table in Figure 6. The left numbers of the table represent

### CAUTION

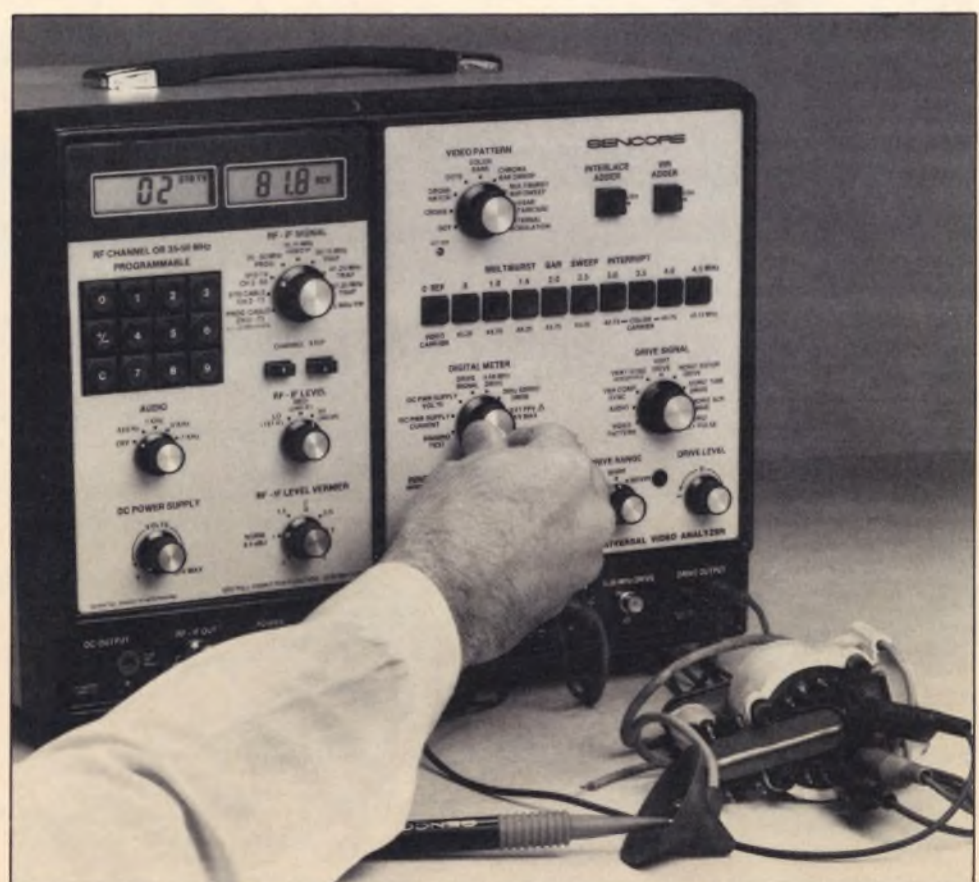
Hazardous voltages are present on the IHVT when the 25 VPP is applied.

the collector peak-to-peak voltages found on the schematic. The top number of the table represents the normal CRT high voltage for the receiver you are working on. The intersection of the two numbers shows the Minimum DC level the test should produce at the high voltage lead. A good IHVT will show this value or higher. A bad IHVT will produce a much lower voltage level.

## The VA62 Universal Video Analyzer Keeps Profits High

Leading consumer electronics manufacturers have accepted and recommend the VA62 for warranty authorization. Some also require the NT64 NTSC Pattern Generator.

With the VA62, you'll isolate video troubles in half the time. It's the only Universal Video Analyzer available *anywhere at any price*. The VA62 lets you identify tuner problems, pinpoint IF troubles, isolate color problems, find defective stages without disconnecting parts, test yokes and flybacks, plus measure signal levels with built in autoranged digital meter. On top of all that, it's obsolete proof! Say "yes" to your future success by saying "yes" to the opportunity to try the VA62, before you buy, on your service bench for 15 days at Sencore's expense. "Try before you buy", another Sencore exclusive. Call us WATS Free 1-800-843-3338 today. ■



**Fig. 7.** The ability to drive the IHVT and prove (beyond doubt) that it is good or bad adds the confidence successful technicians insist upon.



# Successful Servicing Shortcuts "Slice" Troubleshooting Time...

## Super Bowl Pressure

by Don Multerer, Director of Sencore Seminars



**S**ure he can Larry!" It was 10:16 P.M.; my wife had just committed me to working on a neighbor's TV. I enjoy tinkering around at home with my Sencore gear, it keeps me up-to-date and there's no pressure. This was different—this was Super Bowl Eve. Our neighbor's friends and relatives were coming from out of state. At 10:29 P.M., Larry brought his TV over (with a little guilt pressure). "I know it's late," he said, "if you can't fix it, maybe I can rent one." Servicers hear lines like this every day. But, this is different, Larry is a good neighbor in a small town with no fulltime servicer. It's Super Bowl Eve and the pressure is on!

### The Real Problem... No Schematic

One switch turns on my whole workbench. LEDs, LCDs, and scope traces dance to life, impressing the dickens out of Larry. From the look on his face, his set is already fixed. More pressure. Plugging the 19" portable into the PR57 "POWERITE"® confirms Larry's diagnosis: The set is in shutdown. The real problem is bigger. Larry got a "deal" at a discount store. And, it's not listed in Sam's. We have a 19" color TV (import) in shutdown. There's no schematic or parts list. It's 10:30 P.M.; pressure builds...

### Three Step Procedure To Bring Set Out Of Shutdown

"Maybe we can get lucky." I said. (I wanted Larry to share the pressure). "Let's use the procedure we tell our customers to use, to bring a set out of shutdown."

**Step One:** Adjust the PR57 "POWERITE" to 65 VAC out. Plug the set into the PR57 for isolation and power monitoring. Leave the set turned off until you're ready.

**Step Two:** Connect Channel A of the SC61 Waveform Analyzer to the

collector of the horizontal output transistor (don't try this with ordinary scopes, the SC61 is protected to 3000 V). You get a wealth of troubleshooting knowledge by analyzing this important pulse.

**Step Three:** Connect the VA62 Universal Video Analyzer to the tuner input (Select VA62 channel later, if set fires up.) Connect a 10 volt P/P horizontal transistor drive signal from the VA62 drive level output to the base of the horizontal output transistor (HOT). A schematic gives you test points, voltages and waveforms. In this case (Figure 1), you have to find the easiest testing points and use known average drive signals (most drive signals run between 5-15 volts P/P).



**Fig. 1. Troubleshooting a TV set without a schematic requires a new approach. Find the easiest test points and use the VA62's preset drive ranges: 3 VPP for ICs and 30 VPP for transistors.**

Next, hook up a 50 kV probe to the set's 2nd anode. You can use a Sencore HP200 and the VA62 Universal Video Analyzer's external 0-2000 VDC digital meter. For now, leave the VA62 digital meter on the DRIVE SIGNAL level.

Here is what you will be looking for when you drive the horizontal output transistor's base.

1. The PR57 lowers the line voltage to help bring the set out of shutdown. The lower line voltage also prevents damage to components.
2. The horizontal drive to HOT base replaces the missing (shutdown) drive signal.
3. The SC61 (Figure 2) monitors the HOT waveform for proper timing of trace and retrace waveforms, to isolate the possible shutdown cause

to HOT output timing components or the integrated high voltage transformer (IHVT).

Ok, let's "kick her on" and see what happens. It's 10:37 P.M.; more pressure! The current looks okay on the PR57 and a nice HOT pulse waveform pops on the SC61 screen.

No raster yet, because of lower line voltage. A quick timing check of the drive pulse is next. Just push the SC61 DELTA TIME button and adjust the BEGIN and END controls so you light up the positive part of the HOT waveform. The timing is critical and will be the same at 65 VAC and 117 VAC. The SC61 digital readout shows 13.4 usec. Right in the 12-14 usec range for good horizontal retrace.

Measure the DC and P/P volts at the HOT collector by pushing each SC61 button for quick and accurate readings. At half line voltage, expect to see half the voltages called out on a schematic. In this "no-schematic" case, you must work it backwards. The voltages at half the line voltage, should be expected to double as you increase the AC.

Switch the VA62 DIGITAL METER switch to External DC volts to monitor the 2nd anode voltage (19" receivers average 26-27 kV). Now, ease the PR57 "POWERITE" up from 65 VAC toward 117 VAC.

Monitor these key points with an eagle eye:

1. PR57 AC Current Pull: Should increase to re-set point and stop.



**Fig. 2. When troubleshooting most TV's, you'll increase your chance of success by monitoring the horizontal output transistor (HOT) waveform with the SC61 Waveform Analyzer.**

2. VA62 2nd Anode Level: Should gradually increase to your expected average level and stop.

3. SC61 - HOT Retrace Pulse Timing: Should remain the same all the way to full line voltage.

We might get lucky after all! Everything comes up nicely and the raster is restored. Selecting the same VA62 channel as the set produces a crystal clear, locked-in, color bar pattern.

Pressure eases; it's 10:39 P.M.

Taking the VA62 horizontal base drive to the horizontal drive transformer secondary also produces a pattern. Everything after the drive transformer secondary is good. Going to the primary produces shutdown. Looks like the drive transformer could be the culprit! Increasing the VA62 DRIVE LEVEL to 100 VPP, to simulate the higher drive level of the transformer primary, produces no change. In fact, the VA62 signal is not swamped out. This tells you the drive transformer, or circuit, is not shorted. It must be open! The drive transformer is completely encapsulated in black epoxy. Pressure is back; it's 10:41 P.M.

A hot soldering iron on the transformer P.C. board connections might just catch that open. By golly! That did the trick! The set fires up beautifully. It's 10:43 P.M. and the pressure is off. Larry has a new Super Bowl hero.

### Is It Luck Or Is It The Equipment?

Many servicers wouldn't have touched this set during regular working hours, let alone Super Bowl Eve. Believe me, without Sencore instruments, I wouldn't have had a chance in fixing this set.

Why turn away these challenges? Solve them and enjoy the profit with the VA62 Universal Video Analyzer, SC61 Waveform Analyzer and the PR57 POWERITE. Call WATS Free 1-800-843-3338 to put this powerful trio in your shop for 15 days at Sencore's expense. Only Sencore lets you try before you buy. It's 10:48 P.M., Larry and I celebrate. What Super Bowl pressure? ■



# Factory And Field Servicing

## Automated Cap/Coil Testing With The LC77 "AUTO-Z"™ Increases Production And Decreases Analyzing Costs

by Brian Phelps, Technical Writer



Figure 1. After the technician troubleshoots the circuit, the specialist replaces the part. When "recycling" enters the process, costs skyrocket.

**W**e have all heard about the rapid growth in production of electronic products. How can a service technician or manufacturer keep up? It's one thing to meet yesterday's technology, but today's heavy use of integrated circuits is a real challenge. Today, the trend is fewer transistors and more integrated circuits, resistors, capacitors, and coils in electronics products.

Integrated circuits often contain the equivalent of many transistor stages. Since these stages require coupling and filter capacitors, capacitor use has increased. And, of course, it's physically impractical to put large value capacitors inside an IC. Modern circuits demand better filters and tighter component tolerances.

What does this mean to manufacturers and servicers? It emphasizes that, to remain successful, you are going to have to perform "lab quality" tests and measurements on the factory floor and in the field. You'll find that improved cap/coil testing is one way to keep service and production costs down.

### The Right Test Instrument Can Increase Productivity

In service and production facilities, it's not uncommon to have skilled technicians and assembly specialists working side-by-side. The technician troubleshoots to the component level, the specialist replaces the component (Figure 1) and the problem is solved. Right? You know it doesn't always happen this easily!

As a technician, I know that when we troubleshoot complicated circuits, our conclusions can't be correct every time. We can end up recycling the same unit from the technician, to the assembler, to the calibrator, back to the technician, etc. Manufacturers (and service shops) need instruments that can break this costly loop.

### The Fully Automatic LC77 Lets Non-Technical Workers Test Capacitors And Coils With 100% Accuracy.

In manufacturing, many workers don't have to *understand* capacitors and coils, but their jobs may require them to test or replace them. Workers can become more productive if given access to an instrument that answers all their questions about capacitors and coils, eliminates measurement error, and does this automatically so any worker understands — regardless of technical background.

The only instrument that can answer this challenge is Sencore's new LC77 "AUTO-Z". For the first time, an instrument is available that can stop the costly recycling process. The LC77 is so easy to use that any worker can tell if a capacitor or coil is good or bad, automatically, at the push of a button.

### The LC77 Tests Capacitors And Coils Automatically In Seconds

Simply enter the component type and parameters, then select the desired test. The LC77 performs each test automatically and displays the result with "GOOD" or "BAD" on the LCD.

For capacitor testing, enter the capacitor type, value, working voltage, and tolerance using the LC77's touch sensitive key pad. Then simply press the appropriate key for automatic value, (Figure 2)

dielectric absorption, ESR, and leakage tests.

To test coils, select the coil type and press "VALUE" or "RINGER" for error free measurements.

The LC77 even compares the component you are testing to established Electronics Industry Association (EIA) tables that are stored in internal memory. With all the complicated electronics on the inside, only performance and ease of operation are on the outside; that's where it counts.

### What's It Worth To Eliminate Recycling In Manufacturing And Service Operations?

When you consider the impact of not being equipped to isolate and analyze (without doubt) every questionable capacitor or coil in your production or service business, you'll be surprised at the potential loss. Wouldn't you rather be considering profit? Put the LC77 "AUTO-Z" to the test. Try before you buy; call us today WATS Free, 1-800-843-3338, and ask for Sencore's exclusive 15 Day Self Demo. ■



Figure 2. Press the LC77's touch sensitive keypad to select automatic capacitor-inductor tests.

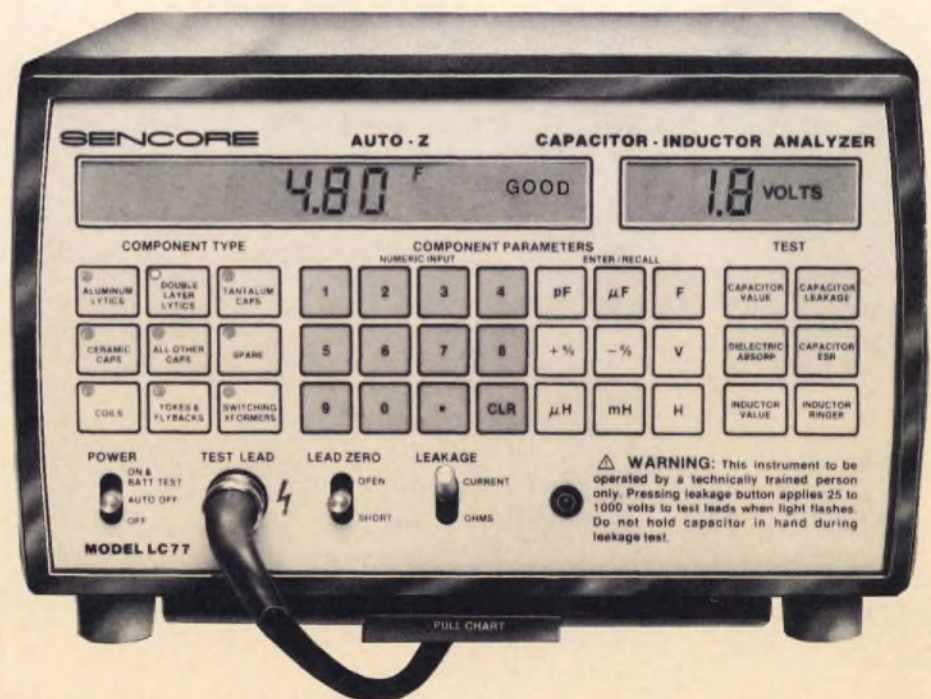


Figure 3. Sencore's LC77 "AUTO-Z" includes automatic cap/coil tests that any worker can use error free with minimum training.

# Announcing Sencore's All New Z METER Line . . . Now You'll Catch Defective Caps And Coils, That All Other Testers Miss, With 100% Confidence And Reliability . . .

Sencore, the world leader in dynamic LC analyzing, announces 3 new patented analyzers exclusively designed to help you find defective caps and coils that other testers miss. So now you can choose the analyzer you need to eliminate your frustrating cap, coil, SCR, and triac problems forever!



**\$995** patented

Choose the LC75 Z METER 2 for market proven dynamic LC analyzing.

- ✓ Dynamic LC analyzer that assures you of finding defective capacitors and inductors that all other testers miss.
- ✓ It's a complete dynamic capacitor tester that makes all four important performance tests to find even those capacitors that are just starting to go bad.
- ✓ It's a complete dynamic inductance tester that tests for value and for the coil's ability to work in-circuit.
- ✓ It checks other components, too, for added value. Transmission lines, leakage in insulation with high voltage applied, SCRs, triacs, and high voltage diodes.

**1** Saturday August 1987  
**Price Increase Aug. 1, 1987**  
**Act Now & SAVE \$100**  
Sencore August 1

**New**



**\$1,295** patented

Price increases to \$1,395 on August 1, 1987

Or step up to the LC76 PORTA-Z for 100% portable, dynamic LC analyzing to 1000 volts!

- ✓ Dynamic, portable LC analyzer that assures you of finding defective capacitors and inductors that all other testers miss.
- ✓ It's a complete dynamic, portable capacitor tester that gives you all four important analyzing tests to find even those capacitors that are just starting to go bad.
- ✓ It's a complete dynamic, portable inductance tester that tests for value and for the coil's ability to work in-circuit.
- ✓ It checks other components too: Transmission lines, leakage in insulation, SCRs, triacs and high voltage diodes.

Choose the Z METER that fits your applications. Then call WATS Free 1-800-843-3338 and tell our receptionist your phone area code and you'll be connected to your Sales Representative, he'll arrange to put the Z METER you need on your bench for a "try before you buy" 15 Day Self Demo. Now's the time to eliminate your frustrating cap and coil problems forever.

**Call 1-800-843-3338 today.**

**New**



**\$1,695** patented

Price increases to \$1,895 on August 1, 1987

Or step up to the ultimate in dynamic LC analyzing with the LC77 AUTO-Z for 100% completely automated, portable, dynamic LC analyzing to 1000 volts!

- ✓ It's the only portable, fully automatic, dynamic LC analyzer that finds defective capacitors and inductors that all other testers miss.
- ✓ It's a completely automatic, portable, dynamic, capacitor tester that makes the four important capacitor tests 100 percent automatically without look-ups, interpretation, or error. Just enter the capacitor value, rated voltage and tolerance and the AUTO-Z automatically reads the capacitor as good or bad.
- ✓ It's a completely automatic, portable, dynamic inductance tester too, that tests for both value and ability to work in-circuit. Enter the value and tolerance and push the tests you want. The meter gives direct measurements and also tells you whether the coil or transformer is good or bad.
- ✓ It checks other components too, for added value: SCRs, triacs, high voltage diodes, transmission lines, and insulation leakage.

## Joe Floyd, Executive Vice President Of Midcontinent Corporation, Tells Why Cable Companies Need The FS74 "CHANNELIZER SR."™

by Paul Nies, Application Engineer



**O**K, so tell me, why does my company need one of your CHANNELIZERs? That question is asked and answered countless times over as our Application Engineers show the FS74 TV-RF Signal Analyzers at various trade and cable shows throughout the United States.

### The Standard Of Comparison Has Changed Testing Requirements

The "bottom line" goal for Cable Television systems is to give customers a satisfactory signal. That goal is becoming increasingly difficult to meet, as Joe H. Floyd, Executive Vice President of Midcontinent Corporation (the parent of Midcontinent Cable Company) told us.

Midcontinent Cable Company (one of the nation's leading privately held cable companies) operates close to 100 CATV systems in the upper midwest and operates systems as far south as Florida. Before Midcontinent's move into CATV 20 years ago, Joe was an engineer for the Public Service Company of Colorado, where he worked extensively with cable television companies.

"System performance today is more important than it was when we started in the mid-sixties . . . Then, you were picking up distant stations or using long-haul terrestrial systems and your signal-to-noise

ratios were pretty high when you got the signals."

"People were comparing the cable to what they had off the air . . . stations 90 miles away with snow and color jumping in and out. If the cable just stabilized the signal, the customer viewed it as a tremendous improvement."

"Until 1972, cable was really a rural innovation. In fact, it was prohibited in larger cities (the top 100 markets) until 1972. In 1972 the world really changed. First, cable companies entered the larger cities and had to deal with longer cascades. Instead of 30 miles of cable, they now had 330 miles and all the attendant issues that came with that!"

"Signal-to-noise was really a problem and the industry demanded better amplifiers, better equipment, better temperature regulation, and better head-end processing equipment. With these demands came the need for better test equipment."

"When it got to the mid-seventies, the satellites came along. Now, you had a reliable delivery system that supplied signals of network quality, that were as good in Ipswich, South

Dakota, as they were in New York City. And, wow! Everybody's standard of comparison started changing and people got concerned about the quality of the picture."

"The performance on the cable system became extremely important, especially in the middle part of the United States, where you have these temperature gyrations going on and signals twisting everywhere from one place to another. But, you've garnered along a customer that is very sophisti-

cated in his standards of comparison. So, you provide him two, or three, or four satellite channels that are really crystal clear and he switches to the next channel—and it does not look of equal quality. He wants to know what is wrong. And, there lies the pressures of the 80's in the cable system."

"For example, in Sioux Falls we, via common carrier microwave, brought in the signals from the independent stations in Denver and Minneapolis. While that service and those common carriers were certainly excellent, they by no standards compare to satellite delivery. *The cable operator has discontinued terrestrial microwave* in favor of other stations by satellite, only because the customer won't stand for their quality any more. And really, those signals are no better, or no worse, than they have been for ten years, it's the *standard of comparison* that is changing!"

### Better Testing Is Needed To Deliver Top Performance

"We have always used an old fashioned measurement system where if more than 5% of your customers call for service in any

month, you have a problem in the system. Now, that's not based on any highly technical sophisticated analysis, that's just based on my 20-year background in the cable business. If 5% call, something is wrong with the system. That 5% rule applies as well today as it did back in the sixties. We just have better ways of testing it."

"The whole game you are working on is that you need a delivery system that provides pictures acceptable to the customer on a daily basis - when he now has a new reference of comparison and he has a heck of a lot better television set. The ultimate picture is better, it is crispy, and the color is much better, he has stereo sound, etc., and he expects all those things to work well. There lies the demand for better test equipment and better training for the personnel that use it."

"I'm delighted that your company is paying attention to the cable television industry. You are developing products of the sophistication that formerly has been only supplied by very expensive equipment or broadcast equipment. Not every cable company can afford that expensive equipment. (continued on page 18)

**// You need a delivery system that provides pictures acceptable to the customer on a daily basis—when he now has a new reference of comparison and . . . a lot better television set. //**

Joe H. Floyd

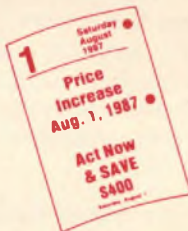


Fig. 1: The frequency coverage of the FS74 "CHANNELIZER" (5 MHz to 890 MHz) makes it ideal for tracing interference. Here, an FM station at 88.1 MHz is monitored to confirm a severe cable ingress problem.



# Test Every CRT On The Market — Plus, Safely Restore 9 Out Of 10 Weak Or Shorted CRTs With The CR70 "BEAM BUILDER"™ — Guaranteed!

- Reliably test every CRT on the market (old or new)
- Dynamic tests you can trust
- Safely restore 9 out of 10 weak or shorted CRTs
- Totally protected from damage from charged CRTs



CR70 "BEAM BUILDER"™ Universal CRT Tester and Restorer Patented \$995  
Price as of Aug. 1, 1987—\$1,295 Save \$300 by Acting Now

Have You Ever—

- 1. Wasted time checking everything else in a TV, data display, or scope, because your CRT tester wasn't able to check the CRT?
- 2. Doubted whether a CRT tester was telling you the truth about the condition of a tube?
- 3. Lost the profitable extra \$35 or more that you could have charged for restoring a bad CRT and kept a customer from throwing away an otherwise good TV?
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Well Now You Can—

- 1. Reliably test every CRT on the market, including: video, projection, computer, camera, scope, radar, and others—without carrying a box full of expensive adaptors.
- 2. Trust the CR70's dynamic tests, which give a true measure of how the CRT actually performs in the circuit.
- 3. Be more profitable and build your business by confidently restoring your customers' weak CRTs.
- 4. Avoid expensive equipment downtime; the CR70 is totally protected from charged CRTs.

## The CR70 "BEAM BUILDER"™ Is Exclusive

The CR70 is a design breakthrough in CRT testers and restorers. No other tester/restorer provides you with this much confidence and capability. But you'll want to prove that to yourself. Here's our offer . . .

### MONEY BACK GUARANTEE

Put the CR70 to the test on your bench for thirty days. During this time you'll be able to check every single CRT that you run into, you'll believe every one of your test results as being reliable, and you'll restore at least 90% of all the CRTs you check with shorts or low emission - or Sencore will cheerfully give you a refund, including freight both ways.

The CR70 is designed to make money for you in today's expanding video, data display, and scope market. Cash in on the tremendous profit potential of this lucrative market with the CR70 "BEAM BUILDER"™.

Find out what goes wrong with CRTs and how you can reliably and profitably test and restore them; call your area Sales Representative and ask for a free copy of the video tape "Universal CRT Analyzing."

To review the tape, or to order your own CR70 Universal CRT Analyzer and Restorer, so you can start profitably testing and restoring CRTs,

**Call WATS Free today 1-800-843-3338**

## Severe Beat Interference On Cable Channel 6

The need to find what was causing poor signal quality on cable channel 6 brought Midcontinent Cable to Sencore several months ago to see if they might try an FS74 CHANNELIZER SR. TV-RF Signal Analyzer. The problem was obvious, somewhere in the miles of cable which serves the 22,000 plus subscribers of Sioux Falls Cable Television (one of Midcontinent's systems), breaks in the cable were allowing the local educational station's FM signal to get into the system. The result was severe beat interference on cable channel 6.

"The channel 6 problem," Joe explains, "has been with us for a long time. I guess Midcontinent has been more aware of it because we belong to a broadcast organization called the Channel 6 Broadcasters." (Midcontinent owns a television station which broadcasts on channel 6 near Pierre, South Dakota). "Channel 6 is a 'strange cat' because it is up against the FM broadcast band and the lower end of the FM band is where the FCC has chosen to allocate educational radio FM stations."

"We first encountered the problem with our channel 6 transmitter; what happens is that you end up with a channel 6 television station sitting here and an educational FM station sitting some 30-40 miles away. The television viewer is sitting there watching channel 6 on his television set with the television set's AGC almost wide open, trying to get the signal. Suddenly, wango! This FM carrier is right down there against the picture. He's got 'squiggly wiggles' on his picture and he's got bars and stuff like that, and he's upset, and he's upset at the broadcaster. He thinks somehow the broadcaster is doing something to interfere (intentionally) with the picture."

"Now comes cable television. Because of the demand for channel 6 on their cable system. Then an educational broadcaster will come on the air. Well, he's hundreds of miles away from a channel 6 'television station' and isn't the slightest bit concerned about that problem. But, what he forgot, is that there is a cable system that works with channel 6."

"Now, in theory, the FM signal should never affect the cable system, because cable systems are radiation free, totally encapsulated. Everything is just swell - that's what the perfect world says it is. In reality, that's not the case. Quite often the cable system is connected with a (balun) connector to the back of the set. If there is an educational FM station close by, its signal will crawl right into the (balun's twin lead) cable. Or, if there is the slightest crack in the cable system, the slightest leak, the amplifiers will pick up the signal and amplify it



**Fig. 2: The Channel 6 ingress problem was traced to a cable connection that had been stressed. In the constantly changing environment, there is no perfect cable fitting.**

with everything else. When it gets to the customer, he's got a mess on his set."

"Sioux Falls has somehow been blessed with two educational FM stations which have chosen to diplex in the same antenna . . . which really intensifies the interference. Channel 6 is a continuous problem . . . a cable system in the environment that we



**Fig. 3: Problems that are particularly hard to find in large systems may be caused by worn and frayed cable cr as in this case, damage caused by squirrels.**

live in, in the Dakotas, is either stretching or compressing continually (Figure 2). It's a very fluid system of coexpansion or contraction, there is no perfect fitting, no perfect cable."

"There is no real solution - the FM broadcasters are not going to go away . . . and will always be using channel 6. At this particular time, we happen to be using it for the ABC local broadcast station which has traditionally been on (cable) channel 6. But, along came educational FM stations. First one, then two, then three (using the same antenna). Now we are stuck with a real channel 6 problem."

### Locating The Source Of The Squiggly Wiggles

Knowing that strong off-air FM signals cause the interference and locating where the signals are getting into the system are two different matters. The source of the ingress can be stressed or corroded connectors, wind-blown and worn through drop cables, or a multitude of other problems, including cable that has been gnawed by squirrels (Figure 3).

Kent Binkerd, head line technician for Sioux Falls Cable Television, explained that the FM signal ingress becomes annoying to the subscribers when the FM signal at 88.1 MHz becomes less than 20 dB below the cable channel 6 audio level. The only way to locate the break is to determine which subscribers are affected and which aren't. The break then lies somewhere between. There are, however, two problems:

1. You need to ask every subscriber on that section of the system how their channel 6 picture is.
2. There may be hundreds of feet of cable, taps, and amplifiers between subscribers.

The method for success in narrowing down the problem is to look at the signal at the amplifiers and line taps without having to bother customers. But, isn't that easily done by using a small, portable, television receiver? As the technicians at Sioux Falls Cable Television will tell you, a small, portable television receiver won't show the interference that the subscriber is complaining about on his new color, comb filter, console television receiver.

As cable technicians know, where there is ingress, there is also egress. So, to locate a leak . . . why not simply measure the signal leaking out of the cable? Kent tried this method too, with a receiver and earphones. But, every time someone in the city keyed a pager, or other business radio, Kent's ears rang from the audio level of that strong overpowering signal.

Kent's last resort (before discovering the FS74) was his spectrum analyzer. It was just sensitive enough to tell him if the FM carrier was less than 20 dB below the channel 6 audio carrier. He couldn't tell if the ratio was 46 dB, as it really should be, but at least he could be sure that it was less than 20 dB. However, he did have just one

problem. Kent's spectrum analyzer isn't portable. Much of the time he had to use as much as 75 feet of cable between the spectrum analyzer and the amplifier tap (on the pole) which he needed to look at.

The FS74 CHANNELIZER SR. changed all that. Using the FS74, Kent can quickly tell when he has a problem with ingress. And, if he does, he can quickly locate it. Several features of the FS74 are important to Kent.

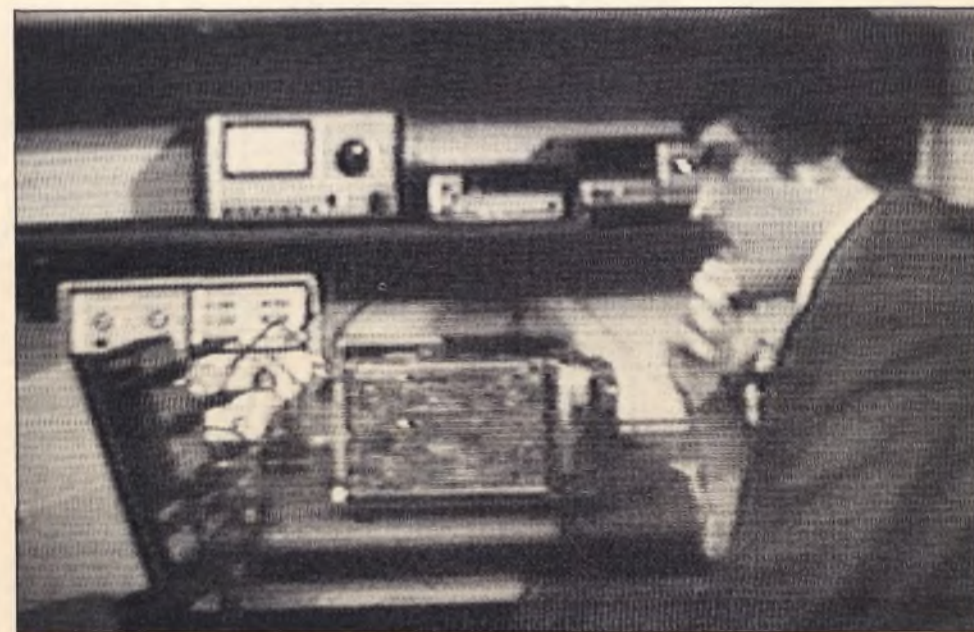
First, the FS74 tunes the entire FM band (automatically) with direct frequency readout. And, the autoranged attenuator lets him read dynamic signal levels from -46 dBmV to a whopping +60 dBmV. Kent uses the FS74's wide band monitor to see the picture and the built-in speaker lets him hear the FM audio. Let's see how the FS74, with portability and automatic tests, gave the answers that solved Kent's channel 6 ingress problem.

Kent's success procedure:

1. Tune to channel 6 RF audio
2. Read the level in dB
3. Tune to 88.1 FM
4. Read the level in dB
5. Subtract the levels . . .

That's all there was to it! With this simple procedure, the channel 6 ingress "squiggly wiggles" problem was quickly traced to a defective connector.

The FS74 CHANNELIZER SR. lets you solve challenges like this everyday to deliver top performance to your customers. This is just a sample of what the CHANNELIZER SR. does that other testers can't. What's performance like that worth? What's it worth to your customers? Call us today WATS Free 1-800-843-3338 and discuss your system needs with your Sencore Sales Engineer. Then, try the FS74 in your system for 15 full days at our expense. It's exclusive, only Sencore lets you try before you buy. ■



**Fig. 4: Interference caused by external RF signals coupling into the cable (ingress) shows up as "squiggly wiggly" interference patterns in the video. When the interference becomes annoying, customers begin to complain.**

**All New**

**Call 1-800-843-3338  
And Learn How To  
Pinpoint Any RF  
Video Trouble,  
Automatically To  
FCC Specifications  
In Less Than Half  
The Time!**



1 Saturday August 1987  
Price Increase Aug. 1, 1987  
Act Now & SAVE \$500  
Saturday, August 1

**FS74 CHANNELIZER SR.—\$2,995**  
Patents Pending



**Price as of August 1, 1987—\$3,495**

At last, a TV-RF Signal Analyzer designed the way you've always wanted it . . . Meet the world's first 100% automatic FCC accurate field strength analyzer. It's exclusively designed and guaranteed to help you analyze and pinpoint any RF video trouble, in any video distribution system in one-half the time. At long last you can accurately check your signal "quantity" and "quality"—all automatically. Here's why . . .

Meet the All New FS74 "CHANNELIZER SR."™—the TV-RF Signal Analyzer you've been dreaming of. You'll find the pesky, time-robbing, frustrating problems all other analyzers miss with these exclusive features:

**Exclusive "frequency offset" feature** automatically retunes for cable HRC and ICC frequency offsets: 100% error proof so you don't have to remember all those offset channels and frequencies.

**Exclusive on-channel automatic signal-to-noise ratio test.** Eliminates time-consuming signal comparison and chart reading.

**Exclusive audio-to-video ratio test** measures directly in dB for easy comparison to FCC specifications.

**Exclusive automatic FCC accurate Hum level test.** Eliminates customer down time, speeds your testing, instantly on any channel.

**Exclusive signal quality check.** Built-in 4 MHz wideband CRT monitor analyzes and pinpoints RF video troubles fast.

**Exclusive built-in autoranging AC/DC volt and ohmmeter** now measures trunkline voltage through RF input—hassle free.

**Exclusive all weather design** holds tighter than FCC specifications from -4° to +104°F. You'll have 100% confidence anywhere anytime!

**Battery operated for true portability,** field tested tough for dependable ease of use and IEEE 488 Bus compatible for non-attended and remote testing.

**OR CHOOSE:  
THE ALL NEW FS73 "CHANNELIZER JR."™**

If you're looking for the perfect FCC accurate performance tester—the FS73 "CHANNELIZER JR." is your ticket to success. It incorporates all the same exclusive automatic "Signal Quantity" checks as the FS74. It's the perfect performance tester for your van, etc.

**Call WATS Free 1-800-843-3338 for your 15 Day Self Demo.** Call us today for a full color brochure or better yet let us put an FS74 or FS73 at your site for 15 days. Only Sencore lets you "try before you buy." Here's our offer . . .



**FS73 CHANNELIZER JR.—\$1,995**  
Patents Pending



**Price as of August 1, 1987—\$2,395**

1 Saturday August 1987  
Price Increase Aug. 1, 1987  
Act Now & SAVE \$400  
Saturday, August 1

**Take One For A 15 Day Self Demo**  
We're so sure you'll detect RF video distribution problems quickly and accurately, we're willing to offer you a no obligation 15 day Self Demo. Put the FS73 or FS74 through its paces for 15 days and see for yourself just what a breakthrough in field strength analyzer design it really is. If you're not 100% satisfied, simply return your FS73 or FS74 and owe nothing.



# Sencore's People, Plans And Progress

## We Have The Challenges You Need!!!

by Doug Bowden, Vice President of Human Resources



### Technical Writer/Application Engineer

Are you interested in putting your ideas to work? In this position you would be responsible for writing Sencore News articles, product catalogs, product manuals and Sencore training materials. Sencore Application Engineering personnel are also responsible for testing all new products released from Engineering. If you have had two to five years of technical writing or servicing experience, you should apply. Requires a two or four year Electronics Degree.

*"There are many reasons why I have chosen Sencore as an employer. Sencore's commitment to state-of-the-art technology guarantees me the technical growth I am looking for to expand my career. Sencore has also been established for 35 years, which gives me the job security I need to grow."*



Rob Barden,  
Sales Engineer

*The reason I chose Technical Sales is simple. I like working with people. Technical Sales also offers a lucrative salary as well as rapid career growth into areas such as Sales Management, Advertising and Marketing."*

### Sales Engineers

If you are self-directed, goal oriented and have personal communication skills you would like to put to work, then you should apply for this position. Sencore Sales Engineers are Sencore's test equipment consultants assisting Sencore customers in the purchase of our products. All sales are made via the telephone from our headquarters in Sioux Falls, South Dakota. A two or four year Electronics Degree is a must for this position.

### Production Technical Supervisor

The individual selected for this excellent opportunity will be fully responsible for coordinating, monitoring and analyzing all technical problems involving Sencore instruments as they are being manufactured on the Sencore product lines. This is a highly visible and responsible position which requires sound judgment, strong technical expertise, and proven ability to supervise 8-10 technicians. A 2 year degree in electronics and 3-5 years of consumer electronic calibration experience are what is needed to qualify you for this position.

#### At Sencore we offer:

- A competitive salary and benefit package.
- Relocation package.
- Continuing education plan with full reimbursement.
- A professional, team work environment.
- State-of-the-art technology opportunities.
- A modern facility located in a city and state with affordable housing and a national "high quality of living" rating.

To find out more about these challenging opportunities

## Call 1-800-843-3338

and ask for a Human Resource Representative . . . or send your resume to:

# SENCORE

Human Resources Department, SN/01  
3200 Sencore Drive  
Sioux Falls, SD 57107

**W**hen we say, "Sencore Means Success", we are referring not only to our customers but also to our many successful Sencore employees. Sencore is seeking goal oriented, technical people in all areas of the company. We have challenging positions open in Sales and Application Engineering to name a few. Let's hear from two successful Sencore employees to find out what they like about Sencore—



Tom Schulte,  
Technical Writer

*"I have used Sencore products for many years and value them for their unique approaches to problem solving and for their state-of-the-art design. An opportunity to write about these products, from an applications viewpoint, was an exciting prospect."*

*Here at Sencore, I have found the challenges I*

*was looking for, plus opportunities for advancement. Team effort is vital here; everyone's contribution is valued highly, and I feel that I am making a difference in the company's progress."*

### Business Building Bulletin (continued from page 3)

equipment promptly went the same place as this dog . . . OUT THE DOOR! It was the PP monitor that helped me find the problem.

Now, I'm not a "super-tech", far from it . . . military service schools and some college training, that's all.

The Sencore equipment I currently have on my bench, namely the PR57, SC61, DVM56A, ST66 & DVM37 are in constant use daily. The Sencore line of equipment is the finest you can use. It is worth every penny! Why?

Think about it! How much time do you waste every day? Want to increase your productivity? BUY SENCORE! If you work commission or are self-employed, this equipment will make money for you. "Pay while you grow is a reality. The facts and figures for streamlining your repairs bear out the initial investment, e.g. If you purchase an SC61, DVM56A, ST66 and PR57 with about 10% down and Sencore financing for 48 months, your payments will be approximately \$125.00 a month.

Let's just say that because of the "usability" of this new equipment you are able to do only one (1) extra major TV repair a week, this is certainly the worst case possible. If you work 50% commission with a \$69.95 major, your commission would be approximately \$35.00.

\$ 35.00 x 50 weeks = \$1,750.00 a year

\$125.00 x 12 months = \$1,500.00 cost a year

\$ 250.00 profit with only one receiver  
extra fixed per week.

Now, in my experience, if you can't turn out one extra major TV repair a week utilizing this top notch equipment only one of two things should happen.

1. You will be seeking a new vocation because you are totally untrained in electronics.
2. John Perry (Sencore Sales Manager) and his staff will gladly "eat" this equipment. (30 day money back guarantee), Tom Hyman (Regional Sales Engineer) will even furnish the "salt"!



John Perry

Tom Hyman

I have had this equipment on my bench, setup and operating, about a month now. My production has increased drastically! At least 50%. Some days I can do 3-4 estimates, 2-3 minor and intermediates, and 2-3 majors! I have an established procedure for TVs . . . 1) take back off, 2) plug into PR57, 3) hook SC61 probe to horizontal output transistor (collector), 4) turn set on. Observe waveform for distortions, check D.C. level, PP level and frequency, also note watts; most TVs pull 100-125 watts. This gives you a large input of data to facilitate problem solving. You can also check pulse width of horizontal output, too to prevent expensive callbacks! And, all at the same time, with only one connection, without moving the test probe.

**I only have one regret: I didn't see the value of Sencore equipment before now. "**



# Sencore Workshops Mean Successful Electronic Servicing

Plan To Attend The All New Sencore TV/VCR Workshop When It's In Your Area.

What you will see demonstrated:

#### VCR Troubleshooting Techniques

- How to test any VHS, BETA, U-Matic VCR head system with 100% proof positive results using Sencore's VA62/VC63 Video Analyzing System.
- How to quickly isolate any VCR Servo lock-up problem using the Sencore VA62 Universal Analyzer and the SC61 Waveform Analyzer.
- How to accurately test and align any multiple head Hi-Fi VCR system in 3 easy steps using the SC61 Waveform Analyzer.

#### MTS Stereo Color Television Troubleshooting Techniques

- How to completely performance test, troubleshoot and align any MTS Stereo system to manufacturer's specs (or better) with Sencore's new exclusive ST65 Video Analyzer Stereo TV Adder and ST66 Stereo TV Analyzer.

- How to quickly isolate any TV shutdown problem dynamically using the VA62 Video Analyzer to fire the chassis up and the SC61 Waveform Analyzer to monitor and analyze H.O.T. output.
- How to check any TV chassis for RF, IF video and chroma response in less than 60 seconds without taking the back off the set.

#### Dynamic Component Analyzing Techniques

- How to dynamically analyze any IHVT in circuit, in seconds, using the patented VA62 ringer test and exclusive IHVT drive test.
- How to dynamically analyze any cap or coil with 100% reliability using Sencore's all new triple-patented Z METERS.
- How to pinpoint any MATV, or cable TV-RF distribution problem with the all new Sencore FS74 CHANNELIZER SR.

All dynamically demonstrated so you can see how you can successfully service the latest TV and VCR electronic systems and circuits.

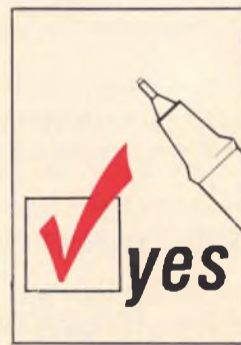
To Register Call 1-800-843-3338 U.S. or 1-800-851-8866 Canada

## Sencore TV/VCR Workshop Schedule

CANADA	Iowa	New York
<b>Manitoba</b>	Sept. 17 Dubuque	Aug. 11 Long Island 12 New York City 13 New York City
July 20 Brandon 27 Winnipeg	<b>Louisiana</b>	<b>No. Carolina</b>
<b>Ontario</b>	Aug. 24 Monroe 25 Shreveport	July 20 Charlotte 21 Charlotte
July 28 Ft. Francis 29 Thunder Bay 31 Sault Ste. Marie	<b>Maryland</b>	Aug. 4 Kinston 5 Jacksonville 6 Wilmington
<b>Saskatchewan</b>	Sept. 15 Baltimore 16 Baltimore 17 Annapolis	<b>No. Dakota</b>
July 21 Regina 22 Saskatoon 23 Prince Albert	<b>Michigan</b>	July 13 Fargo 14 Bismarck 15 Minot 16 Williston
<b>UNITED STATES</b>	Aug. 17 Mackinaw City 18 Escanaba	<b>Oklahoma</b>
<b>Colorado</b>	<b>Minnesota</b>	Sept. 9 Lawton
Aug. 24 Ft. Collins 25 Boulder 26 Pueblo 27 Denver Sept. 14 Grand Junction	Sept. 1 Duluth 2 St. Paul 3 Minneapolis 14 Mankato 15 Rochester	<b>So. Carolina</b>
<b>Connecticut</b>	<b>Mississippi</b>	July 22 Spartanburg 23 Greenville
July 13 Hartford 14 Norwich 15 New London 27 New Haven 28 Bridgeport 29 Stamford	July 28 Columbus 29 Meridian 30 Jackson	<b>So. Dakota</b>
<b>Dist. of Columbia</b>	<b>Montana</b>	July 9 Mitchell
Sept. 28 Washington 29 Washington	July 13 Great Falls 14 Helena 15 Butte 16 Billings	<b>Texas</b>
<b>Florida</b>	<b>Nebraska</b>	Aug. 26 Dallas 27 Ft. Worth Sept. 8 Sherman 10 Amarillo
Aug. 25 Jacksonville 26 Jacksonville	July 6 Lincoln 7 Grand Island 8 Omaha Aug. 5 Scottsbluff	<b>Virginia</b>
Sept. 8 Daytona Beach 9 Orlando 10 Orlando 21 Melbourne 22 Ft. Pierce 23 W. Palm Beach 24 W. Palm Beach	<b>New Jersey</b>	Sept. 30 Alexandria Oct. 1 Alexandria
<b>Georgia</b>	Aug. 24 Paramus 25 Secaucus 26 Newark 27 Perth Amboy 31 Trenton	<b>Wisconsin</b>
Aug. 24 Savannah	Sept. 1 Willingboro 14 Wilmington	Aug. 19 Green Bay 20 Oshkosh 24 Milwaukee 25 Milwaukee 26 Kenosha 27 Madison 31 Eau Claire Sept. 16 La Crosse
<b>Illinois</b>	<b>New Mexico</b>	<b>Wyoming</b>
Sept. 21 Rockford 22 Evanston 23 Elmhurst 24 Harvey	Sept. 16 Farmington 17 Albuquerque 21 Tucumcari 24 Santa Fe	Aug. 3 Sheridan 4 Casper 6 Cheyenne
<b>Indiana</b>	<b>New York</b>	
Sept. 28 Hammond 29 Gary 30 Michigan City	July 30 White Plains Aug. 10 Long Island	



**1** Ask Sue Ann Gustafson, Sencore Workshop Coordinator, to reserve a seat at your scheduled workshop.



**2** Check "yes" I plan on attending the Sencore Workshop on the enclosed sweepstakes return card.



**3** Next mark your calendar so you don't forget. Even if you do, Sue Ann will call and remind you a few days before your scheduled workshop. (P.S. Bring a Technical friend.)



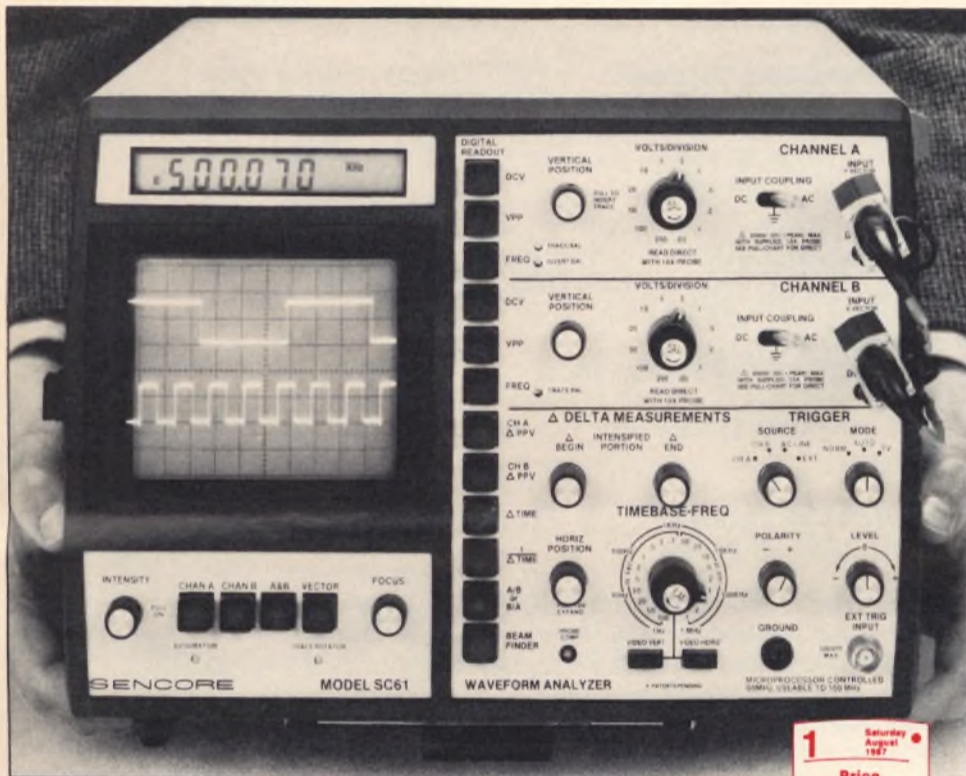
**4** Then be sure to attend to receive your Free Sencore Workshop attendance gift—two specially prepared video training guides. A \$40.00 value.

Your servicing success is our success. Please join us and your technical friends at Sencore's all new workshops.

# ALL NEW SENCORE

Welcome to the All New Sencore Shoppers Guide. We've geared-up to help make your servicing more successful in 1987 by providing factory direct incentives for you, including: our industry exclusive "Try Before You Buy" 15 Day Self Demo program, 30 Day Money Back Guarantee, 100% "Made Right" Lifetime Guarantee, and the Early Bird Specials on page 30. Use the convenient factory direct response card on page 24 or our WATS Free phone number - 1-800-843-3338 — to order or receive more information.

**Completely Analyze Any Waveform To 100 MHz, 10 Times Faster, 10 Times More Accurately, Absolutely Error-Free—Guaranteed**



**SC61 Waveform Analyzer**  
Triple Patented \$2995 **Price Increase Aug. 1, 1987—\$3295**



On GSA Contract  
NSN#6625-01-169-2318

The SC61 increases your testing and troubleshooting effectiveness and virtually guarantees increased profits.

- Puts confidence into your troubleshooting with 60 MHz (useable to 100 MHz) performance and microprocessor-controlled success building features.

- Analyze all schematic waveform parameters at just the push of a button, with the 100% automatic AUTO-TRACKING™ digital readout.

- Faster, more accurate, easier measurements than you ever dreamed possible; and it's error-free — you can't make a mistake in analyzing any waveform.

- Quickly and accurately analyze any test point with exclusive one probe hook-up.

- Rock-solid fiddle-free sync eliminates frustrating adjustment of complicated controls.

- Four times the measuring capability (2000 V) of any regular scope — simplifies TV shutdown problems by analyzing horizontal circuit voltages that would destroy regular scopes.

- Successfully test the most complex waveforms with the professionalism that adds authority to your decisions on waveform analysis.

Use the SC61 Waveform Analyzer on your circuits; compare it to regular scopes — with or without digital displays. You'll agree that it quickly makes you the authority on waveform analyzing and increases your effectiveness more than any regular scope. Call **WATS Free 1-800-843-3338** today and arrange to try the SC61 on your bench with our exclusive 15 Day Self Demo. Only Sencore lets you "try before you buy."

**The Only NTSC Video Servicing System Guaranteed To Cut Your Servicing Time By 54%\***



**VA62 Universal Video Analyzer**  
Double Patented \$3295 **Price Increase Aug. 1, 1987—\$3495**  
On GSA Contract NSN#6625-01-187-5516

Isolate video troubles in half the time with the only Universal Video Analyzer.

- Eliminate aggravating tuner questions with the only universal all-channel cable, FM, VHF, and UHF RF generator.

- Quickly pinpoint hard-to-find IF troubles with modulated troubleshooting signal and exclusive, programmable IF generator.

- Isolate tough problems by simply watching the screen, with innovative, patented troubleshooting patterns.

- Confidently divide and conquer any defective TV/VCR, without disconnecting parts, with exclusive phase-locked drive signals.

- Reliably test expensive yokes and flybacks that have always been such a headache to check.

- Update for new video technology profitably with exclusive phase-locked accessories.

Cut *your* servicing time by 54% or more. Now's the time to say "yes" to more successful servicing, call us today **WATS Free 1-800-843-3338** and put the VA62 to a 15 day trial on your bench.

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

# SHOPPER'S GUIDE

**Quickly, Easily, And Accurately Test, Troubleshoot And Verify Any Mono/Stereo Sound Or SAP Channel With Your Video Analyzer And The ST65**



**ST65 Video Analyzer Stereo TV Adder**  
**Patent Pending \$895 Price Increase Aug. 1, 1987—\$995**

1 Saturday August 1987  
**Price Increase Aug. 1, 1987**  
**Act Now & SAVE \$100**

Add profitable MTS TV analyzing capability to your Sencore Video Analyzer with the ST65 Video Analyzer Stereo TV Adder.

- Updates your VA48 or VA62 Video Analyzer to an integrated Multichannel Television Sound (MTS) Stereo TV analyzing system.
- Exclusive phase-locked design locks your ST65 to your VA48 or VA62 for rock-solid analyzing.
- Performance test any MTS Stereo receiver to prove to yourself and your customer that the TV is performing properly.
- Substitute known-good signals to isolate troubles in any stage — with exclusive adjustable RF/IF, composite, and audio signals.
- Easy to use — a handy pull chart guides you through each profitable test.
- The only tester *guaranteed* to tie stereo troubles down to any and all stages.

Meet the challenge of Stereo TV; there will never be a better time. Call your area Sales Engineer **WATS Free 1-800-843-3338** to discuss this innovative Stereo TV Adder.

## Service VCRs With The Same Efficient Troubleshooting Methods Proven By Thousands Of Video Analyzer Owners

**VC63 VCR Test Accessory \$495** On GSA Contract as accessory

Add the effectiveness of signal substitution to VCR circuits with this patented VA62 accessory.

- Isolate problems in VHS, Beta, and U-Matic VCR formats.
- Find defective heads without expensive substitution.
- Pinpoint defective stages with exclusive substitution signal.
- Troubleshoot color problems with special reference signals.

**The Only Complete, Portable Analyzer For MTS Stereo TV — The ST66 Stereo TV Analyzer**



**ST66 Stereo TV Analyzer**  
**Patent Pending \$1295 Price Increase Aug. 1, 1987—\$1395**

1 Saturday August 1987  
**Price Increase Aug. 1, 1987**  
**Act Now & SAVE \$100**

Get in on the profits from the new stereo TV service market.

- It's a complete MTS Stereo TV/VCR analyzer — simplifies stereo TV service.
- Successfully service MTS Stereo TV audio with all the special signals you need.
- Now, completely analyze all MTS Stereo TVs/VCRs from the antenna to the speakers, with one simple connection.
- Exclusive video patterns for total receiver analysis.
- Eliminate intermittent stereo switching problems with exclusive pilot threshold test.
- Completely portable—take the ST66 on any service call and maneuver your test setup for maximum efficiency without extension cords, etc.
- No complicated setup or specifications needed — quick results keep your servicing profitable.

Call **WATS Free 1-800-843-3338** and ask your area Sales Engineer for Sencore's exclusive "try before you buy" 15 Day Self Demo offer on this exciting new profit builder.

## EIA Standard NTSC Color Bar Patterns At One-fifth The Cost Of Competitive Generators

On GSA Contract as accessory

**NT64 NTSC Pattern Generator \$395 Price Increase Aug. 1, 1987—\$495**

Meet VCR manufacturers' warranty requirements by adding "NTSC" color bar patterns to your VA62 Video Analyzer with this exclusive accessory.

- 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.
- One-fifth the cost of competitive, stand-alone NTSC generators.

1 Saturday August 1987  
**Price Increase Aug. 1, 1987**  
**Act Now & SAVE \$100**

# ALL NEW SENCORE

**Exclusive, Triple-Patented Dynamic Cap And Coil Analyzing . . . Guaranteed To Pinpoint Your Problem Every Time**

**The LC76 Brings Portability To Cap And Coil Testing — Get Lab Accuracy Anytime, Anywhere**



**LC75 "Z METER-2"™**  
**Capacitor and Inductor Analyzer**  
**Triple Patented \$995** On GSA Contract

The first tester designed to solve new high-tech cap & coil challenges while eliminating embarrassing profit-breaking errors.

- Dynamically test capacitors for value, dielectric leakage (up to 600 V applied), dielectric absorption, and equivalent series resistance (ESR)—with 100% reliability.
- Test inductors for value and ringing (effective Q) with the confidence needed for efficient repairs.
- Locate transmission line faults within feet, even in buried or hidden locations.
- Guarantee test results by comparing to EIA standards in the convenient front panel pull chart.

Call **WATS Free 1-800-843-3338** to put the world's only Dynamic LC Analyzer on your service bench for a 15 Day Self Demo, so you'll know you've made the right buying decision.

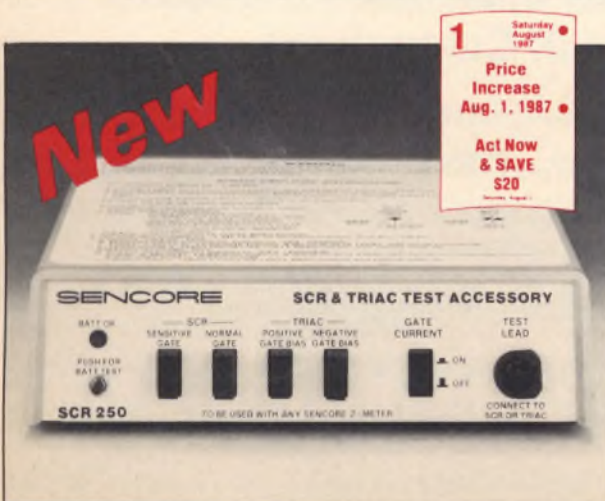
**LC76 "PORTA-Z"™**  
**Portable Capacitor and Inductor Analyzer**  
**Triple Patented \$1295** **Price Increase Aug. 1, 1987—\$1395**  
 On GSA Contract

Get laboratory quality on your service bench or in the field with the most complete and versatile cap/coil analyzer on the market — guaranteed to increase your troubleshooting confidence.

- Patented capacitor analyzer with dynamic leakage tests to 1000 Volts . . . locate capacitor failures other testers miss with Sencore's exclusive value, leakage, ESR and dielectric absorption tests.
- Thorough inductor analysis; won't mislead you like "value only" testers can.
- Exclusive hi-pot tests to 1000 Volts (previously impossible in a portable) isolates leakage problems fast . . . tests transformers, SCRs, triacs, hi-voltage diodes, switches, cables, etc.
- Full day's battery operation; 30 minute auto shut-off to eliminate dead batteries.
- LCD display for easy readability in all locations.
- NBS traceable accuracy for troubleshooting confidence.
- Rugged, all steel construction guarantees lifetime "Made Right" service.

All the original Z METER profit-building tests, plus ESR, are yours to use anywhere, anytime, with the portable LC76. Call **WATS Free 1-800-843-3338** and start your success today with our exclusive 15 Day Self Demo. Only with Sencore can you "try before you buy."

1 **Saturday August 1987**  
**Price Increase Aug. 1, 1987**  
**Act Now & SAVE \$100**  
(See Page 1)



## Dynamically Test All SCRs And Triacs For Leakage And Turn-on With 100% Reliability

**SCR250 SCR and Triac Test Accessory**  
**\$148** **Price Increase Aug. 1, 1987—\$168**

Now you can reliably test SCRs and triacs with any Sencore Z METER.

- Tests *all SCRs and triacs* with true dynamic tests for proof-positive results.

- Exclusive, dynamic leakage test with up to 1000 V applied.
- Test new sensitive-gate SCRs without fear of damaging the device.
- Easy to use, *no setup or component specifications required.*
- Tests industrial and protected-gate SCRs and triacs too.

Compliment your Sencore Z METER by automatically testing SCRs and triacs with the new SCR250 — call **WATS Free 1-800-843-3338** today and discuss these important test features with your Sales Engineer.



# SHOPPERS' GUIDE

**The Only Dynamic, Portable, Automatic Cap/Coil Analyzer Guaranteed To Find Defective Capacitors And Inductors That Other Testers Miss—Anywhere . . . Without Calculations, Lookup Tables, Or Error**



**LC77 "AUTO-Z"™ Automatic Capacitor and Inductor Analyzer Triple Patented \$1695 Price Increase Aug. 1, 1987—\$1895**

On GSA Contract

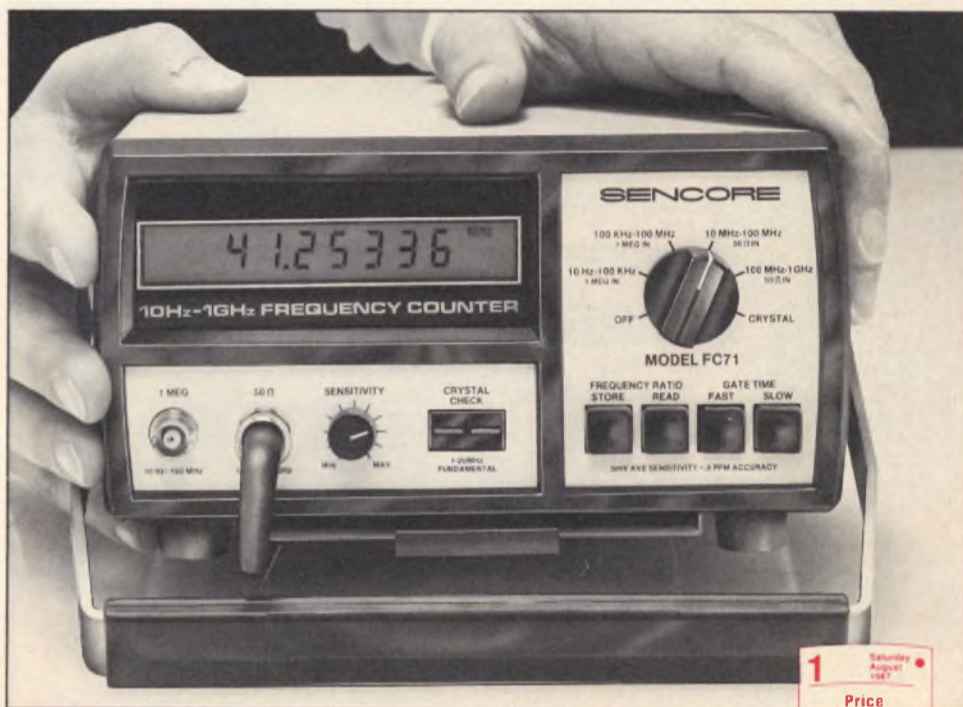


Automatic, microprocessor-controlled to thoroughly test every cap and coil in the industry automatically — and it's portable.

- Dynamically analyze capacitors and inductors with all tried and proven Z METER tests with up to 1000 volts applied in precise, .1 volt steps for more accurate measurements.
- Greater capacitor and inductor ranges extended from .2 to 20 farads to test new, large AC line stabilizing capacitors as found in VCRs and computers. Inductor ranges extended from 10 to 20 henrys to match capacitor ranges.
- 100 percent portable so you can use it anywhere, anyplace, anytime - on the bench, on the job or even on mountain tops to check CATV transmission lines, match capacitance of broadcast towers, etc.
- 100 percent automatic - speeds up your work, does your calculating with computer accuracy, prevents error and interprets components as good or bad to Electronic Industry Association (EIA) standards. All you do is enter the component value, tolerance, and operating voltage, when appropriate, and push the tests you want.
- Zero chance for error - you can't make a mistake. The AUTO-Z is autoranged, autozeroed, and has an auto-off after 20 minutes use when used with batteries. The AUTO-Z is so automatic, it even selects the coil impedance matching automatically when testing inductors. The AUTO-Z also converts all leakage current readings to ohms with the flip of the leakage switch, to 1000 megohms, with up to 1000 volts applied for hi-pot testing. It's also IEEE 488 Bus compatible to make volume testing faster and error free, even with lower cost non-technical personnel.

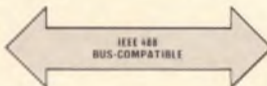
Take your LC77 AUTO Z wherever you check capacitors and inductors — in the field, shop or factory. Be satisfied that you can meet all the challenges new technology brings. Call today **WATS Free 1-800-843-3338** and tell your area Sales Engineer you want to "try before you buy" with Sencore's exclusive 15 Day Self Demo. You'll be sure you've "bought right" when you say "yes" to a Sencore instrument.

**The Only Portable Counter Especially Designed To Measure 10 Hz to 1 GHz to .5 PPM Accuracy In High RF Environments**



**FC71 Portable 10 Hz - 1 GHz Frequency Counter Patented \$995 Price Increase Aug. 1, 1987—\$1295**

On GSA Contract



The only portable counter specifically designed to measure 10 Hz to 1 GHz with .5 ppm accuracy in high RF environments — plus, extra tests make your FC71 more than just a counter; it's an RF analyzer for troubleshooting tough RF problems.

- Five times more accurate than FCC requirements — even on the most demanding job — for measurements you can trust.
- Measure all signals, even complex and noisy signals, with exclusive SNAP-ACTION™ input amplifier — count signals that drive other counters crazy.
- Super 5 mV average sensitivity — the most sensitive frequency counter available — count signals other counters miss.
- Exclusive, microprocessor-compensated timebase for super stability, winter and summer.
- Double shielded for interference-free frequency measurements anywhere—even in the highest RF fields.
- Exclusive automatic crystal check takes the guess work out of servicing crystal controlled circuits.
- Automatic frequency ratio test makes troubleshooting multipliers and dividers a snap — eliminates troublesome calculations, prevents errors.

Find out how the FC71 can add capability, satisfaction, and profits to your application. Call **1-800-843-3338** and arrange a 15 Day Self Demo so you can "try before you buy" to be sure you've made the right choice.

1 Saturday August 1987  
Price Increase Aug. 1, 1987  
Act Now & SAVE \$200

1 Saturday August 1987  
Price Increase Aug. 1, 1987  
Act Now & SAVE \$300

# ALL NEW SENCORE

Now Completely Performance Test Every Single TV/FM Channel, In Any RF Distribution System, To FCC Specifications



**FS73 "CHANNELIZER JR."™**  
TV-RF Performance Tester  
Patent Pending \$1995 **Price Increase Aug. 1, 1987—\$2395**

1 Saturday August 1987  
Price Increase Aug. 1, 1987  
Act Now & SAVE \$400



Make crucial performance tests in any RF distribution system — 100% automatically.

- Microprocessor-controlled digital tuner covers every TV/FM channel from 5 MHz to 890 MHz, so you'll never be frustrated by equipment limitations.
- Super 5 microvolt sensitivity and autoranged attenuator leaves your hands free to make critical adjustments.
- Exclusive, automatic fine tuning with LCD readout of off-channel frequency — identify shifted channels fast.
- Automatically tunes to standard HRC and ICC cable shifted channels in seconds — no need to look up frequencies.
- Use the exclusive automatic signal-to-noise test (even on in-use channels), without taking an off-channel noise reference, to simplify testing, improve accuracy, and save time.
- Eliminate tedious pilot and carrier measurements — read audio-to-video ratio and hum on any channel (while it's in use) automatically.

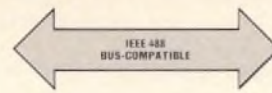
With the growing profits in TV-RF and cable system maintenance, you owe it to yourself to try the Exclusive FS73 CHANNELIZER JR. Call 1-800-843-3338 today to put the FS73 on an exclusive 15 Day Self Demo in your shop or system. Only Sencore lets you "try before you buy!"

Thoroughly Analyze And Pinpoint Any Trouble In Any RF Distribution System, Automatically To FCC Specifications, 100% Automatically And 100% Faster Than Ever Before



**FS74 "CHANNELIZER SR."™**  
TV-RF Signal Analyzer  
Patent Pending \$2995 **Price Increase Aug. 1, 1987—\$3495**

1 Saturday August 1987  
Price Increase Aug. 1, 1987  
Act Now & SAVE \$500



Your success in servicing RF distribution systems depends on locating problems quickly and accurately.

- Quickly tune all off-air, cable, and FM channels from 5 MHz to 890 MHz with the FCC accurate digital tuner.
- Exclusive automatic or manual fine tuning with LCD readout of off-channel frequency and automatic tuning of HRC and ICC cable shifts — simplifies frequency analysis.
- Exclusive 5 microvolt sensitivity on all channels with autoranged attenuator — automatically selects the best sensitivity available to measure weak signals.
- Automatic, on-channel, true signal-to-noise test without removing modulation and upsetting your customers.
- Exclusive, automatic audio-to-video carrier level ratio and hum tests on any in-use channel eliminates calculations.
- Exclusive built-in wide band monitor makes tough picture quality checks a snap.
- Exclusive built-in autoranging AC/DC voltmeter and ohmmeter means you'll never be caught short in the shop or in the field.
- Microprocessor control makes all tests fast, simple, and FCC accurate.

Guaranteed more successful RF distribution system servicing or your money back. Now's the time to lift your phone and dial **WATS Free 1-800-843-3338** and put the FS74 CHANNELIZER SR. to the test on your system for a 15 Day Self Demo. Call us today and you'll soon be successfully locating TV-RF signal problems more quickly and accurately than ever before.

# SHOPPER'S GUIDE

## Earn Big Profits While You Protect Yourself And Your Instruments



**PR57 "POWERITE"®** On GSA Contract NSN#6625-01-124-6269  
**Variable Isolation Transformer and Safety Tester**  
**Patented \$395 Price Increase Aug. 1, 1987—\$495**

1 Saturday August 1987  
**Price Increase Aug. 1, 1987**  
**Act Now & SAVE \$100**

Avoid embarrassment and risk — know beyond a doubt that your AC power (and the equipment you service) is right and safe.

- It's an isolation transformer — prevents profit loss and safety hazards by isolating grounds.
- It's a variable AC Supply — tames challenging shut down problems.
- It's a power line monitor — gives you confidence that your AC power is right.
- It's a amp/watt meter—boosts your troubleshooting efficiency and eliminates callbacks.
- It's a safety leakage tester — build additional profits on every repair and limit your liability with safety leakage checks. (Required by most manufacturers.)

You get security, safety, and profit when you service AC operated equipment with a PR57 POWERITE. Call **WATS Free 1-800-843-3338** and start your success right now with an exclusive 15 Day Self Demo. Only Sencore lets you "try before you buy."

## Big Generator Features In A Rugged, Portable Color Bar Generator

**CG25 Little Huey™**  
**Portable Digital Color Bar Generator**  
**\$198**

Rock-solid patterns in a pocket size generator

- Push button ease — simple to operate.
- Caddy size for take-along convenience on every service call.
- Jitter-free digital patterns for more precise adjustments.
- Adjustable dot size matches the pattern to the set's resolution.
- Battery saving shutoff eliminates the frustration of dead batteries.
- Test leads built-in; ends the search for leads.



## Test Every CRT On The Market—Now And In The Future. Plus, Safely Restore 90% Of All Weak Or Shorted CRTs—Guaranteed



**CR70 "BEAM BUILDER"™** On GSA Contract NSN#6625-01-187-4395  
**Universal CRT Analyzer and Restorer**  
**Patented \$995 Price Increase Aug. 1, 1987—\$1295**

1 Saturday August 1987  
**Price Increase Aug. 1, 1987**  
**Act Now & SAVE \$300**

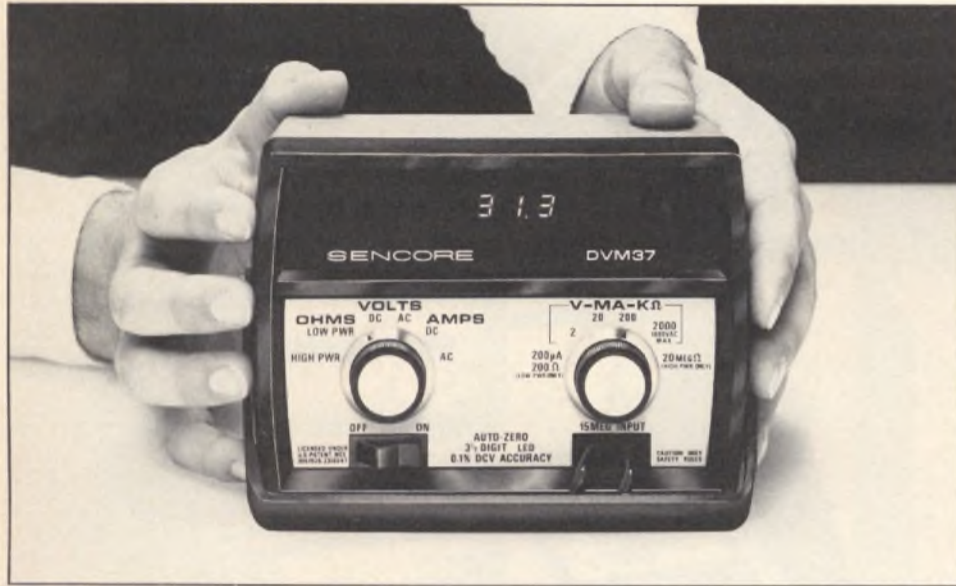
Are you wasting valuable time and profit replacing CRTs that could be restored for increased life and profits? Have you turned down service jobs because you knew the CRT was weak?

- Only the CR70 is guaranteed to reliably test and safely restore every CRT on the market (old or new).  
*All B&W 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*
- Dynamic tests you can trust for troubleshooting confidence.
- Safely restores 9 out of 10 weak or shorted CRTs—guaranteed.
- Always have the right socket for any CRT — and you won't have to carry a box full of expensive adapters.
- Avoid equipment downtime; your CR70 is guaranteed to be totally protected against damage from charged CRTs.

Call us **WATS Free 1-800-843-3338** today for your CR70 BEAM BUILDER, and start cashing in on the enormous CRT restoration market. Ask for Sencore's exclusive "try before you buy" 15 Day Self Demo to be sure you've made the right choice.

# ALL NEW SENCORE

**When The Going Gets Tough, You Need A Tough DVM That Keeps Going — Get The DVM37**



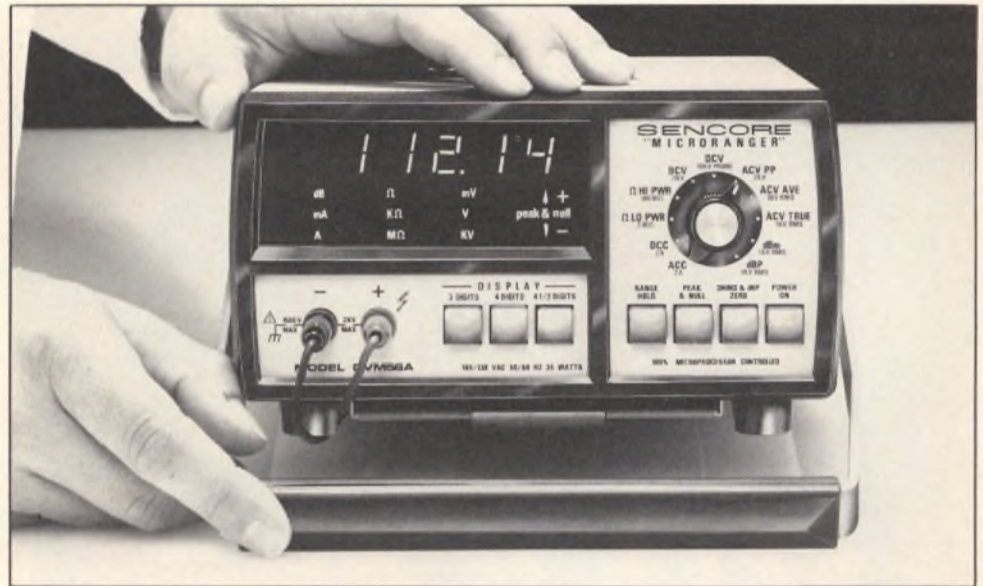
**DVM37 3 1/2 Digit, 0.1% Bench/Portable DVM**  
**\$395** On GSA Contract

For confidence and success in troubleshooting, you need a DVM that holds lab accuracy under the most rugged conditions.

- .1% accurate DVM for bench or field for measurements you can count on.
- 15 Megohm input impedance for minimum loading and 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 DC with TP212 probe (optional).
- An indestructible DVM for both bench and field.

Call today **WATS Free 1-800-843-3338** to put the toughest bench/portable, lab accurate meter on your bench for an exclusive 15 Day Self Demo. Only Sencore lets you "try before you buy."

**100% Automatic Microprocessor-Controlled DVM Will Save You At Least An Hour A Day**



**DVM56A "MICRORANGER"®**  
**4 1/2 Digit, .075% Bench DVM**  
**Patented \$995** On GSA Contract

The most versatile, time-saving bench DVM you'll ever own.

- 100% Automatic; designed to save you time—simply touch and test and the MICRORANGER does the rest.
- Lab Accuracy; .075%, 4 1/2 digit with 15 megohm input impedance — you get accurate, error-free readings every time.
- Versatile; 16 microprocessor controlled measuring ranges — you'll solve new high-tech challenges with your DVM56A.
- Tough; fully protected to 7.5 kV overload and RF interference free—it's built tough for years of dependable measurements.
- Super easy to use — for faster, more efficient troubleshooting.

Enjoy troubleshooting success and more free time when you put this time saving meter to work on your bench. Call **WATS Free 1-800-843-3338** today and ask your Sales Engineer how the DVM56A MICRORANGER will help you profitably meet routine and special troubleshooting challenges. Then ask for an exclusive Sencore 15 Day "try before you buy" Self Demo.



**Solve Stereo TV Servicing Challenges With Simplified Readouts And Convenient Loads**

**SR68 Stereo TV Readout**  
**\$495 Price Increase Aug. 1, 1987—\$595**

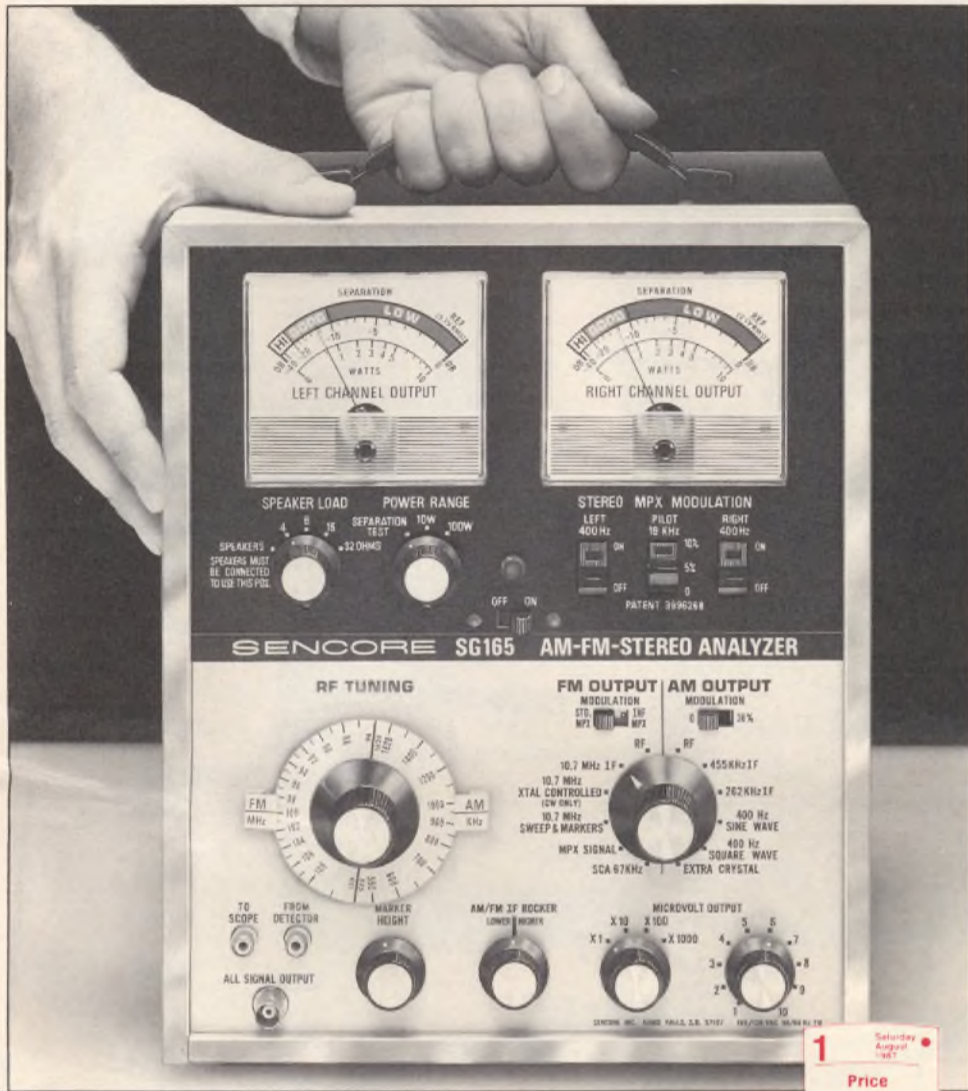
Dual meters and loads to 100 Watts solve stereo TV servicing challenges.

- Analyze Stereo TV audio line or speakers in dB or watts.
- Loads to 100 Watts for dynamic tests and speaker substitution.
- Measure channel separation to -40 dB without calculations.
- Battery operated - use in the shop or in the field.

1 Saturday August 1987  
**Price Increase Aug. 1, 1987**  
**Act Now & SAVE \$100**

# SHOPPER'S GUIDE

## Walk The Troubles Out Of Any Stereo System In Half The Time With The SG165 AM/FM Stereo Analyzer



### SG165 AM/FM Stereo Analyzer Patented \$1,295 **Price Increase Aug. 1, 1987—\$1495**

Designed to boost your audio troubleshooting efficiency — gives you everything you need to completely analyze AM/FM Stereo.

- Provides every AM/FM Stereo signal needed for efficient analyzing of audio equipment problems.
- Everything you need — it's five generators in one: RF/IF, audio, stereo MPX, sweep/marker, and SCA.
- It's a dual channel audio wattmeter to 100 watts with built-in dummy loads for convenient output monitoring.
- It's a stereo separation meter with independent metering to guide you all the way.
- Stereo subcarrier at better than FCC tolerance for accuracy in all your testing and alignment.

Cash in on your share of the success. The electronics industry has been expanding like "wildfire" for several years. Both home and auto stereo servicers have enjoyed spectacular profits. Join these successful servicers and put your bottom line on top. Call **WATS Free 1-800-843-3338** today for full details on the SG165 stereo servicing profit center and a 15 Day Self Demo.

**Trademarks of Sencore, Inc.:** Little Huey, Super Cricket, MICRORANGER®, POWERITE®, Waveform Analyzer, AUTOTRACKING, BEAM BUILDER, CHANNELIZER JR., CHANNELIZER SR., PORTA-Z, AUTO-Z.

**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.

## Test Any Transistor Or FET With 99% Reliability In Less Than 15 Seconds . . . In-Or Out-Of-Circuit



### TF46 Portable "Super Cricket"™ Transistor/FET Tester Patented \$395 **Price Increase Aug. 1, 1987—\$495**

Solves more semiconductor circuit problems than any other instrument.

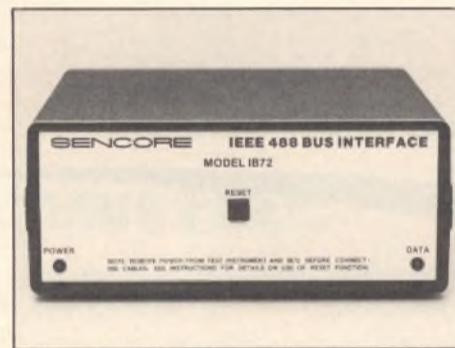
- Patented IN-CIRCUIT "go/no-go" transistor/FET test—saves you the time and hassle of unsoldering.
- Needs no setup book or instructions—be confident in your transistor/FET analyzing.
- Now more automatic than ever, identifies transistor leads from unfamiliar equipment.
- Tests all possible leakage paths to locate troublesome semiconductors.
- Dynamic gain test easily matches transistors for critical circuits.
- Portable operation with auto shut-off so you're never caught with dead batteries.

**1** Saturday August 1-1987  
**Price Increase Aug. 1, 1987**  
**Act Now & SAVE \$100**

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

For faster, more reliable transistor and FET testing, call today **WATS Free 1-800-843-3338** to put a TF46 on your bench for 15 days absolutely Risk Free with Sencore's exclusive "try before you buy" Self Demo Program.

## Add Automation With The IB72 To Reduce Costs And Increase Efficiency



### IB72 IEEE 488 Bus Interface Accessory \$625



Use the IEEE 488 system's automatic features to record data, automate testing, increase productivity, and help workers handle complex processes.

- Lets you interface Sencore instruments to the IEEE 488 Data Bus.
- Uses any software language . . . no special programming skills needed.
- Selectable address, external reset, and data indicator LED aid program development and debugging.

When the solutions to your analyzing challenges can be answered by fully automatic, error-free testing, it's time to get complete specifications and applications information on interfacing your test instruments to the IEEE 488 bus. Call **1-800-843-3338** today and discuss your automated testing applications with your area Sales Engineer.

# Price Increases

# 1

## Saturday August 1987

*Call 1-800-843-3338  
and SAVE!*

### Price To Increase August 1st, 1987

On August 1, 1987, we'll be forced to institute our first price increase in over three years, due to the changing worldwide economic factors I'm sure you've heard about. These modest increases are to cover the rising costs of sole source components incorporated in our products. So browse through the Shoppers Guide and find out just how much you can save by acting now—before the pricing adjustments become effective.

### Early Birds Save Even More

We are offering added specials for those who act early and thus help us secure tighter pricing for future instrument runs. Yes, on the following page you will find our Early Bird Specials. They can help you save up to \$736. But, these specials end Independence Day, July 4, 1987. So be sure to act now to save.

### 0% APR Investment Program Adds To You Savings

This exclusive Sencore program will have you sitting proudly in your own Sencore Dream Shop for as little as \$75.00 a month—with little or no interest carrying charges depending on the length of investment you choose.

Saturday, August 1

August							1987
S	M	T	W	T	F	S	
						1	
2	3	4	5	6	7	8	
9	10	11	12	13	14	15	
16	17	18	19	20	21	22	
23	24	25	26	27	28	29	
30	31						

# 1

## Price Increases Effective August 1, 1987 Act Now And Save!

	Price Now	Price Increases Aug. 1st to
SC61 Waveform Analyzer	\$2995	\$3295
VA62 Video Analyzer	\$3295	\$3495
NT64 NTSC Pattern Generator	\$395	\$495
ST65 Video Analyzer Stereo TV Adder	\$895	\$995
ST66 Stereo TV Analyzer	\$1295	\$1395
LC76 PORTA-Z	\$1295	\$1395
LC77 AUTO-Z	\$1695	\$1895
SCR 250 SCR and Triac Test Accessory	\$148	\$168
PR57 POWERITE	\$395	\$495
FS73 CHANNELIZER JR.	\$1995	\$2395
FS74 CHANNELIZER SR.	\$2995	\$3495
FC71 Frequency Counter	\$995	\$1295
CR70 BEAMBUILDER	\$995	\$1295
TF46 Portable Super Cricket	\$395	\$495
SG165 AM/FM Stereo Analyzer	\$1295	\$1495
SR68 Stereo TV Readout	\$495	\$595

Saturday, August 1



## Announcing Sencore's Interest Free "Pay As You Grow" Investment Plan

This special investment plan puts you in your own Sencore Dream Shop for only pennies a day. Our special graduated low APR financing rates that run from 0% for 12 months to 9.9% for 48 months will save you hundreds of dollars versus conventional loans. Plus there is no prepayment penalty for paying off early or adding on to your account as business grows. Follow the steps below to see just how little your monthly investment will be for your own Sencore Dream Shop.

Length Of Installments  
(Simple Interest APR Loan)

- 48 Months  
9.9% APR
- 36 Months  
6.9% APR
- 24 Months  
3.9% APR
- 12 Months  
0% APR

\$82	\$96	\$110	\$124	\$137	\$151	\$165	\$178	\$192		
\$82	\$98	\$115	\$131	\$148	\$164	\$180	\$197	\$213	\$229	
\$91	\$113	\$136	\$159	\$181	\$204	\$227	\$249	\$272	\$294	\$317
\$83	\$125	\$167	\$208	\$250	\$292	\$333				

1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500 7000

Amount Invested (Round Up Or Down To Nearest \$500)



# Call 1-800-843-3338 And Save With Sencore's Early Bird Specials!



## Buy the:

## Get The Early Bird Bonus FREE:

You Save  
By Acting  
Before  
July 4th

You Save  
By Acting  
Before The  
August 1st  
Price  
Increases.

SC61 Waveform Analyzer for \$2995	TP212 Transient Protector Probe - \$24.95, HP200 50,000 VDC High Voltage Probe - \$60, (2) NP229 Scope Needle Point Adapter - \$19.90, 39G81 RF Demodulating Scope Probe - \$29.95, DP226 Scope Probe - \$60, and PC227 Protective Scope Cover - \$29	\$524	\$300
VA62 Video Analyzer for \$3295	(Your choice of one) VC63 VCR Test Accessory - \$495, NT64 NTSC Pattern Generator - \$395, PR57 "POWERITE" Variable Isolation Transformer and Safety Analyzer - \$395, or ST65 Video Analyzer Stereo TV Adder for 1/2 price (\$447.50) or the ST66 Stereo TV Analyzer for \$895 (\$1,295)	Save up to \$695	\$200
ST66 Stereo TV Analyzer for \$1295	BY234 12 volt Rechargeable Battery - \$60	160	100
LC75 Z METER for \$995	SCR250 SCR and Triac Test Accessory for 1/2 price	74	
LC76 PORTA-Z for \$1295	SCR250 SCR and Triac Test Accessory - \$148	248	100
LC77 AUTO-Z for \$1695	BY234 12 Volt Rechargeable Battery - \$60 and SCR250 and Triac Test Accessory - \$148	408	200
FS73 CHANNELIZER JR. for \$1995	(2) BY242 6 volt Rechargeable Battery - \$88	488	400
FS74 CHANNELIZER SR. for \$2995	(2) BY242 6 Volt Rechargeable Battery - \$88 and CC244 Custom Built Carrying Case - \$148	736	500
FC71 Frequency Counter for \$995	BY234 12 volt Rechargeable Battery - \$60	360	300
CR70 BEAM BUILDER for \$995	Advertising and Promo Kit - \$60	360	300

# Sencore Means Success

## For You In Electronic Servicing



### **Sencore works to make you successful:**

For over 35 years, Sencore has been dedicated to just one goal—making you more successful in Electronic Servicing. We're proud to say that we plan on sticking to this simple, yet important, mission.

You see, as we phase into our second generation of leadership, we realize that your success truly will mean a successful future for Sencore as well.



### **All American Made with exclusive design.**

When you say "yes" to Sencore, you're saying "yes" to good old American ingenuity at its finest. With 93% of Sencore's product line holding at least one patent, you're assured of exclusive, time-saving, money-making features not available anywhere else. You see, Sencore instruments are designed by practical troubleshooting pros - for practical troubleshooting pros. That's why you can count on Sencore for test equipment that saves you that all-important analyzing time.



### **Every instrument designed with your time in mind.**

Sencore's engineers know from experience that as an Electronic Servicing Professional, your time really is money. Lost or wasted time is money right out of your pocket. Our designers know that every time you have to fiddle with a knob, connect and reconnect leads, or come up with an inconclusive or misleading test result, it costs you dearly. That's why as you review the Sencore product line, you'll notice that each Sencore instrument has a fresh, uncluttered, easy-to-use look. We put the complex electronics on the inside to help keep your operation simplified on the outside.



### **Every product backed by 100% Made Right Lifetime Guarantee**

Each unit is 100% Made Right in America's heartland by skilled craftsmen who have your troubleshooting needs in mind. That's why Sencore products are literally world renowned for their toughness, quality, innovation, and outstanding value. Less than 2% are returned for warranty service.

## **Dealing Direct With The Sencore Factory Adds To Your Success**



### **Sencore is committed to your success.**

Unlike others, Sencore's commitment to your success just begins at the delivery dock. Consider that one phone number **1-800-843-3338**, connects you, 24 hours a day, to a factory full of friendly folks dedicated to making you and your business more successful. You get fast, friendly product delivery; most items are in stock and are shipped within 48 hours of receipt of your order. Our exclusive "Pay As You Grow" Investment Plan will put you in your Dream Shop for just dollars a day. So you literally pay as your Sencore instruments help you grow and prosper. That's why saying "yes" to Sencore is saying "yes" to your future success.



### **Factory service turns problems into opportunities.**

Your service after the sale is second to none in any industry. Our standard 72 hour turn-around on service repairs and 48 hours on parts means maximum up-time and productivity from each instrument. Plus since our Engineering, Service, and Quality Assurance organizations are under one roof, your serviced instrument is renovated to better-than-new performance with the latest engineering updates; is refurbished to like-new appearance; and undergoes final aging and quality checks just like our new units—all at no extra cost. Best of all, you can be sure your serviced instrument is right on specifications, as each unit is calibrated against Sencore's NBS-traceable Prime Standards Laboratory.



### **Extensive technical application support to help ensure your success.**

Sencore's industry exclusive Sencore News, Application Bulletins, Field Workshops, and helpful Application Engineers guarantee that you'll be getting the most from your investment. Our newly added, state-of-the-art, video production studio will even add a new dimension to your after the sale application support, with both operation and training tapes. Our obligation and support is just beginning instead of ending, when you buy test equipment from Sencore.



### **Your success is guaranteed.**

You can't make a wrong buying decision when you say "yes" to investing in Sencore. You're not investing in just an instrument, you're investing in your own piece of an entire organization dedicated to making you more successful.



### **WATS Free number for easy contact with your friends at the factory.**

The same WATS Free success number, **1-800-843-3338**, that connects you to a fast, friendly Order Processing Rep, also connects you to our Application Engineers for technical consultation, Service Technicians for quick field repair tips, and our Telemarketing Engineers for after the sale follow through—all at no added expense to you. You simply need to pick up the phone and ask.



### **Exclusive buyer protection plan assures you of quality.**

Since every Sencore unit has quality built in and not troubleshot out; only Sencore can offer you a 100% Made Right Lifetime Guarantee. This exclusive Buyer Protection Plan assures you that your unit was engineered and manufactured right the first time—or we'll make it right—for the lifetime of the instrument, at no cost to you. It even guards your instrument for a lifetime against rusting out—so plan on profiting from your Sencore investment for a long time.



### **Money back guarantee assures you of satisfaction.**

Finally, Sencore's no nonsense 30 Day Money Back Guarantee assures you that you've made the right choice. Every Sencore instrument and accessory is covered by the industry exclusive guarantee of satisfaction. Simply stated—if you're not 100% satisfied with your Sencore instrument, return it for a full refund—including freight both ways—and owe nothing. You're always sure that you've "bought right" when you say "yes" to a Sencore investment. See for yourself, ask to try your Sencore instrument for 15 full days before you buy.

**Start your success right now by buying right. See Sencore specials inside this cover.**

*Herb Bowden*

Herb Bowden  
President/CEO



**Built In The Heartland Of The USA By Fellow Americans  
Showing The World We Are Still In Front**



Mount Rushmore National Memorial, Black Hills of South Dakota