SENCORE NEWS

Issue #151 Nov./Dec. 1990

Will this be another estimate-only set or will it go to the bench to generate profit?

See page 21

Only The FS74A Allows You To See The Picture, Hear The Audio, Plus Measure The Critical Levels, Ratios, Hum And Noise In Just Seconds. . .

If you're like most companies, your present field strength meter will allow you to check signal levels only, but many troubles in cable systems just don't affect the signal level! So how can you ensure your customers are receiving the absolute best signal? Sencore recommends the following **1, 2, 3** Go-No-Go testing!

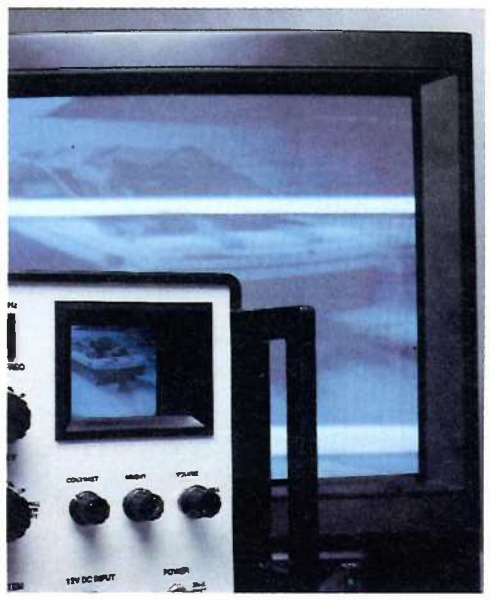
1 Sencore's New FS74A Channelizer Sr. allows you to measure signals all the way from the headend to the subscriber's tap, automatically and without any interpretations. Simply connect the signal and digitally tune through the channels in your system. You'll quickly read the video and audio levels of each and every channel from 5 to 890 MHz.

2 With the FS74A, hum and S/N tests are simple and error free. Simply tune to any RF channel, switch the function selector to either HUM or S/N and read the meter. There is no faster or more accurate method. (patented)

3 Use the FS74A Channelizer Sr. to actually view the video on the exclusive built-in monitor. The FS74A passes a full 4 MHz of video so you will see the beat, ingress, or ghosting problems on the video monitor. You simply step through your system while viewing the monitor.

Plus, you get:

- FCC, HRC, and ICC cable shifting.
- Exclusive integrated AC and DC voltage measurements through the RF or DVM inputs.
- Portable — battery operation.



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(736-2673)

Is It The TV Or The Cable? You Can Find Out In Minutes With Your FS74A CHANNELIZER SR.

by Brian Phelps,
Marketing Communications Writer

- **Pinpoint cable troubles with on-channel S/N and Hum tests.**
- **Use the FS74A's built-in monitor for quick and easy testing.**

In This Issue

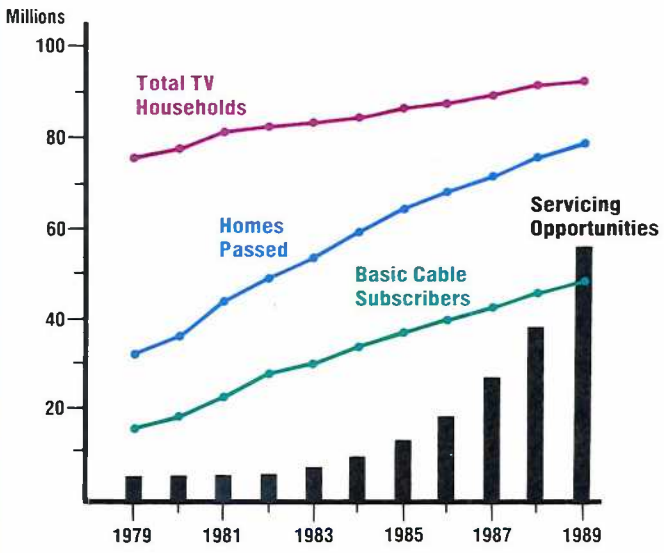
Video servicing is changing again! Have you explored the new money-making opportunities? By delivering more channels and better quality pictures to the home, cable TV is on the leading edge of a "Video Revolution." And, where cable is not available, consumers have made their desire for more channels apparent by purchasing and installing satellite receivers.

An Opportunity To Expand Your Video Business

Every technology change brings opportunity. Antenna and satellite work is booming in areas where cable is not available. And many homes have added antenna systems, satellite receivers, and built-in cable systems to distribute signals. Privately owned "miniature cable systems" extend the city cable system and offer additional opportunity.

Cable companies are usually only responsible for the input signal to miniature (MATV) systems. Video servicers are needed to install, maintain and upgrade them as cable companies rebuild and expand. You'll find independent miniature cable systems in mobile home parks, hospitals, hotels, apartment buildings, condominiums, nursing homes, schools, churches and businesses, too. Such systems often contain their own receiving antennas, satellite dishes, and processing equipment. Many include local origination channels, camera security systems or other cable services. Local video servicers are needed to install and maintain these independent cable systems and TVs.

Every new video product gives you new servicing opportunities. Above, a distribution signal is being checked for level and quality.



Most U.S. cities have been wired for cable or are in the process of selecting franchises. Nonetheless, cable is expected to continue growing throughout the 1990s.

Customers Want You To Decide Whether The Trouble Is In The Cable Or Their TV

Customers want, and are willing to pay for, a clear video picture on every TV channel. When the TV or cable system degrades the picture, they ask the familiar question, "Is it my TV or is it the cable?" These customers want you to use your skills and test instruments to provide the answer and correct the problem. Show the customer where the problem is or repair their TV and you have a happy customer. This may require that you work together with the cable tech to solve the problem. Since you share the same customer you both will benefit.

In the customer's home, the servicer often must decide if the trouble is in the TV or in the cable. The right decision saves time.

Common customer complaints include:

- Snowy or grainy picture
- Bars rolling upward in the picture
- Interference lines in the picture
- Flickering or flashing picture

By reviewing these symptoms alone, it's difficult to tell if the problem is in the cable or the TV. In fact, there are many other symptoms that could point to either the cable or the TV. To tell where the trouble is, and to keep from lugging sets to the shop unnecessarily, you'll want a way of analyzing the entire cable system and every channel. What are some of the challenges you face if you want to be successful as a complete "Video Service Shop?"

Analyze cable signals quickly and easily with the FS74A CHANNELIZER SR.—wherever you go.

You'll see troubles with signal combiners, directional couplers, line splitters, line taps, amplifiers, and the coax itself. You'll need to measure frequency, signal level, noise, hum, and interference. Plus, you'll want to monitor the picture at any point in the system. We'll see how your FS74A TV-RF Signal Analyzer can help you solve TV-RF troubles, but first let's see how a typical cable system works.

Cable Systems Receive, Generate, Process, Combine, And Distribute RF-Video Signals

Cable systems receive signals from antennas and satellite/microwave receivers or originate video signals from VCRs and video generators. These signals are processed and combined on a single coaxial cable at the beginning of the cable system. This point is called the headend. At the headend, carefully selected components (active and passive) amplify the desired RF signal, filter adjacent channel signals and spurious output signals, adjust the audio-video RF carrier ratios, provide AGC action, and place video signals on specific RF carriers.

The three methods used to process the headend signals are:

1. Strip amplifiers
2. Heterodyne processors
3. Demodulator-modulators

Strip amplifiers: The simplest and least expensive way to amplify a single channel or channel band. Strip amplifiers provide gain, filtering, AGC action and reduce the audio level. They have no mixer circuits to produce spurious output signals.

Heterodyne processors: These special units reduce the incoming RF signal into separate video and audio IF frequencies where good signal filtering and amplification is possible. The IF signals are then converted to the desired RF cable channel. This method is popular because of good filtering, gain, AGC performance and the ability to convert the signal to other cable channels.

Demodulator - modulator: The demodulator receives the input RF signal and detects the separate video and audio components. A modulator reverses the process and uses the separate audio and video inputs to modulate the signals back to a desired RF carrier. Once the signals have been processed and converted to an RF cable channel, the individual RF channels are put together (combined) so they exist on a single cable. This is done by using a device called a signal combiner. The combiner is made of directional couplers in series that combine the signals while maintaining good isolation and impedance matching.

The combined RF-video signals are then carried through the system on a 75 ohm coaxial cable. You'll see several sizes of cable used, for example:

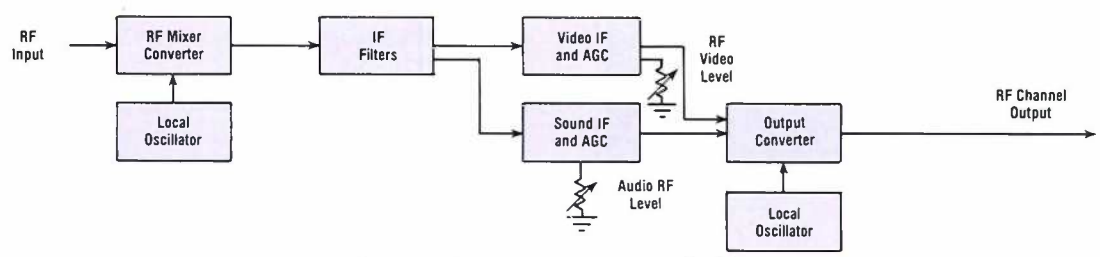
- Flexible braided shielded cable (RG-59, RG-6 and RG-11)
- Solid armored shielded cable (.412, .500 or .750 inch)

Cables must have good RF shielding so the cable signal does not radiate out or be affected by strong external RF signals. The RF signal levels are attenuated as they travel down the cable. The amount of signal loss depends on the cable type, length, temperature, and the frequency of the RF signal.

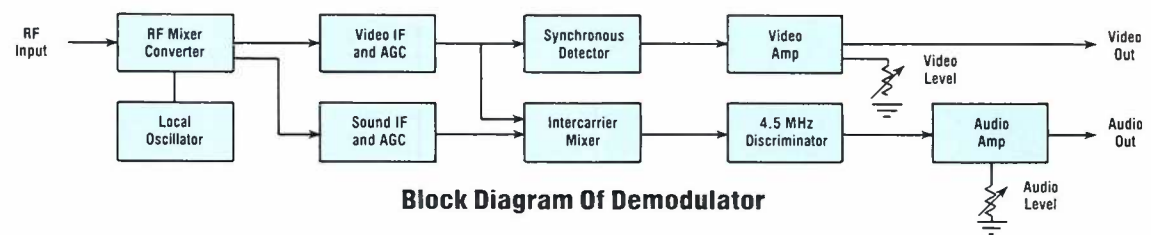
Broadband RF amplifiers (trunk amplifiers) and line extenders are positioned along the cable path to amplify the RF signals to overcome the losses of the cable and passive devices. These amplifiers must have enough gain to match the system losses and must amplify all the frequencies carried on the cable system. Such amplifiers are rated in dB gain and require specific input signal levels to work properly.

Passive devices such as line splitters, directional couplers, and line taps are used to route the signal. Line splitters divide the signal into several paths, while directional couplers and line taps remove a small amount of signal to deliver elsewhere or feed TV terminals. Passive devices also attenuate the RF signal.

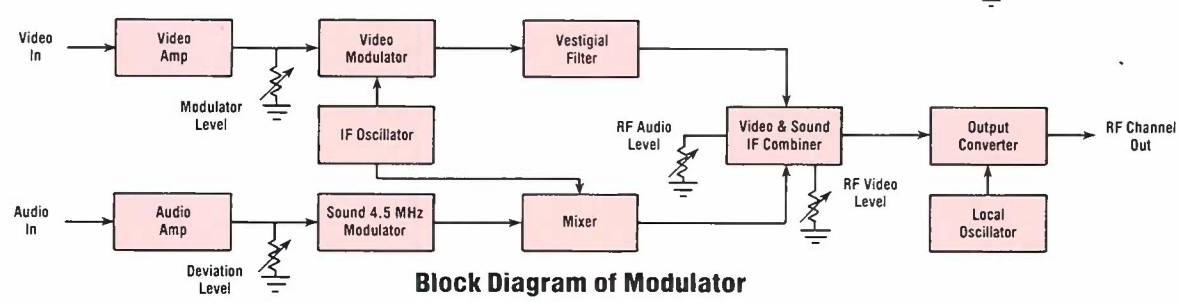
If the system has even one little problem, you'll probably get phone calls from customers. The most common customer complaint is a snowy or grainy video picture. This occurs when the cable signal at the customer's TV falls below the FCC required minimum RF level of 0 dB or the signal/noise ratio of the cable signal is below 40 dB. It may



Heterodyne Processor Block Diagram



Block Diagram Of Demodulator



Block Diagram of Modulator

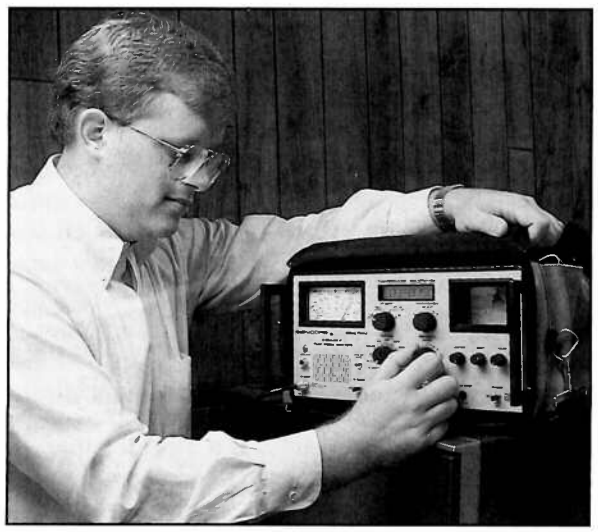
Three common methods used to process received TV-RF signals at the headend are: strip amplifiers, heterodyne processors, and demodulator-modulators. Once processed, the new RF signals are routed to the signal combiner.

surprise you to know that snow and grainy video is not always a cable problem. Troubles in RF - IF amplifier stages, AGC circuits, antenna connections or circuits in the TV itself can cause this symptom. Let's see how to solve troubles with snowy/grainy pictures.

Pinpoint Snowy Video Problems With Automatic Tuning, Level, And Signal To Noise Measurements

To solve troubles with snowy or grainy pictures, first, test the signal level; second, check the signal/noise ratio. Here's how easy it is with the FS74A CHANNELIZER SR.:

1. Connect the cable signal to the RF INPUT jack
2. Switch the function switch to RF VIDEO-FM
3. Set the RF BAND switch to CABLE
4. Select the channel
5. Pull the AFT knob
6. Switch the RF RANGE to AUTO



The FS74A TV-RF Signal Analyzer proves that the cable is the problem. The servicer can now concentrate on solving "in house" cable problems or confidently advise the cable company.

That's it! The signal level is displayed and the digital readout tells you if the channel is on frequency. Microprocessor controlled circuits have automatically tuned the FS74A to the channel you selected. No more fiddling with the tuner or attenuator. If the signal level is below 0 dB, look for a cable problem. If the signal is higher than 0 dB, check the signal-to-noise ratio.

You can pinpoint troubles caused by signal processors, RF line amps or broken shields by checking the signal-to-noise ratio. And you can do it on-channel with the FS74A.

Noise is always present in a cable system, but must be kept at least 40 dB lower than the video signal. The FS74A patented S/N test samples the channel noise during vertical blanking which lets you perform the S/N test on-channel! *Typical meters require you to use an empty channel or remove all modulation.*

To measure the signal/noise ratio:

1. Select the channel to be measured
2. Switch the FUNCTION switch to NOISE REF
3. Press the NOISE REF STORE button
4. Switch the FUNCTION switch to S/N

The reading is automatically calculated and displayed. For the signal-to-noise ratio, a reading of over 40 dB is good. If your signal level is 0 dB or better and has a signal-to-noise ratio greater than 40 dB, check the TV receiver.

Hum Modulation Test Isolates Hum Problems

Hum often shows as bars in the picture slowly rolling upward. This can be caused by AC power supply ripple. In cable systems, the culprit is usually poor DC power supply filtering or regulator problems in cable amplifiers or headend processors. Bad AC grounds and poor cable shields may also cause hum. You'll see the same symptoms in TVs that have bad filters or broken circuit ground paths.

You can stay ahead of power supply failures in cable system's preventative maintance by checking for hum each time you test for signal level or signal-to-noise. Simply switch the FS74A's FUNCTION switch to HUM. The FS74A detects hum on RF carriers even when the channel is fully modulated with sound and picture. You won't notice hum in the picture at readings of less than 2%, but 3% hum will begin to show noticeable hum bars. Your customer will probably complain before the hum percentage reaches 5%.

The biggest bonus of checking the percentage of hum is the ability to locate system problems such as bad power supplies and broken cable shields early . . . before they fail completely!

Wideband Video Monitor Shows Picture Interference To Make Troubleshooting Quick And Easy

One of the toughest challenges for video servicers is "lines in the picture." These "lines" can be caused by such things as:

- Spurious signal output from headend
- Co-channel interference or cable ingress
- Adjacent channel interference
- Intermodulation between channels
- Harmonic products/RF reflections in cable amps

Unfortunately, TV receivers are also capable of producing interference lines. Although getting a good picture is the final goal, a TV doesn't make a good troubleshooter. Here's why: TVs use AGC, narrow IFs, and/or special traps to minimize noise and interference. For troubleshooting, the B&W TV's bandwidth is too narrow, and the color TV's is designed to operate with the proper RF input level (0dB).

The FS74A's wideband video monitor lets you identify and isolate cable system troubles anywhere in the system (Fig. 1):

1. Attach the RF input and tune in the desired cable channel
2. Pull the VOLUME-CRT ON switch below the video monitor
3. Set the contrast and brightness controls and observe the picture

The FS74A's monitor passes the entire 4 MHz video bandwidth so you can see maximum detail in the picture. It uses no video peaking or tuner response shaping, so you can analyze the "unmodified" channel signal. Input video levels to the monitor track with the input attenuators, so you can check picture quality anywhere in the cable system to isolate problems.

Find Intermittent Cable Flickering Problems Quickly With The TV-RF Signal Analyzer

In cable systems, intermittents are generally caused by bad cable connections, intermittent amplifiers, solder connections or water damaged equipment. Most cable intermittents are seen by the customer as a picture that "flashes" or "flickers" or goes "snowy on and off." TV receivers can have similar symptoms.

Ringing

Ghosts

Co-channel interference

Fig. 1: These are three tough to find problems that show up in the FS74A monitor, but are hard to find with a meter or spectrum analyzer.

To find intermittents, you must simultaneously observe the effects of the intermittent on the customer's TV and the cable system. The FS74A simplifies this procedure. You can monitor the cable signal level at the same time you observe symptoms on the wideband video monitor. This provides instant verification of the cable problem and its effect on the cable level. Follow the cable system back using this method, and you'll quickly isolate the cause of the problem.

If you have questions about this article, or want to learn more about how you can take advantage of the opportunities the "video revolution" offers, call your Area Sales Engineer today, **1-800-SENCORE (736-2673)**. Ask him about using the FS74A CHANNELIZER SR. for 10 days FREE to see how it can help you save time and increase your profits.■

The SG80—One Cable Receiver Analyzing In One Investment

By Brian Phelps, Marketing Communications Writer

One Cable Hookup Gives You All These Signals . . .

- **AM**
- **FM**
- **IF**
- **Baseband Audio**
- **AM Stereo**
- **FM Stereo**
- **Multiplex**
- **Etc.**

To Analyze All These Receivers . . .

- **Yamaha**
- **Craig**
- **MCS**
- **Fisher**
- **Pioneer**
- **Carver**
- **Technics**
- **Onkyo**
- **Delco**
- **Denon**
- **JVC**
- **and many more . . .**

To be profitable in today's service environment, you're faced with many challenges. New advances in receiver design place stronger requirements on you and your equipment. In addition, profits come only when you use efficient service techniques.

If you have the equipment and tools to do the job to your customers' expectations, you'll make profits and your customers will come back. That's why Sencore designed a new AM Stereo - FM Stereo Analyzer for *all* of your receiver testing needs.

The SG80 is like having a high-performance broadcast transmitter in your own shop. It lets you know your service work is done right the first time, every time. Let's look at some of these issues and see how the SG80 solves the problems associated with them.

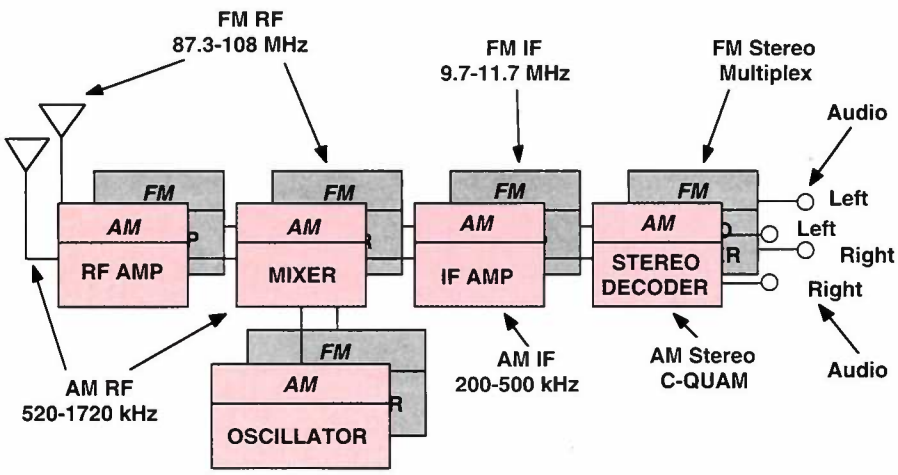


Fig. 1: The SG80 gives you all the signals you need for any stage, AM or FM.

What Advantages Would I See By Having Both FM And AM Signals In One Instrument?

Since most receivers have both FM and AM, you'll need analyzing signals for both. Sencore provides one analyzer with all the signals you need to test and troubleshoot both the FM and AM parts of any receiver.

The SG80 AM Stereo - FM Stereo Analyzer simplifies AM/FM receiver testing and troubleshooting by making the AM and FM part of a receiver look alike (Fig. 1). How does it do this? The SG80 supplies the same test signal and modulation options for both AM and FM from the same jack and same cable. Furthermore, the same controls are used to select the desired signals.

When you look at a receiver, you find that the AM tuner has the same stages as the FM tuner. Both have a front end which amplifies and converts the over-the-air broadcast signal to a fixed intermediate (IF) signal. Both have IF stages to amplify and filter the AM or FM signal. They are much alike - only the frequencies and bandwidths differ. In fact some receivers use the same IF amplifiers for both AM and FM signals with different tuning components switched in as needed. Then, at the detector, the AM or FM signal is converted back to the basic audio signal.

Altogether, there are three types of signals: RF, IF, and audio. The SG80 supplies these signals from the same output jack and uses the same controls for both AM and FM. You simply turn the RF-IF MPX SIGNAL switch for the signal you want.

Once you have chosen the signal, you use one signal output jack for all your test signals. The SG80 eliminates the need to learn special setups or hunt for the correct front panel jack. This makes the operation of the SG80 easy to understand and easy to use. It makes AM and FM troubleshooting look alike.

Most Receivers I Work On Now Have Digital Tuners. How Can I Be Sure These Digital Tuners Work Correctly?

In the days of analog tuned receivers, receiver tuning was not precise. The consumer "tweaked" in the receiver until the sound was good or he looked at a tuning indicator to fine-tune the receiver. The servicer only needed a signal source with enough accuracy to roughly calibrate the tuning dial to the correct frequency.

Today, most modern receivers use digital tuners. Now, the customer tunes the receiver to the assigned station frequency with little, or no, ability to fine tune the receiver. Tuning relies on the accuracy of the tuner and its internal fine tuning circuits to properly receive the desired station. If a digital tuner becomes non-linear or doesn't correspond to the tuned station, you've got an interesting service challenge on your hands.

Digital receivers result in two servicing needs you did not have with analog tuning. First, you need a digitally accurate AM/FM signal source that's more accurate than the receiver you are servicing. Second, you need to quickly tune from the top to the bottom of the band to check the tuning linearity. The SG80 fulfills both needs.

The SG80 provides a digitally accurate signal that is locked to a crystal reference. When you select a station frequency, you know the signal

Fig. 2: Digital tuners need an accurate signal source to confirm they work correctly.

is correct. You can quickly identify tuning problems in even the latest digital tuners.

The SG80 tuning was designed specifically for testing and troubleshooting AM and FM receivers. The SG80 tunes in steps identical to the FCC station spacings. The SG80 tunes FM in 200 kHz steps (Fig. 3), and AM in 10 kHz channel steps. Turn the knob to walk through the assigned FCC station frequencies. It's that simple. But, what if you suspect the receiver is tuned slightly off channel? How do you check the FM AFT circuits? The SG80 lets you fine tune the signal source for these special needs. Simply push in on the RF-IF TUNING knob, and the SG80 changes to the fine-tuning mode. In FM, the fine tuning steps are 10 kHz apart. In AM you can fine tune the SG80 in 1 kHz steps. The SG80 digital tuning system gives you the flexibility you need for any tuning situation.

"The SG80 turned my tough digital tuner problems into a piece of cake!"

Most RF generators make you tune through the entire band to get from top to bottom. The SG80's special wraparound tuning feature lets you check both ends of the tuning band in seconds. Tune instantly from the top to the bottom of the band in a single step, similar to the way most receivers tune. This saves valuable time on tuning linearity tests.

Why Do I Need Precise Signal Levels?

Performance testing is an important part of receiver servicing. It tells you what is working and what's not working before you begin troubleshooting. Once the repair is complete, a second performance test ensures that the repair was done correctly and that the receiver works to manufacturers' specifications.

Performance tests such as receiver sensitivity, 50 dB quieting, and auto seek level need precise RF signal levels. The SG80 provides these precise signals, whether high or low. You can drop the signal down to a tiny three-tenths of a microvolt for your sensitivity and low level tests. Or, boost the signal to a whopping 250,000 microvolts for testing the receiver's response to overload conditions or to service high level IF stages. The six step coarse attenuator gives the wide output range you need. The computer-compensated vernier attenuator supplies the accuracy you need for setting exact levels between steps.

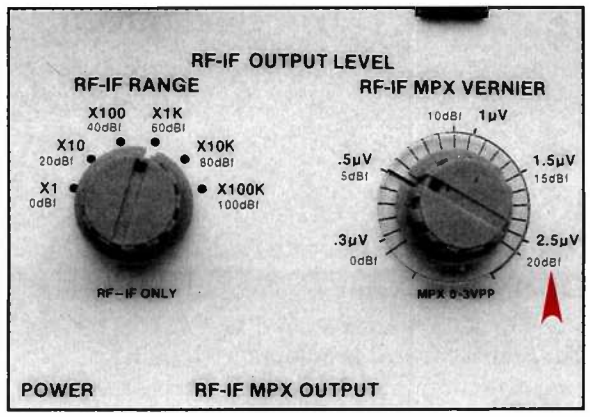


Fig. 4: The SG80's microprocessor calibrated attenuator is calibrated in both microvolts and dBf to match all manufacturers' specifications.

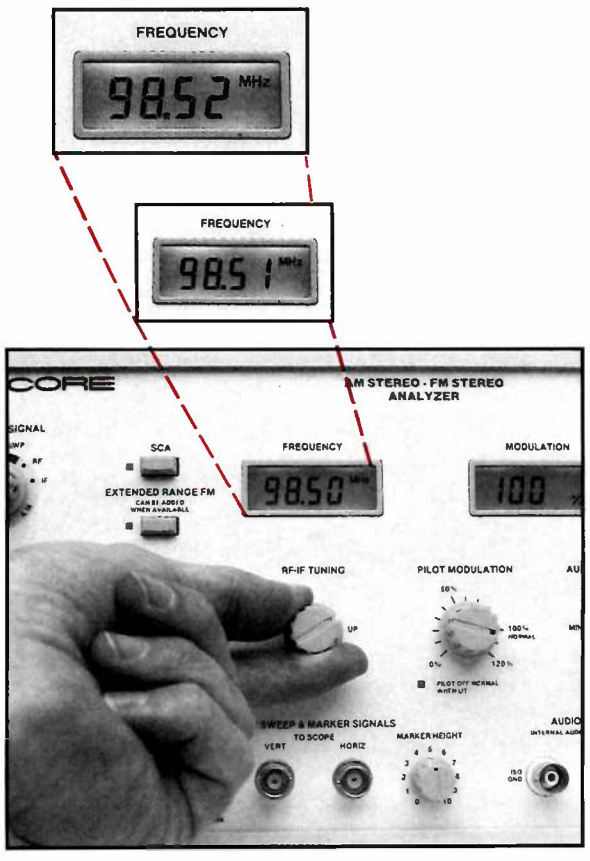


Fig. 3: The SG80 starts at the standard test frequency of 98.1 MHz, and tunes one channel at a time as you turn the knob.

How Can I Avoid Converting dBf Into µV And Vice Versa To Get The Proper Receiver Signal Levels?

The SG80 has level indicators calibrated in both dBf and µV. As you notice, some receiver specifications are listed in"dBf" while others are listed in microvolts. Some generators are calibrated with only one output level. Many others are calibrated with dB levels that differ from the published specifications such as "dBm" or "dBemf." You have to do time-consuming conversions to compare the generator setting to the levels in the service literature.

This is not the case with the SG80. The RF signal output is calibrated in both standard IHF specifications: microvolts into 75 ohms and dBf (Fig. 4). The microprocessor-calibrated attenuator supplies the precision you need for setting exact levels with confidence.

How Can I Prove Multiple Width IFs Are Working Correctly?

The SG80's exclusive, tuneable FM sweep generator lets you positively test and align all IF stages, including those with variable bandwidths. The SG80's new IF sweep signal tests all FM IF circuits from the older tuned circuits to the latest ceramic IF circuits.

First, the SG80 can be used like a conventional FM sweep generator with a fixed 10.7 MHz center marker and side markers at 10.6 and 10.8 MHz. But, today's receivers limit the use of conventional sweep signals. Ceramic IF filters often have center frequencies other than at 10.7 MHz. The tuneable sweep and marker system in the SG80 allows you to fine tune the markers to determine the frequency of these non-standard IFs. By simply turning the RF-IF TUNING control, the markers can be tuned higher or lower in frequency. The center marker can be tuned from 9.7 to 11.7 MHz to tune to the frequency of any IF filter.

Some newer receivers have multiple bandwidth IFs. The SG80 tuneable sweep and marker system lets you quickly determine the bandwidth of each IF selection. By tuning the marker from one side of the response curve to the other, you can positively measure the width of the IF response. You can read the corner frequencies of the IF response curves directly from the SG80's lighted LCD display.

Once you've narrowed a problem to a stage after the stereo decoder, what do you do next?

Many servicers reach a dead end street when they confirm the problem is after the decoder. Without a phase-locked audio drive signal, all they can do is hope that signal tracing and guessing will lead them to the bad part(s).

The SG80 AM Stereo - FM Stereo Analyzer lets you continue your dividing and conquering, even in the audio circuits! The SG80's audio injection analyzing signal is phase-locked to the RF and IF signal to quickly pinpoint audio problems. This dynamic drive signal is protected and isolated so you can divide and conquer with confidence.

The SG80 provides three low-distortion audio sinewave signals for performance tests and troubleshooting. The 400 Hz signal tests the lower end of the audio response. A 1 kHz

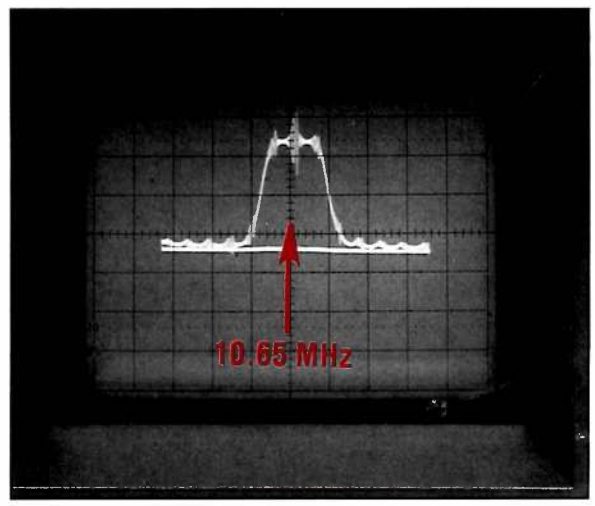


Fig. 5: Only the SG80 lets you tune the center marker of the sweep system to match the circuits under test. Here, a center-marker frequency of 10.65 MHz matches the fixed-tuned IF stages.

signal checks for audio response in the middle of the audio band. The higher end of the band uses a 5 kHz signal. Three squarewave signals are also supplied for testing and troubleshooting. A squarewave signal is rich in harmonics and tests the whole audio frequency response of both AM and FM receivers.

> ***"Precise signal levels are more important than ever before."***

The SG80 RF circuits have a special patented design to test these low noise receivers, while supplying the accuracy of digital tuning. Four separate PLL oscillators, combined with other exclusive circuitry, give the SG80 an FM noise level that is more than 85 dB below the carrier. That's clean enough for any receiver.

Is My FM Generator's Signal Clean Enough For Modern Receivers?

Many receivers now have improved tuner and IF circuits for lower noise and better performance than ever before. Most FM test generators are no longer capable of supplying signals clean enough to test these modern receivers. For a better understanding, lets look at how the signal to noise (S/N) test is done:

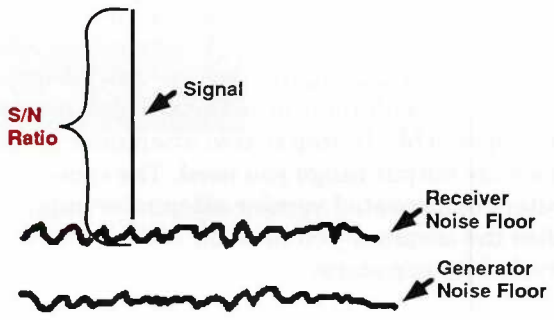


Fig. 7: The SG80 provides very low background noise, allowing you to make accurate sensitivity and S/N tests on low-noise receivers.

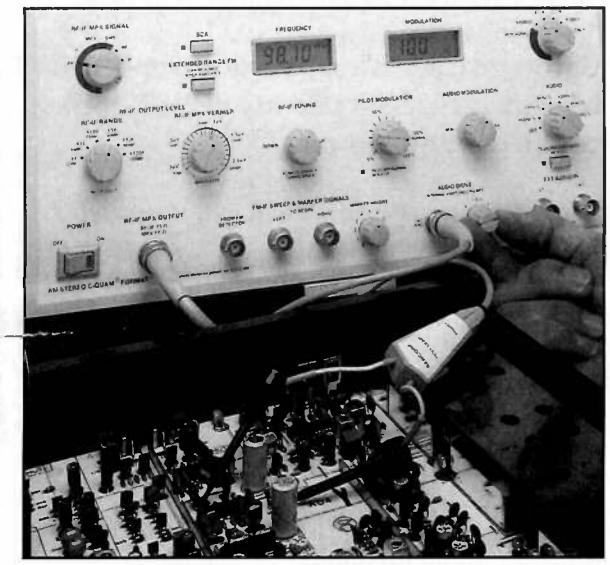


Fig. 6: The SG80's phase locked audio drive signal lets you continue your dividing and conquering even in the audio circuits.

As figure 7 shows, the noise in the test generator must be less than the noise generated by the receiver. If the generator has higher noise levels, it will make the receiver appear to be less sensitive.

Digital signal generation techniques use a circuit called a PLL (phase locked loop). A PLL compares a voltage controlled oscillator (VCO) to a reference, typically a stable crystal oscillator. Any difference in the VCO frequency results in a correction voltage that brings the VCO back to the correct frequency. The process causes a slight variation in the RF frequency. The correction is actually a small amount of frequency modulation, seen by FM detectors as noise.

This is the reason most low-noise generators use older technology L/C tuning instead of true digital tuning. L/C tuning produces low noise, but has the offsetting problem of carrier frequency drift.

Will Over-The-Air Signals Allow Me To Test Receivers For Proper Operation?

There are several problems with using an over-the-air signal for testing purposes. First, unless you live in a large metropolitan area you probably don't have enough radio stations to cover the range of both AM and FM bands. Second, an over-the-air signal does not give you a stable, known reference signal to base your testing results. You don't know if the receiver's AFT circuits are pulling the station in, or if the signal is right on.

Furthermore you have no control over the broadcast signal's level and quality. Its signal strength and quality are subject to changes which you cannot control. You simply can't perform accurate and conclusive tests without a stable, accurate signal.

The digitally accurate, high quality signals of the SG80 AM Stereo - FM Stereo Analyzer are a must for checking today's digital tuners. The SG80 uses advanced digital technology and a stable crystal reference to give you positive and precise tuning. Its low distortion analyzing signals (<.01% THD) let you test even the most advanced receivers with confidence. And, since you can adjust the RF-IF and the modulation levels for both FM and AM, you've got the most versatile trouble- shooting system around.

> ***"Today, you've got to have a broadcast quality test signal in your service if you expect to do a quality and profitable job, regardless of the price of the receiver. Our SG80 is the only generator/analyzer available that gives us that broadcast standard."***

Is There Any Way A Computer Could Help Speed Up Receiver Performance Testing?

The SG80 includes the exclusive Sencore computer interface port. This allows you to tie the SG80 into any computer with either of two Sencore accessories. The IB72 IEEE 488 Bus Interface Accessory or the IB78 RS232 Interface Accessory give you full computer control to make automation and documentation a reality.

If you can see how the SG80 would help your receiver servicing, call your Sencore Sales Engineer at **1-800-SENCORE.** He can get an SG80 on its way to you so you can see how it fits your testing needs. If you're not sure yet, we'll send you a FREE Tech Tape showing you the opportunities you and your SG80 can conquer. ■

Fig. 8: Two computer interface accessories give you the choice of IEEE-488 (GPIB) or RS232 if you want to automate your testing.

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

Your Number One Tax Saver For 1990—A Whopping $10,000 Test Equipment Write-Off

by Karla Bertrand, Accounting Manager

It's time for your year-end 1990 tax planning. The number one business tax saver is still the $10,000 write-off. Business equipment purchases up to $10,000 can be completely written off as a business expense in 1990 (IRS Code Section 179).

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

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

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

One limitation is that your taxable income must be at least as much as the equipment cost in order to take advantage of this. Assuming you meet the income requirement, *if you do not take advantage of this write-off, you lose it for 1990.*

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

$10,000 x 20% = $2000 depreciation

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

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

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

Tax savings offer an excellent opportunity to improve your business ($10,000 is an especially nice write-off). *Plan your business equipment purchases now* to maximize your tax savings and minimize your costs. Call **1-800-SENCORE** today to update with the latest in electronic test equipment. Don't let this money-saving opportunity

Sencore's Christmas Specials Savings

How to calculate your savings:

	Example	Enter Your Figures Here:
STEP 1: Fill in the catalog price of the equipment you are interested in purchasing:	$84.23 (special #2) *Catalog Price*	
STEP 2: Write in the amount of savings shown in our specials*:	$13.24 (savings) *Specials Savings*	
STEP 3: Subtract Step 2 from Step 1 to find your net cost of the equipment:	$70.99 (net cost) *Your Net Cost*	

*** This is what Sencore Saves You If You Order *Before December 25!***

$10,000 Write-Off Savings

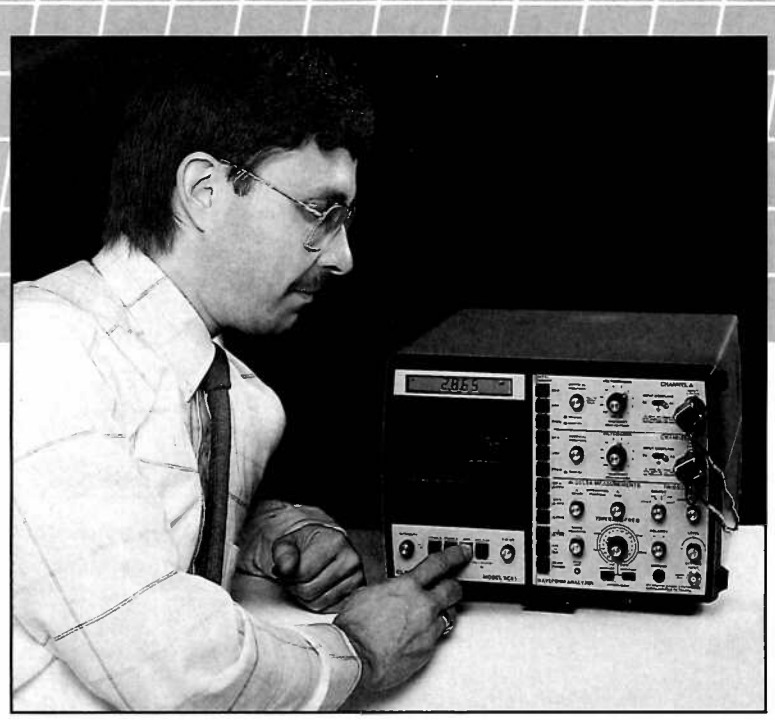
The Number One Tax Saver For 1990: IRS Code, Section 179 lets you write off up to $10,000 of business equipment purchases as an expense. This means your investment in Sencore Test Equipment now, in 1990, can mean saving thousands on your tax bill!

	Example	Enter Your Figures Here:
Step A: Multiply your net cost from Step 3 times your tax bracket (15% or 28%) to calculate your tax savings using up to a $10,000 write-off.	$19.87.72 (28%) *Net Cost x Tax Bracket*	
Step B: Take the savings you calculated in Step 2 above, and add step A to it. This is your total savings.	$33.11.72 (total savings) *Specials Savings + Step "A" Above*	

Depreciation Savings

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

	Example	Enter Your Figures Here:
STEP A: Take your first year's depreciation of 20% on the amount in Step 3 above (Step 3 x 20%).	$14.19.80 (1st year) *20% x Your Net Cost*	
STEP B: Multiply Step A by your Tax Bracket percentage (15% or 28%).	$3.97.54 (28%) *Your Tax Bracket % x Step "A" Above*	
STEP C: Take the savings you calculated in Step 2 above, and add Step B to it. This is your *first year* savings! Plus, you can depreciate the remainder over the next five years!	$17.21.54 (1st year savings) *Specials Savings + Step "B" Above*	
	Your First Year Savings	**Your First Year Savings**



How To Speed Up Common VCR Adjustments

by Greg Carey, Application Engineer, CET

- **Use the SC61 to set these common VCR adjustments the easy way:**
  - **-Head Switching**
  - **-Tracking Fix**
  - **-Record Current**

Why are many VCR servicers ignoring alignment checks? It seems there are two reasons. First, many do not understand the purpose of each adjustment because the brief instructions in the service literature do not explain how each affects the VCR's performance. Second, many find the procedures too time consuming because several pieces of test equipment must be used with an assortment of leads, operating instructions, and tolerances.

We will help you understand VCR alignment better by looking at three of the VCR adjustments that cause the biggest questions for VCR servicers. We will explain what each adjustment does in the circuit and then show how the fully integrated tests of the Sencore SC61 Waveform Analyzer let you quickly make every measurement or adjustment.

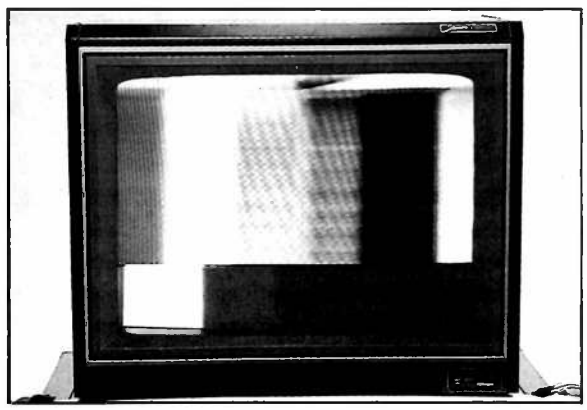


Fig. 1: A tear appears on the picture if the VCR switches between heads at the wrong time.

Setting Head-Switch Timing

All VCR alignment instructions require adjustment of the head-switching signal. Let's be sure we understand the purpose of the head-switch signal. The VCR circuits produce a visible horizontal noise bar when they switch from one video head to the other. If the circuits switched between heads half way between vertical sync pulses, the picture would have a noise bar right in the middle of the screen. Or, if the circuits switched during vertical sync, 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, often below the viewable picture. The switching happens three or four horizontal lines before vertical blanking to prevent sync problems.

The "Head Switch" (sometimes called the "Head PG" or the "Head Shifter") adjustment changes the timing of the head-switch square wave relative to vertical sync. Some VCRs have only one control, which affects the timing during playback. Others have two controls; one for recording and one for playback. Still others have three controls; one affecting the position of the positive recording transition, the second affecting the position of the negative transition, and the third affecting playback timing. All three types use identical alignment procedures.

Refer to the following instructions whenever you use your SC61 to make headswitch timing adjustments.

1. Connect the probes to the test points specified in the VCR alignment instructions.

2. Set the SC61's TRIGGER MODE switch to "AUTO"and the TRIGGER SOURCE switch to the channel ("CHA" or "CHB") with the head-switching signal. (Set the TRIGGER LEVEL control to zero.)

3. Set the TIMEBASE-FREQ switch to the "1 m sec" position. (Press the HORIZ POSITION knob in for regular sweep.)

4. Press the A&B (dual trace) button under the CRT and adjust the VOLTS/DIVISION switches and VERTICAL POSITION controls for each vertical input until both waveforms appear on the CRT.

5. Adjust the HORIZ POSITION control to view the right-hand edge of the CRT trace, and then adjust the horizontal vernier (the small knob in the center of the TIMEBASE-FREQ switch) until a square-wave transition and vertical sync pulse appear at the right edge of the waveforms.

6. Adjust the HORIZ POSITION control until the square-wave transition lies on the CRT's center, calibrated, graticule line.

7. Pull the HORIZ POSITION control to expand the waveform ten times.

The waveform will look like the one in Fig. 2. Notice that we can easily see the horizontal sync pulses ahead of the vertical sync interval. Simply adjust the VCR control so there are 3.5 horizontal lines before vertical blanking.

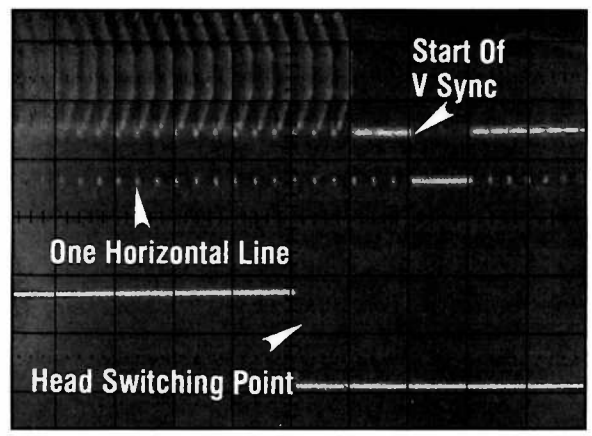


Fig. 2: The SC61 expands the waveform with plenty of detail to follow the head switching alignment instructions directly.

The SC61's "ADD" function makes it even easier to compare the timing of the two signals. To add the two input signals together, press the CHAN A and the CHAN B CRT selector buttons simultaneously. Now, the head-switching squarewave causes a "jog" to appear in the composite video signal. Most people find this makes comparison easier than placing one waveform next to the other.

Setting "Tracking Fix" Adjustments

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 the correct delay between a square-wave at one test point and a pulse at a second test point. Some Panasonic VCRs, for example, need a delay of 0.4 milliseconds for machines with two video heads but need a delay of 7.3 milliseconds for four-head machines.

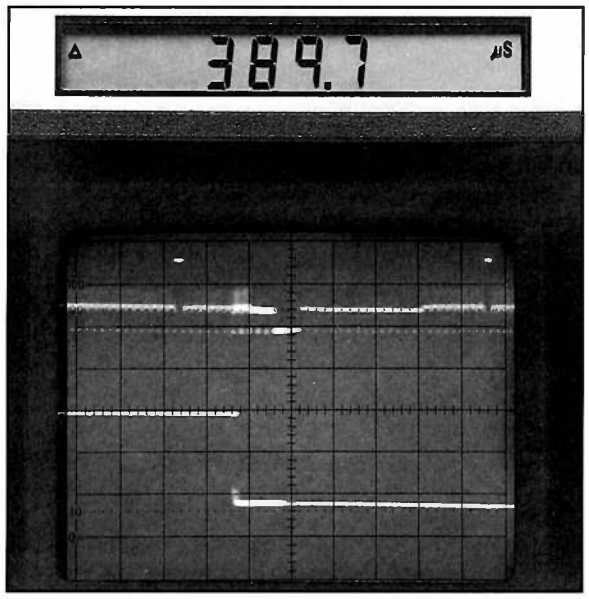


Fig. 3: Preset the SC61 Delta Time's intensified bar until its beginning touches the switching square wave and the digital readout shows the correct time delay. Then adjust the VCR control until the vertical sync pulse just touches the end of the intensified bar.

Making these measurements with a conventional scope calls for very attentive graticule counting. We must measure the time on one signal relative to the second signal. To complicate matters, the second waveform contains "jitter" (it moves back and forth as the tape plays) caused by the tape motion and the constant correction from the servo circuits. We must remember how many little squares one signal should be displaced from the second signal on the CRT, while we try to interpolate the average position of the moving signal.

The SC61's "Delta Time" function eliminates these problems (Fig. 3). We read the time delay between signals directly on the SC61's digital readout. The Delta Time test provides accurate time measurements directly on the waveform. We don't multiply switch settings or count CRT graticule markings. The results are accurate, whether the horizontal sweep speed is in the "Cal" or the uncalibrated mode. Parallax errors or interpretation errors between the two signals don't cause problems either because the Delta Time test marks the waveform itself, instead of requiring us to align waveform segments with the CRT graticule.

To measure time, we press the DELTA TIME button (Fig. 4). This activates two controls called DELTA BEGIN and DELTA END. These two controls position an intensified zone, called the"Delta Bar", anywhere we want it on the waveform. The SC61 measures the time duration of the Delta Bar and displays the time on the digital readout.

To measure the delay between two signals, we simply adjust the beginning of the Delta Bar until it just touches the transition in the first waveform. Then, we adjust its end until it just touches the transition in the second trace and read the digital readout to see the time delay between the signals.

Setting Record Current Adjustments

A few millivolts of measuring error become critical when adjusting the Chroma and the Luminance Record Current controls. The typical signal level for Chroma Recording Current is only 30 millivolts. The Luminance Record Current has a level around 100 millivolts.

These two adjustments determine whether the VCR will record a clean signal. If the signals are too large, the video heads will saturate the tape, causing a noisy picture or incorrect colors during playback. If the signals are too small, the tape will have a poor signal-to-noise ratio.

Two things complicate the adjustment of these controls when using a conventional scope. First, the trigger circuits of most competitive scopes have a difficult time locking to the composite video signal. Second, we must measure the peak-to-peak voltage level of a small part of the complete signal, meaning we must carefully count graticule divisions.

We will rely on the special SC61 sync separators to grab onto the video sync pulses and hold the waveforms in perfect synchronization. We will use the special "Video Preset" position of the TIMEBASE-FREQ switch to

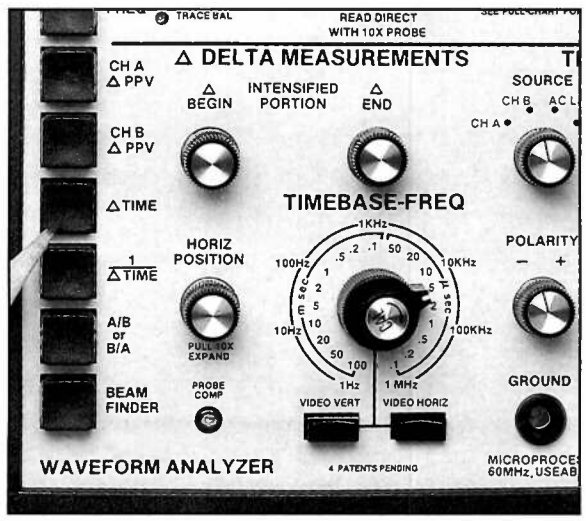


Fig. 4: Pressing the Delta time button activates the Delta Begin and Delta End controls which position an intensified bar on the CRT waveform.

instantly switch from the horizontal to the vertical sweep rates at the push of a button. We use Delta PPV function for these adjustments. Just as with the Delta Time measurements (covered earlier), these buttons activate the intensified Delta Bar controlled by the DELTA BEGIN and DELTA END controls. We adjust the controls until the Delta Bar just covers the part of the waveform the alignment instructions tell us to measure.

To adjust the Chroma Record Current control, display the signal at the horizontal sync rate. Next, highlight the cyan bar (Fig. 5) of the VA62A Universal Video Analyzer's Chroma Bar Sweep pattern or NTSC split-field video pattern (both video patterns produce the same results). For the Luminance Record Current, we display the signal at the vertical sync rate and highlight the vertical sync interval. Then, we simply adjust the VCR circuits until the digital readout shows the correct peak-to-peak amplitude.

Alignment Gets Easier With Practice

You can see why it's important to check the alignment of the internal VCR controls. Some will need minor touch-up, while others will need full adjustment. With your SC61 simplifying things even further, you'll become a VCR pro in no time.

Do you need more VCR service information? Call **1-800-SENCORE** and ask your Sales Engineer about Sencore's NEW simplified VCR book. You'll get helpful VCR tips to make your VCR servicing more efficient. ■

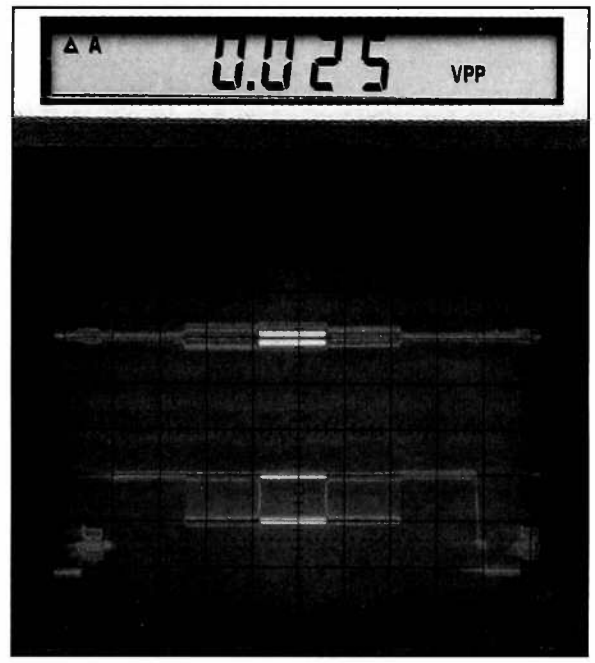


Fig. 5: Use the Delta PPV function to highlight the cyan bar. Then adjust the circuit until the digital display shows the correct level.

Sencore Tech Talk

Simplifying FM Deviation Adjustments

Sync Tip (Carrier) Frequency

Use the VA62A's Multiburst Bar Sweep pattern and release all the BAR SWEEP INTERRUPT buttons to give you a black raster. With a black raster input, the sync tip signal is easily identified as the dimmer of the two traces on the SC61.

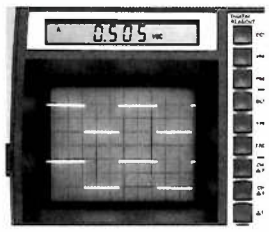
Set up the proper modulator frequency for the type of VCR you are servicing with the SC61's Delta Bar END control. Then adjust the VCR's Sync Tip control until exactly one cycle of the signal (the dimmer trace) is intensified.

Deviation Frequency (Peak White Frequency)

Use the VA62A's Chroma Bar Sweep pattern and release the 3.0, 3.5, and 4.0 MHz BAR SWEEP INTERRUPT buttons to give you a 100% white raster. With a white raster input, the peak white signal is easily identified as the brightest trace on the SC61.

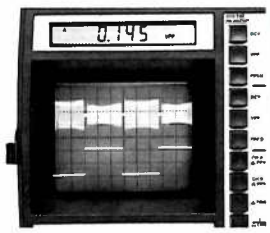
You can set up the Deviation Frequency using the same procedure you used for setting the Sync Tip Frequency, except you adjust the Delta Bar for the brighter trace. (For complete details, call **1-800-SENCORE** and ask for your FREE copy of Tech Tip #135).

Completely Analyze Any Waveform 10 Times Faster, 10 Times More Accurately With The Patented SC61 Waveform Analyzer™



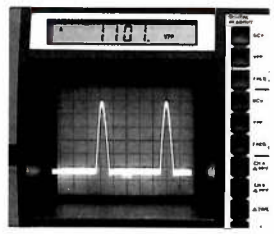
AUTOTRACKING™ Digital Measurements:

Speeds troubleshooting bias problems, calibration, and alignments; plus much more.



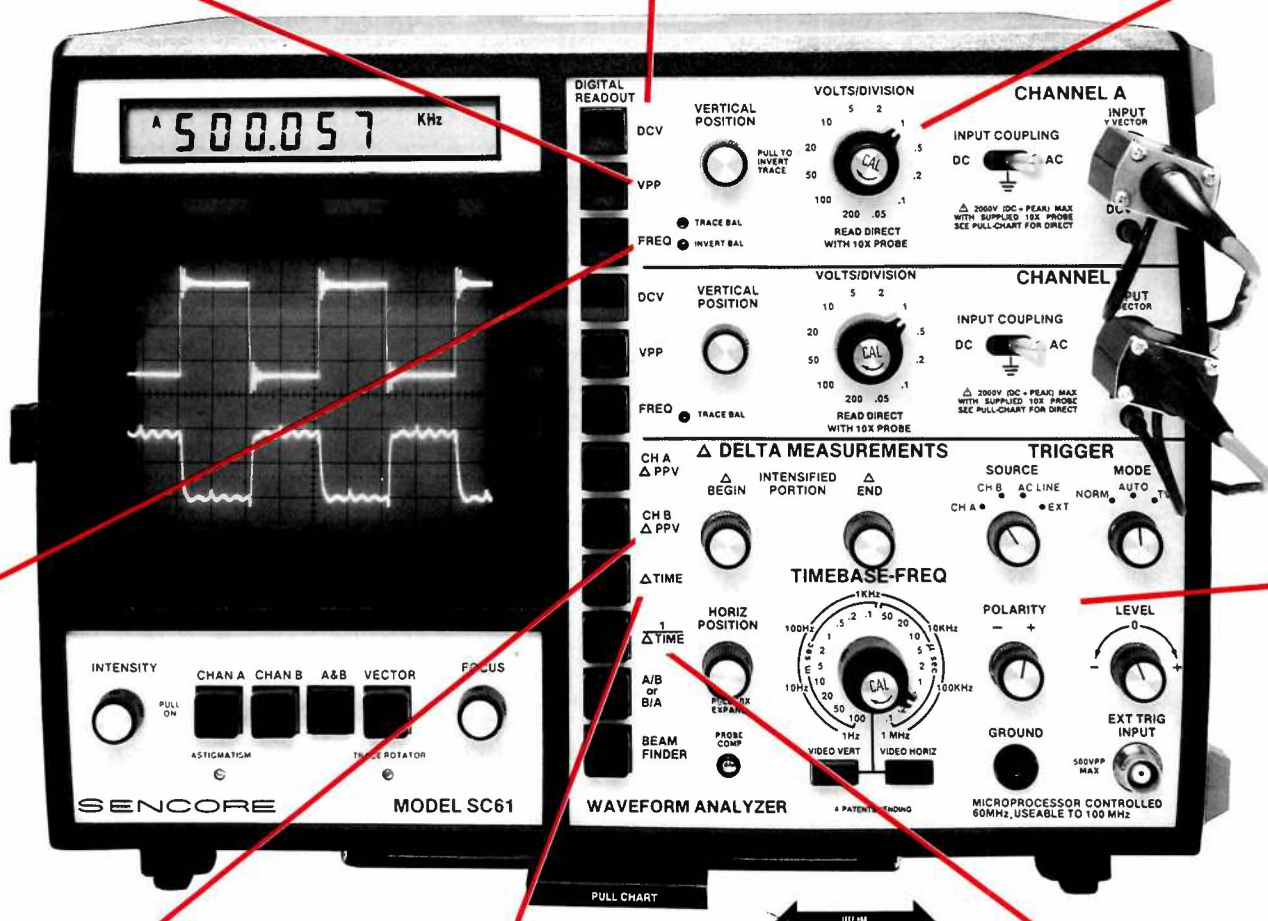
Automatic Peak-to-Peak Volts

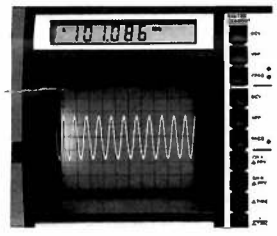
Catch elusive high frequency glitches and spikes by comparing the digital readout to the CRT waveform amplitude.



Four Times The Measuring Range - Patented

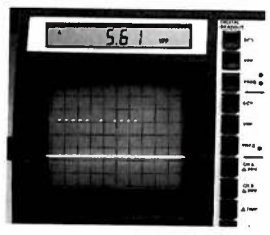
This means you can now measure in more circuits than ever before, with the confidence that your scope's front end is safe from damage.





Automatic Frequency Measurements - Patented

The readings are fast and digitally accurate to 100 MHz.

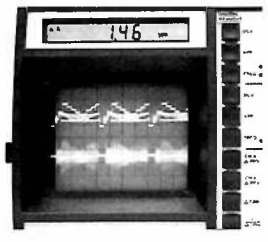


Rock-Solid Sync

The SC61 provides triggering all the way to 100 MHz and cancels noise to eliminate "sync jitter", delivering the most solid sync you've ever seen or used.

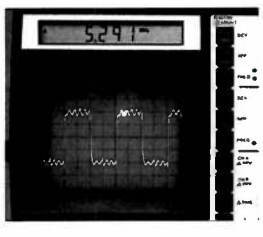
$3,295

RS232 Compatible



Delta Peak-to-Peak Volts Of Any Part Of The Signal

Great for troubleshooting or aligning complex waveforms found in broadcast, VCRs, video monitors, cameras, and much more.

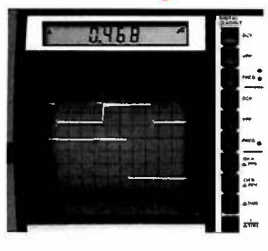


1/Delta Time — Frequency Of Any Part Of The Signal

Measure any interfering frequencies riding on top of another signal.

Plus

Special video sync separators, video presets, automatic frequency ratio test, × 10 expand, channel A invert, plus much, much more.



Delta Time For Any Time Reading

Use for measuring digital pulse widths, pulse spacing, time delays, etc . . .

Call 1-800-SENCORE

(736-2673)

Compare Digital Readouts—LCD vs. On-Screen Display. Discover Which Is Best For You.

by Greg Carey, CET

- **The SC61 gives you accurate, error-proof readings without adjusting cursors**
- **The SC61's LCD display is three times larger than on-screen displays**

Since Sencore introduced the SC61 Waveform Analyzer, many scopes with digital readouts have come on the market. It might seem these digital readout scopes do pretty much the same thing as the SC61, but side-by-side comparisons show major differences. These differences affect your work in a variety of ways.

The SC61 Is Different Than A Digital Readout Scope

Why is the SC61 Waveform Analyzer different than a digital readout scope? Because Sencore designers understand how you make measurements in your daily testing. We know you need more than waveshape every time you make a test. It's often more important to know the DC, peak-to-peak, or frequency of the signal. Look at what you have to do with other units:

Cursors Or Automatic Readings?

Others: CRT Based Cursors (Figure 1)— *Most digital readout scopes use CRT-based cursors to make every reading. Most cursors are manually operated. You adjust one cursor to the top and a second cursor to the bottom of the waveform for every test of signal amplitude. Manually controlled cursor measurements are slow. And, since you must determine where the signal begins and ends, the digital readings are affected by the same interpretation errors that plague manual calculations.*

Sencore: Autotracking™ Peak-to-Peak— To test peak-to-peak with the SC61, just connect either test probe to the circuit and press the "PPV" button (Fig. 2). The digital readings are accurate even if the CRT is not displaying the waveform. There is no need for adjusting cursors. The verniers may be left uncalibrated without affecting accuracy. You can't make a mistake.

DC Volts— Even With AC Coupling!

Others: Not All Measure DCV—*Not all competitive scopes can measure DC voltages. If they can, you often must use cursors again. You position one cursor to the "ground" reference point, and then move the other to the average signal level. Since the average level depends on the waveshape, you must decide where to set the cursor. In addition, DC measurements require you to set the input coupling to the "DC" position. If not, the DC reading will be in error. Plus, the vernier must be calibrated.*

Sencore: Autotracking™ DCV—By comparison, the SC61 provides two DC channels. It doesn't matter whether you have the signal displayed, the sweep circuits in sync, the verniers calibrated, or whether you have the input coupling switch in the "DC" position. The Autoranged, Autotracking DC test tracks along with the signal, automatically and makes error-free measurements every time.

Delta Time And Frequency

Others: *Most digital readout scopes base time readings on the calibration of the CRT's horizontal circuits. Once again, you must keep the horizontal vernier calibrated or get a reading error (Figure 3).*

Sencore: The SC61 Delta Time readings are crystal-referenced, whether you have the vernier in or out of the calibrated position. The same thing is true of Delta Frequency. You get an accurate reading every time.

1/Delta Time

Others: *Many digital-readout scopes have a "one-over-delta-time" function, but it only works when the horizontal vernier is calibrated. The others do not have a separate frequency function for the times you need more accuracy. Since every frequency test is based on a manually set time measurement, the accuracy is limited by how closely you can estimate the starting and stopping point of one complete cycle of the signal, usually 1 to 5%.*

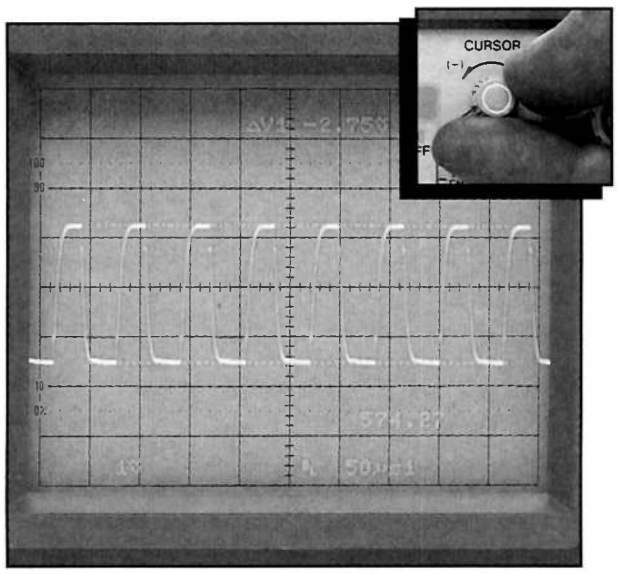


Fig. 1: Cursor-based digital readings force you to lock a waveform and manually determine the signal limits.

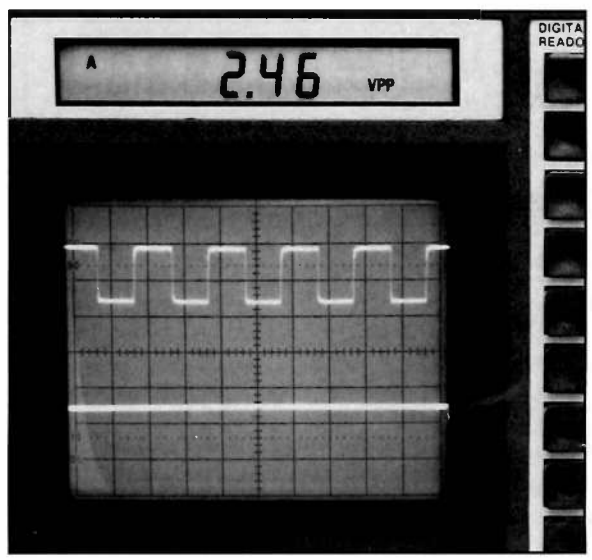


Fig. 2: Only the SC61 gives accurate peak-to-peak readings if the vertical vernier is uncalibrated.

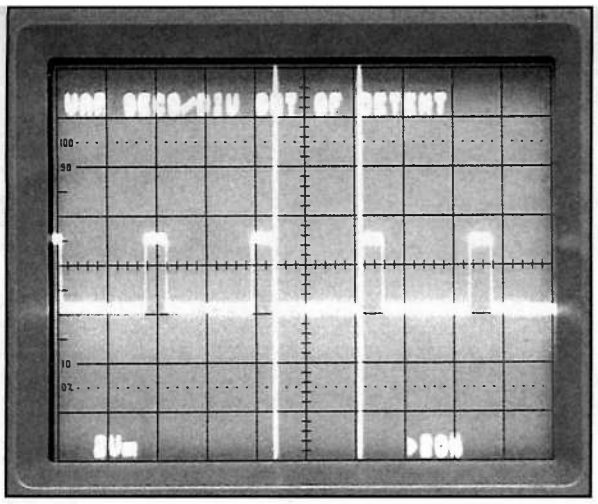


Fig. 3: Competitive scopes give errors when the horizontal or vertical vernier controls are "uncalibrated."

You press the one button that defines the test (and that button has only one function), and then look at the single direct-reading, liquid-crystal display. You keep your mind on the circuit you are testing.

The SC61 does all of the calculating for you. It lets you spend your time troubleshooting your circuit, not your test equipment.

The SC61's Autotracking tests are accurate, whether or not you have a waveform on the CRT. Its CRT is usable to 100 MHz and its input is protected to 3000 volts. Its Delta tests are accurate, even if the CRT verniers aren't calibrated.

Compare For Yourself And See How The SC61 Waveform Analyzer Outperforms Digital Readout Scopes

The best way to compare the SC61 Waveform Analyzer with digital readout oscilloscopes is in a side-by-side comparison. Below are comparisons of the SC61 to two popular competitors. We've left room for you to write in your results when you compare the SC61 in your own tests.

After running through these general comparisons, put the SC61 Waveform Analyzer and the competitive scope to work, measuring some of the signals you see every day. See which one really saves you time.

Call **1-800-SENCORE** today and ask your Area Sales Engineer about trying the SC61 on your bench for a 10 day FREE trial. Compare the SC61 Waveform Analyzer to your scope and see which instrument is the best for you. ■

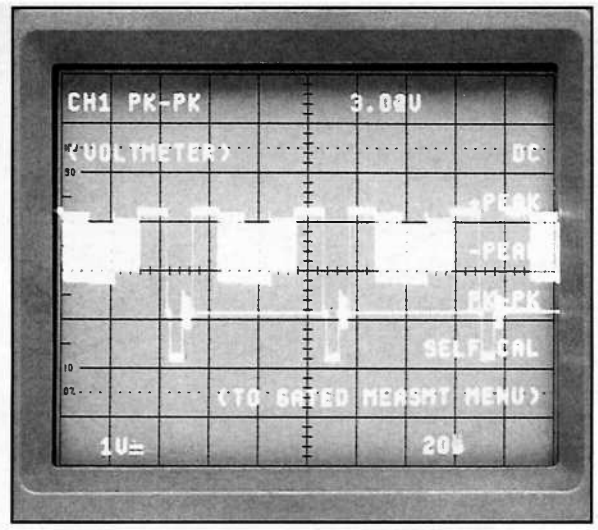


Fig. 4: Multiple readings can be complicated, and some readings disappear for certain set-ups, making even more confusion—they take your mind off your circuit.

Sencore: The SC61 Waveform Analyzer gives you both frequency tests. Press a button and the SC61 calculates frequency from the Delta test. When you need more accuracy, press the Autotracking frequency button for Channel A or B. The SC61 automatically displays the frequency with up to 6 digits of resolution. It is accurate to 0.001%, compared to 1% to 5% for a delta test. It's 100% autoranged and error-free.

Digital Readout

Others: *Finally, let's compare the readouts. Most digital readout scopes print the digital readings on the CRT, using the same electron beam that draws the waveform. This method often causes flicker or holes to appear in the scope waveform during the time the electron beam draws the digital readings. The biggest problem with on-screen displays: their size. The numbers are often too small to read causing you to lose concentration on the circuit you are troubleshooting (Fig. 4).*

Sencore: The SC61's LCD digits are more than three times larger than the on-screen displays. The SC61 display is easy to read, even if you are viewing it from some distance. You get one reading with zero chance of error.

Easy To Use

Others: *Most scopes scatter the readings all over the CRT (Fig. 4). Channel A readings are in one place. Channel B readings are in another place. A different area tells you where you've set your vertical attenuator for channel A and B. Another display tells you where you've set your horizontal sweep speed. Another might tell you about delayed sweep, while another might tell you something about the trigger circuits. For more complication, many push buttons have 3, 4, or 5 completely different uses, depending on which menu or sub-menu you have selected.*

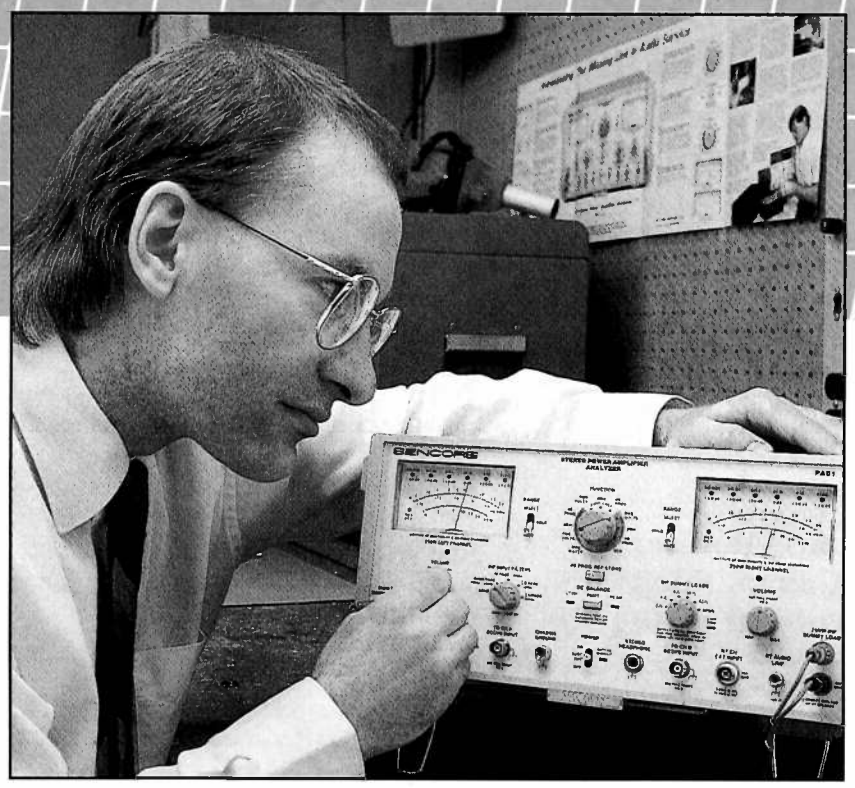
Sencore: The SC61 gives you each reading you want, when you want it. You look at the same spot every time.

Function	Test Results: Sencore SC61	Tektronix 2246	Hitachi V-1100A	Your Test
Channel A Only				
DCV (Operator Steps Needed)	1	3*	4*	
PPV (Operator Steps Needed)	1	2	6	
Frequency (Operator Steps Needed)	1	4	2	
Alternate A&B (Operator Steps Needed)	6	28	N/A**	
P-P Cursors	N/A	Auto	Manual	
P-P Follows Signal Change Automatically	Yes	Yes	No	
DC While AC Coupled	Yes	No	No	
Readings On Both Ch.	Yes	Yes	Some	
Read Without Display	Yes	Some	No	
Frequency Reading	6 Dig.	No	3 Dig.	
Freq. Accuracy	0.001%	N/A	0.1%	
Freq. Ratio	Yes	No	No	
Accurate Readings If Verniers Uncal'ed				
DCV	Yes	No	Yes	
PPV	Yes	No	No	
Freq.	Yes	N/A	Yes	
Delta PPV	Yes	No	No	
Delta Time	Yes	No	No	
1/Delta Time	Yes	No	No	
Auto. PP OK On Video	Yes	No	N/A	
TV Triggering Mode	Yes	Yes	Yes	
Digital Makes Black Holes In Waveform	N/A	Yes	Some	
Multi-Function Controls	No	Yes	Yes	
Stable Triggering	Yes	Yes	Some	
Measuring Range	2,000	400	400	
Protection	3,000	400	400	
Hand-sized Controls	Yes	No	No	
Toll-Free Answers	Yes	?	?	

* Includes moving input coupling switch to "DC"

** Does not have all functions on channel 2

(NOTE: All results taken from actual lab tests of competitive instruments, or from the specifications provided by the individual manufacturer.)



A Complete Audio Monitoring Bench . . . In One Instrument!

by Larry Schnabel, Editor

- **Measure up to 250 RMS watts per channel using the PA81.**
- **Learn how to prevent burning up components, even intermittent burn-ups.**

How many times have you wished:

✓ you had another meter to compare both channel readings instead of jumping from the left channel to the right channel with one meter?

✓ you could just reach up and switch from a 4 ohm to an 8 ohm load without using jumper wires or extra resistors?

✓ you had that manufacturer-specified filter at your fingertips to verify that noise problem you can't nail down?

✓ you could see everything at once: power out, sinewave out, and dB level out—all while listening to the audio without switching units in and out of your bench setup?

✓ that big amp hadn't burned out again as you brought the power up?

Your wish has come true. The PA81 Stereo Power Amplifier Analyzer is a complete audio monitoring bench, in one instrument! You get all the meters, all the loads, all the filters, and all the protection you need to do the job right. The "Missing Link In Audio Analyzing" is an extraordinary time-saving instrument that's only a little bigger than a breadbox. Read on:

Twin Autoranged Wattmeters Make Each Job A Snap

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

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

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

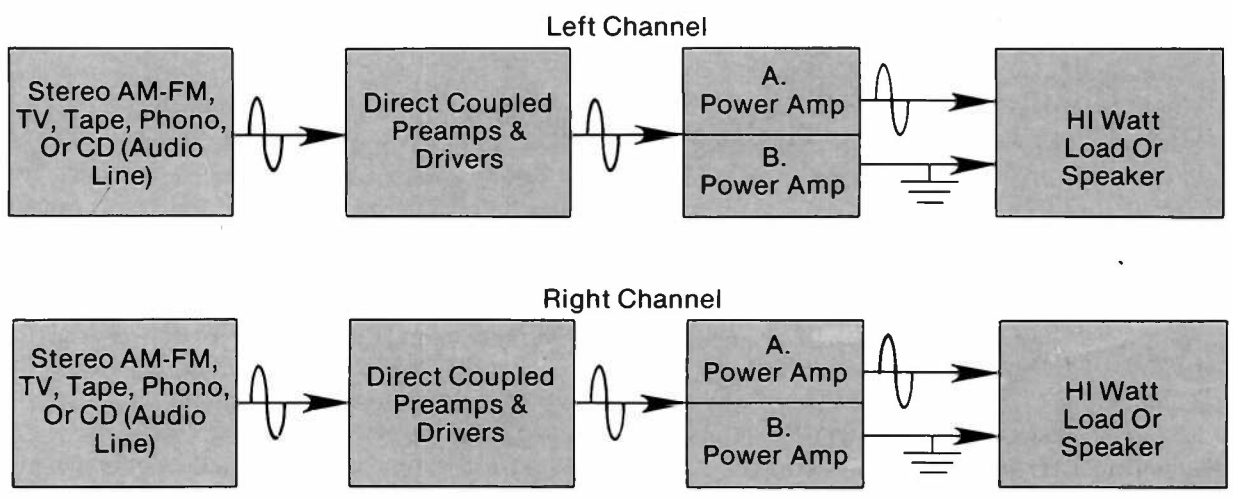
Built-in IHF/EIA Loads And Filters Make Your Audio Troubleshooting Work Easier and More Accurate

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

The PA81 Stereo Power Amplifier Analyzer provides you with the dummy loads (2, 4, 8, 16, and 32 ohms) to service all stereo audio amplifiers. Each dummy load meets IHF/EIA standards and has matched left and right channels to provide equal and proper loading for both stereo channels. The PA81's dummy loads can handle up to 250 watts per channel and are fan cooled to prevent overheating.

Industry test standards also require low and high pass filters for a number of audio tests. These filters limit the audio measurements to a specific frequency range while maintaining a flat frequency response for all tests.

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



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

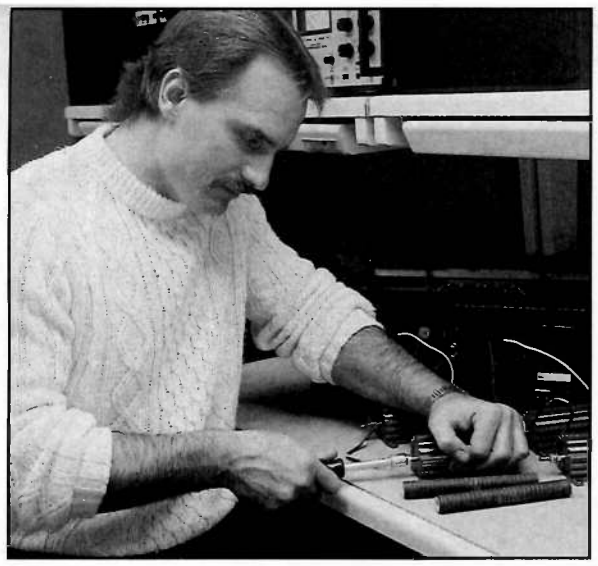


Fig. 1: Rigging up resistors for audio power measurements can be time consuming and inaccurate.

Monitor Sound Quality Three Ways At All Times

Sound quality can be fine at low levels but it can deteriorate as the power is "cranked up". Loudspeakers are generally too loud to use for high power testing, yet you need to know the quality of the audio signal when the power is increased.

Most servicers don't check the sound quality at higher power levels. They either don't want to listen to a stereo turned wide open or fear the amplifier or speakers will be damaged.

The PA81 lets you check the quality of the audio signal at any power level, in three different ways! *#1* Built-in high quality speakers let you trace the problem to any stage just by listening to the sound. Each channel is autoranged and has its own volume control so you can monitor the audio quality without the tremendous blast associated with most high power amplifiers.

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

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

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

An RMS or DC voltmeter is still a very valuable tool for servicing an amplifier with one defective channel. You can compare signals from the working channel to the signals in the non-working channel to help narrow the problem down.

Sometimes service literature makes reference to stage gain in decibels (dBs). A dB is simply a ratio of an output level to an input level. Of course, you can still use a simple voltmeter to measure the input and output voltages, but you need a calculator to figure the gain since the formula is slightly complicated.

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

You simply touch the test leads to the circuit point and read the autoranged PA81 analog meters for RMS volts, DC volts, or gain in dB (Fig. 2). The external inputs give you a wide measuring range so you can measure signals from the microphone to the output stages of a high-powered amplifier.

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

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

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

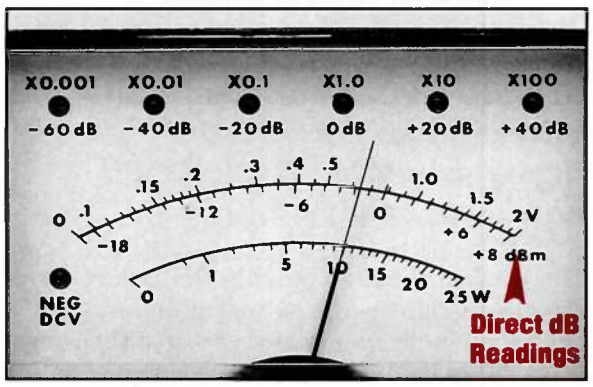


Fig. 2: The PA81 automatically calculates and displays the gain directly in dB, saving you time and reducing chance for error.

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

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

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

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

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

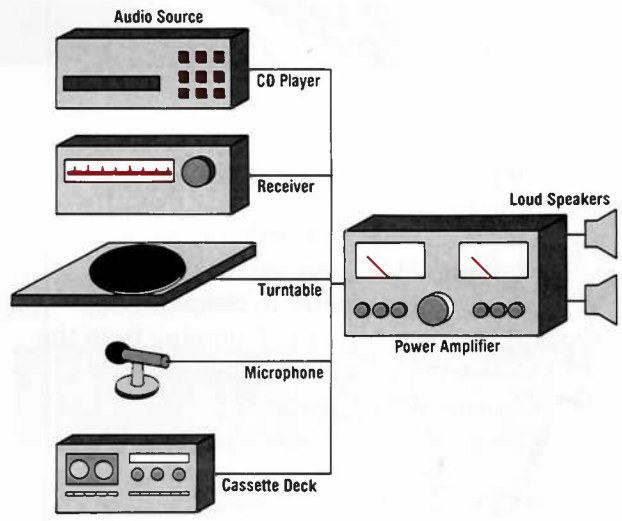


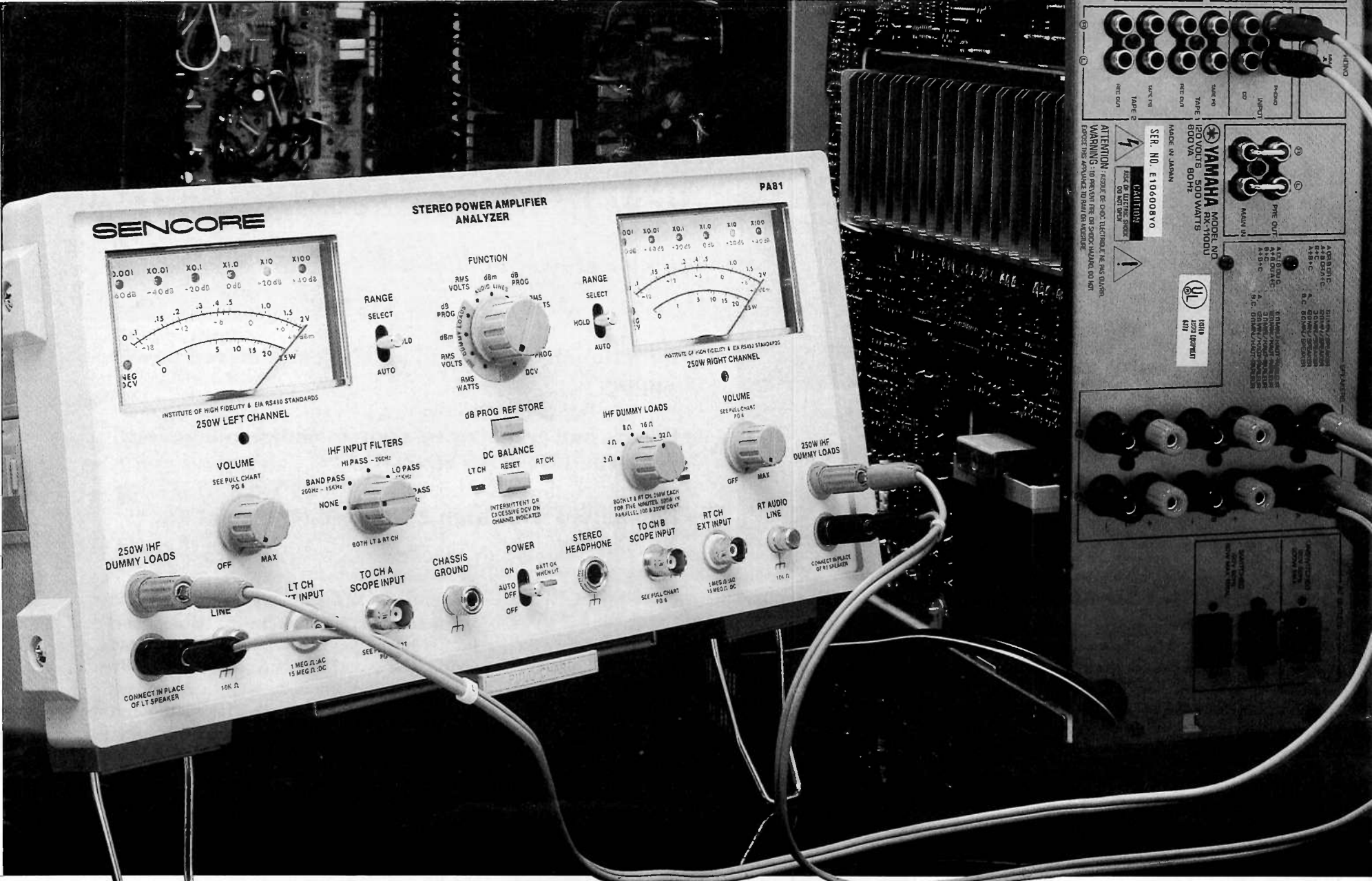
Fig. 3: The PA81 lets you check the source signal before it reaches the power amplifier.

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

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

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

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



Automatically Measure Level, Monitor Waveshape, And Listen To The Audio While Safely Doing All Amplifier Analyzing - Even At Maximum Power...

With The PA81 Stereo Power Amplifier Analyzer!

$1,995 Only from Sencore!

Most audio benches aren't really equipped to service modern amplifiers!

RMS voltmeters don't have enough frequency response for audio work. Eight ohm dummy loads aren't compatible with today's popular 2 and 4 ohm stereo systems. Signal tracing with a voltmeter takes a lot of time, and conversion calculations are not always accurate. A technician may spend valuable time trying to isolate the cause of a DC offset voltage. Each time the intermittent occurs, he's left wondering which channel went bad, or he's watching his costly replacement components go up in smoke.

The audio servicer really needs an instrument that picks up where his other equipment lets off...

Introducing the "Missing Link In Audio Servicing." The NEW PA81 Stereo Power Amplifier Analyzer allows you to measure the level, listen to the audio, and view the audio during all amplifier tests. The PA81 provides everything you need for analyzing signals from microphone level signals to power amplifier outputs fully integrated into one complete package, with:

- Twin Frequency Compensated Autoranged Wattmeters: 250 watts per channel (500 watts if paralleled or 5 KW is using the PM82 POWER MAX), and listen to audio clarity with built-in volume control
- Built-in IHF/EIA Testing Components At Your Fingertips: 2, 4, 8, 16, 32 ohm-zero reactance loads, and all specified bandpass audio filters
- Monitor Sound Quality At Every Step To Prevent Backtracking
- Measure RMS Volts And dB As You Trace Through Circuits: Plus, programmable dB to measure stage gain
- Test Intermittents To Prevent Amplifier Damage: Built-in DC balance test-automatically opens loads
- Test Audio Line Levels To Make Sure The Driver Input Signal Is Correct: Check turntables, AM tuners, FM tuners, TV stereo demodula tor outputs, CD players, etc. for standard line levels
- Monitor Stereo Separation To 126 dB: Monitor, troubleshoot, or align AM-FM or TV Stereo separation circuits

Call 1–800–SENCORE

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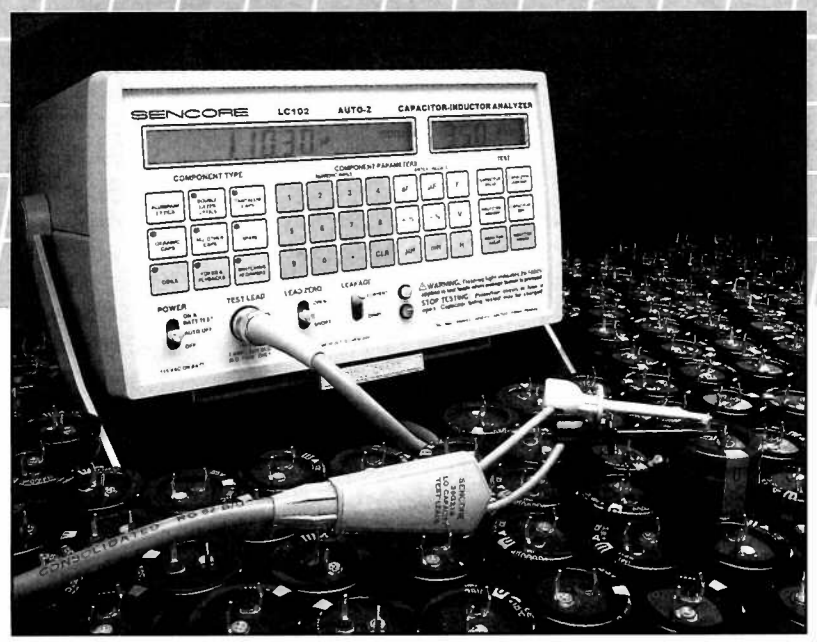


Switched Mode Power Supplies—How They Work And How To Troubleshoot Them

by Rick Meyer, Application Engineer

- **Functionally similar to a TV's scan-derived power supply**
- **Locate bad transistors, transformers, and zeners with the LC102 AUTO-Z**
- **Capacitors with high ESR often test "good" for value only**

Power supplies are simple, aren't they? A transformer, a few diodes, a capacitor and that's it. That was the past. Enter the switched mode power supply. On the surface, these new power supplies look extremely complicated. Once you understand how they work, however, you will find that they are quite simple.

Switched mode power supplies aren't really new, they have been around for quite a few years. They were first used by the military and in aerospace. These industries were looking for lightweight, compact power supplies to power sophisticated electronic circuits. Soon the switched mode power supply became popular in the computer industry. Their use continued to flourish and we now see them being used in televisions, VCRs, cameras and other consumer electronic products.

A switched mode power supply is very similar to the scan derived power supplies used in televisions. Recently, we have seen scan derived voltages being replaced by switched mode power supply voltages. VCRs are also beginning to use more switched mode power supplies.

As you can see, switched mode power supplies are here to stay. Let's see how these power supplies work and how to service them.

Knowing The Basics Of Switched Mode Power Supplies Helps To Increase Your Troubleshooting Efficiency

There are three basic types of switched mode power supplies: the step-down, step-up, and the inverting, or flyback type. The flyback type is used, primarily, in consumer products; so we will concentrate on this type. There are many similarities between the flyback type switched mode power supply and the scan derived power supplies of modern day televisions (Figure 1).

Some of the similarities are:

- Both use a flyback transformer.
- Both operate at a relatively high frequency.
- Both use a transistor to switch power on and off to the transformer.
- Both have a damper diode to reduce the inductive kickback from the transformer.
- Both regulate the operation of the circuit to control the output voltage levels.

There are also a few differences between the scan derived supplies used in televisions and the switched mode power supplies. They are:

- The switched mode power supply is not restricted to 15,734 Hz for its operating frequency.
- The regulator may change either, or both, the frequency and the width of the pulse, whereas the scan derived power supply varies the DC voltage to the stage.
- The switching transistor and associated circuitry, in the switched mode power supply, is often also the oscillator circuit. The scan derived power supply uses a separate oscillator circuit.

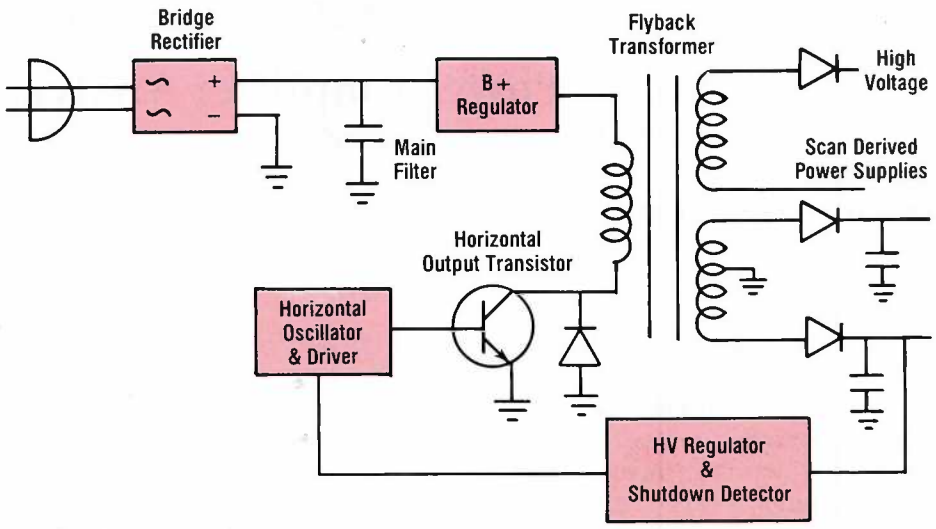


Fig. 1: The scan derived power supply for a television looks functionally similar to the switched mode power supply.

Figure 2 shows a functional block diagram of a typical VCR switched mode power supply. To start with, the switched mode power supply needs a source of power. This is supplied by a conventional power supply. Raw, unregulated B + is supplied through the switching transformer to the collector of the switching transistor. The switching transistor alternately connects and disconnects the bottom side of the transformer to ground. This results in the alternate creation and collapse of a magnetic field in the switching transformer. This changing magnetic field supplies the transformer, or flyback action.

Figure 2 also shows a second winding on the input side of the transformer. This winding generates a signal that alternately turns the switching transistor on and off. This sustains the oscillator action and forms a loop for the oscillator circuit. Several windings are contained on the secondary of the switching transformer. These supply varying amplitude pulses to high speed switching diodes and their associated filtering circuits. These are the DC output voltages of the switched mode power supply.

One advantage of a switched mode power supply is the efficiency that can be achieved in its regulation. Traditional power supplies often regulate the output voltage by dumping the excess energy into resistors which convert the energy into waste heat. In a switched mode power supply, only the amount of energy needed is used. This is the reason for its higher efficiency.

Voltage regulation is achieved by sampling the DC output voltage and comparing it to a reference voltage. This comparison is then used to adjust the amount of time the switching transistor is turned on, ultimately regulating the output voltage. An optocoupler is used in the regulator circuit to maintain good isolation between the primary and the secondary portions of the power supply.

There are two basic types of regulators: the pulse *width* modulated regulator (Fig. 3) and the pulse *rate* modulated regulator (Fig. 4). Switched mode power supplies in televisions

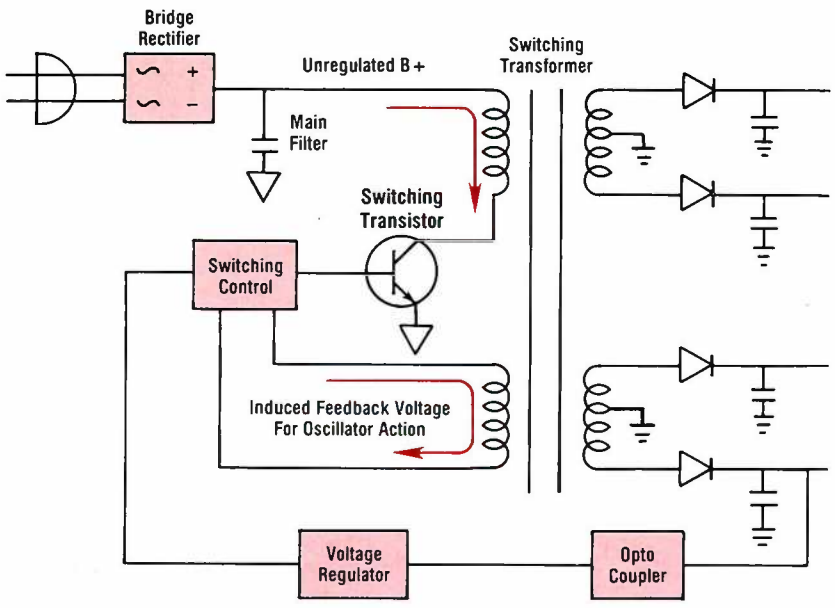


Fig. 2: A typical VCR switched mode power supply combines the switching transistor and transformer to form the oscillator circuit.

use either type. The pulse rate modulated regulator is often used in VCRs, but, this is by no means universal.

In a typical VCR using pulse rate modulation, the switched mode power supply may operate at frequencies as high as 90 kHz, while the VCR is in the off mode. When the VCR is turned on, more energy is required and the frequency of the switched mode power supply drops to 40 to 60 kHz. This lower frequency results in wider switching pulses, thus, more energy is supplied to the switching transformer. As different functions are selected on the VCR, the energy needs change and the frequency of the switched mode power supply changes.

Now that we understand the basics of how the switched mode power supply works, lets see how to troubleshoot it.

Knowing What Signal And Components Are Needed Helps Determine What To Check When Servicing

A VCR symptom of "no power supply voltage" could be caused either by a problem in the switched mode power supply or a short on one of the output lines. Before troubleshooting the switched mode power supply, disconnect the power supply from the rest of the VCR and use an ohmmeter to check for direct shorts. If no shorts are detected at either the outputs of the switched mode power supply or the VCR circuits they are feeding, reconnect the plugs and service the switched mode power supply.

When a switched mode power supply isn't working, first check for raw B + . You can easily do this with the Sencore SC61 Waveform Analyzer. Simply connect the SC61 test probe to the collector of the switching transistor. This transistor will be fairly easy to locate because it is the largest transistor in the power supply. Use the digital DC voltmeter on the SC61 to check for the presence of B + . If no DC voltage is present at the collector of the switching transistor, check the low voltage power supply. These supplies are very simple and are of the conventional diode supply type. Check for a blown fuse first. If the fuse is blown, look for a shorted B + power supply diode or a short in the switching power supply.

One of the main components in a switched mode power supply is the switching transistor. All the power is controlled by this transistor and, thus, it controls relatively high currents. In addition, most present day VCR switched mode power supplies use the switching transistor as part of the oscillator circuit. Failure of this transistor will stop all actions within the power supply. If the input fuse is blown, and the B+ power supply diodes are good, suspect a shorted switching transistor.

Once the B + is working, look at the waveform on the collector of the switching transistor. The SC61 Waveform Analyzer is excellent for this since you won't exceed its voltage input capability (patented to 3000 VPP). In addition, you can quickly analyze the switching pulses using the digital meter on the SC61.

Check the frequency of the switching pulse using the digital frequency counter on the SC61. With the VCR in the "Off" position, the switched mode power supply should still be operating to supply voltage to the clock and microprocessor. Check the frequency of the

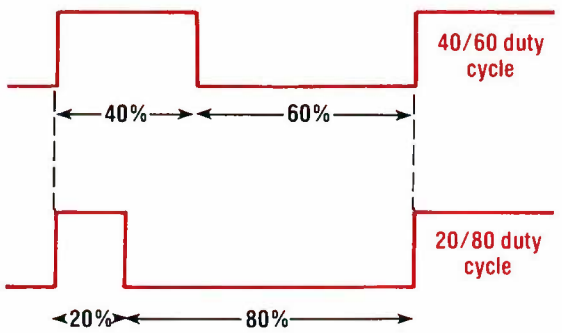


Fig. 3: A pulse width modulated regulator varies the output voltage by varying the width of the pulses applied to the switching transistor.

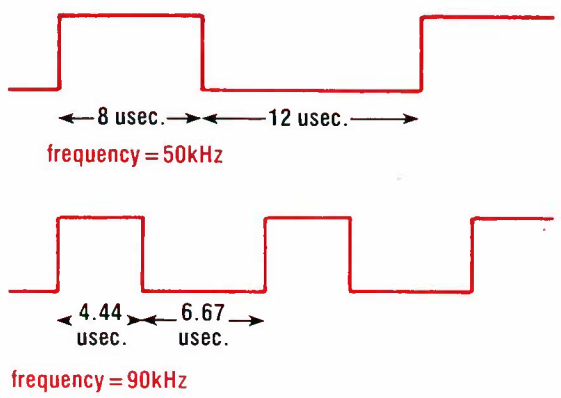


Fig. 4: A pulse rate modulated regulator varies the frequency of the pulses being fed to the switching transistor. This frequency change results in a change in the pulse width.

pulse and record it. For example, the waveform shown in Figure 5 is for a typical Quasar VCR. The frequency of the switching pulse, for this particular VCR is 98 kHz with the VCR in the off mode.

If a switching pulse is present at the collector of the switching transistor, check to see if the regulator section is working properly. Simply turn on the VCR, or select a function, and watch for a change in the switching pulses. In a pulse width modulated regulation system, the width of the pulses should change. In a pulse rate modulated regulation system, the frequency of the pulses should change.

Finally, check the output DC voltages from the switched mode power supply, using the SC61. It is important to check these voltages with a scope since you want to check the DC voltage and see if there are any voltage spikes. Read the DC voltage on the supply line, then press the VPP button on the SC61 and read the peak-to-peak amplitude of any spikes on the power supply line. Typically you should see 0.1 volt peak-to-peak or less.

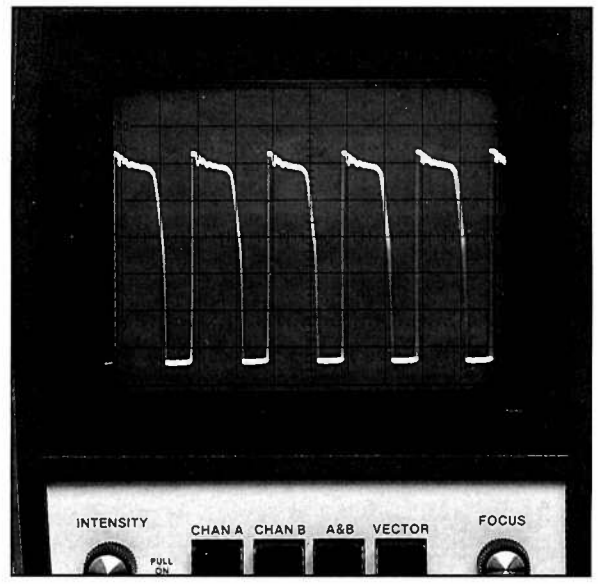


Fig. 5: A normal switching transistor collector waveform will often show some ringing. The frequency of the pulses varies with the load applied to the switched mode power supply.

The LC102 AUTO-Z Can Help Identify The Defective Component Causing A Switched Mode Power Supply To Fail

One of the most important components in a switched mode power supply is the switching transistor. This transistor can be tested with a transistor tester for a "go/no-go" test. Occasionally these transistors may test good at the low voltages used by transistor testers, but fail at the higher circuit voltages used in these power supplies. The reason for this is that a transistor acts like a zener diode when a voltage is applied between its collector and emitter. The transistor blocks any flow of current between the collector and emitter until the voltage becomes larger than the transistor's breakdown voltage. It then conducts heavily. If the transistor begins to conduct at a voltage lower than the operating voltage of the circuit, it will stay on and dynamically act like a shorted transistor.

You can check the switching transistor for too low a breakdown voltage using the leakage test on the LC102 AUTO-Z. Use a 1 k current-limiting resistor to limit the current applied to the transistor. You will also need a DC voltmeter or the SC61 to monitor the transistor's breakdown voltage.

First remove the transistor from the circuit. Next, connect a 1 k resistor to the collector of the transistor. Then connect up the LC102

AUTO-Z, across the emitter-collector junction. Connect the red lead to the collector and the black lead to the emitter for NPN, and reverse the leads for PNP. Program the AUTO-Z to the same voltage supplied by the input power supply of the switched mode power supply. Perform the LC102 leakage test and note if current is being drawn as shown by a current reading on the LC102. If the current shows only a few microamps, the transistor is not breaking down at that voltage level. Increase the LC102 voltage by 50 volts and test the transistor again. If a current reading is now obtained, use a voltmeter or the DCV function of the SC61 to measure the voltage across the collector to emitter of the transistor. This is the breakdown voltage. This technique determines the actual breakdown voltage of the transistor. It must be higher than the voltage applied to the switching transistor. If it is not, the transistor is bad and should be replaced.

Find Shorted Turns

If you find a shorted switching transistor, it may have been damaged because of a shorted switching transformer. The INDUCTOR RINGER on the LC102 AUTO-Z quickly checks these transformers for a single shorted turn. With the switching transistor removed, perform the LC102 ringing test at the primary winding of the switching transformer. If the transformer rings 10 rings or more it has no shorted turns. If it rings less than 10, remove the transformer and again perform the ringing test. If any of the windings on the transformer ring 10 or more, the transformer is good. If it rings less than 10, the transformer has a shorted turn and it may ruin a new switching transistor immediately. Replace It! !

Locate Bad Zener Diodes

Regulation of switching mode power supplies requires the comparison of the output voltage to a reference voltage. The reference voltage is often obtained using a zener diode. A defective zener diode will result in a wrong reference voltage and cause either poor regulation or a total shutdown of the switched mode power supply. Zener diodes can be easily tested using the LC102 AUTO-Z.

To test a zener diode, connect the LC102 AUTO-Z to it with the red lead to the cathode and the black lead to the anode. Apply a voltage higher than the zener's rated voltage through a current limiting resistor, and check the voltage drop across the zener diode. To perform this test, set the LC102 about 5 volts higher than the rated voltage of the zener diode. This ensures proper diode turn-on through the current-limiting resistor. Press the LC102 leakage test button. The LC102 should indicate that current is being drawn. If the current reading on the LC102 shows only a few microamperes, the diode is not conducting. Increase the voltage setting of the LC102 by an extra 5 volts and test the zener diode again. When the LC102 shows current flow, measure the voltage drop across the zener diode with a voltmeter. This is the zener voltage and should correspond to the voltage value listed in the schematic.

Track Down High ESR

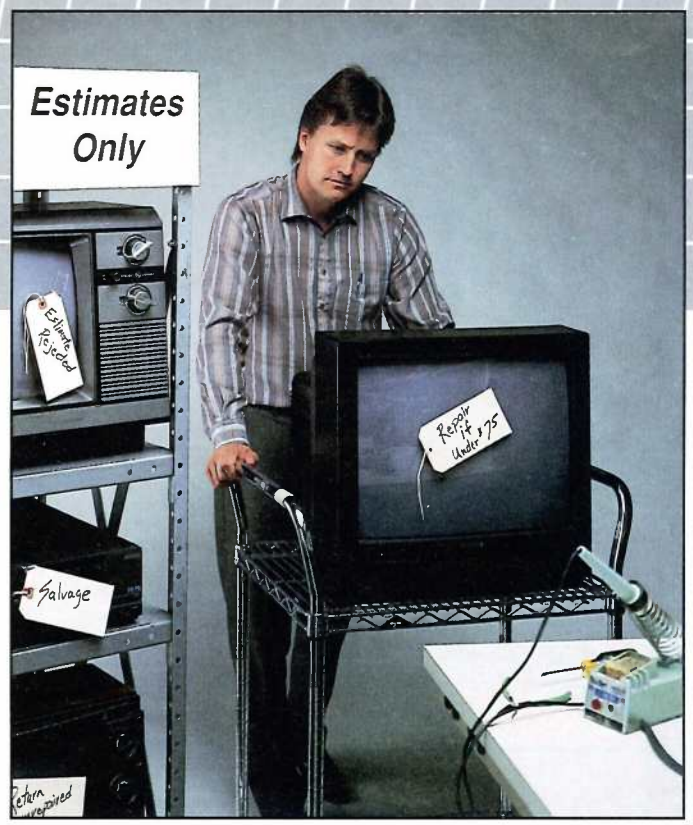
Other components that fail in switched mode power supplies are the filter capacitors used in the various DC power supply outputs. These capacitors are typically aluminum electrolytic and are operating at high frequencies (up to 100 kHz). Due to the makeup of these capacitors, they all have some internal resistance called Equivalent Series Resistance, or ESR. This resistance is caused by the resistance of the leads, lead welds inside the capacitor, and the foil that makes up the capacitor plates. As the capacitor charges and discharges, current flows through this internal resistance and generates heat. If the ESR becomes too large, excessive heat is produced and the electrolytic capacitor dries out. In addition, this excessive ESR effectively isolates the capacitor from the circuit it is trying to filter. The end result is excessive ripple or high frequency spikes on the DC power supply line.

A capacitor with too much ESR will often check good for capacitance. You can use the LC102 AUTO-Z to test the filter capacitor for excessive ESR. The LC102 automatically tests the capacitor, compares the readings to EIA standards, and tells you if it is good or bad.

As you can see, the LC102 AUTO-Z gives you several tests to locate defective components in switching mode power supplies that you cannot find any other way. It will help you:

- Locate transistors that break down at high working voltages.
- Identify shorted switching transformers.
- Test reference zener diodes.
- Locate bad filter capacitors with high ESR.

With the knowledge you have learned in this article, you can tackle that next power supply problem with confidence. Now, all you need is the right equipment. Call your Area Sales Engineer at **1-800-SENCORE**; he'll help set you up with an LC102 FREE 10 day trial. And ask him about the Tech Tip on switched mode power supplies, #158. ■



How To Keep Potential Profits In Your Shop

by Rick Mull, Sales Engineer

- **Performance test before you start the estimate**
- **Start at the collector of the horizontal output transistor**
- **Estimate the repair right the first time**

"How much is it going to cost?"

That's typically one of the first comments servicers hear from customers with a TV or VCR in for repair. How do you answer this type of question? Your answer can be the difference between making a quick profit or chasing your profits out the door and down the street.

Servicers are now forced to estimate the cost of repair vs. the cost of replacement for many items they repair. If you estimate a TV or VCR too high in regard to its selling price, you probably won't be taking in a lot of business. On the other hand, if you estimate a set too low, you could put yourself in an embarrassing situation and ultimately lose money on the job.

"Am I Sending Profits Out The Door?"

Can you remember any sets this past week that you sent back unrepaired? If you're like most servicers, you've had at least one or two sets that the customer decided to take home unrepaired due to a spendy estimate.

After the customer walked out the door with the unrepaired set in hand, did you second-guess yourself or feel like you had lost a potential profit? You may be losing profits you weren't even aware of if the following examples sound familiar:

1. Are you able to provide your customer with an estimate that you can confidently stick with?

2. When you're unsure of the true defect of a repair, do you estimate high to protect your shop from embarrassment or loss of profits?

When a customer receives an estimate for what he thinks is too much money, he'll often reply, "I'll just buy a new one!" Then, most likely he'll take the set to another shop and have it repaired for the same price or even less.

That particular set may have turned out to be profit for you, but you didn't know. So the bottom line is: WILL THIS REPAIR BE PROFITABLE? That's a decision you'll have to make in a minimal amount of time.

Many customers don't want to spend more than $75 for repairs. How do you explain high estimate charges?

To make that prompt and wise decision, you need techniques and the instruments to back you up. Sencore understands your problems. That's why we offer you the methods and the instruments to help you make that estimate as soon and as accurate as possible. There are three key techniques you can use every day for estimating service repairs. A good, quality estimate is the key to keeping those profits inside your service center. Read on for details.

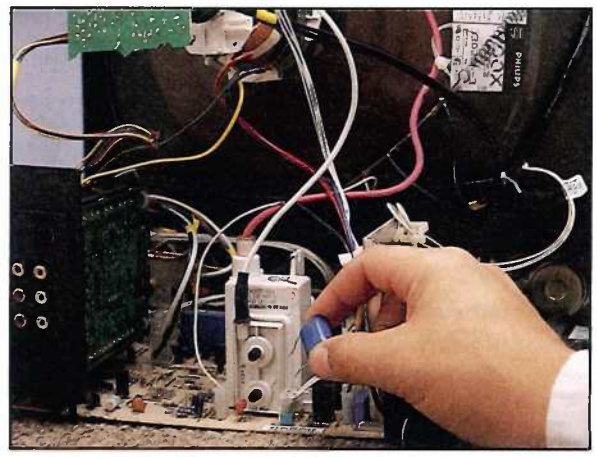
Key #1 - Performance Test To Find TheRealProblems

The first thing you need to do is performance test the repair. Performance testing shows you all the symptoms and defects so you know what needs to be repaired before you start. You need to start from ground zero, even if the customer told you what the symptoms are. No one can afford to be burned by hidden defects that only show up later - after the estimate has already been made.

You can performance test a TV or VCR in minutes with the VA62A Universal Video Analyzer. The VA62A helps you find the real problems from the topside - without taking out a single case screw.

The VA62A RF signals cover all VHF, UHF, and cable channels through channel 99 so you can test any tuner on any TV or VCR. If you suspect a tuner problem, you can even substitute the signal with a modulated IF signal. Getting you as close to the problem as possible is what the VA62A is all about.

Patented video patterns make performance testing easy. Just switch through the exclusive patterns to nail down problems with color circuits, video response, convergence, gray scale, and much more. The VA62A patterns are troubleshooting patterns - they're de-



A $75 IHVT and a fifty cent capacitor can give you the same symptoms on a defective TV. You need a way to identify the defect before you put a high estimate tag on the set.

Sencore test equipment gives you ease-of-use combined with exclusive analyzing capabilities for smarter troubleshooting.

signed to help you find problems.

Key # 2 - Start At The Nerve Center Of The TV

Whether you have a dead set or a set with marginal problems, the collector of the horizontal output transistor is the best place to start your troubleshooting. This central "nerve center" is perhaps the single most important test point in the TV. The waveform should be a voltage spike running at the frequency of the horizontal circuit (15,735 Hz for NTSC sets). The main B+ power supply line is also present at this point.

Now, all you have to do is hook onto this point with your scope, right? Well, not so fast. The normal voltage at this test point is 700 to 1200 volts peak-to-peak. Unless you have an SC61 Waveform Analyzer on your bench, this signal is going to damage your scope.

Only the SC61 can safely measures this waveform - up to 3000 volts. You can confidently hook up to the output transistor's collector every time without worrying about arcing or burning out your scope's circuits.

Once you're connected onto the collector, you push one SC61 button to read the peak-to-peak voltage. Then you push one button to read the DC voltage. If you want to read frequency, one button again. And, through all these measurements, you don't have to swap probes or leads since all these readings are taken through one probe. It's that easy! You take the readings fast, and you move on. Your estimate is on schedule.

Key #3 - Estimate The Repair Right The First Time

Many shops make it common practice to estimate the worst case on all repairs they do, such as estimating an integrated high voltage transformer (IHVT) at $75 dollars a pop. By the time you add labor and other costs to the estimate, you're talking about a bill of $125 to $150.

Most customers won't have the average set repaired for that price. Some of them may even take the set down the street to another shop for a second opinion. If the second shop comes in with a lower estimate, you've lost the profits on this repair, plus you've probably lost a customer for good. And, if the problem was just a 50 cent capacitor, your reputation may be damaged even further when the customer tells his friends about your billing practices.

Exclusive and dynamic analyzing tests make the VA62A Universal Video Analyzer your answer to keeping estimates at a satisfactory level and keeping you out of trouble when costs run high. The VA62A gives you exclusive and dynamic analyzing techniques to pinpoint any defect to a single component or circuit in a matter of minutes.

Tests like the patented ringing test make your IHVT testing a lot easier. With one hookup, the ringing test tells you if there is a shorted turn in the IHVT. Shorted turns cause total failure of the flyback and usually takes other components with it. You can't afford to guess on one of the most important and expensive parts of the TV.

The IHVT drive test checks out the high voltage section of the transformer. You simply drive the IHVT with a special VA62A analyzing signal and monitor the voltage output of the flyback. These tests are exclusive - you won't find them anywhere else.

Once you've completed these thorough and accurate IHVT tests, you can feel confident about your estimate. (For more complete information about these tests, call **1-800-SENCORE** and ask your sales Engineer about Tech Tips #116 and #117)

With your knowledge, the proper equipment, and solid troubleshooting techniques, you'll be able to make that estimate as quickly and accurately as possible. No more inflated estimates for your customer to turn down. And, most importantly, no more getting burned by an estimate that was too low.

See For Yourself

The best way to get started is to evaluate the instruments on your bench and see how they affect your profits. Call your Sales Engineer today at **1-800-SENCORE**, and he'll help set up a troubleshooting package so you can keep those profits where they belong—in your

Sencore Tech Talk

Don't Forget The CRT

Another expensive part in a television is the cathode ray tube (CRT). A bad CRT produces several common symptoms which are easily observed on the picture screen. However, the same symptoms that are produced by a bad CRT may also be the result of a problem that is external to the CRT. Here are some examples:

Dark or dim picture: This could result from a CRT with weak emission, a shorted gun element, or an open cathode (K). Other possibilities include wrong bias, insufficient second anode voltage, low or missing filament voltage, or a problem in the video circuits.

Dark blacks and overdriven whites: A weak CRT gun could result in non-linear light output from the tube (called bad "gamma"). The same symptoms are also caused by problems in the video amps, or wrong bias voltages to the tube.

Bad color tracking or gray scale: A tricolor CRT that has a weak gun will produce a picture that cannot be color balanced. Instead of pure whites and shades of gray, the picture may look reddish, greenish, etc. Misadjusted background or bias controls, or a defective chroma demodulator also produces these symptoms.

Intense color: Another symptom possibly caused by a defective CRT is a bright colored raster that cannot be adjusted. This may result from a short inside the CRT, or an open control grid. An external defect such as a shorted driver may also cause the symptom.

Test The CRT First

Never assume that the CRT is at fault based only on the fact that it produces a bad picture. Before you attempt to restore a tube, always test it first with the CR70 Beam Builder. The CR70 dynamically tests CRTs with the most thorough and accurate tests anywhere, including tests for:

1. H-K Shorts
2. G1 Shorts
3. Cutoff
4. Emission
5. Emission Life
6. Color Tracking

By testing the CRT with the CR70 before you make the estimate, you'll be absolutely certain of the CRT's condition. The CR70's dynamic tests indicate the true condition of any CRT - from TV CRTs to camera tubes.

Deciding Which Restoration To Use

Different CRT gun failures require different levels and types of restoration, as determined by the CR70 test results. The CR70 provides five different levels of restoration and shorts removal to match the CRT gun failure. The table below lists the restoration method you should use based upon the tube's test results. A detailed explanation of these methods of restoration is included in Tech Tip #156. Call **1-800-SENCORE** for your FREE

CR70 Test Results				CR70 Restoration Procedure
Cutoff	Emission	Life	Tracking	
Good	Bad			Auto Cycle, then MAN1 if still weak.
Bad	Good			Auto Cycle once.
Bad	Bad			Auto Cycle. REJUV if less than 20 mA restore current.
Good	Good	Bad		Auto Cycle once.
Good	Good	Good	Bad	Auto Cycle lowest gun(s).

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

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

VA62A Universal Video Analyzer

$3,495 U.S. Funds Patented

- Identify tuner problems with All-Channel, VHF, UHF, and Cable RF Generators.
- Pinpoint IF problems with modulated troubleshooting signal and exclusive programmable IF/RF generators.
- Isolate any video problems with patented video and standard color-bar patterns.
- Find defective stages, without disconnecting parts, using exclusive phase-locked drive signals.
- Test yokes and flybacks, plus measure signal levels with autoranged digital meter.

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

Update For New Technology With Exclusive Phase-Locked Accessories

VC63 VCR Test Accessory $495

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

ST65 Video Analyzer Stereo TV Adder $995

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

NT64 NTSC Pattern Generator $495

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

RG67 NTSC Video Monitor Adaptor $890

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

For More Details Call 1-800-SENCORE (736-2673)

The Only Complete Analyzer For All Your Receiver Servicing Needs

SG80 AM Stereo–FM Stereo Analyzer

Patented $3,995 *A Sencore Exclusive!*

How many FM-only or AM-only receivers have you seen lately? You won't find many. So, if you service one receiver format, you'll need equipment to service both

Only the SG80 provides all the FM and AM analyzing signals you need-in one instrument. You can walk any problem out of any receiver, from the antenna to the speakers, without swapping cables or switching signal sources

The SG80 simplifies your performance testing and troubleshooting challenges by making AM and FM look the same. You use the same techniques and key injection points to isolate any AM or FM defect. You now can performance test and troubleshoot AM and FM with one instrument designed with your time in mind.

Completely Performance Test In Less Than 10 Minutes:

50 dB Quieting Sensitivity
S/N
Separation
Muting Threshold
Pilot Detect Sensitivity
Auto Seek Levels
Tuning Range
etc.

Accurately Isolate Any Defective AM Or FM Stage In Less Than 10 Minutes:

RF
IF
Multiplex
Stereo Decoder
Matrix
Amplifier

Plus You Get:

- Rock solid digital tuning and microprocessor calibrated attenuators for fast, accurate, channel-by-channel and level control.
- Exclusive tuneable IF sweep system allows you to dynamically analyze the latest FM IF stages.
- High quality signals give you confidence the receiver is operating at peak performance.
- Optional IEEE 488 or RS232 computer interface accessories automate your receiver testing.

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