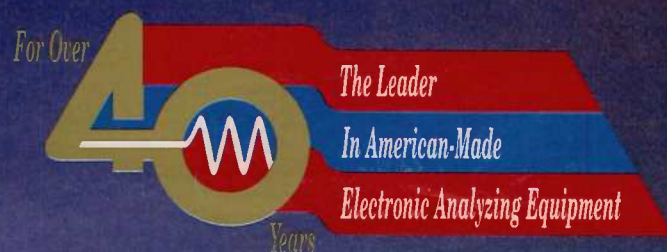


SENCORE NEWS

Issue #152 Jan./Feb. 1991

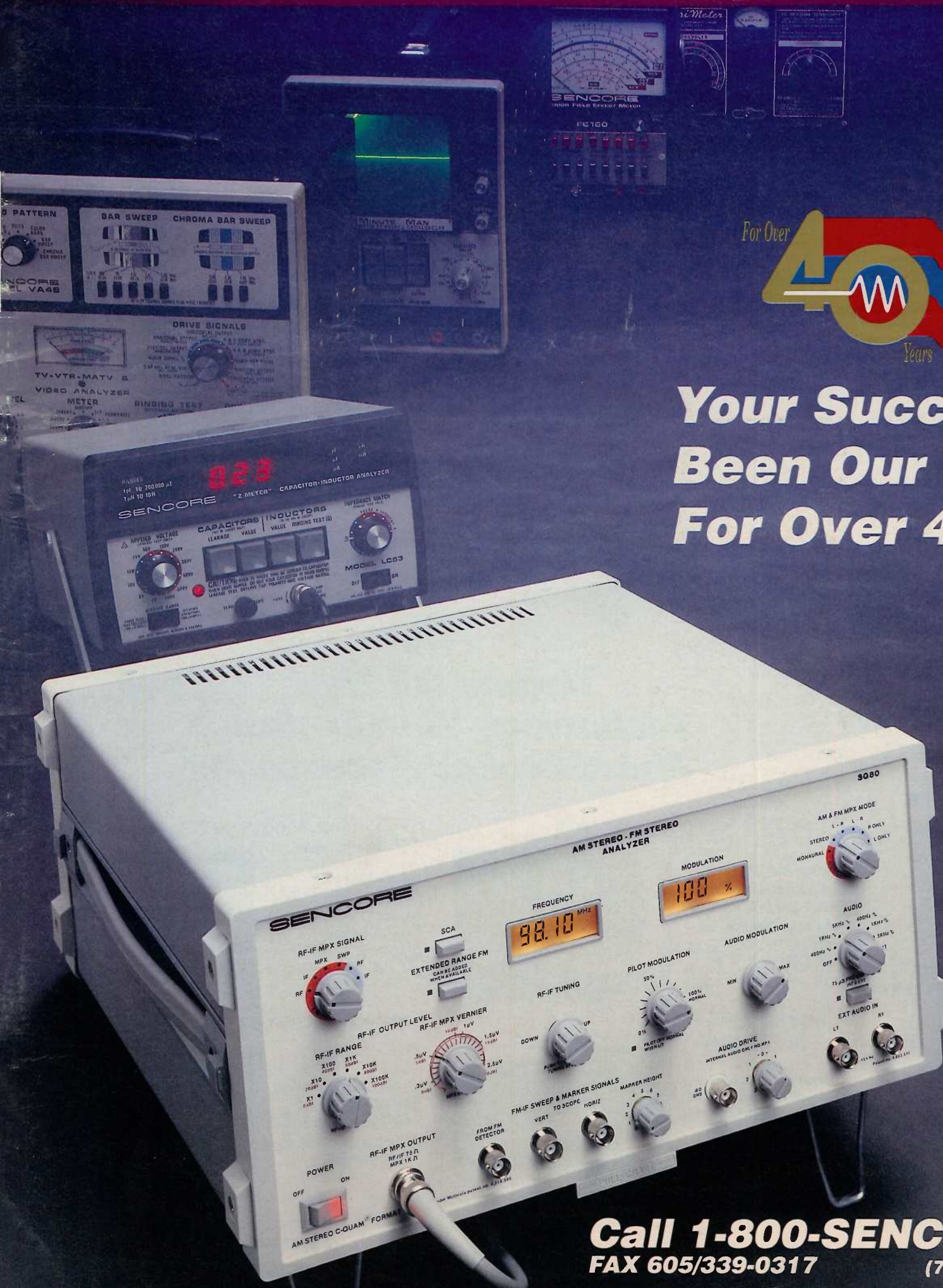
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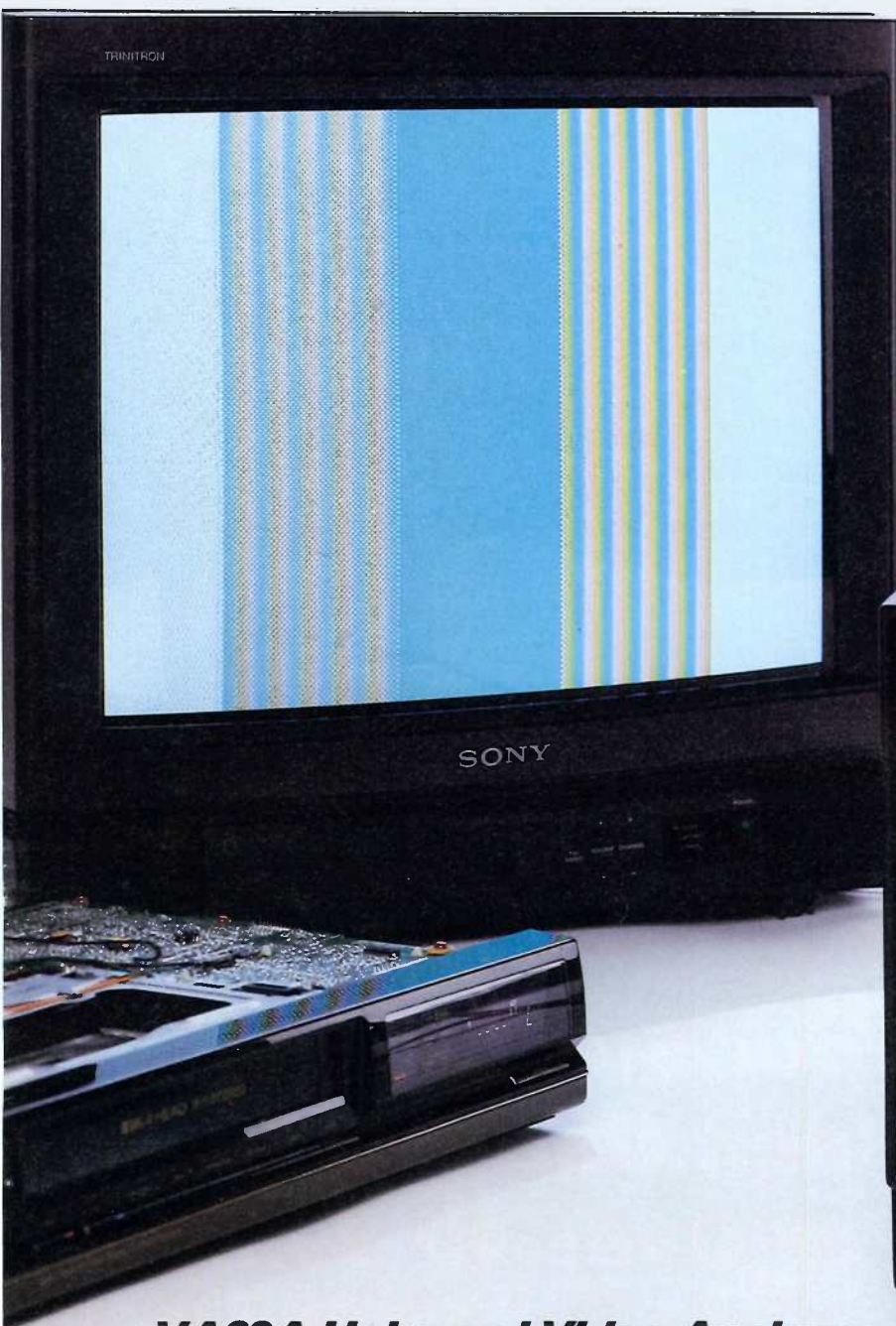
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See Page 16

1991



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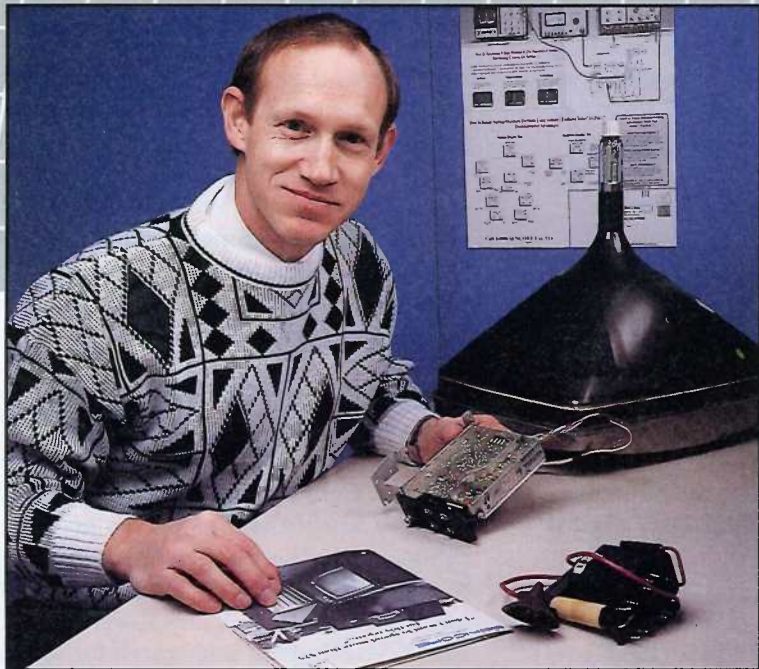


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Fast, Accurate Estimating For Profitable Repairs

By Tom Schulte, Application Engineer

- Test the tuner in minutes
- Learn how to dynamically analyze IHVTs and yokes
- Test CRTs for all defects and restore them into working condition

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It's 8:30 on a bright, warm Tuesday morning and all is right with the world. The service van is running like a top and you hit most of the traffic lights green on the way to work. You've just opened the shop with a freshly brewed cup of coffee in your hand; you feel ready to take on any challenge.

You turn your attention to the rack of TVs waiting their turn for you to transform each of them back into a beautiful, working set. The first set on your bench is a 19" color TV that just came in for service. As you begin your diagnosis, it looks like a major part could possibly be at fault. Your high spirits and your hopes for a profitable repair drop through the floor as you remember that the customer told you she didn't want to spend much on the repair, and now may not have the set repaired when she sees the estimate. With the cost of the part plus labor, the estimate could add up to a substantial percentage of the price of a new set.

Since the economy has started getting a little tighter, past experience shows the customers will be more likely to repair vs. buying new. But you're still concerned that a high estimate means that a potentially profitable repair is going to walk out the door. Really, your greatest concern is that if the major part you suspect isn't truly defective, you may actually be sending profits out the door for no good reason. If only you had a way of being certain if the part was truly defective without sinking a lot of time into the set just for the estimate!

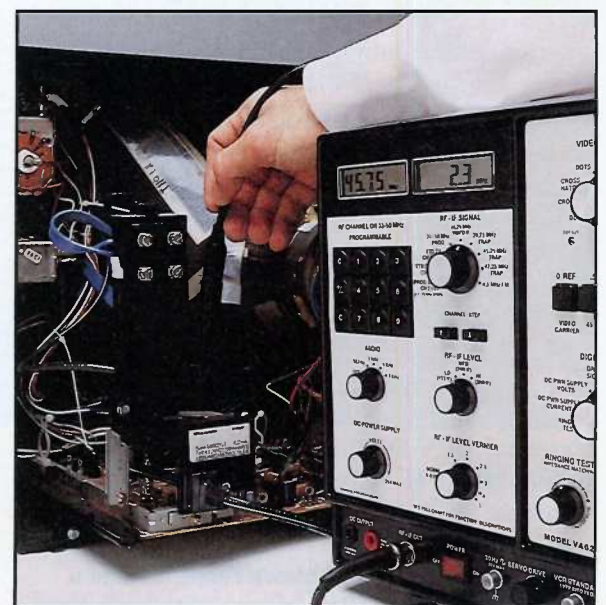
Let's take a look at how you can make the best use of your test equipment to quickly verify whether the major parts of a TV are defective or if they're capable of functioning properly. The parts we'll test include the most expensive parts of a TV: the tuner, IHVT, yoke, and CRT.

Analyze Any Channel Or Sub For The Tuner

If a TV (or VCR) seems to have problems related to the tuner, use your VA62A Universal Video Analyzer to do a quick but thorough tuner test. Your VA62A covers all VHF, UHF, and cable channels through channel 99 with

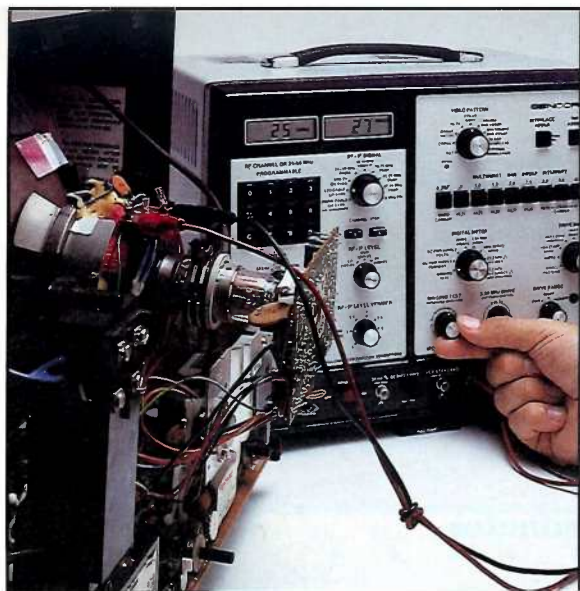
calibrated RF output levels. You also get a tuner substitution signal to help you do a total tuner test in a matter of minutes.

If the complaint was that the set didn't work well on some channels, use the all-channel RF generator on your VA62A to verify operation on any of the channels. Start by setting the RF-IF LEVEL control to HI and the vernier control to 1 (NORM) to supply a standard 1000 microvolt (0 dBj) signal to the set's antenna input. Then, step both the tuner and your VA62A through the channels in each frequency band (low band 2-6, hi band 7-13, mid band cable 14-22, etc.) to quickly verify if the tuner works properly at a normal signal level on all channels.



The VA62A lets you directly substitute for the tuner so you can give your customer an accurate estimate.

For a set with a symptom of either a snowy or overloaded picture, use your VA62A's calibrated RF output to quickly test the tuner sensitivity and RF AGC operation on any channel. First, with the RF-IF LEVEL control set to HI, set the RF-IF LEVEL VERNIER to 5 to give a maximum output of 5000 microvolts. Look for signs of picture overload; the tuner's AGC circuit should be able to handle



Verify the condition of IHVTs and yokes with the VA62A's dynamic and patented Ringing Test.

this higher RF level. Then, reset the RF-IF LEVEL control to MED (this drops the RF level to 500 microvolts) and look for snow in the picture; the tuner should still deliver a relatively snow-free picture at this lower RF level.

When the set doesn't work well on any channel and you want to verify that the tuner is the problem without any doubt, use your VA62A's 45.75 MHz VIDEO IF signal to totally bypass the tuner. First, set the RF-IF SIGNAL switch to 45.75 MHz VIDEO IF and connect the RF-IF OUT cable through your supplied IF adapter to the IF input jack on the TV chassis. If the tuner is soldered directly to the main circuit board, use your 39G72 Troubleshooting Balun to connect across the tuner's IF Out connection. Then, with the vernier set to 1, set the RF-IF LEVEL control to MED. If the rest of the set functions properly with the substitute IF signal, you know the problem is definitely related to the tuner.

Dynamically Test IHVTs And Yokes

For a problem that is possibly related to the IHVT (integrated high voltage transformer) or yoke, again use your VA62A to quickly verify whether the IHVT or yoke is defective. Your VA62A's Ringer Test checks for shorted turns (the most common flyback and yoke problem), plus the Horiz Key Pulse Drive Signal and External DCV Digital Meter help you test for proper IHVT HV circuit operation in just minutes.

If the set shuts down, blows fuses, or has a shorted horizontal output transistor, use your VA62A to quickly determine whether the problem is caused by a shorted turn in the IHVT or yoke. A shorted yoke or IHVT could cause more damage if you fix the symptoms and don't find the cause of the problem.

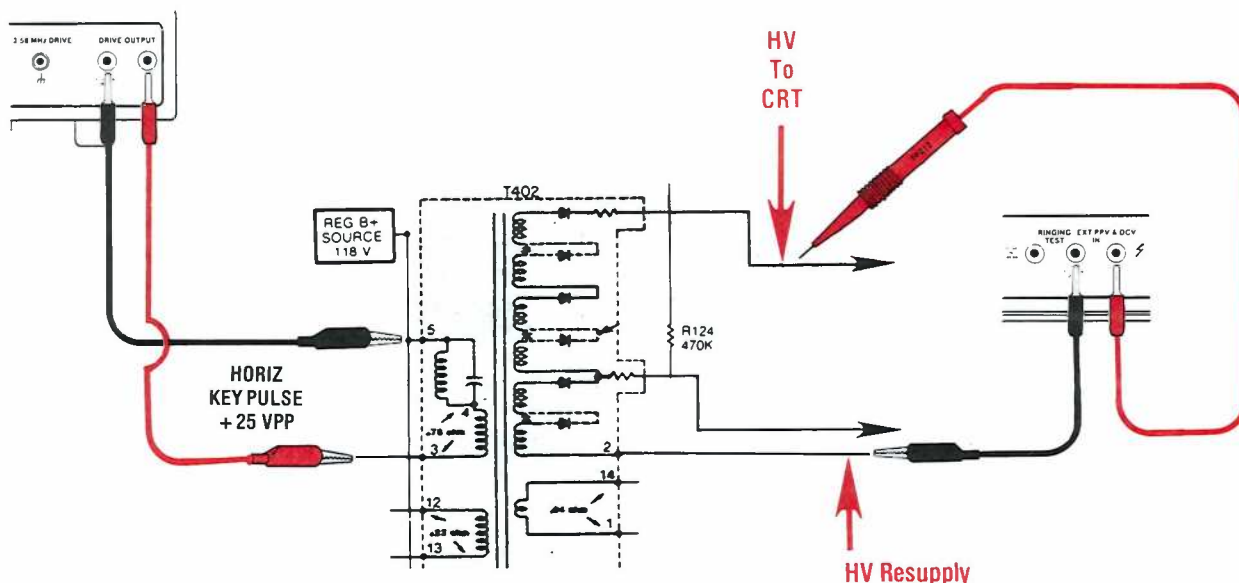
Note: Be sure to remove all power from the circuits before performing the ringing or IHVT drive tests.

To test the IHVT in circuit, first disconnect the collector of the horizontal output transistor, the yoke plug, and the CRT socket. Attach the leads from your VA62A RINGING TEST jacks to the connections leading to the IHVT

primary winding; this is the winding that connects to the collector of the horizontal output transistor. Then, rotate your VA62A RINGING TEST switch through each position, noting the position with the highest reading. If this highest reading is ten or greater, the IHVT does not have a shorted turn in any of its windings. If the highest reading is less than ten, repeat the test out of circuit before you officially label the IHVT as defective.

When the IHVT produces insufficient high voltage, but the other output voltages from the IHVT are near normal (scan derived voltages and pulse signals), use your VA62A to dynamically test the HV secondary section of the IHVT. Perform this test by driving the IHVT primary with the VA62A HORIZ KEY PULSE and measuring the DC voltage output from the HV secondary with the EXT DCV digital meter.

Note: Do not perform this test unless the IHVT has already passed the RINGING TEST.



Drive the primary of the IHVT while monitoring the secondary with the VA62A digital meter. Only the VA62A gives you this test.

With the IHVT out of circuit, first connect the DCV meter probe (with the TP212 accessory probe connected) to the high voltage lead and the DCV meter common lead to the bottom of the high voltage secondary winding. Then connect the leads from the DRIVE OUTPUT jack to the primary of the flyback. (Red output lead to horiz. output collector connection and black output lead to supply voltage connection.) Turn the VA62A on and adjust the DRIVE LEVEL control for 25 V P-P, positive polarity.

Set the DIGITAL METER switch to EXT DCV and read the DC output. Remember to multiply the reading by 10 to compensate for the

TP212. Now compare the DC reading to the chart in Figure 1. If the reading is higher than the value in the table, the HV secondary and HV diodes are good.

In the case that the IHVT doesn't have shorted turns, but there are symptoms of overload, check for leakage from the primary to the mounting bracket or to other windings in the transformer. With the IHVT out of circuit, use an ohmmeter set to its highest resistance range to verify high insulation resistance from the primary to the mounting bracket and other windings.

To locate leakage that only occurs with circuit voltages applied, use your Z Meter set to its highest voltage output to test for breakdown leakage. Connect one of your Z Meter test leads to one of the pins on the primary and connect the other lead to the mounting bracket or to a connection on any other winding. Then, push your Z Meter's CAPACITOR LEAKAGE button and watch for leakage current on the display. A small amount of

leakage current may initially flow, but within a couple seconds, should settle to zero. If the display continues to display current or overranges, the IHVT is defective.

To test the yoke, connect your VA62A Ringing Test leads across the yoke winding and perform the ringing test in the same manner just described for the IHVT. Each winding must be individually tested on a yoke since a short in one of the windings is less likely to couple to the other windings, compared to the closely coupled windings of a flyback. Since there are only three or four windings involved, however, this adds very little time to the test.

For a more in depth discussion of testing yokes, flybacks, and HV multipliers, call 1-800-SENCORE and ask your Sales Engineer for a copy of Tech Tip #116 and #117 or circle #105 on the Fast Facts Card.

Test CRTs For All Failures

Many of the symptoms caused by a defect in the CRT can also be caused by problems in other TV circuits. These symptoms include low brightness, picture wash out, overdriven whites (gassy look), overly bright picture with retrace lines, or bad gray scale. If the set

| Collector PPV | CRT HIGH VOLTAGE | | | |
|---------------|------------------|------|------|------|
| | 20k | 25k | 30k | 35k |
| 500 | 1000 | 1250 | 1500 | 1750 |
| 700 | 700 | 890 | 1000 | 1250 |
| 900 | 550 | 690 | 830 | 970 |
| 1100 | 450 | 560 | 680 | 790 |

Figure 1: Use the ratio between the normal high voltage and collector PPV to determine the proper output voltage for the IHVT test.

appears to have a CRT problem, don't guess about it. Use your CR70 Universal CRT Analyzer And Restorer to totally analyze the CRT so you can confidently tell your customer about the condition of the CRT. That's something they'll often want to know before they consider investing money in any repair. CRTs can develop one or more defects affect-



Use your CR70 Beam Builder to analyze the condition of the television's most expensive part (the CRT) without mistakes.

ing picture quality. Following is a summary of CRT symptoms and problems to aid you in using your CR70 for quick, positive CRT troubleshooting:

H-K Shorts Test

An H-K short results in a washed-out picture, a single-colored bright raster, or hum in the picture if the filament is powered from a 60 Hz transformer. H-K shorts cannot be removed because the surge current that is needed to remove the short will destroy the filament, resulting in a dead CRT. Unless you

install a filament isolation transformer, the CRT is unusable and needs to be replaced.

G1 Shorts Test

A G1 short results in loss of brightness control, excessive brightness (on one color of a color CRT), or retrace lines. This short is usually caused by a flake of cathode material that lodges between G1 and the cathode. Your CR70 quickly and safely vaporizes shorting particles with the REMOVE G1 SHORT function, returning the CRT to normal operation.

Cutoff Test

Bad cutoff results in a CRT with poor contrast, too-dark grays with overdriven whites ("gassy" look), or color smear. This is caused by the inability of the CRT gun to conduct properly when it is biased almost off, such as when a dark gray area of the picture is being scanned. The area of the cathode surface involved is the center, the most heavily used portion. Bad cutoff usually indicates at least partial depletion of the electron emitting material in the very center of the cathode surface. Your CR70's restoring current reactivates the electron emitting material around the depleted center zone, returning the tube closer to its original operating performance.

Emission Test

Bad emission results in a CRT with low brightness. This is caused by the inability of the CRT gun to conduct sufficiently when it is biased fully on, such as when a bright white area of the picture is being scanned. Bad emission usually indicates that an unwanted coating of positive ions has accumulated on the entire area of the cathode, limiting the ability of the cathode to supply current. This condition, one of the most common CRT faults,

is highly recoverable with the CR70. Your CR70's restoring current "boils off" the coating over the entire cathode surface, safely restoring the cathode's ability to supply current.

Emission Life Test

Bad emission life means that little life remains in the CRT and may cause a marginal picture in some chassis. This is caused by the entire cathode surface either being worn (partially depleted) or coated over to the point of having little reserve capacity. A bad emission life test, especially after restoration, indicates that the gun is definitely suffering from a worn cathode surface. A gun with bad emission life, but which passes the other tests, may produce a marginally acceptable picture now, but will have a shortened life expectancy.

Color Tracking Test

Bad color tracking results in a CRT that can't be adjusted for proper gray scale. This imbalance occurs when the emission levels of the three color CRT guns don't balance properly. Your CR70's Auto Restore function reactivates the cathode on the weakest gun(s) to bring the three guns back into balance.

For a more in depth discussion of testing and restoring CRTs, call 1-800-SENCORE and ask your Sales Engineer for a copy of Tech Tip #141, #145, and #156, or circle #106 on the Fast Facts Card.

If you want to ensure yourself of estimates that are accurate and profitable, call your Sales Engineer at 1-800-SENCORE. He'll help you keep those profits where they belong - in your cash register. He'll also send you the Tech Tips you need so you can give the best estimate possible. ■

Circle #110 on the Fast Facts Card for more information on profitable estimating.

Sencore Tech Talk

10 Tips To Help You Use Your VA62A Better

1. Find tuner and tuner-control problems: A bad tuner control circuit can be confused with a bad tuner. Use your VA62A's all channel VHF and UHF RF generator to test each channel to tell which needs repair.

2. Find fringe level or overload problems: You may be tempted to do fringe and overload testing in the customer's living room to duplicate their signals. Instead, use the VA62A's microprocessor controlled variable RF output to duplicate signals from "far fringe" to excessive, right at your bench.

3. Correct contrast and brightness problems: Problems affecting the dynamic operating range of the video IF and video amplifiers are tough to find with a meter or scope. Use your VA62A's 10 BAR STAIRCASE video pattern to trace these problems. Watch for all 10 brightness levels on the CRT.

4. Isolate causes of "poor video": Smear or lack of fine detail makes the picture

nearly unwatchable. Your VA62A's MULTIBURST BAR SWEEP video pattern lets you check for correct performance, right on the picture tube.

5. Check for full chroma response, right on the screen: Poor tint range is often hard to find. Use your VA62A's CHROMA BAR SWEEP video pattern to confirm full chroma bandwidth, without taking the back off the set.

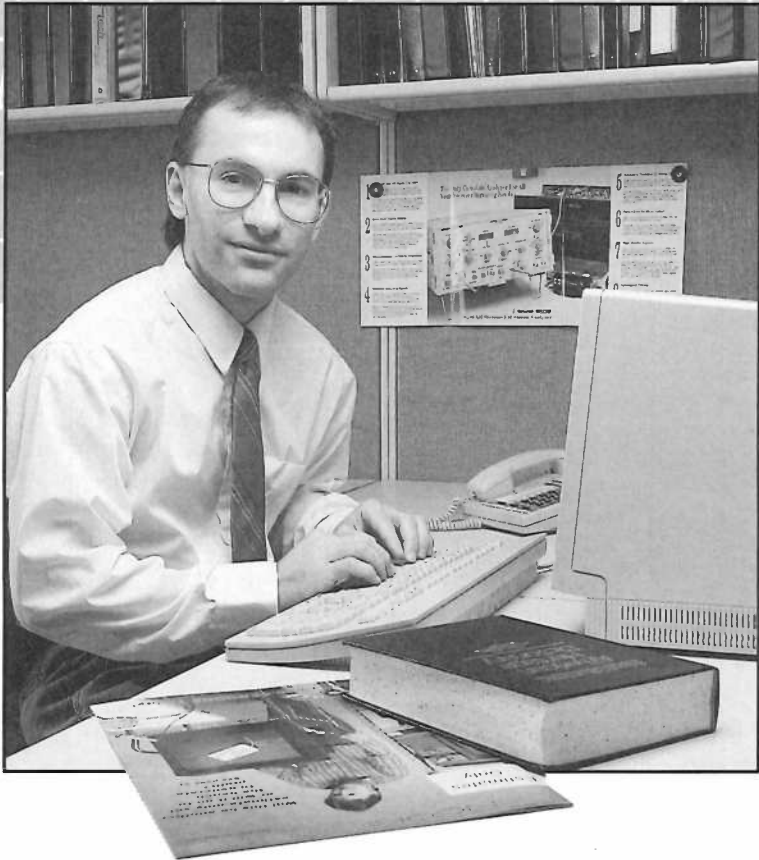
6. Isolate video problems, from the antenna to the CRT: Video problems often affect bandwidth or dynamic range only. Scope and voltmeter readings don't show you the whole picture. Use your VA62A to substitute a good signal into a circuit. Watch the CRT to confirm which stages are working.

7. Troubleshoot vertical circuits faster than ever: Vertical circuits can be some of the toughest to troubleshoot. Use your VA62A's regulated power supply to isolate bias (DC) problems, then use the vertical drive signals to isolate the bad stage.

8. Watch for color-lock when tracing color problems: The ICs used in color circuits need phase-locked inputs to work. Use the VA62A's phase-locked signals to test these ICs in the circuit. Since the VA62A signals are phase-locked, just watch for a return of color on the CRT.

9. Drive horizontal circuits to see if they're really bad: Horizontal failures don't leave you with many symptoms - other than a dead set. Your VA62A supplies three kinds of horizontal drive signals, to let you feed into any circuit from the oscillator, right up to the output transistor or SCR. If the "lights" come back on, you know you've found the problem.

10. Dynamically test yokes, flybacks, or triplers: Deflection components are more likely to fail than others because of the high voltages and currents involved. Use your VA62A's patented ringer test, along with the innovative tripler and "integrated flyback" tests, to confirm whether they are good or bad.



Letter From The Editor

Larry Schnabel, Editor

This year marks a milestone in the history of Sencore. We are now 40 years young and still growing! Pages 16 and 17 of this issue take you back over the changes, advances, and growth you and Sencore have experienced over the past four decades.

One of the many changes we've seen over the years has been the evolution of the *Sencore News*. The *Sencore News* has been helping technicians like yourself with loads of troubleshooting techniques and tips, while keeping you up-to-date on the latest changes in the industry. This year we're including even more technical information in the *Sencore News*, part of the constant improvements we're making to give you even more support.

Renew Your Subscription

We publish and distribute the *Sencore News* free of charge to most technicians. We will continue this policy, but we want to make sure we deliver the *Sencore News* to the people that really benefit from the articles.

On the outside of this issue, you'll find a subscription renewal form. If you haven't returned the renewal card from the last *Sencore News*, we need you to take a minute and fill out this renewal form. Just complete the card and drop it in the mail. Your subscription will be renewed for another year of the industry's most supportive publication. I don't think you'll want to miss a single issue.

Need More Information? We've Made It Easier For You

This issue also contains a new feature. We know you're busy and might not always have the time to pick up the phone and

call. The *Sencore News* Fast Facts Card now gives you a convenient means of requesting information from Sencore. All you need to do is circle the number corresponding to your request, and we'll send the information to you free of charge. You'll receive information that you can really use—information written for servicers by servicers.

Write Us A Letter

Our experienced crew of technical writers research and prepare articles with one common goal: making your troubleshooting faster, easier, and more profitable. Although we do use outside authors occasionally and most of the tips we share come from customer input, sometimes the communication circle isn't quite complete. Technicians like yourself don't often get the chance to share thoughts and experiences with their peers.

It's time to rectify that.

Starting with the next issue, we will publish a column with feedback from you, our customer. You can share your ideas with other professionals in the field on anything from troubleshooting tips to billing practices. We expect this column to be interesting and helpful to a wide variety of readers.

But, we need your help. We encourage you to send in your letters, postcards, notes, or whatever to us for publication. Since you're the end user, you are our best source of information. You can send your input to:

**Letters To The Editor
Sencore, Inc.
3200 Sencore Drive
Sioux Falls, SD 57107**

We prefer letters of 250 words or less. Even though some subjects may be lengthy, try to keep the information brief so we can print as many letters as possible. A brief list of possible subjects includes:

- Setting VCR adjustments
- Tips on restoring CRTs
- Locating replacement parts
- Feedback on Sencore programs and policies
- Training new technicians
- New business opportunities
- Troubleshooting startup/shutdown circuits

We'll consider publishing any information that will be helpful to technicians like you, whether it be a method to clean VCR heads or new ideas for computerizing your parts inventory. Or, if a particular article or Tech Tip helped you out, tell us so we can tell others.

Since most *Sencore News* readers are Sencore equipment owners, we will naturally give some priority to letters that use or include Sencore test equipment. The *Sencore News* is another support piece offered by Sencore, and we want you to get the most out of your test equipment. We're here to help. ■

Call 1-800-SENCORE For Fast Action-Anytime, Anywhere!

Most test equipment manufacturers don't offer a TOLL FREE number; and those that do, have it for just one reason – to sell their product. If you have a question after you buy their instrument – you're on your own.

For years, Sencore has been supplying our customers with one TOLL FREE number for fast answers to a variety of questions. You can ask about instrument applications as well as questions regarding investment options.

But, how many times have you gone to call a TOLL FREE number for service, parts, or just plain help, only to forget the number and have to spend valuable time looking it up? Or, have you ever been on a service call in a remote location where you couldn't look up the number, even if you had to? The best TOLL FREE support in the business doesn't do you any good if you have to waste time looking up the number. What's needed is one easy-to-remember number for fast answers to all of your electronic instrument questions.

Sencore lets you call anytime, anywhere, TOLL FREE with a number you can't forget. Simply call **1-800-SENCORE** for fast technical support, and answers to any questions you have about Sencore products!

Give it a try right now! Dial **1-800-SENCORE (736-2673)**, and we'll answer any questions you have concerning a new product, or applications of a Sencore instrument you own. We're looking forward to supporting you even better in the future!

With Sencore, You Get Innovative, Time-Saving Instruments... Plus, You Get The Best Support In The Industry

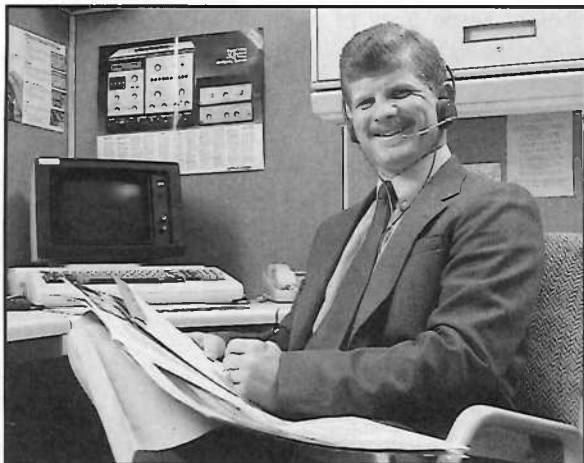
One number, **1-800-SENCORE**, connects you 24 hours a day, to a factory full of people dedicated to making you and your business more successful. The same TOLL FREE number that connects you to your friendly Area Sales Engineer, also connects you to our Technical Application Engineers for technical consultation, and to our Service Technicians for quick field repair tips – all at no added expense to you. Simply pick up the phone and call.

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Here's Our Offer To You:

Invest in any Sencore instrument on our 30 Day Money Back Guarantee. Simply stated,

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Tech Schools. These exclusive all day workshops are regularly scheduled around the country, so you can see first hand how an investment in Sencore equipment will add value to your servicing capabilities.

Fast After-The-Sale Service. You get fast 72-hour turn-around time on service repairs, and 48 hours on parts delivery, guaranteeing you maximum up-time and minimum down-time. Or, call TOLL FREE **1-800-SENCORE** and talk to a service professional who will help you with instrument repair questions.

Exclusive Lifetime Made Right Guarantee.

In addition to the 1 year warranty on parts and labor (less than 2% are returned for warranty service), Sencore offers you a 100% Lifetime Made Right Guarantee. We guarantee your instrument was made right the first time—or we'll make it right—for the lifetime of the instrument.



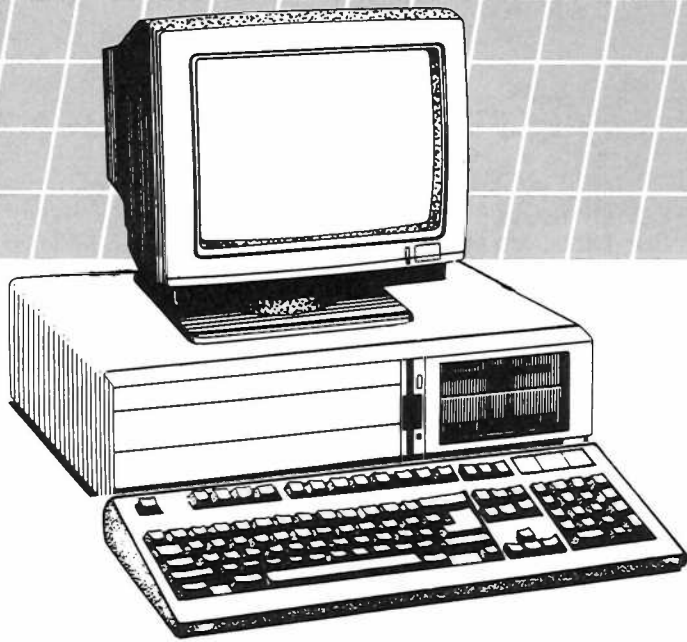
Order Direct 1-800-SENCORE (736-2673)

Computers Improve Efficiency Of Consumer Electronic Service Centers

Part 1

Reprinted from "Service Profit Profiles"

Courtesy of EIA



- Computers simplify parts inventory systems
- Computerized invoices offer many advantages

The first computers were physically large, relatively unreliable, power hungry, extremely expensive, and software had to be written from scratch by the user, or more likely by a programmer employed by the seller. Their applications were limited to storing, sorting, and manipulating huge amounts of data. The only people who owned computers were governments, banks, large corporations, and other large institutions that could afford the big price tag and had lots of data to handle.

Gradually, computers became smaller, less expensive and more powerful, and prewritten applications software began to appear on the market. Smaller and smaller businesses began to use computers to keep track of their clients: doctors, lawyers, stores, consultants, and more. Today there's hardly a type of business that can't computerize and save money while becoming more efficient and being more responsive to customers. This includes consumer electronics service centers.

Chuck Biddinger of Birmingham, Alabama is one of the service center owners who have computerized. His system was installed in October 1989, and was operational in November 1989. He bought a multiuser system, both hardware and software, from a computer systems company in Lincoln, Nebraska. "Multiuser" means that the computer can be used by more than one person at one time. This is achieved by using specially designed software and a central computer with terminals. Including the cost of a trip to Lincoln to evaluate the system, and a second trip to Lincoln for him and his secretary to learn the system, the cost was around \$18,000. The system consists of an IBM 386 personal computer with four terminals and three printers.

The system has a 150MByte hard disk drive and two Printek Form Pro 2000 printers, which have 15-inch wide carriages. The printers are used for printing invoices and job tickets.

Biddinger has five full-time techs working for him. He has one terminal on his desk, one on

the secretary's desk, one on the counter, and one in the service area. He may soon have to add one more terminal.

Five Year Search

Biddinger says that he had been looking for the past five years for a computer system that would handle all of the tasks that a service facility requires. At one time he had used a small computer for inventory, but it did not meet his needs. The new system, however, promised to do all that he wanted it to, and it has fulfilled that promise. There were, how-



A computerized parts inventory keeps track of your current stock while saving valuable time.

ever, some things that he wanted to see changed. For example, the wording on the invoices was not what he wanted, so he changed it to suit his business and customers. Because the software he purchased is extremely flexible, it was easy to do this. The system is saving Biddinger money. For example, it has saved him the cost of hiring another secretary. In the past, his secretary would spend two hours a day writing invoices. Now Biddinger is doing it himself on the computer in a fraction of the time, leaving her

free to devote her time to the other demands of a business that has grown since the computer was installed. He's sure that if he had not put the system in he would have had to hire another secretary to handle the increased workload.

Keeping Track Of Parts

Another real savings, but one that is more difficult to quantify, is the time he saves by using the computer to keep on top of his parts inventory. Until he put the system into use, Biddinger didn't really have a good parts inventory system. In some cases when a repair required a part, even if it was a common part, it might be out of stock, or it might even be on hand, but no one knew it. So a technician, or someone else whose time was also valuable, made a trip to the distributor to get a part or module. With the computerized inventory system, Biddinger establishes a minimum quantity of each part, and when the stock gets to that level it is included on a daily reorder report so it can be readily reordered on a routine basis, rather than an emergency one.

Biddinger also experienced the problem that plagues organizations that don't keep good track of inventory: he had duplicates of some parts on hand that he should have only one of, tying up valuable capital that could be used more profitably.

With the new system, Biddinger knows exactly what quantity of each component and module he has on hand at all times, and even receives reorder information automatically. The parts inventory is updated in this way: when the technician removes a part from inventory to make a repair, he notes it on the job ticket. Then when Biddinger makes up the invoice, he enters into the computer the parts that have been used. This automatically updates the inventory quantity of that part.

Customer information is handled in the following manner: when a defective product is brought in, the name, address, and phone number of the customer is entered into the computer along with a description of the

product and the nature of the problem. The computer prints up a customer claim form and a job ticket that accompanies the product through the repair process. Additionally, the service literature location is printed on the job ticket.

Backing Up The Data

In the six months Biddinger has had the computer system, it has performed flawlessly. However, one thing that people who sell computers preach to their customers is that the information on the hard disk should be regularly copied to another permanent storage medium, such as floppy disks or magnetic tape. Biddinger now is using floppy disks to back up his hard disk, but this is cumbersome. With his present volume of business, it takes about 15 floppy disks to store all of the information on the hard disk. He does a complete backup once a week, as well as a daily backup of new information.

Biddinger is in the process of buying a tape drive that can store all of the hard disk information on a single tape. That way he can do a full back up of the hard disk every day with little effort. He then will recycle the daily tapes each week.

Handling Customer Inquiries

Another benefit of the computer system is its speed and accuracy in answering customer inquiries. In the past when a customer requested the status of a repair, Biddinger sometimes had to check in several places. This took time, and annoyed customers because they had to wait. Now when a customer inquires, Biddinger takes their name, or address, or phone number and enters it into the computer. The exact status of the unit is displayed immediately. This information can be accessed from any of the terminals in the facility.

This information is readily available because the status of the repair is updated whenever an action is taken. When the technician begins the job, he takes the job ticket that was generated when the customer brought the set in, and enters into the computer the time when he started work on the set. Any time parts are ordered the technician enters that information. Other pertinent status information is entered as it develops.

Parts Pricing

The computer even prices out parts, based on pricing information that Biddinger has entered. In fact, the software included a basic inventory of commonly needed parts, so it wasn't necessary to enter most of the parts descriptions; it was necessary only to enter the number, cost and location of each part on hand. It was, however, necessary to enter descriptions of any nonstandard parts that weren't included in the inventory list.

Something else about this system that Biddinger finds valuable is the daily listing of repaired products he can generate. With this list he knows at a glance which sets are ready for customer pick-up, so he can get on the phone and ask customers to come in and pick them up.

Becoming Computerized

Biddinger says that it took him about three months to get "computerized." For the first month he more or less played with the computer system, learning what it could do for him, reluctant to trust it with his important information, and so keeping records both on paper and on the computer.

Over the next two months, Biddinger began to track VCR repairs using the computer. He started with VCRs because his VCR technician is a young man who was eager to work with the computer and to learn how to use the service software system. After that first three months he began to put the rest of his repairs on the computer.

The Computer Eases Repetitive Tasks

Biddinger says that a major benefit of converting to the computer system is that the task of information entry has been dramatically cut. Before computerization, customer information had to be entered a number of times for a single repair: a claim form, a job ticket and, once the repair was complete, an invoice. Now, all the customer information is entered only once. The same information is automatically inserted into the customer's claim ticket and the job ticket.

Preparing invoices with a computer gives your customer the information he needs, and helps keep your records up to date.

Once the repair is complete and it's time for Biddinger to generate an invoice, he doesn't have to write out the name, address, phone number, etc., of the customer, or a description of the product. That information has been stored in the computer since the time the customer brought the unit in. Biddinger merely has to instruct the computer to print out an invoice and an invoice is automatically printed. If it is a warranty job, the warranty form is printed automatically.

The computer database also includes a comprehensive list of standard product service procedures, so that Biddinger no longer has to write or type in the steps that went into a repair. He merely has to enter a two letter code for that particular type of repair, and the

computer generates the complete text that describes every step of the procedure that is carried out when this type of service is performed.

If a customer comes in at a later date with the same or a different product, assuming that the customer has not moved or changed phone number, the counter person does not have to type in the customer information. He merely asks "Have you had work done by us before?" If the answer is yes, the counter person asks for the person's phone number and when he enters it into the computer, all the information—name, address, date of any past service work done—all comes to the screen. Now only the information on the current product and problem needs to be entered.

Asked what he would do if the computer goes down, Biddinger is silent for a moment then chuckles and says he hopes it never does. Then he says that when he asked the vendor that question the reply was that he would have to go back to paper until the system could be returned to service. Biddinger is now so happy with the way the system works that he never wants to go back to paper.

Benefits

Here's a partial listing of the benefits of computerization to Biddinger's operation:

- Saved the salary of another administrative person
- Eliminates unnecessary and costly trips to distributors
- Provides the precise status of his inventory at all times
- Keeps track of exactly what service literature he has on hand and where it is
- Maintains the exact status of every repair at all times, including which jobs are completed, which are in progress, what parts are on back order, the date back ordered parts are received, and which jobs are awaiting approval of the estimate
- Keeps track of exactly how much time each repair took, what parts were used, how much the parts cost
- Keeps track of which warranty claims have been paid and which have not been paid. This makes it easier to follow up on warranty payments that are overdue
- Keeps track of tax information to provide to the accountant at tax time

There are other ways to go about managing a service center with the help of a computer. Many organizations manage very well with a single-user system, and some even get the job done using general purpose software that they have tailored themselves.

The conclusion of this article in the next issue will describe some of these other approaches to service center computerization, and will offer some tips and suggestions on how to go about choosing a computer system. ■

(Remember to enter the computer sweepstakes on the outside of this issue.)



Expand Your Business Into Servicing Computer Monitors

By Stan Warner,
Market Research Engineer

- Computer sales have nearly tripled in ten years
- Servicing computer monitors is similar to servicing televisions

In just a few short years the computer has become a familiar product to almost everybody. Gone forever are the days when only large companies could afford a computer, and it took a mainframe that nearly filled an entire room to sort business records or to do mind-bending arithmetic. Now powerful, affordable desktop sized machines are taking on exciting new chores in every phase of business and even in the home.

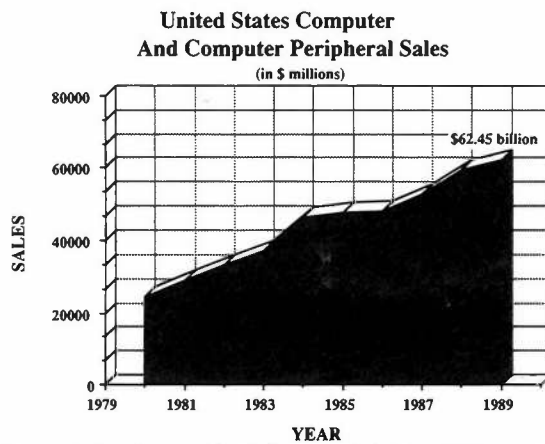
Desktop publishing systems which combine text and graphics are bringing printshop-quality to financial reports, company newsletters, and sales presentations. Surgeons can now create computer-animated, 3-D images of their patients, long before they pick up a scalpel. In the home, the computer provides budgeting, word processing, and high quality graphics for games.

According to the Electronics Industry Association (EIA), the computer and peripheral market has grown from \$24.3 billion in 1980 to over \$62.5 billion in 1989. Nearly eight out of 10 office workers (78%) use computers - according to the *Office Environment Index*. Also, 50% of top executives report having a terminal or personal computer in their office. According to the EIA, the home computer market was \$5.5 billion in 1988 and was projected to be over \$7 billion by 1990.

Every Computer Needs A Monitor

Whether it's a personal computer, minicomputer, or mainframe, every computer system has one thing in common: each needs a monitor or terminal to display input and output information. And while personal computers have one monitor per computer, minicomputers and mainframes may have hundreds or more depending on the size of the system.

A monitor operates much like a television without a tuner or an IF (this makes a monitor less complex than a TV). Instead of receiving an RF signal, converting it to an IF, and detecting the signal to produce video, a monitor receives the video information directly from the computer through red, green, and blue (R,G,B) data lines.



Computer sales continue to grow into the 1990s as they penetrate even more elements of our society.

Generally, the computer also supplies the horizontal and vertical synchronizing pulses. Past these minor differences, monitors have similar vertical, horizontal, output, and high voltage circuits as televisions.

There's one other subtle difference: while virtually every television in the United

States scans at a horizontal rate of 15,734 kHz, a vertical rate of 59.94 Hz, and uses 525 scanning lines, most monitors don't operate at these standards. Since monitor designers aren't tied to the NTSC format, they've increased the horizontal scanning frequency and the number of displayed horizontal and vertical pixels to produce very clear, high resolution images. (A pixel is the smallest picture element the monitor can produce.)

Resolution on computer monitors has been improving steadily since the late 1970s. Where images on the computer graphics adapter (CGA) monitors were rather fuzzy, today's mainstream monitors produce a very sharp, clear picture. Currently the industry has settled in on the video graphics array (VGA) standard. VGA has a horizontal scan rate of 31.5 kHz, 640 horizontal pixels and 480 vertical pixels. The IBM 8514A standard has 1,024 horizontal pixels and 768 vertical pixels. Some monitors, called multisync monitors, have the ability to switch (or sync) to whatever

| Mode | Horizontal Frequency (kHz) | Vertical Frequency (Hz) | Horizontal Resolution (Pixels) | Vertical Resolution (Lines) |
|--|----------------------------|-------------------------|--------------------------------|-----------------------------|
| CGA (Color Graphics Adapter) | 15.8 | 60 | 640 | 200 |
| MDA (Monochrome Display Adapter) | 18.4 | 50 | 720 | 350 |
| HGC (Hercules Graphics Card) | 18.4 | 50 | 720 | 350 |
| EGA (Enhanced Graphics Adapter) | 21.8 | 60 | 640 | 350 |
| PGC (Professional Graphics Controller) | 30.1 | 60 | 640 | 480 |
| VGA (Video Graphics Array) | 31.5 | 60 | 640 | 480 |
| Apple MAC II | 35.5 | 67 | 640 | 480 |
| Super VGA | 35.2 | 56 | 800 | 600 |
| 8514 A | 35.2 | 87 | 1,024 | 768 |
| XGA (Extended Graphics Array) | 48.4 | 60.5 | 1,024 | 768 |

Computer monitors now have improved performance with faster scan rates and better resolution.

horizontal and vertical scan frequency the computer is feeding them.

The Opportunity Is There

There are excellent opportunities for the video servicer in the monitor repair business. Computer servicers may have a tendency to shy away from monitor servicing because they are more accustomed to digital circuits. They may feel more comfortable having someone familiar with television working around the monitor's high voltage circuits. Large institutions

(banks, colleges, manufacturing firms) may be looking for someone to take up the maintenance of all of their monitors. Many computer stores go through the lengthy process of shipping their monitors back to the manufacturer for service, when they could be repaired locally much faster and more economically.

Even though monitors have different scanning frequencies, they fail in the same way that TVs do. Just as the TV servicer, the monitor servicer deals with poor video response, collapsed vertical raster, bad

power supplies, blown outputs, loss of horizontal sync, and no high voltage. Anyone with basic television servicing knowledge has the background needed for monitor repair. The opportunities are available for the willing.

Watch for upcoming issues of the *Sencore News* to find out what's needed to get into the monitor servicing business. ■

Circle #122 on the Fast Facts Card if you are servicing or planning on servicing computer monitors.

Computer News Reports 50 Percent Monitor Fatality Rate

The October, 1990 issue of *Computer News* contained a report on the increase of VGA monitor failures. It stated that in the case of the IBM 8513, "Larger users are reporting more than a 50 percent fatality rate within the first two years. And, it's not just IBM having these problems - there has been an epidemic of VGA monitor failures nationwide."

"One of the major sources of problems has been bad flyback transformers, which supply the high voltage to the CRT. Since four manufacturers supply about 80 percent of the

monitors sold in the United States, these problems can be found in the majority of VGA monitors."

With the cost of a flyback ranging between \$40 and \$75, the average monitor repair bill with labor usually runs between \$125 and \$325. According to the president of National Advancement Corp., Don Doerr, "It's no surprise to see the increasing numbers of monitor repair companies popping up all over the country."

Sencore Tech Schools Full Day Troubleshooting Workshops

What Is A Sencore Tech School?

An exclusive all day workshop where you learn the latest Video and Audio troubleshooting techniques using Sencore's innovative instruments.

What Do You Learn?

- How to troubleshoot any VCR problem using a 6-step funnel procedure.
- How to troubleshoot and isolate any VCR Servo problem in 30 minutes or less...no more tough dogs!
- How to troubleshoot any Digital Tuner problem with just one signal injection.
- How to troubleshoot any Audio Power Amplifier in half the time using an exclusive 3-way monitoring system.
- How to troubleshoot any AM/FM Receiver problem using just two hook up leads.

Who Should Attend?

- Owners/Technicians who want to service more Video or Audio faster with fewer tough dogs.

- Owners/Technicians who want to expand their service into more video or audio servicing.
- Sencore Instrument owners who want to learn how to use their instruments more effectively.
- Owners/Technicians who want hard proof technical demonstrations that show Sencore instruments are a good investment.



What Do You Receive?

- A full day of technical troubleshooting techniques, including some theory and exclusive troubleshooting procedures.

- A specially prepared troubleshooting work book with many Tech Tips and technical information learned through the day!
- Input shared with other participating technicians.
- A Certificate of Achievement.

How Do You Register?

- Select the Tech School closest to your area.
- Call **1-800-SENCORE** (736-2673) or Fax 605-339-0317.
- Ask for Tech School Registration.
- We'll take care of the rest and even call to remind you the day before your Tech School.

But hurry, each Tech School is limited to the first 30 technicians.

How Much Does It Cost?

Right now, just your time and participation for the day.*

Circle #123 on the Fast Facts Card for information on Tech Schools.

March

| Location | Video | Audio |
|---------------|--------------|---------|
| Winnipeg, MB | March 5,6,7 | March 8 |
| Regina, SK | March 18,19 | |
| Saskatoon, SK | March 21, 22 | |

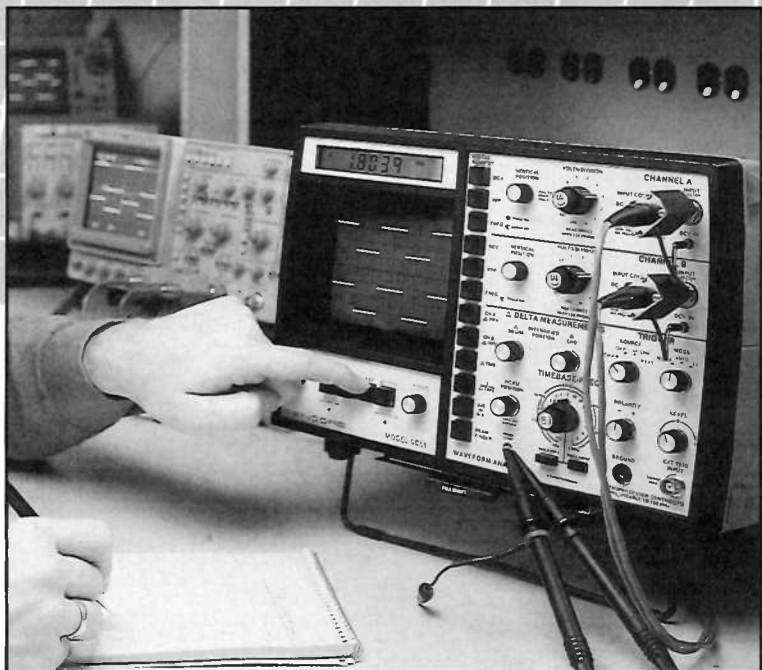
April

| Location | Video | Audio |
|--------------|-------------|----------|
| Edmonton, AB | April 1,2 | April 3 |
| Calgary, AB | April 16,17 | April 18 |

June

| Location | Video | Audio |
|--------------------|---------------|---------|
| Kitchner, ON | June 3,4 | |
| Carleton Place, ON | June 6,7 | |
| Vancouver, BC | June 11,12,13 | June 14 |
| Pointe Claire, PQ | June 18,19,20 | June 21 |

*A registration fee is charged in some areas to cover additional costs.
All Workshops are conducted in English.



What's Important For Analyzing Today's Waveforms?

By Brian Phelps, Technical Writer

- Being able to measure DCV, PPV, and frequency with one probe hookup
- Having rock-solid triggering for rock-solid waveforms
- The capability to analyze waveforms up to 3000 VPP

Are you one of thousands of technicians who realize the importance of a good oscilloscope for today's circuits?

Whether you're considering updating your present scope or buying your first, you want to be sure you make the right decision. You should consider the following needs before you decide:

One Probe Hookup — Technicians can't afford to be swapping probes and monitoring several displays at once. There's too much time involved with untangling cords and reattaching probes to the circuit. You don't need the extra chance for error.

Triggering — In order for any scope to be useful, it must be able to lock onto a waveform with rock-solid sync throughout its entire bandwidth. A good scope should be able to sync onto a waveform with little or no user adjustment.

Input Capability — Today's circuits test the input capability of an oscilloscope as never before. A scope must be sensitive enough to measure extremely small signals, yet have enough input capability to measure higher voltage signals.

Ease Of Operation — Today's circuits are complex enough. Why compound the problem by having a scope that is hard to use? Look for the needed features and ease of operation if you want the most productivity from your scope.

But are these your real needs for an oscilloscope? What features should you look for in a scope in the future? This article will answer some of these questions and hopefully help you make a wise decision. We want you to purchase the equipment that is right for you.

One Probe Hookup

Servicers are pulled "off-track" all too often even on simple jobs by not completely analyzing each test point. It's far too easy to miss an

important clue to a defect because it's inconvenient to switch probes and take a different reading.

Schematics have as many as three different parameters listed at specific test points: DCV, PPV, and frequency. If you're going to experience successful troubleshooting, you'll need to make these measurements at any test point at

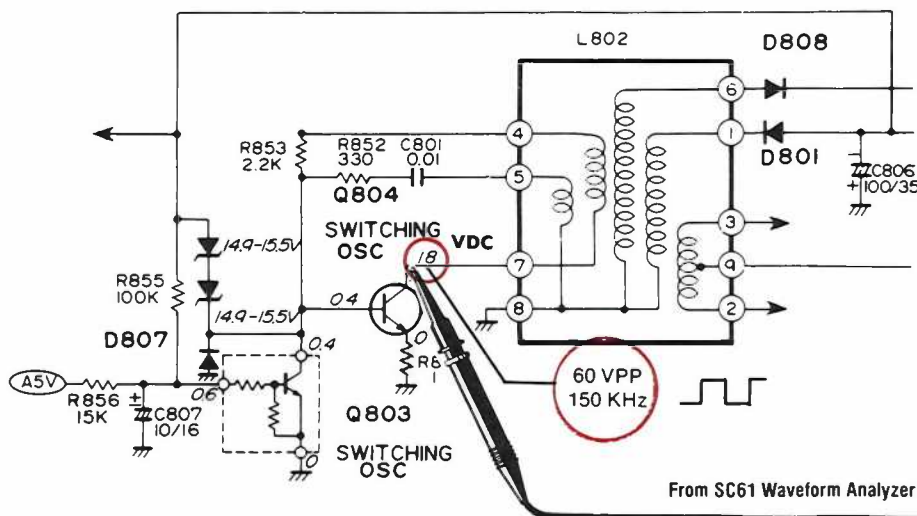
frequency, Delta PPV, Delta time, Delta frequency, and ratio measurements - all automatically. You just hook up the probe, push a button, and read the large, easy-to-read LCD display. You don't even have to fiddle with any knobs since the SC61's circuits won't let you make a mistake.

Triggering

Analyzing the shape of the waveform is often as important as the DCV, PPV, or frequency readings. The trigger circuits allow an oscilloscope to lock onto a waveform and display it on the CRT as a stable image so you can analyze it for defects. Unfortunately, some oscilloscope's trigger circuits don't always allow you to see a stable waveform.

A common cause of triggering errors in many scopes is noise generated in the triggering circuits. Noise of this type often goes unnoticed when viewing a square wave signal, but may cause problems in other waveforms, such as sine waves. A

sine wave is one of the most difficult waveforms to trigger on because the amplitude is constantly changing. The scope



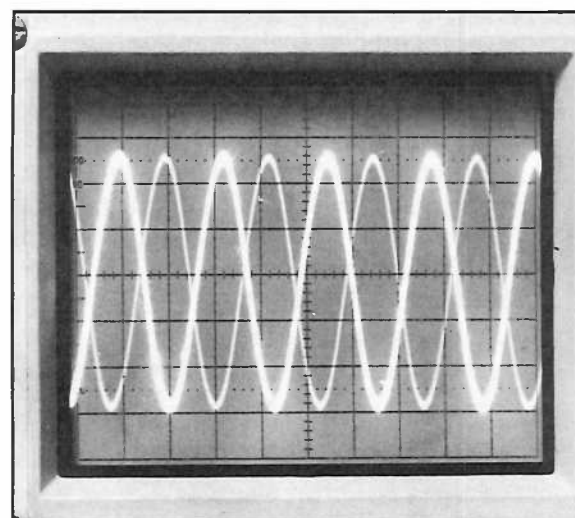
The SC61 Waveform Analyzer lets you measure DCV, PPV, and frequency with one probe hookup.

any given time. To complicate matters, you'll also need to be aware of measurement errors due to loading of the circuit with extra probes.

Besides the error of circuit loading, it's inconvenient and time consuming to hook up and use a scope, DVM, and frequency counter for every test point. But you do need to make these measurements quickly and accurately if your troubleshooting is to prosper. What you need is a way to analyze the signal without graticule counting, complicated setups, or wasting time by swapping probes.

The SC61 Waveform Analyzer is the only true waveform analyzer with one probe hookup for complete test point analysis. With one probe hooked into circuit, the SC61 analyzes every parameter of the signal so you don't miss a single defect.

The Waveform Analyzer provides DCV, VPP,



Many oscilloscopes have a difficult time trying to sync onto sine waves and more complex signals.

should trigger at exactly the same amplitude point on the signal each time it begins its sweep to prevent jitter or instability.

Inherent noise in the trigger circuits can cause small changes in the triggering point on the signal, which cause the scope to begin its sweep at a slightly different point on the waveform each time. This causes the sine wave to jitter horizontally because the sweep is shifting horizontally by a small amount on each succeeding sweep. Triggering errors may appear as a thickening of the trace horizontally or, in an extreme case, as a ghost image. These ghost images are the result of the scope triggering at extremely different levels on succeeding trace sweeps, creating multiple images after several cycles have been displayed.

Inherent noise in the triggering circuits is not the only major cause of sync instability. Another key factor is the trigger response time of the trigger circuits themselves. The triggering circuits must respond faster than the waveform you are measuring in order for the trigger circuit to "see" the signal it must trigger on. To see the signal, the trigger circuit's response must be faster than the frequency you are measuring.

The SC61 produces rock solid sync with stable triggering circuits so you don't have to fiddle with triggering controls. The SC61 uses differential amplifiers to virtually eliminate inherent noise in the triggering circuits and ECL (Emitter Coupled Logic) to meet the high speed trigger requirements for today's circuits. Let's examine closely how these circuits produce superior triggering and sync.

Differential Amplifiers Reduce Noise Pickup

First, let's look at the use of the differential amplifier circuits in the SC61. The main advantage of differential amplification is that many interference sources cancel each other. Let's compare a differential circuit with a non-differential circuit (commonly called a "single-ended" circuit) to see how this is done.

The most common source of interference in single-ended circuits is ground currents caused by magnetic fields that induce small signals in the printed circuit board. These magnetic fields may come from circuits near the amplifier stage, such as an oscillator or power supply, or strong RF fields entering through the case of the scope. These noise signals are amplified by the various stages and can cause the noise-induced sync instability we discussed earlier.

The differential amplifier of the SC61 shown in Figure 1 ignores these ground currents because an equal, but opposite, polarity signal is produced in the second leg of the differential circuit. The two opposite signals cancel each other so that only the desired signal (that is applied at the differential amplifier input) appears at the amplifier output. The use of differential amplifiers significantly reduces the amount of self-induced noise in the triggering circuits.

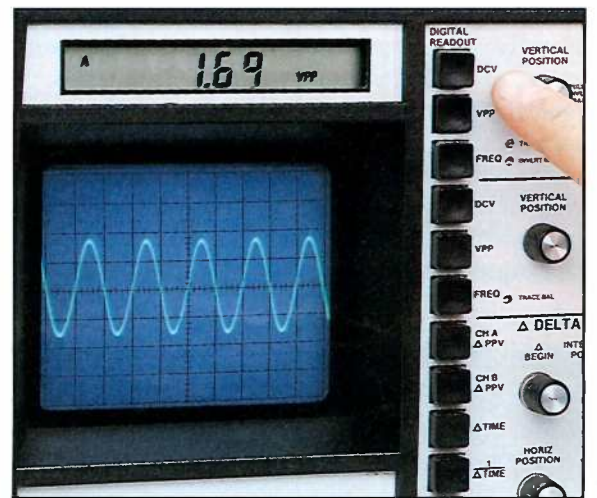
Most other scopes use several single-ended stages in their trigger circuits, resulting in less internal noise immunity. By using differential amplifiers through the entire triggering circuits of the SC61, we virtually eliminated

sync instability due to internal noise. But what about providing extremely fast trigger response time for rock-solid sync through the entire SC61 bandwidth?

ECL Provides Much Faster Trigger Response

We found the use of ECL had several advantages compared to other digital logic families in high frequency applications. Many other brands of oscilloscopes use the TTL (Transistor Transistor Logic) logic family in their triggering circuits. Let's compare the characteristics of ECL and TTL as they apply to oscilloscope triggering circuits.

ECL's main advantage is that it is a much faster logic family than TTL. ECL is the type of logic used for frequency counters, phase-



The SC61 locks onto and displays sine waves with no jitter or shifting on the waveform.

Differential Amplifiers Cancel Noise

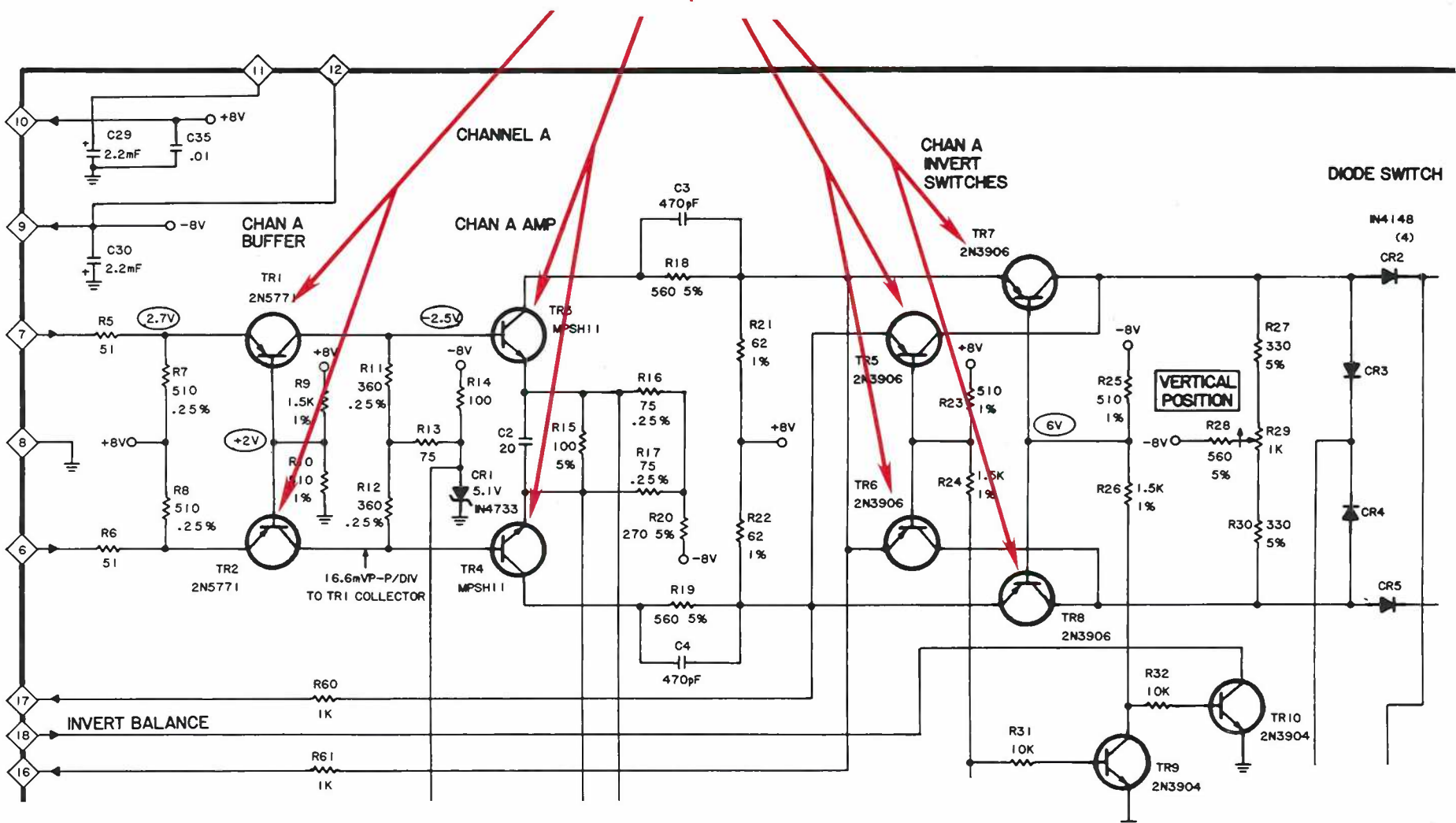


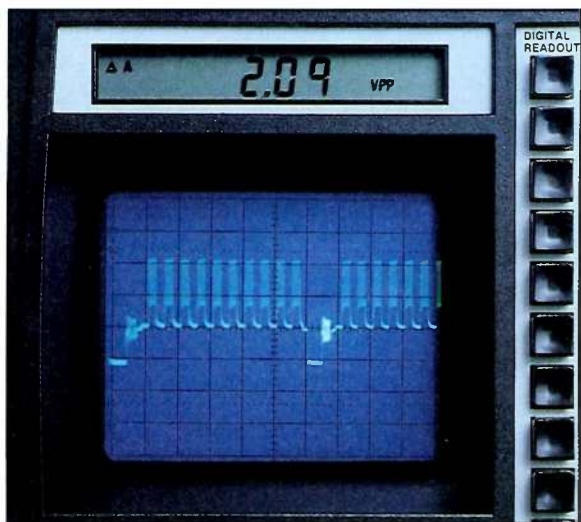
Figure 1: The use of differential amplifiers throughout the trigger circuits of the SC61 produce rock-solid waveforms even under the most adverse signal conditions.

locked loops, and other high frequency circuits. This made ECL use ideal for the fast triggering requirements of the SC61. However, ECL has several other key advantages compared to TTL.

TTL tends to be a very noisy logic family. Each TTL logic gate produces a switching transient every time the output swings from one logic state to another. These transients can cause noise problems within their own circuit, or the noise may be radiated to other circuits through inductive coupling. ECL does not produce noise transients and uses differential operation (which we just discussed) offering better internal noise immunity.

In addition, ECL has a much higher sensitivity than TTL because the IC input is the base of the transistor rather than the emitter as with TTL. Thus we need fewer stages of amplification, which reduces the chance of noise pickup or generation.

Finally, ECL has almost 8 times the dynamic range of TTL. Dynamic range is simply the operating limits from the smallest to the largest input signal that will result in reliable operation. This extended dynamic range means that you don't have to reset the triggering controls as often when the amplitude of the input signal changes.



Special sync separators help the SC61 lock onto composite video waveforms.

The Waveform Analyzer fits the bill for today's digital and conventional circuits when it comes to rock-solid sync. The SC61 simply locks onto waveforms faster and easier than any oscilloscope. But video circuits seem to be cropping up everywhere. How does the SC61 sync on video circuits?

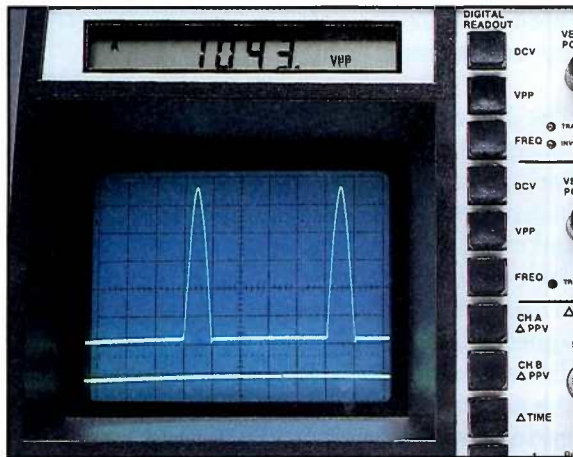
Special Video Sync Separators Provide Rock-Solid Video Waveforms

The Waveform Analyzer even produces rock-solid sync on difficult to sync video waveforms. Composite video signals represent an extraordinary triggering problem for most scopes because the signal is actually made up of several different, inter-related signals. The SC61 combats this problem with special video sync separators to lock the triggering circuits to the vertical or horizontal sync pulses. There is even a special digital circuit added in the video mode that prevents the double image caused by interlace scanning when you use

the SC61 to view the VIR (vertical interval reference) signal.

Input Capability

When you consider purchasing a new scope, you should consider the extreme circuit requirements you face every day. Ideally, a scope should have the necessary sensitivity in its vertical amplifiers to respond to very low value signals. On the other hand, it must have the capability to measure large value signals without restriction or possibility of damage to the input circuits. Let's see how the Waveform Analyzer stacks up on the very important input capability parameter.



The SC61 lets you safely measure signals large enough to damage all other oscilloscopes.

Input Capability Dictates How And Where You Can Use Your Scope

Perhaps you've been unfortunate enough to have damaged an oscilloscope by applying an excessive voltage to the vertical inputs. This is easily understandable since the input protection on some scopes is only 250 volts peak-to-peak. With only 250 volt input capability, what would happen if you attempted to view the waveforms present on a horizontal output transistor used in a computer CRT display or a TV receiver? These transistors may have PPV as high as 1500 volts. You simply would be unable to measure these waveforms without severely damaging your scope.

But 1500 VPP wouldn't even come close to damaging the Waveform Analyzer. The SC61 measures signals as small as five millivolts and is protected up to 3000 volts (DC + Peak AC). This lets you make unrestricted measurements in very low level circuits, while giving you the confidence to make measurements in even the most powerful circuits.

Patented circuitry inside the SC61 gives you a full 3000 volt protection over the entire bandwidth. You can set the vertical attenuators to any setting without worrying about damaging the SC61's front end. That's the kind of reliability you need from an oscilloscope. And you won't find it anywhere else.

Ease Of Operation

Now that we've discussed some of the inner features of the Waveform Analyzer, let's take



The video preset positions on the SC61 let you sync onto video waveforms at the vertical or horizontal rate with the push of one button.

a look at some of the human engineering features designed for ease of operation on the outside. The SC61 was designed to give you maximum analyzing capability with a minimum number of controls. The SC61 has less than half the controls of most competitive oscilloscopes.

The SC61 will even save you time when you are setting the timebase control with its easy-to-use sweep, calibrated in both time and frequency. The SC61 even sets the sweep speeds automatically in the "Video Preset" mode. You just push the vertical or horizontal button and the sweep speed is automatically selected to display two complete waveforms on the CRT.

The front panel was designed for ease of operation, too. Every control is functionally grouped just where you'd want it to be. Large-sized pushbuttons and controls prevent accidentally bumping adjacent knobs or controls, reducing the chance for errors.

Watch The SC61 Tech Tape - See How It Fits Your Needs

Just imagine using an instrument so powerful and reliable that you can hook up the probe anywhere in the circuit without risk of damaging the instrument or the equipment you're testing. Imagine hooking up one probe to analyze everything you need to know about a test point. Imagine having all the features you need on the easiest to use scope on the market today.

Now imagine this instrument on your bench increasing your productivity. Just call **1-800-SENCORE** and ask for your Area Sales Engineer. He'll send you a copy of the SC61 Tech Tape so you can see how the SC61 fits your needs. You won't find a more reliable or easy-to-use oscilloscope anywhere. ■

Circle #127 on the Fast Facts Card for a FREE SC61 Tech Tape.

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



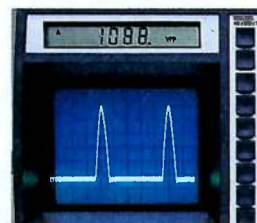
AUTOTRACKING™ Digital DC Volts Measurements:

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.



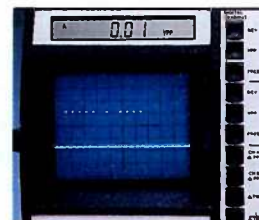
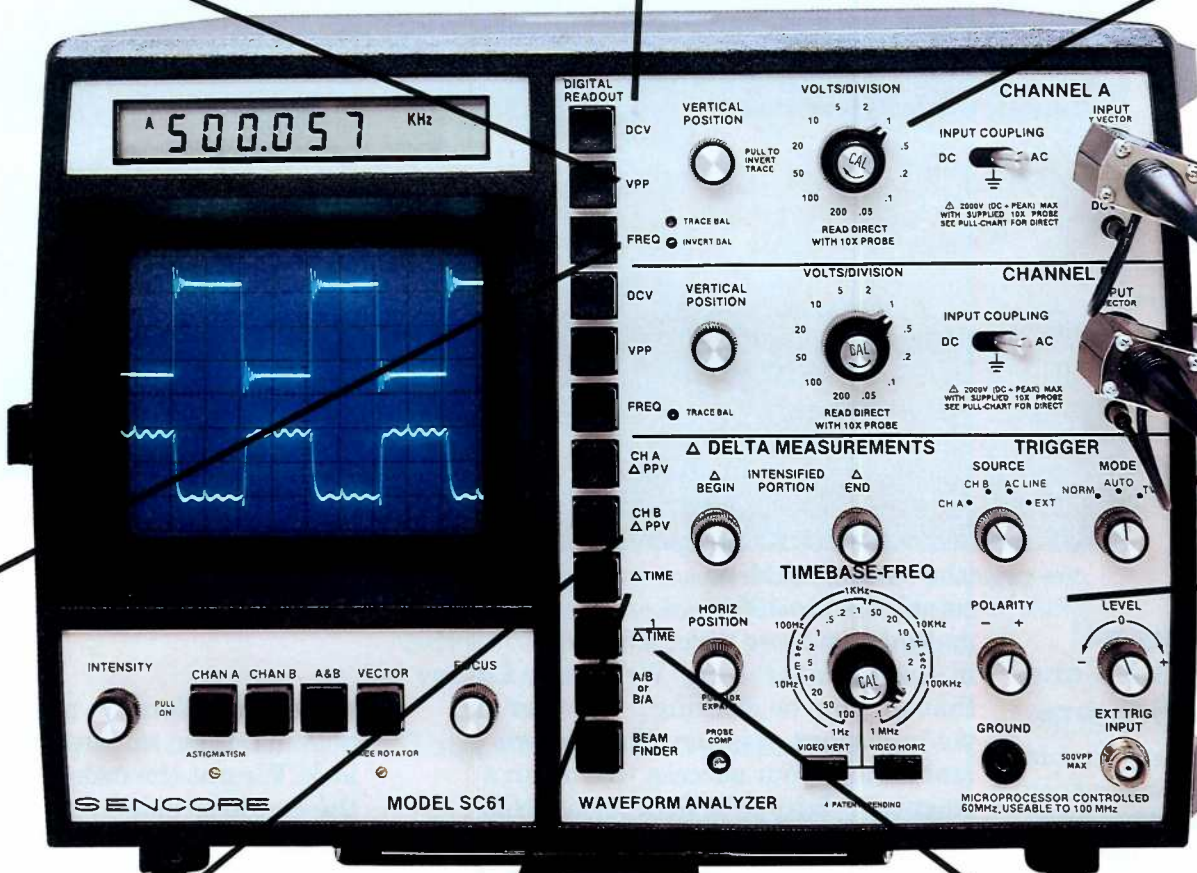
Four Times The Measuring Range - Patented

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Your Success Has Been



One of Sencore's first logos was just a hint of things to come.

Sencore celebrates 40 years of helping electronic servicers this year. It's been a great 40 years and we hope it lasts another 40. During our long relationship, you've probably seen many new faces along with the 53 employees that have been with us for 10 or more years.

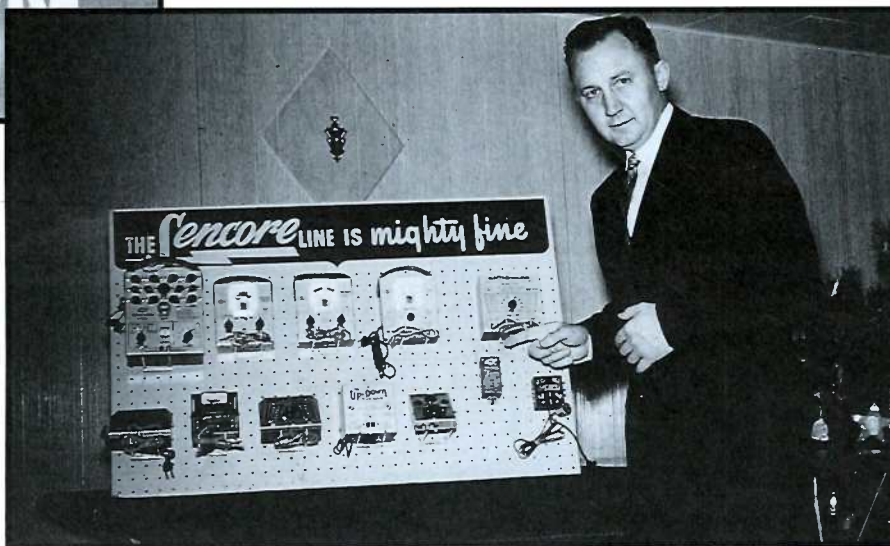
We're starting our year long celebration with this special anniversary *Sencore News* issue. This issue is just the start of the many good things to come in 1991. Because this is our anniversary year, let's spend just a couple of minutes to look at some of the things that have made you and Sencore successful for over 40 years.

Sencore's success story may not be new to many of you, but it's one that really explains what Sencore is about.

Sencore was started in 1951, in downtown Chicago, Illinois by R.H. ("Herb") Bowden. While working as a Field Rep. for one of the leading television manufacturers, Herb noticed that most servicers were having difficulty using the engineer grade equipment they were required to use. The equipment didn't help them service.

So, Herb began customizing the equipment to fit both his and other servicer's needs. Slowly his customizing caught on, and with a small loan and big goals, he began a small manufacturing facility. Herb started by employing family and friends and working on a build-by-order manufacturing process.

The business continued to grow over the next several years as people discovered the true benefits of Herb's innovative ideas and instruments, and in 1970 the decision was made to expand and move to Sioux Falls, South Dakota. Since that time, Sencore has made a real home for



An early photograph of founder Herb Bowden explaining the Sencore product line.

the business in Sioux Falls, and is proud to be involved with this community.

During the past 40 years, Sencore has remained dedicated to just one goal (the same goal Herb established in 1951) - making you more successful in electronic servicing. We're proud to say that we plan on sticking to this simple, yet important, mission. You see, we realize that your success will mean a successful future for Sencore as well.

Sencore Sticks To It's Founding Beliefs

When you say "yes" to Sencore, you're saying "yes" to good old American ingenuity at its finest. With 86% of Sencore's product line holding at least one patent, you're assured of exclusive, time-saving, money-making features not available anywhere else.

Our Design Engineers know from experience that as an Electronic Servicing Professional, your time really is money. Lost or wasted time is money right out of your pocket. Our designers know that every time you have to fiddle with a knob, connect and reconnect leads, or come up with an inconclusive or misleading test result, it costs you dearly.

That's why when you review any instru-



Sencore equipment has always been designed for the servicer by the servicer.

ment in the Sencore product line, you'll notice a fresh, uncluttered, easy-to-use look. We put the complex electronics on the inside to help keep your operation simplified on the outside.

Dealing Direct With The Sencore Factory Adds To Your Success

As technology advanced, we chose to adjust our marketing program to better meet the needs of our customers. With our final phase of sales and marketing in full swing, we are servicing our final customer directly through our direct marketing programs and toll-free support.

Unlike others, Sencore's commitment to your success just begins at the delivery dock. Consider that one toll-free number, **1-800-SENCORE**, connects you to a factory full of friendly folks dedicated to making you and your business more successful. You get fast, friendly product delivery; most items are in stock and are shipped within 48 hours of receipt of your order.



Sencore moved to Sioux Falls service industry.

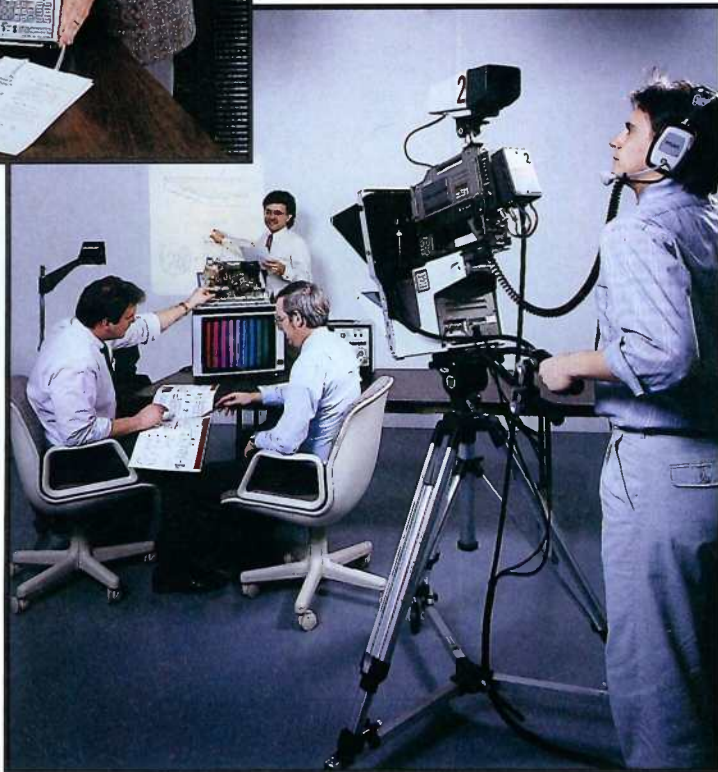
en Our Success For Over 40 Years



Sencore's exclusive product line is 86% patented and available only through Sencore.



Ills, SD in 1970, where we remain committed to the



Sencore's after-the-sale support is unequalled in the industry with Technical Bulletins, the Sencore News, a video production studio, and toll-free support.

first time - or we'll make it right - for the lifetime of the instrument, at no cost to you. It even guards your instrument for a lifetime against rusting out - so plan on profiting from your Sencore investment for a long time.

Our service after-the-sale is second to none in any industry. Our standard 72 hour turn-around on service repairs and 48 hours on parts means maximum up-time and productivity from each instrument. Plus, since our Engineering, Service, and Quality Assurance organizations are under one roof, your serviced instrument is renovated to better than new performance with the latest engineering updates. Best of all, you can be sure your serviced instrument is right on specifications, as each unit is calibrated against Sencore's NIST traceable standards.

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

Your Success Is Guaranteed

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

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

Since every Sencore unit has quality built in and not troubleshot out, only Sencore can offer you a 100% Lifetime Made Right Guarantee. This exclusive Buyer Protection Plan assures you that your unit was engineered and manufactured right the

Finally, Sencore's no nonsense 30 Day Money Back Guarantee assures you that you've made the right choice. Every Sencore instrument and accessory is covered by the industry exclusive guarantee of satisfaction. Simply stated, "If you're not 100% satisfied with your Sencore instrument, return it for a full refund. You're always sure that you've "bought right" when you say "yes" to a Sencore investment.

We're looking forward to spending many more years helping your service business. Whether you're new to Sencore or have been with us from the start, I'd like to personally welcome you aboard and wish you luck for the next 40 years.

Thanks for making Sencore successful! We make a great team!

Al Bowden
President and CEO,
Sencore Inc.

New



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With The PA81 Stereo Power Amplifier Analyzer!

\$1,995 Only from Sencore!

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

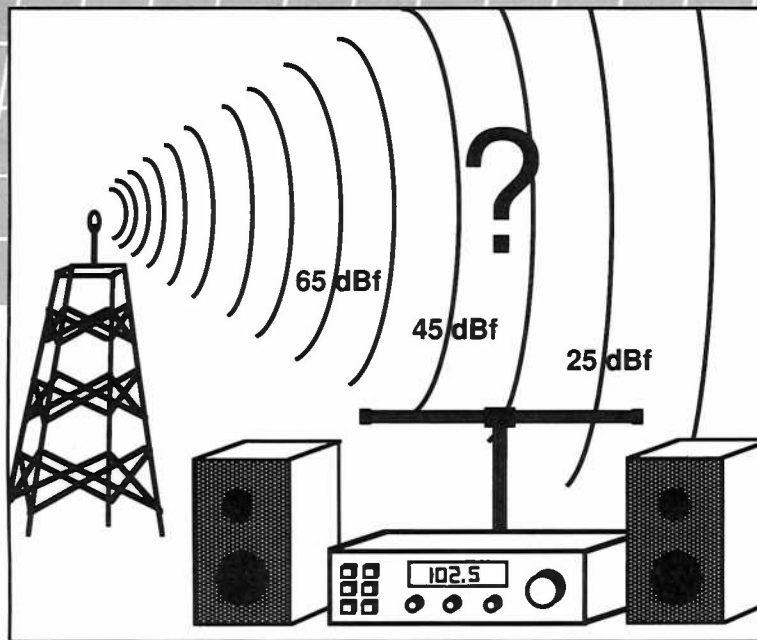
RMS voltmeters don't have enough frequency response for audio work. Eight ohm dummy loads aren't compatible with today's popular 2 and 4 ohm stereo systems. Signal tracing with a voltmeter takes a lot of time, and conversion calculations are not always accurate. A technician may spend valuable time trying 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:

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Taking The Mystery Out Of FM Receiver Sensitivity Testing

By Rick Meyer, Application Engineer

- Receivers with good sensitivity pick up more radio stations
- The SG80 gives you exact levels needed for sensitivity testing
- Troubleshoot RF and IF stages with the SG80's substitute signals

When was the last time a customer commented "My radio doesn't seem to pick up as many stations as it used to"? This type of complaint is often hard to confirm or deny. How do you know if there is a reception problem with the radio, or simply a bad antenna signal feeding into it.

Fortunately, there is a test that can quickly confirm whether the problem is with the radio or in the customer's antenna system. It is called a sensitivity test, or more precisely, a 50 dB quieting test. This article will explore FM receiver sensitivity, how to test for it, and what to do if it is bad.

What Is Sensitivity?

The term sensitivity defines the ability of a receiver to receive a relatively weak RF signal and produce an acceptable audio output from it. The better the sensitivity of a receiver, the weaker the signal it can pick up.

poor sensitivity will pick up the local stations because of their large signal strength. Distant stations, however, will be lost in a "hiss" of noise.

Your customers probably know very little about the sensitivity of a receiver. They only know the receiver doesn't sound like it should or used to. When their receiver has poor sensitivity, they can't pick up that favorite football game or music program, or they may be annoyed by the background noise when they try to tune in a favorite station.

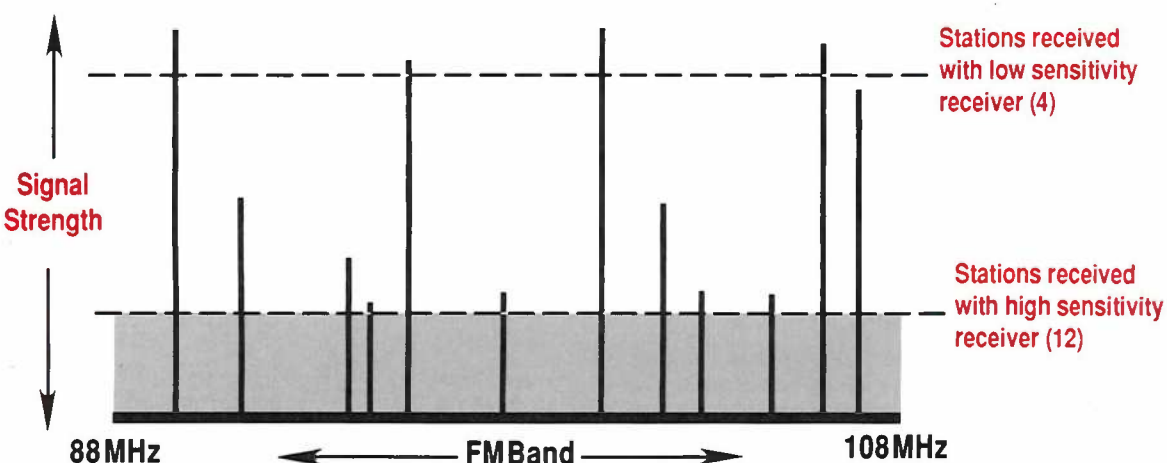
A Sensitivity Test Helps You Identify The Source Of The Problem

To help your customer determine if the problem is in the receiver, antenna system, or with the broadcast signal itself, you need to determine the sensitivity of the receiver. You can then compare the sensitivity reading to the specifications of the receiver. If they are

radio gets worse as we travel farther away from the broadcast transmitter. We hear noise in the form of a background hiss. This hiss becomes more and more objectionable the farther we get from the station.

Two types of sensitivity tests were developed using the background noise as the judge of quality. The first test developed was the usable sensitivity test. This test used a signal-to-noise (S/N) ratio of 30 dB as its qualifying ratio. In the early days of radio, 30 dB of signal-to-noise was considered acceptable. Thirty dB corresponds roughly to a distortion of 3 percent. Today, this level is considered barely acceptable, and more likely, an unusable level.

Today, the 50 dB quieting test has become accepted as a better qualification of a receiver's acceptable sensitivity. At 50 dB, the noise level in the output signal is barely audible. Virtually all receivers have published specifications on 50 dB quieting sensitivity. Thus, if you have the specifications for the receiver, you can readily compare its performance to its spec. If you don't have a spec sheet, just remember that the typical mono 50 dB quieting specification ranges from 10 dBf to 30 dBf. For stereo, you can expect ranges from 20 dBf to 40 dBf. Typically the higher the quality of receiver, the better the sensitivity.



A receiver with poor sensitivity will only pick up a few strong local stations but miss the rest.

The main purpose of a receiver is to take the many weak RF signals being fed into it from the antenna, amplify them, sort out the desired signal, and then decode the information into an acceptable audio output. The signal from a local station may produce as much as one to two volts of RF signal at the antenna terminals of the radio. On the other hand, the signal from a distant station may produce only a few microvolts. A radio with

close, the receiver is not at fault. If the sensitivity tests bad, then the receiver needs servicing or adjustment.

A sensitivity test determines how small a signal can be received for a given quality of output signal. One way to judge the quality of the signal is to define how much noise is acceptable in the output audio signal. We all have heard how the audio from an FM car

You Can Make A Sensitivity Test In Four Fast Steps

The 50 dB quieting test requires a controllable RF signal source with known output levels. Off-the-air signals won't work for this test since they cannot be controlled. You need an FM signal generator with precise, controllable RF signal levels.

Here are the basic steps you need to do a 50 dB quieting test on an FM receiver:

1. Set up the standard FM receiver test setup and measure the audio output level
2. Remove the modulation from the RF signal
3. Remeasure the audio level to calculate the S/N ratio
4. Reduce the RF level until the S/N ratio is 50 dB

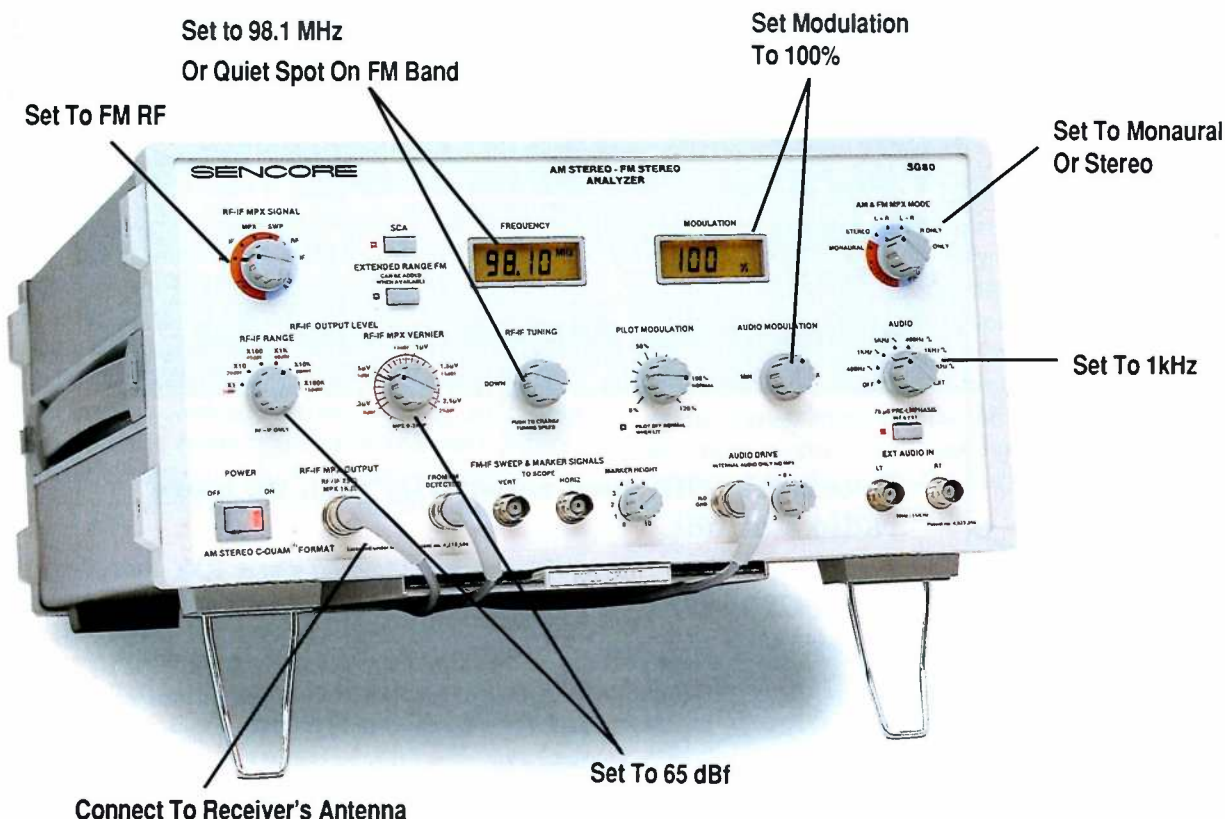


Figure 1: The standard FM signal setup on the SG80 can be used for the 50 dB quieting sensitivity test and many others as well.

You will notice that this test also requires you to measure the output level. You can use any type of audio signal level measuring device such as an audio voltmeter or an oscilloscope. The test is easier and faster, however, if you use the PA81 Stereo Power Amplifier Analyzer with its dual channel dB programmable feature.

Having an accurate signal level is perhaps the most critical part of determining sensitivity. The Sencore SG80 AM Stereo - FM Stereo Analyzer, with its microprocessor calibrated RF signals, is ideal for this test. The SG80 is designed to let you do the 50 dB quieting test as well as many other tests in a matter of seconds.

To show you more detail on the 50 dB quieting test, let's walk through the test using the SG80 and the PA81. First, we need to apply the standard reference RF test signal to the receiver. In most cases you will already have the SG80 set up for this signal and can skip this step. The SG80 is set up as follows: (see figure 1)

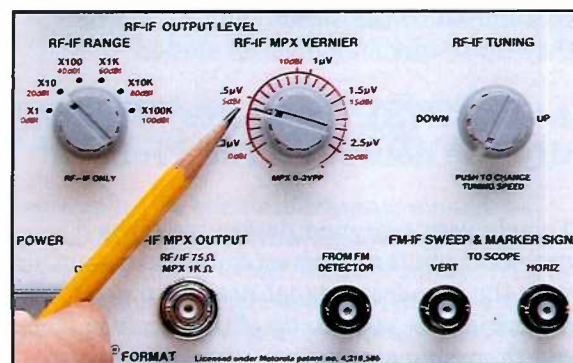
- Connect SG80 to the receiver
- Select FM RF
- Set to 65 dBf
- Set to 98.1 MHz (or a quiet spot on FM



The PA81 Stereo Power Amplifier Analyzer program-mable dB function takes the calculations out of many radio tests.

band) Note: set the receiver to the same frequency.

- Select 1 kHz audio
- Select monaural or stereo
- Adjust modulation to 100%



You can read the 50 dB quieting sensitivity directly from the RF-IF Level controls on the SG80.

Next, we need to set up the PA81 to measure the audio output of the receiver. If we are going to measure the output from the speaker outputs, do the following:

- Connect the receiver to the dummy load inputs
- Match the PA81's dummy loads to the receiver's outputs
- Select dB PROG on the dummy load section of the PA81's function switch
- Turn the receiver up to just before the audio clips. Note: we need to do this to get the most dynamic range for our measurements.
- Press dB PROG REF STORE

This is a standard setup to do many tests such as signal-to-noise, 50 dB quieting, stereo separation, and others. Now we simply perform the following three steps to complete the 50 dB quieting test.

STEP 1: Turn off the AUDIO control on the SG80. This removes the audio modulation from the signal and the SG80 is applying a carrier only.

STEP 2: Read the meters on the PA81. This is a measurement of the receiver's signal-to-noise. It should be much greater than 50 dB or we know the receiver has a problem.

STEP 3: Reduce the RF signal level being fed into the receiver. We do this by turning down the RF-IF OUTPUT LEVEL on the SG80 until the meters on the PA81 read 50 dB. This is the 50 dB quieting level. For mono, this level should be in the 10 dBf to 30 dBf region. For stereo, this level should be in the 20 dBf to 40 dBf region.

But what if the 50 dB quieting level is much higher than this or we can't even get a signal-to-noise ratio of 50 dB? What do we do then? This is where the SG80 AM Stereo - FM Stereo Analyzer really goes to work. The SG80 lets you walk through the receiver from the antenna to the audio output to locate the problem. Before we show you how the SG80 conquers sensitivity problems, let's look at some of the possible causes for poor sensitivity.

Several Circuit Defects Can Affect Sensitivity

Probably one of the most obvious causes of poor sensitivity is a bad RF amp. The RF amp boosts the signal level high enough so that it is well above the noise floor of the mixer. If the RF amp shorts, no amplification occurs and the signal-to-noise ratio will be poor. If the RF amp opens, the signal-to-noise will be even worse. At first glance, you might expect that an open RF amp would result in no signal at all. But remember, the RF amp is being fed signals in the 100 MHz region. An open RF amp has enough internal capacitance to allow some of the RF signal to jump right over the open junctions. In fact, the capacitance of the board is often enough to allow a large level signal to pass.

A second, not so obvious, defect is a bad RF tuned stage. If the tuning voltage changes, or a component goes bad, one or both tuned stages will be off frequency. The mistuned stage will actually try to block the desired signal even though later stages will still amplify it. The end result is poor sensitivity.

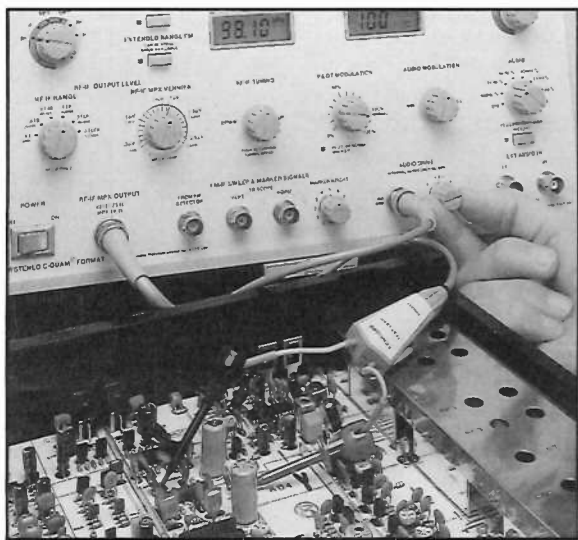
A third cause of poor sensitivity is a bad IF stage. If an IF amp goes bad, the signal fed to the FM detector is reduced and the final quality of the sound is degraded. Likewise, a bad IF tuned stage will greatly affect the amount of signal fed to the detector. In general, a bad IF stage has much greater effect and often completely blocks the signal as compared to a bad RF amp. Remember, the IF signal is only 10.7 MHz as compared to 100 MHz for the RF signal. Thus, the IF signal is less likely to jump across a defective stage.

Signal Injection Can Help Locate Sensitivity Problems

The SG80 AM Stereo - FM Stereo Analyzer helps you identify receivers with poor sensitivity, and also allows you to find the defect causing poor sensitivity. If the receiver has poor sensitivity, you can inject the SG80 RF and IF signals into its respective stages to locate the cause of the lost or weak signals.

The RF Amp Is Vital To Good Sensitivity

The output signals of the SG80 are protected from external voltages and allow you to inject into the input and output of any stage to determine if it is amplifying. Simply feed a signal from the SG80 into the output of the RF amp, for example, and determine what level is needed for a given signal-to-noise ratio. Then inject the same signal into the input of the RF amp. You should now be able to turn the RF level down on the SG80 to obtain the same signal-to-noise ratio. If you need as much or more RF signal at the input of the RF amp as compared to the output, then the RF amp is bad. If, on the other hand, you can reduce the level to get the same signal-to-noise ratio, the RF amp is good.



The SG80's substitute signals let you track sensitivity problems down to a specific stage without disconnecting components.

Likewise, you can determine if any of the IF stages are bad by injecting an IF signal from the SG80 into any of the IF stages. For best results, start at the output of the last IF stage and work backwards towards the mixer. You should be able to use a smaller signal at the input of each stage. If you find that you need to use more signal to get the same signal-to-noise ratio, then the stage is bad.

Another cause of poor sensitivity is an improperly tuned stage. You can check the tuned circuits in the RF amp section by feeding a low level RF signal from the SG80 into the antenna terminals. Decrease the RF signal level until there is appreciable hiss in the audio. If there is an adjustable bandpass filter, try tuning it while you listen to the audio. Peak the adjustment for best signal and least hiss. If you get no improvement, return the adjustment to its original position.

As you can now see, sensitivity testing is easy and gives you a wealth of information about the condition of the RF and IF section in the receiver you are servicing. The SG80 AM Stereo - FM Stereo Analyzer gives you the precise signal levels needed to perform this test. In addition, the SG80 helps you pinpoint bad RF and IF sections by allowing you to walk problems out of the stages.

You've just seen how a single instrument can help you walk through any receiver sensitivity failure in an easy, step-by-step procedure. How can the SG80 help you? Simply call 1-800-SENCORE and ask for your Area Sales Engineer. He can help. ■

Circle #141 on the Fast Facts Card for more information the SG80.

Figure 1 shows a simplified schematic of a modern receiver. All broadcast signals in the area are picked up by the antenna and fed to the input of the radio. These signals appear as RF voltages on the antenna input terminals of the radio. These RF signals are fed to a tuned circuit that performs the first level of signal selection. The tuned circuit is a bandpass filter narrow enough to pass only the desired signal and those immediately adjacent to it. This helps prevent overload of the RF amp that could occur if we allowed all the signals to be fed to it. Notice that a tuning voltage is fed to the varactor diodes in the first tuned stage. This voltage is used to tune the circuit across the FM band.

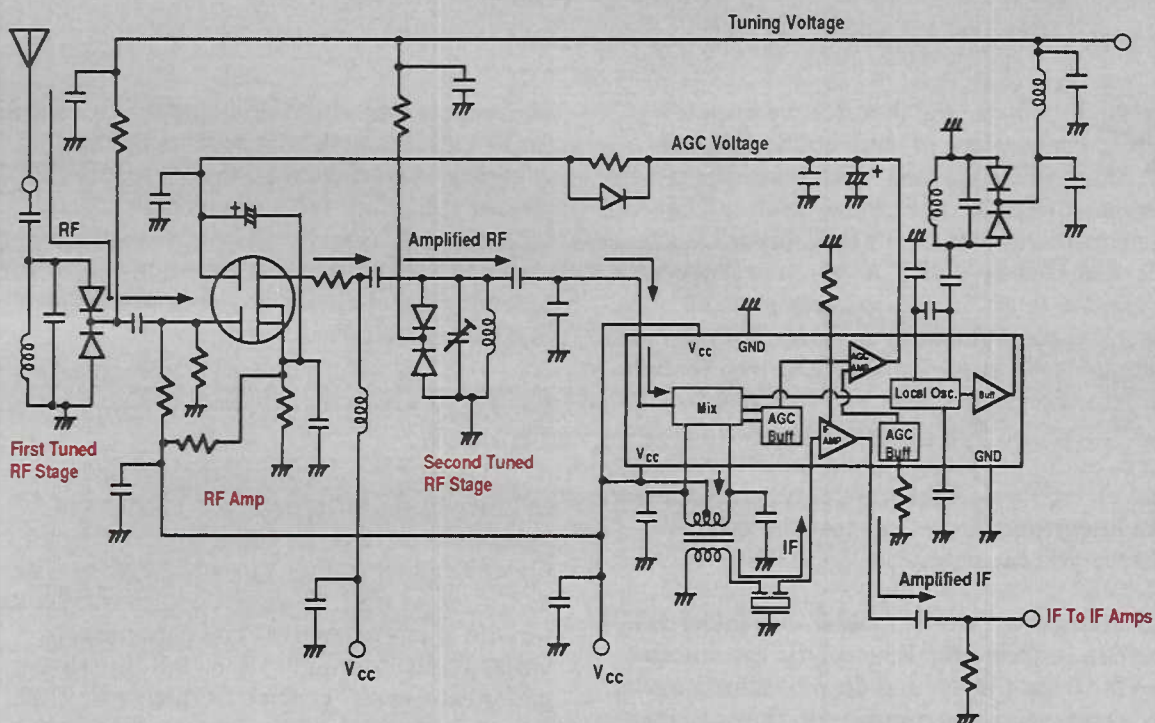


Figure 1: Even though modern receivers use a combination of FET RF amps and IC technology, sensitivity problems are not uncommon.

Next, the bandpass filtered RF signal is fed to the RF amp. The RF amp's main purpose is to amplify the weak RF signals to a level high enough to keep them above the noise floor of the mixer. The mixer produces noise which remains at a relatively constant level regardless of the input signal level. As Figure 2 shows, a low level signal fed into the mixer would result in an output with a poor signal-to-noise ratio. By amplifying the signal before it enters the mixer, the resultant signal-to-noise is greatly improved.

If we were only concerned with receiving low level signals, a fixed gain amplifier would suffice. The RF signals received by the antenna vary widely in RF level. They can be as small as a few microvolts or as large as a volt or two. A fixed high gain RF amp would produce a distorted signal on high input level signals. The gain of the amplifier is therefore, controlled by an AGC voltage developed further along in the radio. The AGC voltage controls the gain of the RF amp and thus controls the size of the signal ultimately fed into the mixer.

Again referring to the simplified schematic in Figure 1, notice that a second tuning stage is used between the RF amp and the mixer. This stage filters out even more of the unwanted signal. This tuned stage is fed from the same tuning line as the first tuned stage.

The Mixer And IF Stages Complete The Signal Amplification Process

As we see in Figure 1, the output of the second tuned RF stage is fed to the mixer (inside the IC). The mixer combines the amplified RF signals with a local oscillator signal to create an intermediate frequency signal. By doing this, any broadcast signal can be converted to one frequency which can then be amplified and filtered much better than the original RF signals.

The mixer combines the input RF signal and the local oscillator signal to produce signals that are the sums and differences of the two original

signals. All of these signals, plus some mixer noise are fed through the first IF bandpass filter which allows only the difference signals to pass.

Once the signal has been converted to a common IF frequency, it is further amplified and filtered. The filtering in the IF section is very sharp and eliminates all signals except the desired signal. Several (2 or more) stages of amplification and filtering are done in the IF sections. An AGC system is sometimes used in the IF section although limiting of the signal is acceptable and often desirable. The end result is to supply a signal to the FM detector that is of sufficient amplitude to provide the optimum audio signal from the detector output.

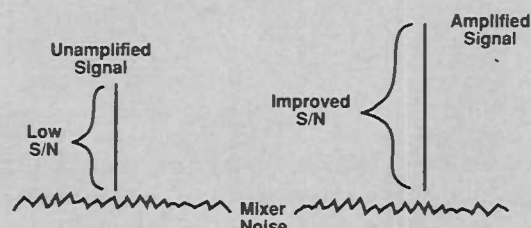
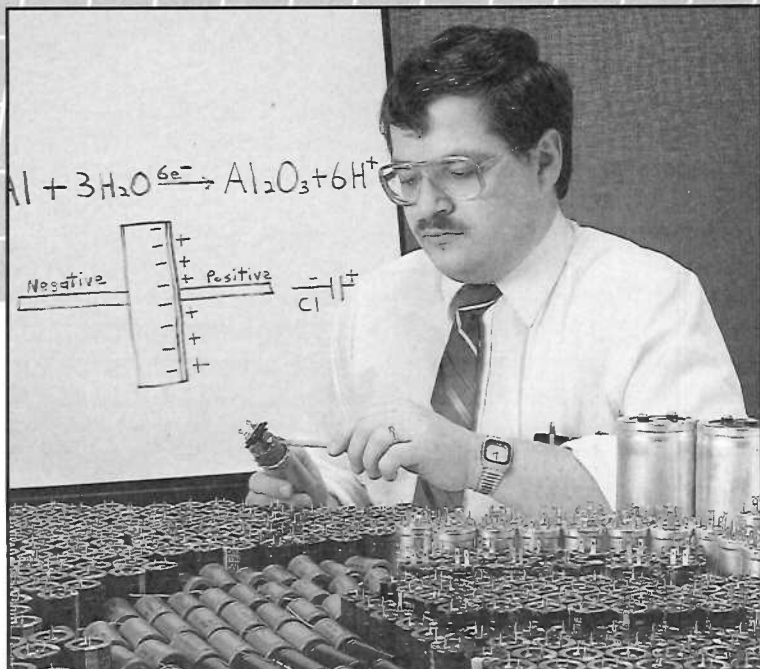


Figure 2: Amplifying the signal before it is fed into the mixer improves the signal-to-noise.



Electrolytic Capacitors - A Look Inside The Silver Can

By Paul Nies, Application Engineer

- Aluminum electrolytics yield a high capacity and voltage rating in a small package
- Lytics go bad in circuit or sitting on the shelf unused
- Test for all failure modes with the LC102 Auto-Z

Electrolytic capacitors have been the cornerstone of electronics since the days of "wireless". What service technician isn't familiar with the cylindrical, silver appearance of aluminum electrolytic cans? Electrolytics, or "lytics" as we commonly call them, are found in nearly every piece of electronic equipment ever made. They are still the mainstay in power supplies, even though selenium rectifiers gave way to silicon diodes and integrated bridge rectifiers. Lytics still serve as coupling capacitors in audio circuits, just as they did in the days of tubes. Not even the integrated circuit has lost the need for electrolytic capacitors.

But the sturdy, stable appearance inferred by the can is deceiving. Electrolytic capacitors are far from sturdy, and despite their longevity as an electronic component, they are far from perfect. Aside from the cathode ray tube, the aluminum electrolytic capacitor is the only electronic component that is virtually guaranteed to wear out.

What causes an aluminum electrolytic capacitor to self-destruct? Why do they become useless just setting on a shelf? Why does an electrolytic go off like a fire cracker if you ignore its polarity? In this article, we'll take a closer look at aluminum electrolytic capacitors to learn what makes them work and what makes them fail.

Enough Capacitance To Do The Job

In order to appreciate the complexities of aluminum electrolytic capacitors, we need to understand why other types of capacitors can't do the job as well. The most important characteristic of any capacitor is its capacitance value. Capacitor applications fall into three major categories: 1) block DC/pass AC, 2) RC time constants, and 3) energy storage.

When used for DC blocking/AC coupling, the AC resistance of the capacitor (X_c) follows the formula $X_c = \frac{1}{2\pi fC}$. At low frequencies, a large capacitor is needed to keep the resistance low. In time constants ($T = R \times C$) time (T) is in seconds when R is ohms and C is farads. Again, large values of capacitance are often needed. Energy storage applications, such as power supply filters and strobe capacitors, require large capacitors that can withstand high voltages.

Almost all capacitors above 1 μF in value are electrolytics (tantalum or aluminum). More specifically, all capacitors above 10 μF and 100 VDC are aluminum electrolytics. While double layer "Super Caps" exceed aluminium lytics in value (up to 10 F), and ceramics exceed them in voltage rating (up to 10 kV), the aluminum electrolytic is the only capacitor that provides large amounts of capacitance at high working voltages. This relationship between capacitance and voltage is the major reason for choosing an aluminum electrolytic for a specific application.

Size, Value, And Voltage Rating

A capacitor consists of two conductive plates (electrodes) which are physically separated by an insulating material (dielectric). Three factors determine the value of a capacitor:

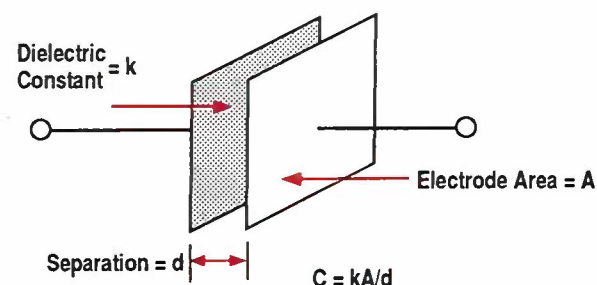


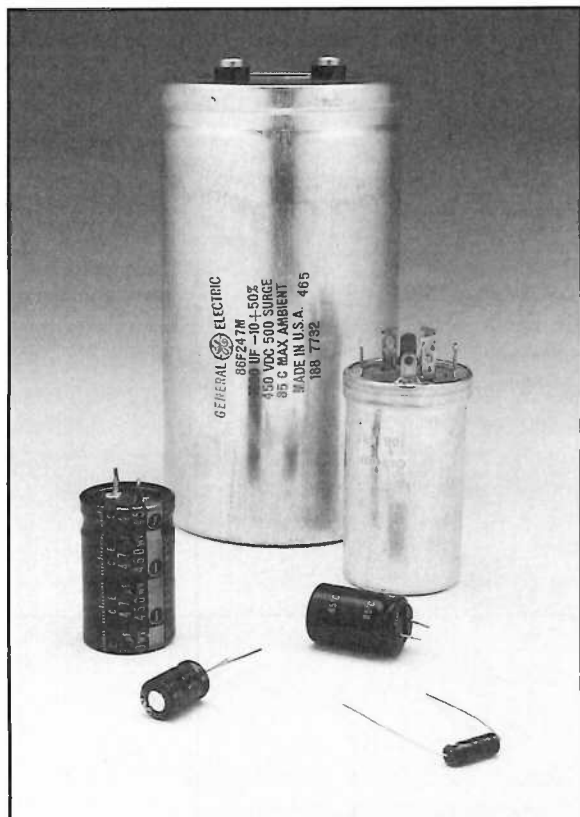
Figure 1: The value of electrolytics is determined by three factors: dielectric constant, separation between the plates, and surface area of the plates.

1) the surface area of the plates, 2) the dielectric constant of material between the plates, and 3) the distance between the plates. This is illustrated in figure 1.

Increasing the surface area of the plates (A) causes a direct increase in capacitance value. An example is the tuning capacitor commonly used in RF front ends. As you tune the receiver, the capacitance value changes. When the plates are fully meshed, the capacitance is greatest - but the value is still less than 400 pF. As you see, the physical size becomes staggering if surface area alone is the value-determining factor. Other factors must be altered to efficiently increase capacitance value.

Changing the distance between the plates and using a dielectric having a better constant (k) are other ways to increase capacitance value. Both of these factors depend on the dielectric. The dielectric constant is an indication of how well a material can hold an electrostatic charge. Air is given a reference value of 1. Materials that can hold more charge than air have a higher dielectric constant and will provide a higher capacitance value if substituted for air as the dielectric in a capacitor.

However, an additional aspect of the dielectric is dielectric strength, as shown in figure 2. This is a measure of how much voltage a 1 mil. (0.001 inch) thick piece of the material can withstand. This determines how closely the plates can be spaced which ultimately determines the voltage rating and size of the capacitor. Low dielectric strength means that



Aluminum electrolytics, which contain a large capacity in a small package, come in many shapes and sizes.

| DIELECTRIC MATERIAL | APPROXIMATE DIELECTRIC CONSTANT, k | DIELECTRIC STRENGTH VOLTS/MIL |
|----------------------------|---|--|
| AIR | 1.0006 | 76 |
| ALUMINUM OXIDE | 8.4 | 10,000 |
| CHLORINATED DIPENYL | 5.3 | 350 |
| IRRADIATED POLYETHYLENE | 2.3 | 2500 |
| POLY CARBONATE | 3.1 | 3900 |
| POLY STYRENE | 2.4 | 600 |
| POLYETHYLENE | 2.3 | 1200 |
| POLYETHYLENE TEREPHTHALATE | 3.0 | 4000 |
| POLYPROPYLENE | 2.3 | 650 |
| POLYTETRAFLUORO | 2.1 | 2000 |
| POLYVINYLIDENE FLOURIDE | 8.4 | 375 |
| RUBY MICA | 6.8 | 4000 |

Figure 2: The aluminum oxide dielectric yields the best dielectric strength vs. dielectric constant.

the dielectric needs to be thicker to achieve a useable voltage rating. The increased thickness, in turn, decreases the capacitance value. There is a tradeoff between dielectric constant and dielectric strength. The compromise that yields the best voltage rating, capacitance value, and size is the aluminum oxide dielectric. This is the main ingredient in aluminum electrolytic capacitors.

Aluminum Electrolytic Construction

Aluminum electrolytic capacitors are so named because their dielectric is aluminum oxide. Their construction is shown in figure 3. Aluminum electrolytics capitalize on all three value determining factors. First, the dielectric constant of aluminum oxide is about 8 times better than air and 2 to 4 times better than most other dielectrics. But the dielectric constant is the least of the contributions of the aluminum oxide dielectric.

Electrolytic Construction

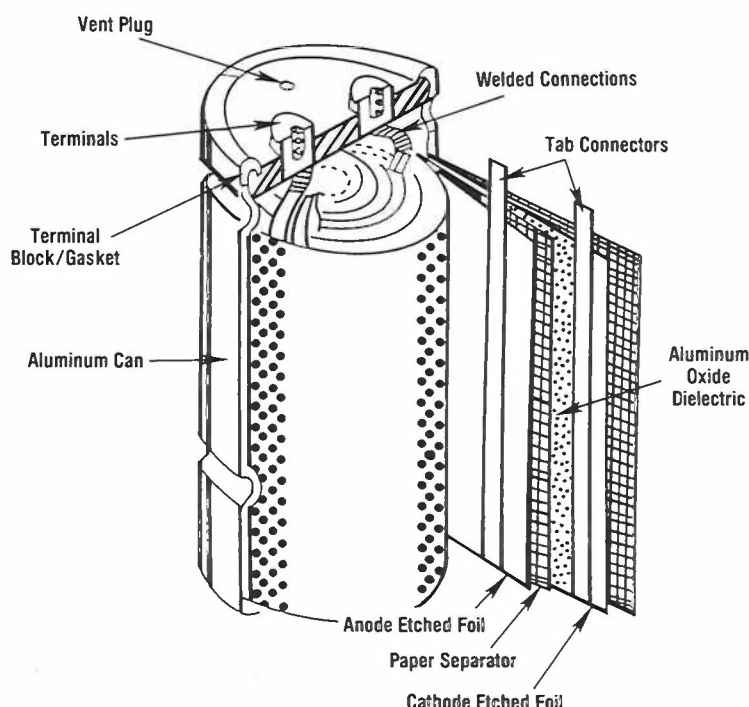


Figure 3: An inside view of the basic construction of an aluminum electrolytic capacitor.

The single most important reason for the large CV (capacitance x voltage) rating of aluminum electrolytic capacitors lies in the tremendous dielectric strength of the aluminum oxide which allows extremely close plate spacing. A 1 mil-thick aluminum oxide dielectric can withstand a 10,000 volt potential. The plates in a 450 volt aluminum electrolytic, for example, are separated by just 93.3 microns (millionths of a meter) which is 82 times thinner than a human hair.

If you've ever unraveled an aluminum electrolytic, you've encountered a wet piece of paper sandwiched between two aluminum stripes. Many people mistakenly think the paper is the dielectric. It isn't. As figure 3 shows, the dielectric is a fine layer on the surface of one of the foil strips. The paper, soaked in electrolyte, is really part of the other plate. It serves as a conductor to charge the metal plate and also as a reservoir to replenish the oxide dielectric.

A final factor which provides a major contribution to the large value rating of aluminum electrolytics is that the oxide dielectric is etched into the aluminum plates. This makes the plates coarse like sandpaper. The resulting channels and tunnels make the surface area many times larger than the physical square inch area.

A Limiting Factor

Just as the aluminum oxide dielectric is the key to the success of the aluminum lytic capacitor, it's also at the heart of lytic failures. An electrochemical reaction occurs in aluminum electrolytics whenever voltage is applied. This reaction, summarized by the formula



keeps the oxide replenished. The current, "6e-", is the leakage you measure when

checking a capacitor. Hydrogen gas is a by-product of the reaction. Under normal operating conditions, the hydrogen is absorbed back into the electrolyte. But when the capacitor is hooked up backwards, the current is so high and the reaction so intense that enough gas builds up to blow the capacitor apart.

Most aluminum lytics have a rubber seal or vent plug to prevent the component from blowing under momentary overloads. But this seal also allows external substances to enter. Air enters and eventually dries out the electrolyte. This is one reason why even the best lytics have a shelf life as short as 5 years.

Aluminum electrolytics can be easily damaged by cleaning solvents. Solvents, such as trichloroethylene and freon, which are used to clean PC boards, may seep through the seal. They will erode the electrolyte and oxide dielectric and cause the cap to fail within a few short months.

Failures in Aluminum Electrolytics

So far we have looked at how aluminum electrolytics work and what their limitations are. But these components are quite prone to failure. Some aluminum electrolytic capacitor failures are the result of manufacturing abnormalities, some are the result of overload,

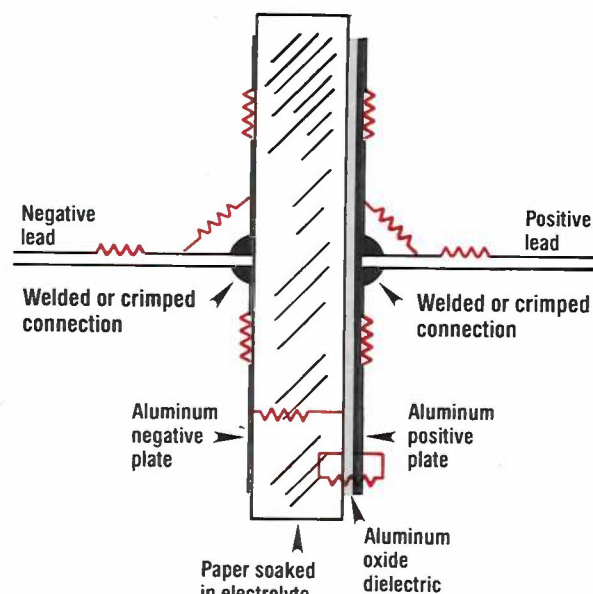


Figure 4: The equivalent series resistance is the combination of all the electrical resistances in a capacitor.

and some are the result of normal operation and construction.

ESR—Equivalent series resistance is the total of all the electrical resistances in series with the capacitor plates, as illustrated in figure 4. All aluminum electrolytics have a normal amount of ESR. But poor mechanical connections caused by vibration or mechanical stress, or increased resistance between the wet paper and the metal conductor plate due to drying, will cause excessive ESR.

The effect that excessive ESR has on a circuit depends on the application. In frequency sensitive applications, such as audio cross-overs, the increased series resistance acts like a voltage divider and greatly alters the circuit parameters. In filtering applications, ESR

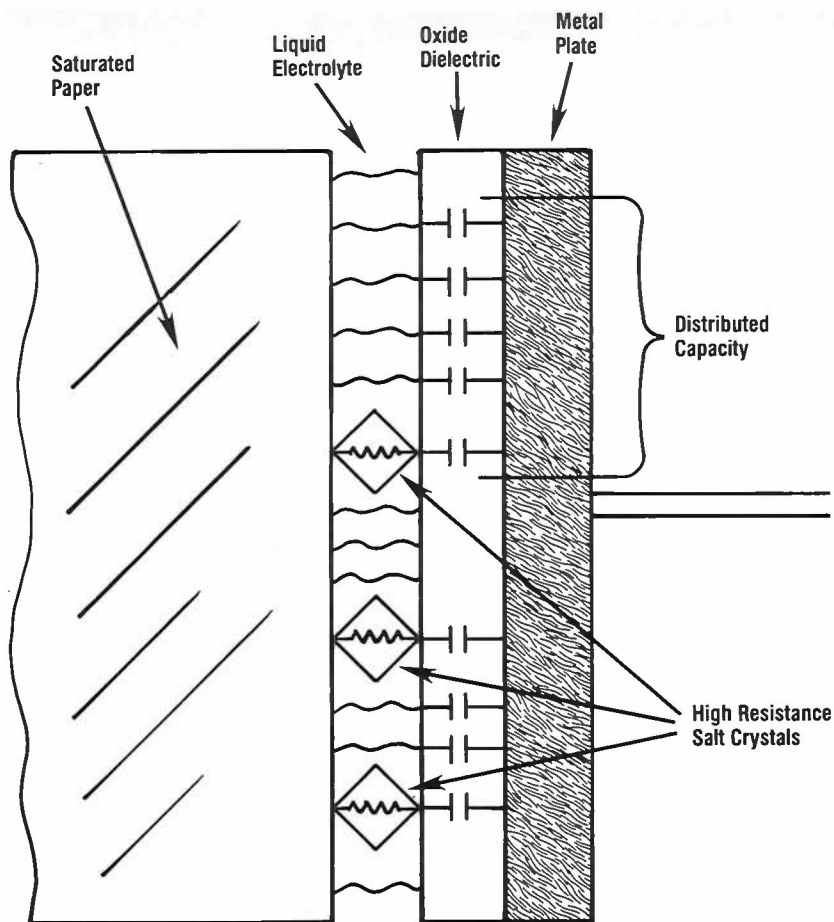


Figure 5: As an electrolytic dries, some of the chemicals in the paper spacer cause high resistance salt crystals to form.

causes excessive ripple. You wouldn't think of placing a resistor between the "negative" leg of a capacitor and ground in a power supply, yet that's essentially what excessive ESR does.

ESR can be a problem even if the circuit is not outwardly affected by it. The ability of a capacitor to handle the AC ripple current in a power supply is limited by its ability to dissipate the heat produced. The heat is determined by I^2R , where I is the RMS ripple current and R is the capacitor's ESR. As R increases, so does the heat. Increased heat dries out the electrolyte faster which increases the ESR even more, accelerating the capacitor's failure.

D/A—Dielectric absorption is the inability of a capacitor to release all of its stored energy. Circuits most affected by D/A are those which depend on the cap to hold a precise DC level, such as sample and hold circuits and analog-to-digital converters. Power supplies are affected by D/A because of the reduced filtering ability of the capacitor.

Aluminum electrolytic capacitors develop excessive D/A as they dry out. As the electrolyte dries, the water is replaced by salt crystals from the dissolved chemicals. The crystals cause some sections of the paper-to-plate connection to have increased resistance. This resistance is not enough to cause high ESR yet, but its effect is similar to the model illustrated in figure 5.

Leakage—Leakage is current that flows through the dielectric between the plates in a charged capacitor. All aluminum electrolytic capacitors have some normal leakage as discussed earlier, but excessive leakage disrupts circuit bias and loads power supplies.

Excessive leakage occurs when the oxide dielectric is no longer replenished by the

electrolyte. Leakage usually results from a dried out capacitor, but it may also occur when an aluminum electrolytic capacitor remains unused for a long period of time, such as setting on a stockroom shelf.

It is not uncommon for an unused, "new" capacitor to blow power supply fuses or even "blow up" when it is put into a circuit. The weakened dielectric cannot withstand the sudden voltage and the electrochemical reaction causes a sudden gas buildup. Leakage, caused by the capacitor setting unused, can be corrected by reforming the dielectric. By applying a current-limited voltage to the capacitor, you can rejuvenate many defective lytics.

Value Change—Value change occurs when the dielectric dries out, or when an internal connection breaks.

Aluminum electrolytics fail least often because of wrong value. One of the other failures (ESR, D/A or leakage) usually cause the capacitor to fail first. This is one reason why troubleshooting circuits containing aluminum lytics is often difficult - most capacitor meters are value only testers.

The LC102 Auto-Z - A Complete Capacitor Tester

The best way to analyze aluminum electrolytic capacitors is to thoroughly test them for all possible failures. And since aluminum electrolytics go bad just setting on your distributor's shelf, you can't let even new capacitors go untested.

The LC102 Auto-Z tests capacitors for all capacitor failures - something "value-only" testers can't do. The portable Auto-Z lets you test capacitors automatically so you can't miss even a single hidden defect.



The LC102 Auto-Z tests electrolytics for all capacitor failures and automatically tells you if the capacitor is GOOD or BAD.

The Auto-Z is a technological breakthrough assuring your tests are accurate without interpretation errors or "look-up" time - yet the tests are kept simple enough for anyone to use. You simply enter value, tolerance, and working voltage (up to 1000 volts!) and push a button. The Auto-Z does the rest as you select the tests you want. All readings are automatic for all four failure modes plus you get a "GOOD" or "BAD" indication telling you if the capacitor meets Electronic Industry Association (EIA) and industry specifications.

Equivalent Series Resistance: You can analyze capacitor ESR simply by pushing button and reading the LCD display. This patented test is impossible to perform with an ohmmeter because the resistance is inside the capacitor. The LC102 measures the ESR, compares the reading to its internal memory of EIA standards, and displays the results as "GOOD" or "BAD".

Dielectric Absorption: To test D/A, the Auto-Z charges the capacitor, discharges it, and then measures the remaining voltage on the capacitor. The patented test is done automatically by pushing one button. The D/A is calculated and displayed as a percentage change with the "GOOD" or "BAD" interpretation automatically made for you.

Leakage: The LC102 Auto-Z tests capacitors under full load with up to 1000 volts applied. The Auto-Z's internal computer tells you if the capacitor's dielectric leakage is within the limits as defined by the EIA. The leakage test catches the capacitors that are already in the failure mode plus it finds the capacitors that are just starting to show signs of excessive leakage. Capacitors are automatically discharged when the LEAKAGE button is released, protecting the operator from shock hazard. The current limited leakage voltage is also excellent for reforming those leaky lytics that go bad setting on the shelf.

Value: The LC102 checks for capacitor value from 1 pF up to 20 Farads with no decimal moving or interpretation. The microcomputer in the LC102 compares the capacitor's measured value with the tolerances you've entered. If the capacitor measures within tolerance, the Auto-Z's display will read "GOOD". If the capacitor falls out of tolerance, the display will show "BAD". That's a Sencore exclusive - you won't find it anywhere else.

Electrolytic capacitors are here to stay in today's electronic world. And since they do fail, the LC102 Auto-Z can be your biggest asset since it tests electrolytics for all failure modes. If you've got a defective electrolytic, the Auto-Z will find it for you.

If you'd like to find out more about the Auto-Z, call toll-free (1-800-SENCORE) and talk to your Sales Engineer. He'll listen to your needs and help you decide what's right for you. And ask him about the NEW "Servicer's Guide To Component Analyzing." ■

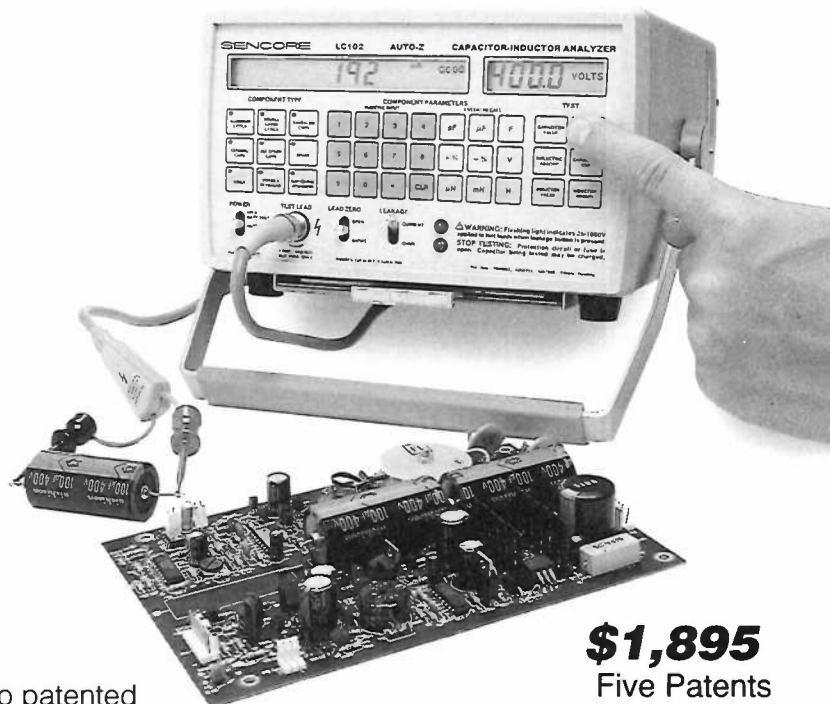
Circle #144 on the Fast Facts Card for a FREE copy of the "Servicer's Guide To Component Analyzing."

What Components Are Causing You To Lose Valuable Servicing Time...

Capacitors? ➤

Only the patented LC102 Auto-Z allows you to catch all capacitor defects.

- Capacitor value to 20 farads to test even memory back-up and storage caps.
- Leakage with up to 1,000 volts applied simulates actual circuit operation.
- Dielectric Absorption (voltage recovery) shows you how the cap responds in-circuit.
- Equivalent Series Resistance (resistance of the leads, plates, solder connections, etc.) especially important in newer high frequency circuits.

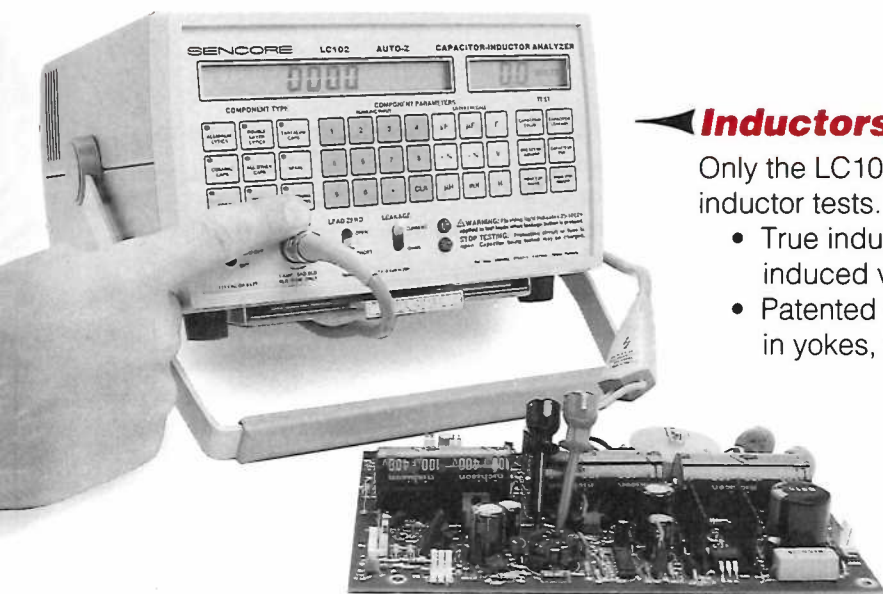


\$1,895
Five Patents

Inductors? ➤

Only the LC102 Auto-Z provides two patented inductor tests.

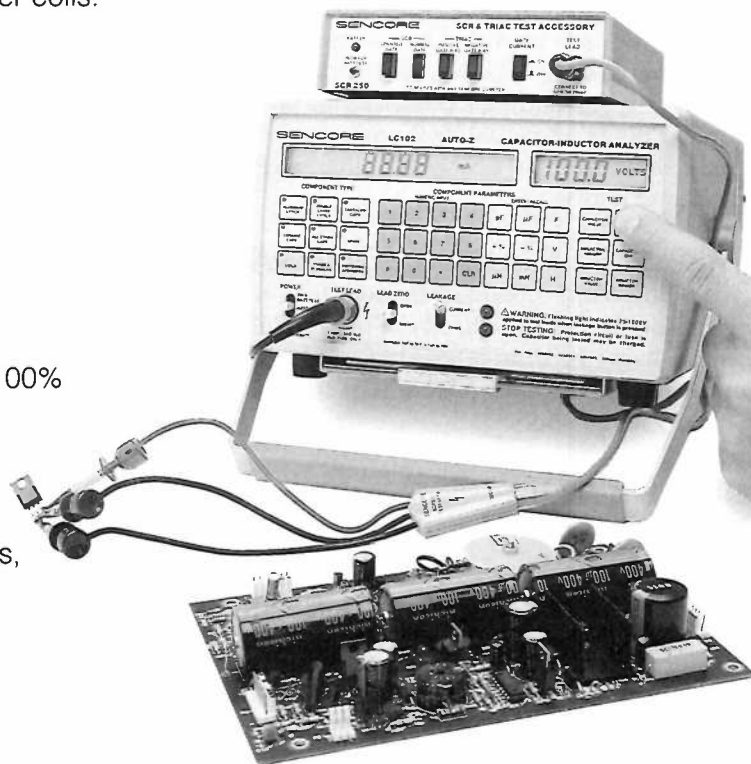
- True inductance value to 20 Henries measures the induced voltage versus the inductive reactance.
- Patented ringer test catches even single shorted turns in yokes, flybacks, and many other coils.



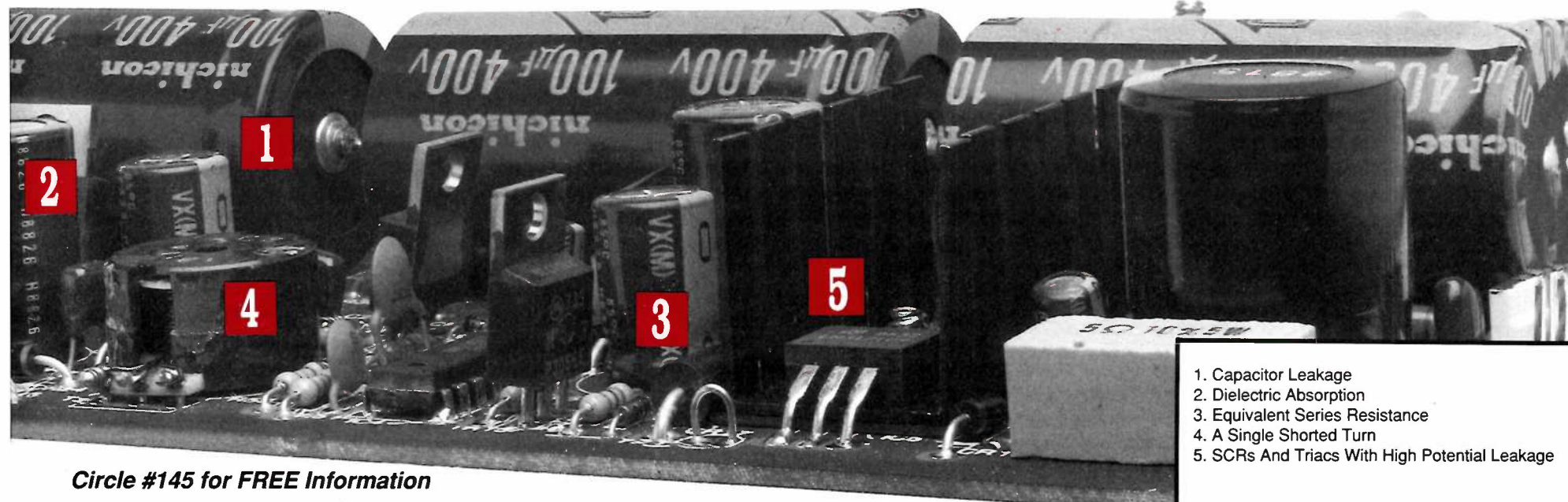
SCRs, Triacs, And Other Components? ➤

Only the LC102 Auto-Z allows you to dynamically test special components with 100% reliability.

- Test SCRs and triacs for turn-on and leakage with up to 1,000 volts applied eliminating swapping.
- Hi-Pot breakdown testing to catch arcing and hidden failures.
- Cable and transmission line tests pinpoints the distance to opens and shorts, even in buried cable.
- Hi-Voltage diode test checks for leakage at full operating voltage.
- Plus, you get portable on-site use for all tests.

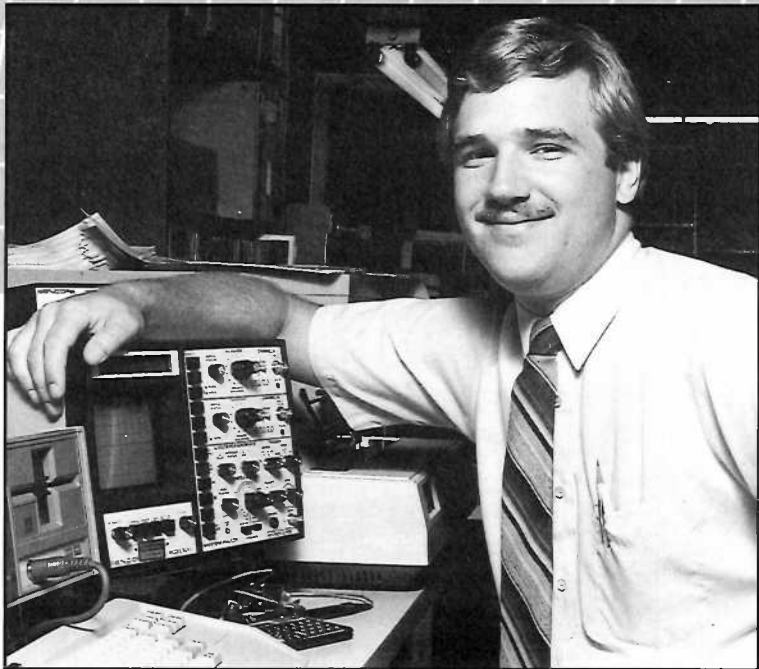


If You're Unable To Find All Five Of These Defects Below, Call 1-800-SENCORE ext. 520, For Free Technical Information!



1. Capacitor Leakage
2. Dielectric Absorption
3. Equivalent Series Resistance
4. A Single Shorted Turn
5. SCRs And Triacs With High Potential Leakage

Circle #145 for FREE Information



Good Quality And Good Service. You Get The Best Of Both With Sencore Instruments

By Dave Drewes, Quality Assurance Director

- Sencore instruments are tested three times to find all early failures
- Three day service puts your instrument back on your bench with minimum downtime
- Sencore's Loaner Program keeps your bench productive even while your instrument is being serviced

Quality is perhaps the most important, but hardest to measure attribute of any product. It is how an individual perceives the characteristics of a product. This perception varies drastically between people and includes how the product looks, ease of use, percent of up time, serviceability, safety features, how often it fails, services provided by the manufacturer, and even cost. As you see, it is very difficult to objectively measure all these things on one scale. This is why quality is sometimes looked upon as an "image" of the manufacturer in the customer's eyes.

True quality cannot be accurately measured, but monitoring certain indicators tells a manufacturer if the quality of his products is worse or better than it was before. At Sencore, our measurement for products in the field is called Field Yield.

Sencore Maintains High Quality Levels

Our Field Yield is the percentage of major products staying in the field (non-defective) for periods of 120 days and one year. The 120 day period gives a good measure of the product's reliability. Presently, the 120 Day Field Yield is 95.9% and the One Year Field Yield is 93.5%. These numbers mean less than five units out of 100 are returned defective within 120 days, and less than seven out of 100 are returned defective within their warranty period.

Compare these figures to TV sets. Can you imagine buying 100 TVs and returning only five of them in one year? National Electronic Sales And Service Dealers Association (NESDA) figures show the average failure rate for televisions is approximately .8 times per year. This figure makes Sencore's 93.5% Field Yield even more impressive. You can depend on Sencore instruments.

How Is This Quality Achieved?

Sencore products are fully tested a minimum of three times. First they are functionally tested and calibrated by our Production personnel. Next they are sent to Quality



The "Shake 'n Bake" room weeds out any unit that would fail within the first month's use. We find the problems so you won't have to.

Assurance and thoroughly tested to all specifications. Then each product is tested again when it comes out of our aging room. Sencore products are aged up to 100 hours in our "Shake 'n Bake" (aging) room. In this torture chamber, the entire unit goes through extensive, dynamic aging, simulating the first month of use. In this burn-in period, the products are continually vibrated, the AC line power is cycled from normal (117 V), to 135 V, to off, while the ambient temperature is kept at 95 degrees.

Any product we force to fail would have failed in our customer's hands, but we found it here instead. Products passing this rigorous testing have the best chance of working with high reliability for you.

All Sencore instruments are safety leakage tested to meet all EIA (Electronic Industry Association) and CSA (Canadian Standards Association) requirements. Leakage testing provides you with safe test equipment under all conditions.

All tests and measurements are traceable to the National Institute Of Standards And Technology (NIST). You get the assurance that every measurement you make is accurate and reliable.

Production samples are checked in adverse conditions, including temperature extremes, high humidity, high-level vibration, drop and shipping tests, and electro-magnetic interference. All of these conditions are encountered by Sencore customers, so we want to make sure our products work anywhere.

The quality levels in our Field Yield are possible because Sencore products are built with pride in workmanship. We stand behind every product with a 100% Made Right Lifetime Guarantee. If a problem develops due to a manufacturing or engineering defect, the repairs will be made free of charge. The most important thing to everyone at Sencore is placing high quality, reliable products in your hands.

We also have a five year rustproof guarantee. Actually, it has become so matter-of-fact that we hardly talk about it anymore because Sencore products simply do not rust. While it may seem out of the ordinary to have a guarantee like this on test equipment, it is



Every piece of calibration equipment used at Sencore is NIST traceable and is monitored regularly against our prime standards.



Our Service Technicians are just a toll-free call away, ready to help you with any service problem.

important to customers along salty coastlines or in humid environments.

High quality products mean success to the user. And since your success means the success of Sencore, we're striving to make our instruments even more reliable. You've come to rely on the quality of Sencore products in the past, and we'll continue to provide you with products you can rely on in the future.

Rely On Sencore's Factory Direct Service When You Need It

Even with all this built-in quality, some products may still fail. Quality is also the theme in Sencore's reliable Service Department, backing your equipment with the same care and procedures of new equipment. Technicians report any problems found in quality, design, or workmanship of any product. Thus customer complaints quickly turn into product improvements.

After repair, instruments are "heatrun" to force remaining failures out of the product at the factory, not at your bench. That may sound like a lot of extra work and expense to try to make your instrument fail. But we feel it's worth it so you don't have to send your instrument in again for repair the next day, week, or month. We do it right the first time.

After the "heatrun", the units are re-tested with the same quality tests used on our production lines. Less than 2 out of every 100 repairs come back for the same problem within 90 days. Other manufacturers' service departments believe that five out of 100 is good enough. We don't. That's why we are working at cutting this number even more. We simply want to give you the highest quality, most reliable products that you can count on.

A high quality product is just one reason our customers keep coming back. Our service after the sale is the best in the industry. Here's seven big reasons why Sencore is #1:

1. Three Day Service

One of the goals of our Factory Service Department is to repair and ship instrument repairs within 72 hours. We realize how important test equipment is to you and your work. That's why we provide 72 hour service at no extra charge. Just mark "Please Rush" with your instrument, and we will.

2. Direct Communication

We offer a unique service for those customers that may want to repair their own instrument. Any customer can call on our toll-free number (1-800-SEN-CORE) and talk to a Factory Service Technician, FREE of charge. If you have a question on any Sencore instrument, we'll put you in touch

with a technician who knows what you're talking about.

3. Instrument Renovation

By working directly with engineers here at Sencore, we keep tabs on the latest design and performance specification changes on our instruments. Having this knowledge allows us to completely update instruments when they are sent to the factory for recalibration or repair. Updates increase the lifetime and reliability of your instrument - at no additional cost to you.

4. Traceable Standards

The Service and Quality Departments work closely to verify NIST. The Quality Department maintains a Primary Standards Lab where we, with the help of our own metrologist, confirm that our Service procedures and methods are traceable to NIST. All

test equipment that is processed by the Service Department is furnished with a "Certificate of Calibration". This certificate verifies traceability for a given length of time, usually one year.

5. Genuine Sencore Parts

All parts sold or used during servicing are genuine Sencore parts. We maintain stock to provide full customer support for seven years after the manufacture date. After this time, parts will be stocked according to demand and vendor availability. We have stock to replace parts on many of Sencore's instruments that haven't been manufactured in ten years.

6. 48 Hour Parts Shipping

All parts orders are shipped within 48 hours after we receive your order. This support reduces your downtime to a minimum. We even have UPS Red Label Service which allows us to send it next day delivery. Just ask for Red Label Shipping when placing your order. Some custom manufactured parts and subassemblies may take longer than 48 hours to ship because stock is based on demand and vendor availability.

7. Return Authorization

Sencore's Service Department is unique among factory service centers in that we do not require return authorization. We are staffed to handle all peak periods, because when your instrument needs servicing, you need it back on your bench as soon as possible.

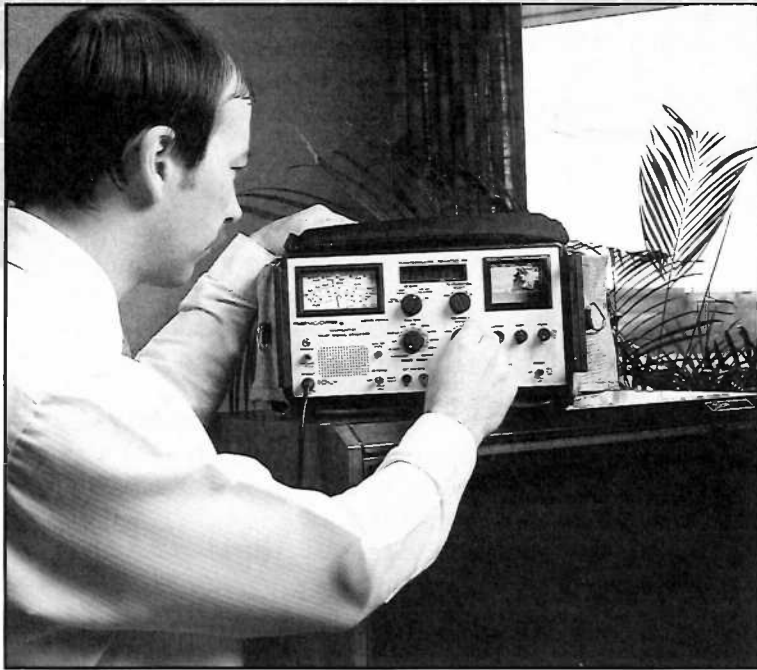
Simply pack the instrument in the box it came in (or similar), and return it to us at the factory. Just include a brief note explaining what services your instrument requires, and we'll take care of everything else.

Have questions on servicing a Sencore instrument? Do you need help repairing a Sencore instrument yourself? Call us toll-free at 1-800-SEN-CORE and we'll take care of your instrument needs. We want your Sencore instrument to work right. ■

Circle #148 on the Fast Facts Card if you have a question on quality or service.



Our Service Parts Department sends your parts order on its way within 48 hours.



TV-RF-Video Servicing Solutions Beyond The Repair Bench Can Increase Business Profits

By Glen Kropuenske, Application Engineer

- Discover opportunities and solutions for antenna work
- Track S/N problems on-channel!
- Find ghosting and interference problems with the FS74A's video monitor

How completely does your business serve your customers? Do you offer solutions for customers beyond the repair bench? Are you turning down opportunities for added profit?

Successful electronic service centers have a passion to serve customers. They do everything possible to insure customers get the most enjoyment and satisfaction from their video products. For many, this means offering solutions beyond the repair of a TV or VCR. Offering video solutions can lead to an avalanche of servicing opportunities and growth for your business. Let's look at one opportunity.

With all the modern VCR and television receivers on the market, one would think the average customer would be 100% satisfied with the picture on their TV. You know the opposite is true. Video signals are often imperfect due to problems with antennas, preamplifiers, download cables, or RF distribution equipment. Your best TV repair job cannot compensate for poor RF video signals.

There are over 90 million U.S. television households. About 45 million of these homes depend on some type of antenna or satellite reception for their television RF signals. Antennas and satellite dishes provide local information along with network, educational, or independent channel programming. TV RF signals from antennas or satellites can be poor for many reasons, but people still desire high quality TV pictures. Low signal level, poor S/N ratio, ghosting, co-channel, and other interference problems degrade RF signals.

These systems develop problems affecting a single household, or perhaps an entire apartment complex. And when complaint calls start filtering in, you can bet the users want the system fixed in a hurry, at any cost.

You can pickup extra income doing installation jobs or servicing a regular maintenance program. Just a couple contracts can give you that extra income to top off your regular profits. Let's take a look at some of the problems and solutions of antenna - satellite work so you can start exploring these new opportunities.

Estimating And Testing Signal Levels

Mother nature causes antenna elements, connections, and download cables to break or oxidize - reducing the signal strength causing snowy TV pictures. Testing antenna signal strength requires an estimate of the signal intensity present at the antenna and the use of a sensitive signal level meter.

The signal intensity present at an antenna depends on the TV station's power, frequency, transmitting antenna height, intervening

terrain, and distance (see Tech Talk box). To produce a good TV picture, the signal strength supplied to the TV receiver or VCR by the antenna should be higher than 1000 μV (0 dBmV). This level is high enough so the TV receiver does not add noise to the picture. Testing for this adequate signal level requires an RF signal strength meter calibrated in industry standard μV and dBmV.

The Sencore FS74A Channelizer Sr. tunes directly to each off-air TV channel for measurements of signal level in μV or dB. It measures fringe signals to -46 dBmV or strong

Sencore Tech Talk

Estimating Field Strength vs. Distance

Estimating the signal level measured by a field strength meter hooked to an antenna requires that the $\mu\text{V}/\text{meter}$ signal intensity be converted to its equivalent power in dBmV or μV across a 75 ohm impedance. Use the following formulas:

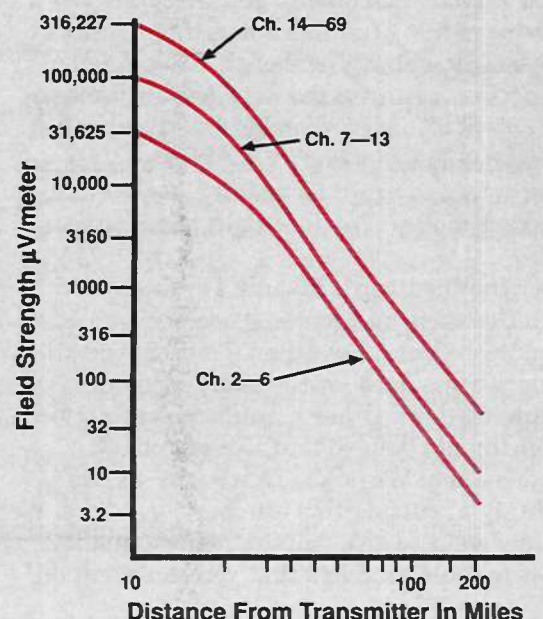
$$\text{Meter reading in } \mu\text{V} = \frac{\mu\text{V} / \text{m}}{.021 \times \text{Frequency in MHz}}$$

$$\text{Meter reading in dBmV} = \frac{20 \log (.0484 \times \mu\text{V} / \text{m})}{\text{Frequency in MHz}}$$

The antenna gain and height increase the signal strength induced in the antenna. Antennas used for TV reception commonly have multiple elements. The additional elements increase the level of the received signal. A five element antenna has a 6-8 dB gain while a 10 element antenna offers a 9-10 dB gain compared to a dipole. When considering antenna height, figure a 6 dB increase each time you double the height. For example, when increasing the antenna height from 30 to 60 feet you would add 6 dB of signal gain.

To estimate the signal level, add the antenna's dB gain and height correction in dB to the converted dBmV level. Remember,

these are only estimates, but they can be helpful when troubleshooting or installing new antennas. The measured antenna signal level will depend on elevation, terrain, and signal blockage.



Estimated field strength vs. distance for TV station operating at full power with 1000 ft. transmitting antenna and 30 ft. receive antenna.

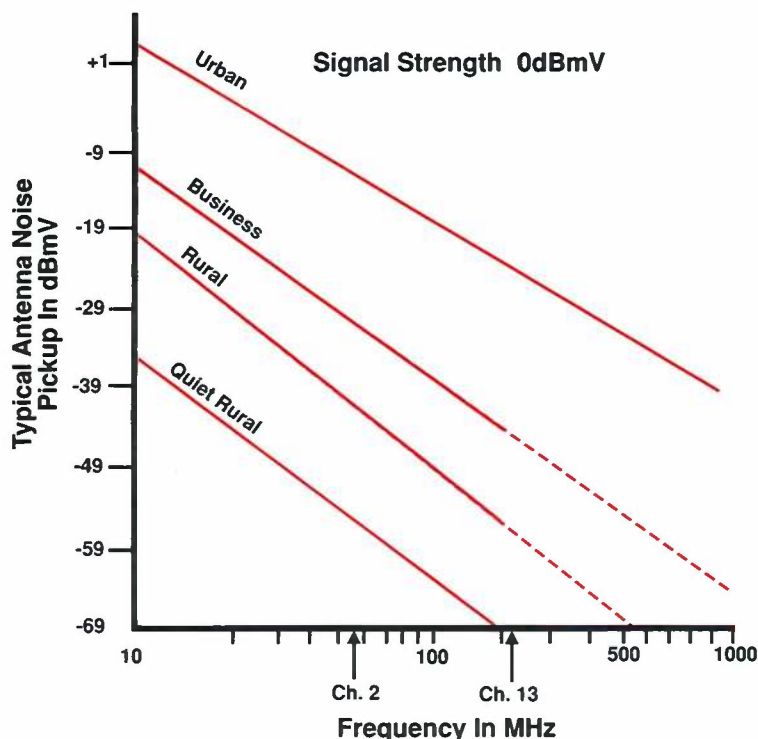


Figure 1: Urban areas show considerably more noise pickup on antennas than in rural areas.

local signals to +60 dBmV. Tuning and attenuator switching is automatic for error free readings in seconds.

You simply make one connection to the FS74A and read the meter. You don't have to worry about formulas or calculations since both μ V and dBmV are displayed directly and automatically.

Analyze S/N Ratio Problems With On-Channel Noise Test

Signals greater than 1000 μ V don't insure noise free pictures on the TV. Results of studies done by the National Cable Television Association indicate a S/N (signal-to-noise) ratio of over 42 dB is required to get 90% of the viewers to agree the picture was "fine". This means that the power of the television signal must be 42 dB greater than any interfering noise signals. If the signal strength supplied to a properly working TV is over 0 dB, and the S/N ratio is greater than 42 dB, the video picture will be snow free.

The noise generated in a 75 ohm antenna or TV system with a 4 MHz bandwidth is -59 dB. The antenna, cable, and electronic equipment along the RF signal path all increase the noise level. This means the noise in a television system is always higher than -59 dB and the best S/N ratio is obtained at the antenna.

Along with the internal noise of the antenna system, the antenna can pick up undesired noise. The level of undesired noise to the antenna depends on the frequency and location. Noise pickup comes from natural sources such as solar noise and lightning discharge, or from man-made sources such as ignitions, motors, neon lights, or corona discharges from power lines.

Figure 1 shows average noise level curves adapted from the Reference Data for Radio Engineers and National Bureau of Standards. The curves show a considerable difference between noise pickup between a quiet rural

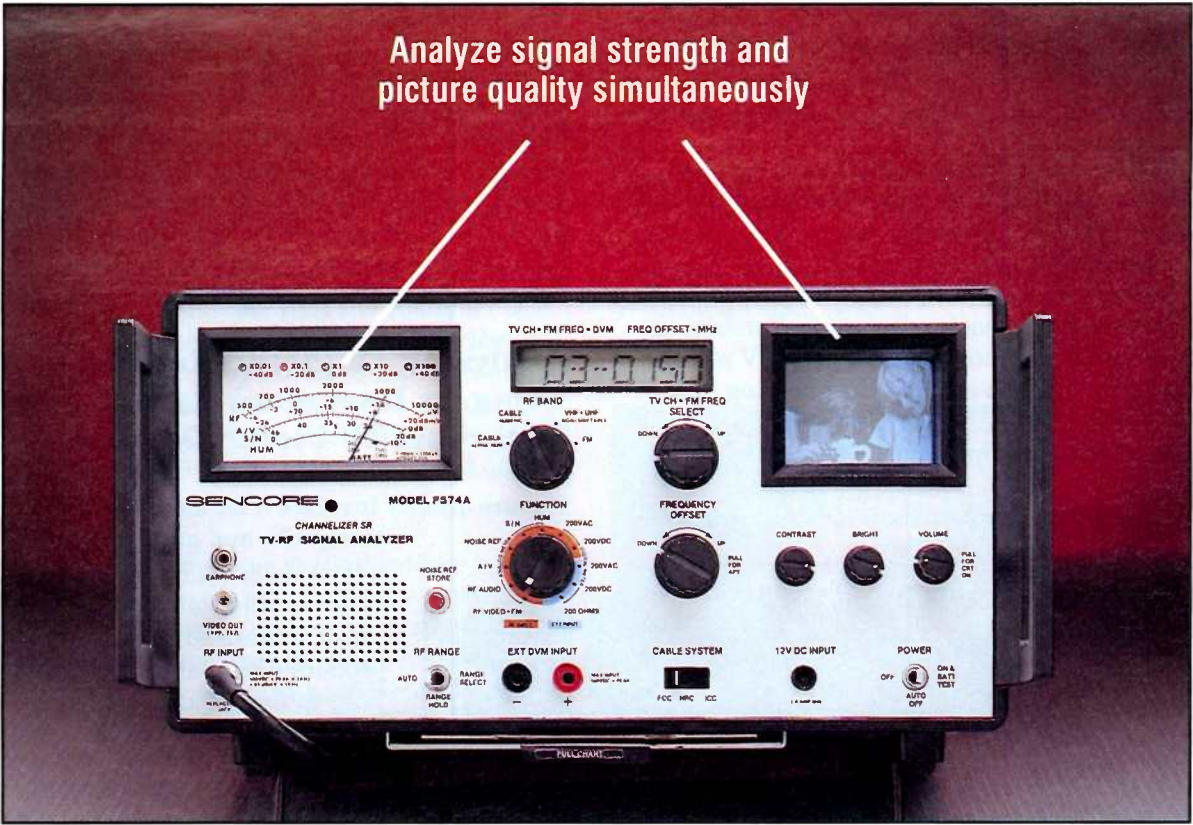
area and urban area. At 0 dBmV, the noise pickup on channel 13 would be minimal. The noise level is equal to the thermal noise of the system. The same 0 dBmV signal received by an antenna in the urban area may have a noise pickup of close to -20dB. The difference of over 50 dB means you need a much stronger signal to produce an acceptable picture in an urban area.

It is important that the antenna gain and height provide an acceptable signal level to achieve a good S/N ratio at the antenna. If you cannot get a signal level greater than 200 μ V (-14 dBmV) consider a better antenna, stacked antennas, or additional height. To get the signal to the TV with a level of at least 0 dBmV and a good S/N ratio, all signal losses must be considered. The signal loss of the downlead depends on the length and size of the cable and the signal frequency.

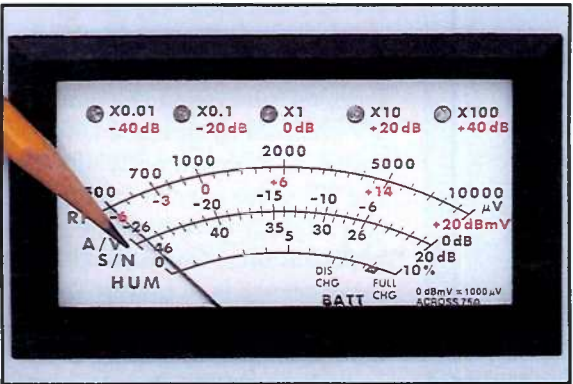
Other devices in the signal path such as signal combiners, dividers, and A/B switches further reduce the signal level and S/N ratio. If the noise at the antenna is near the thermal noise of the system, each dB of attenuation in the signal path directly lowers the S/N ratio.

Using the FS74A Channelizer Sr., first check the input and output signal levels and note the dB loss of the cable or processing devices to pinpoint problems. If the normal losses between the antenna and TV reduce the signal to less than 0 dB, consider installing a preamplifier near the antenna. A preamp will preserve the S/N ratio at the antenna and provide gain to offset the signal losses. The preamplifier will amplify the input signal and noise. In addition, the preamplifier will add some noise decreasing the S/N ratio by its rated noise figure. For example, if the S/N ratio is 49 dB and the noise level of the preamplifier is 3 dB, the output S/N will be 46 dB.

To confirm the S/N ratio will not affect the TV picture, you need a true on-channel measurement of the noise in the RF channel being tested. The FS74A measures the noise in the RF video signal during vertical blanking and automatically calculates the S/N ratio. The test provides a true indication of noise on-



The FS74A lets you measure the signal strength of the RF signal and analyze the picture on its built-in CRT at the same time.



Signal to noise ratios are calculated and displayed automatically on the FS74A's meter. Here a S/N reading of over 46 dB indicates a clean signal.

channel for analyzing TV-RF distribution equipment.

The FS74A's patented S/N test makes tests without removing or decreasing modulation. The ratio is displayed directly on the meter in dBmV so you can't make an error. The test is as easy as pushing a button and turning a knob. You won't find an easier or more accurate S/N test anywhere.

Analyze Ghosting Problems With The Portable FS74A TV Monitor

Ghosting is bothersome to TV watchers and frustrating for antenna servicers. Ghosts on

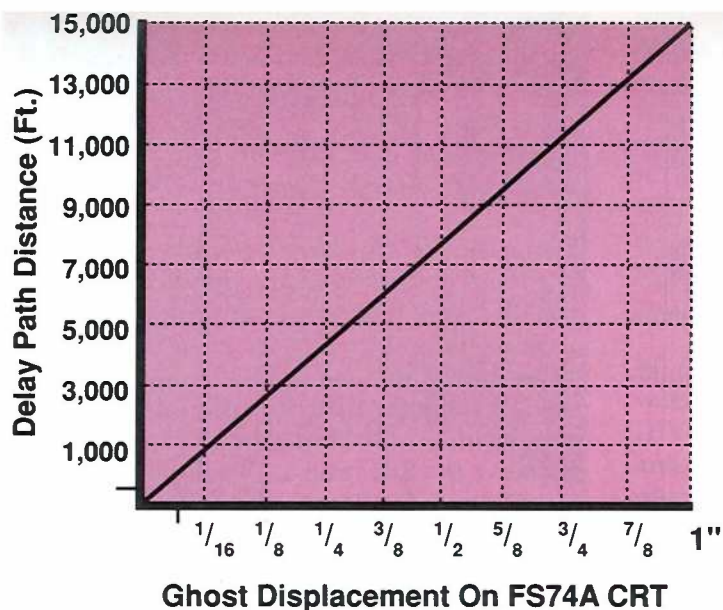


Figure 2: Distance of signal delay to produce CRT ghost displacement on the FS74A TV video monitor.

the TV picture occur when a delayed signal from the same transmitter reaches the TV microseconds after the direct signal path. Signals that bounce off objects like buildings or towers add extra distance to the signal path. These ghost signals arrive at the antenna at various angles and strengths causing signal reflections and ghost images on the TV picture. Ghosting can also occur when the signal encounters an impedance mismatch in the cable or equipment in the signal path to the TV.

A signal level reading provides no help in testing or troubleshooting ghosting problems and may cause improper antenna orientation when peaking the antenna to a ghost signal. The best way to analyze ghosting is through the use of a TV picture monitor. Combining the signal level indication with a TV picture monitor lets you analyze the ghosting at the antenna and determine the travel distance of the offending signal.

The Sencore FS74A Channelizer Sr. lets you

see the CRT picture while monitoring the signal level at the antenna. Testing the signal at the antenna determines if the ghosting is due to multi-path signals at the antenna or an impedance mismatch. The FS74A's signal strength meter combined with its video monitor helps identify the angles at which the ghost signal reaches the antenna. And, you don't have to drag along an extra TV since the FS74A operates for hours on one battery charge.

Rotate the antenna and note where the ghost signal is the most distinct while monitoring the FS74A's level meter. You can minimize antenna ghosting by shifting the antenna direction or by choosing a more directional antenna or

array to provide signal rejection to the ghost signal path.

To make a ghost visible on a TV screen requires that the path of the ghost signal travel at least 200 ft. farther than the main signal. Ghost signals traveling less than 200 feet farther than the direct signal path cause only a slight picture smear.

Travel distances between 200 and 15,000 feet produce signal delays of 1/32 to 1 inch on the Sencore FS74A video monitor. The chart in figure 2 shows the additional travel distance which produces the ghost displacement on the FS74A's TV video monitor. Use this chart and the ghosted signal on the FS74A's monitor to help tune in the best antenna signal possible.

Analyzing TV Picture Interference Using An Integrated Signal Level Meter And TV Picture Monitor

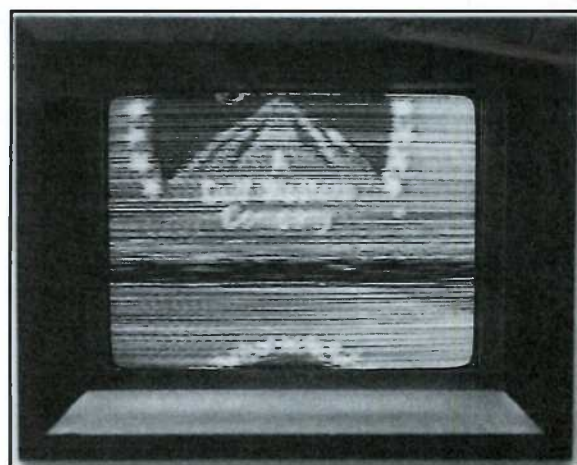
Picture quality involves a lot more than signal level, S/N, and ghosting. Any television antenna inherently receives other off-air signals. These undesired signals can produce diagonal or horizontal lines in the picture, poor sync, noise, or distortion in the audio.

Co-channel interference is caused by a TV station on the same channel. If this type of interference is severe, it causes horizontal lines across the picture and loss of sync. To minimize co-channel interference, the FCC separates transmitters using the same TV channel by at least 180 miles, and occasionally offsets the TV video carrier frequencies slightly to reduce the perceptibility. Co-channel interference is not a big problem for most small antenna installations, but can be prevalent with high-gain antennas mounted on tall towers. Atmospheric or tropo-

spheric conditions also cause co-channel interference by causing TV signals to travel greater distances than normal.

The amount of co-channel interference depends on the power of the co-channel TV transmitter, the distance to the antenna, and the receive antenna's gain and directivity. Rotating the antenna to peak the co-channel interference can help identify the offending signal direction. But since the interference is on the same frequency, filters cannot be used to eliminate co-channel interference. Identifying the location of the offending co-channel can help determine if a different antenna pattern or higher front-to-back ratio can be used to minimize the interference.

Other signal interference shows up in the TV picture as diagonal or wiggly lines referred to as beats. These lines usually aren't caused by antenna problems. They are caused by strong signals received by the antenna other than the desired TV signal. These strong signals overdrive antenna preamplifiers, TV or VCR RF amplifier stages, or other electronic equipment in the TV signal path. The severity of the beat interference depends on the strength and number of interfering signals. Analyzing interference problems requires a TV picture monitor and signal level meter.



Many interference problems show up as beats or lines on a TV. Use the FS74A to monitor these problems and track them down to the source.

The FS74A tests for interference using its wideband monitor at the input and output of the system to verify the presence of interference. Once you have identified where the beat interference is developed, check for the presence of strong local off-air signals. Use the level meter to test off-air TV or FM radio signals or other strong RF signals near the TV band. Once the offending signal(s) is identified, you can determine what type of filter or equipment changes are needed to reduce the level of the offending signal(s) to eliminate the interference.

With a modern TV-RF signal analyzer, such as the Sencore FS74A, you can thoroughly analyze and pinpoint any TV-RF video distribution system problem automatically. For additional information on providing solutions in antenna and TV-RF distribution troubleshooting, call 1-800-SENCORE and talk directly with a friendly technical sales engineer. He'll listen to your needs and come up with a solution that works for you! ■

Circle #138 on the Fast Facts Card for information on profitable MATV servicing.



Don't let a misaligned TV set mislead you. The FS74A's wide band monitor shows if a problem actually exists.



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!

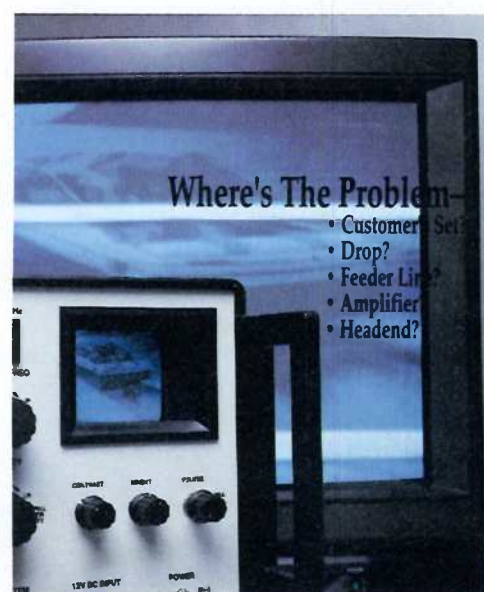
1 Sencore's New FS74A Channelizer Sr. allows you to measure signals all the way from the headend to the subscriber's tap, automatically and without any interpretations. Simply connect the signal and digitally tune through the channels in your system. You'll quickly read the video and audio levels of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

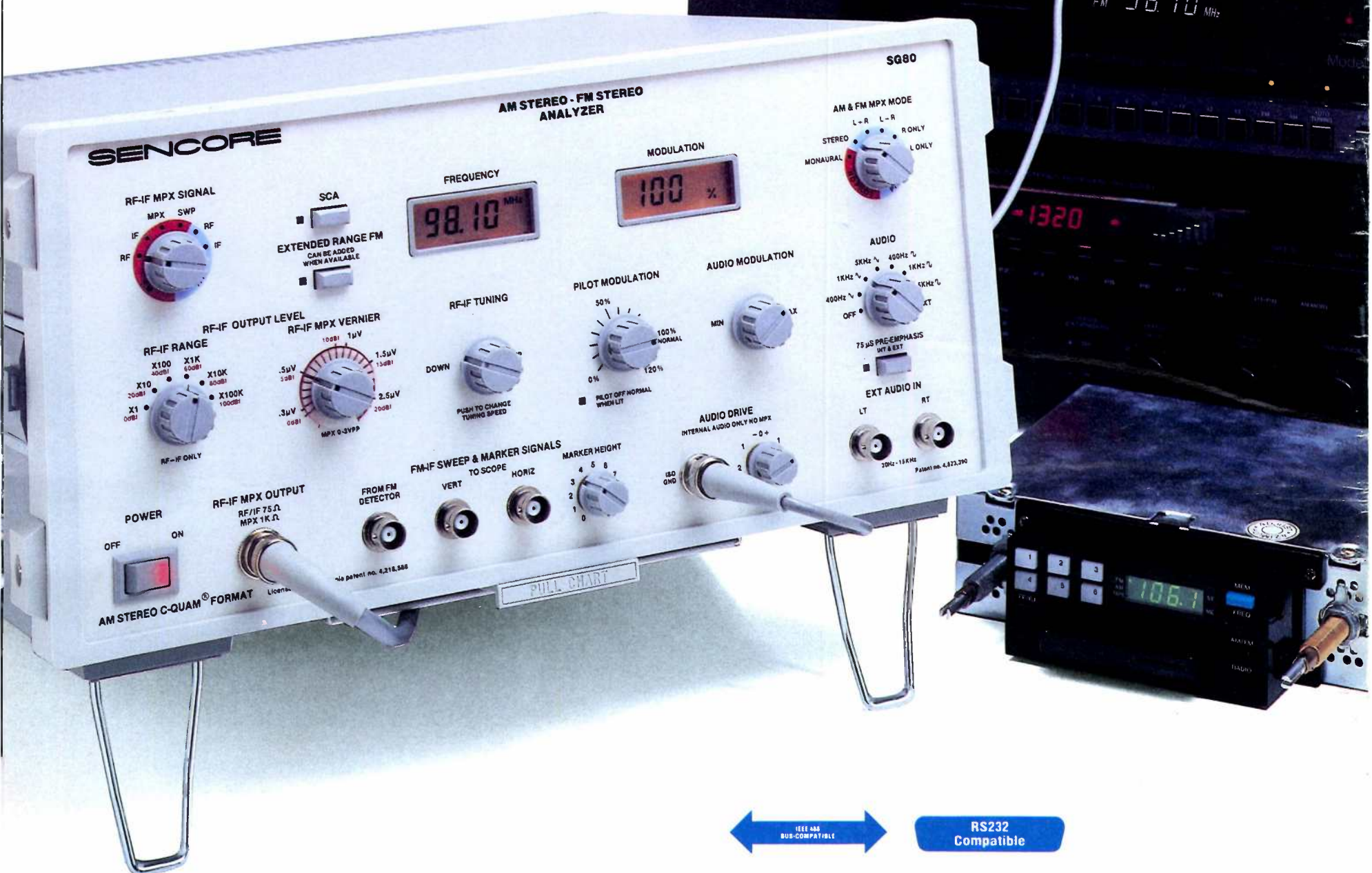
- FCC, HRC, and ICC cable shifting.
- Exclusive integrated AC and DC voltage measurements through the RF or DVM inputs.
- Portable — battery operation.



For More Details Call 1-800-SENCORE Ext. 532
Circle #150 for FREE Information. (736-2673)

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SG80 AM Stereo-FM Stereo Analyzer

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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.