SENCORE NEWS

ISSUE #123

The SC61: Owners Tell Us How They Increased Their Productivity

We recently surveyed our SC61 customers and asked them to explain how the SC61 helps them increase their productivity. Hundreds of SC61 owners, from every area of electronics, responded. Three main SC61 features were mentioned again and again as the most important reason for increased productivity. What is the biggest timesaving feature? We'll let you decide, but chances are your scope doesn't have what it takes to make you as productive as the SC61. Find *out why* by reading about the scope features that are important to our SC61 owners. Then ask yourself if your scope is really allowing you to be as productive as you could be.
Page 3

Industrial SC61 Scope Probe

Several of our large quantity SC61 purchasers asked us to build a scope probe which they could repair in the field. We call the probe our industrial SC61 probe and are now making it available to all SC61 owners. Learn the details of this new, field repairable probe.
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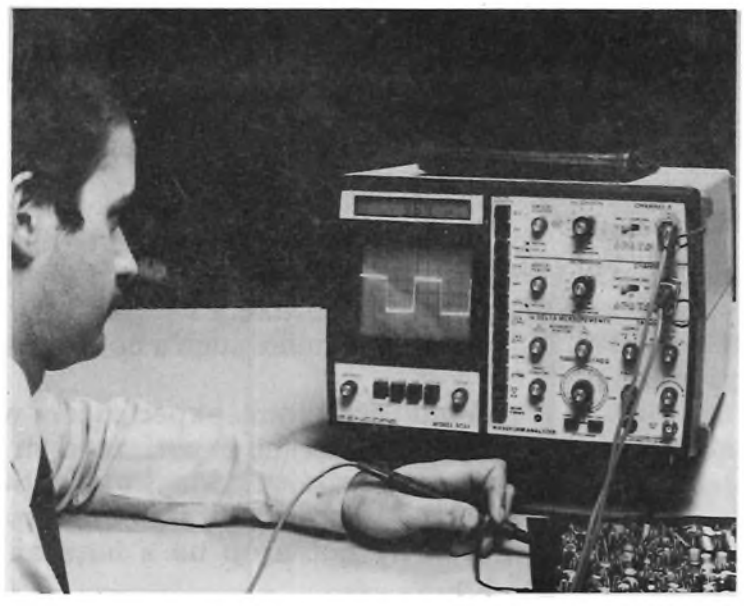

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Video Service Update

Servicing Vertical Circuits (Featuring The RCA CTC108 Chassis)

Vertical circuits are probably the toughest stage in a television receiver to troubleshoot. Learn how the VA62 Video Analyzer, using signal substitution, helps you isolate even the toughest vertical problem in just minutes.

Page 12

How To Dynamically Test Projection CRTs

It takes a special CRT tester to check a projection tube: and only the CR70 can do it. Find out what makes the CR70 so unique and why it is a must for any video service technician who services projection TVs.

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FCC Accuracy All Day

The FC71 is the only truly portable counter on the market that gives you FCC accuracy for a full day. All other counters have either an oven or a sloppy timebase. Discover the secret of the FC71 ovenless timebase and portable, FCC accuracy. **Page 6**

Is A Volt A Volt?

Everyone takes for granted that the readings on any DVM will agree with the readings from a DVM made by another manufacturer. Discover how every piece of Sencore equipment is calibrated to insure that it agrees with standards. **Page 11**

LC53 Owners Speak Out About Their "Z"

The LC53 is a very versatile meter for checking capacitors, coils, high voltage diodes, SCRs, and even coaxial cables. In past issues of the Sencore News we've told you how to use the LC53 in all of these applications. Now discover for yourself how the LC53 performs in these applications by reading comments taken directly from customer letters. Then decide which application will be the most important for you. **Page 8**

Plus, These Features:

Sencore Recognizes Outstanding Employees

Meet some of the people at Sencore who provide you with the best service and product available. **Page 26**

New Test Leads Keeps Your Equipment In Top Shape

Update your equipment with new leads and keep your equipment functioning to its fullest capabilities. **Page 23**

Field Application Bulletin

Special notes on how to use your Sencore instruments to their fullest capabilities. **Page 24**

Dear Sencore;

My experiences with the Sencore SC61 Waveform Analyzer are:

"The SC61s clear dual trace display and accurate timing of these waveforms are a necessity. Its ease of use has made it a working tool of several of our technicians. Whether it be a level measurement, frequency check, or simple alignment of one of our magnetic tape drives, the SC61 has worked perfectly. Its combination of features has saved many manhours previously spent on setting up separate instruments. When wasted time translates into wasted dollars, every minute saved by the SC61 is money in the bank."

Jeffrey W. Hohman
Marketing Director
Hohman Telephone Company
Pelican Rapids, MN

"I have repaired and calibrated test equipment for the period of 1960 to 1973. Since then I have repaired all types of electronic equipment. The SC61 is one of the finest scopes I have ever worked with. The ease of being able to see a display and having the capabilities of digital readout at the same time with the same probe is remarkable. I feel that this scope can replace 95% of all scopes in use. This scope definitely gives you more for your money."

William E. Tice, Jr.
Technical Services, Engineering
Rex Hospital
Raleigh, NC

"We would rather use the SC61 than our other scopes, including Hitachi and Tektronix. Sometimes the technicians will wait to use this instrument if someone else is troubleshooting with it. As far as troubleshooting time, it has decreased significantly. We only have to use one test point and instrument for reading frequency, voltage and to see the waveform".

Earl Clossin
Director of Clinical Engineering
St. Luke's Hospital
Cleveland, OH

"The SC61 paid for itself within the first 3 months I had it by saving technician time. The SC61 takes the guesswork out of circuit tracing. Other departments are continually wanting to borrow our SC61 and not use their more expensive scopes. It has gotten so serious that I feel I must put a chain on it to keep tabs on the SC61 so someone doesn't borrow it permanently. Hats off to Sencore."

J.A. Petrenko
Engineer
Sohio
Cleveland, OH

"The SC61 operates better than you advertised. The ability to read frequency, VPP, VDC all at your finger tips is simply amazing. It does cut my time in half. It's an excellent product, keep them coming."

David Denhup
Electronic-Mechanical Engineer
Alinabal
Milford, CT

"We were quite impressed with the quality and versatility [of the SC61]. The ease of use was demonstrated by how fast our technicians chose this unit over the other scopes we use."

Alan L. Waller
Supervisor Electronics
Airpax Corporation
Cambridge, MD

"I find that with the SC61 I can get in and out of a job faster, and [getting] out of a job [fast] is where the money is. The SC61 has increased my productivity and made some difficult to understand circuits easy."

George Tschappat
Tech I
ERS
Oklahoma City, OK

The SC61 is the only scope on the market that is guaranteed to double your scope productivity. In the following article we'll take a look and see why we are able to make such a bold claim.

What are your experiences with the SC61? Have you experienced an increase in productivity? Maybe the SC61 has helped you find a tough dog problem. If so, why not drop us a note and let us know.

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NOTE: These quotes are the opinions of each user. The name of the company is included for reference only. The companies do not necessarily endorse the product.

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The SC61: Why Owners Say it's "...A Dream Come True..."

by Steve Fritcher, Application Engineer

We call the SC61 a waveform analyzer. Why? Because it does more than just display a waveform — it analyzes the waveform too. We asked our SC61 owners to tell us how their SC61 Waveform Analyzer helped double their productivity. Three things were mentioned again and again. Let's take a look at these reasons, and see why they are important to you too.

Digital Readout

Digital readout ranked as the number one reason why the SC61 doubles our customers scope productivity. To see why a digital readout is such an important time-saver, let's look at the procedure necessary to obtain the important waveform information from a conventional scope without a digital readout. First, we position the waveform so that the bottom tip of the waveform touches a graticule line, like the waveform in figure 1. Then, we'll count the graticules up to the very tip of the waveform. If the tip of the waveform falls in between markings, you must estimate its height. Now, to find the peak-to-peak voltage of the waveform, we need to multiply the graticule count by the scope's Volts/Div setting.

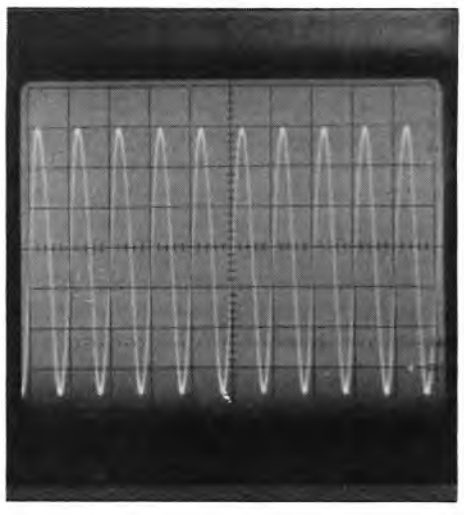


Fig. 1: Conventional scopes require the time consuming chore of graticule counting to obtain any useful measurements.

Wouldn't it be faster if you could just push a button and get the peak-to-peak voltage reading automatically? You could save all that time you wasted counting those graticules, and save the time you spent converting the graticule reading into a voltage.

Fig. 2: The SC61's digital readout provides you with all the waveform's essential parameters with just a push of a button.

That's exactly what the SC61 does for you. Its digital display automatically shows the peak-to-peak voltage of a waveform with just a push of a button (shown in figure 2).

The SC61 not only measures peak-to-peak voltages, it also measures the DC voltage and frequency of a waveform, too—with just a push of a button. This means you get an accurate digital readout of the three most important waveform characteristics without any time consuming graticules counting or complicated multiplication. The entire waveform is analyzed just through the pushing of a few buttons.

One of our customers is Doug Julander, the Director of Biomedical Engineering at Lakeview Hospital in Bountiful, UT. Doug found that with the SC61 his time savings are incredible.

> *"The SC61 has been a dream come true. At the push of a button all the bio-medical equipment readings necessary for calibration are right at my finger tips. No need to turn to a calculator or a DVM or a frequency counter. Time saving is incredible, as well as important, and the readings are stable and accurate, I can trust them...I can count on the precision of my SC61—and it has never let me down...."*
>
> *Doug Julander*

Fig. 3: Doug Julander has found that his time savings have been incredible since he started using the SC61.

One Probe Measurements

While our SC61 Waveform Analyzer allows you to digitally measure three different circuit parameters, it's not at all like having three separate instruments. The SC61 is one instrument that performs many different measurements through just one probe. This saves you the time involved in switching test leads, and also eliminates the possibility of loading down the circuit by connecting too many test leads.

Most other scopes with a digital readout are piggy-back units that require you to use more than one set of probes. You could just as well have many separate pieces of equipment since you have to use separate probes for each measurement, like the setup in figure 4. To read a DC voltage, you need to connect the DC voltmeter to the circuit. Then, to read the peak-to-peak amplitude, you need to connect the peak-to-peak meter. Finally, to get a frequency reading, you need to connect the frequency counter to the circuit. Connecting all these test leads to the circuit at once loads down the circuit and causes erroneous results, not to mention the confusing pile of test leads it leaves you with. For example, connecting four instruments, each having a 1 megohm input impedance, appears to the circuit as one instrument with an input impedance of 250 kilohms. The SC61, on the other hand, takes all three measurements from just one test probe. This means you can view the waveform, digitally read the DC volts, volts peak-to-peak, and frequency — all without moving a probe or loading down the circuit.

Fig. 4: Eliminate the confusion encountered when using many instruments. Take all your measurements through just one probe with the SC61.

C. A. Honey, a retired design engineer for Hughes Aircraft, probably speaks best for the SC61 customers who find the SC61's one probe measurements most important.

(continued on page 4)

"At Hughes I had access to every expensive oscilloscope, especially Tektronix and Hewlett-Packard, I spent the last 16 years designing test equipment for Hughes and used Tektronix in designing and checking out the equipment...None of the other brands to date can do the things which are easily accomplished with the SC61. The Hewlett-Packard and Tektronix scopes with their "piggy back" digital units were too slow and cumbersome with all the extra test leads. Those readouts on the CRT itself could not do the same measurements as quickly as the Sencore SC61."

C.A. Honey

The SC61's Rock Solid Sync

The third major reason that our customers gave for their SC61 doubling their productivity is rock solid sync.

Think about all those times you tried to view a noisy waveform on your conventional scope. Remember how you carefully adjusted the triggering just to make the waveform slightly visible. Even then the trace had shadows and extra images appearing on it, like the waveform in figure 5. As soon as you let go of the trigger knob, the waveform disappeared—all that work for just a barely visible waveform.

Well, that won't happen with the SC61. The SC61 uses fast ECL logic and noise cancelling differential amplifiers to provide the SC61 with the best sync in the business. A quick adjustment of the trigger knob, and the waveform is solidly clamped on the SC61's CRT. No knobs to fiddle with, "no muss or no fuss". Plus, you can bump the scope, turn it off and back on, or disconnect the leads and reconnect them. The analyzer will lock rock solid onto the waveform every time.

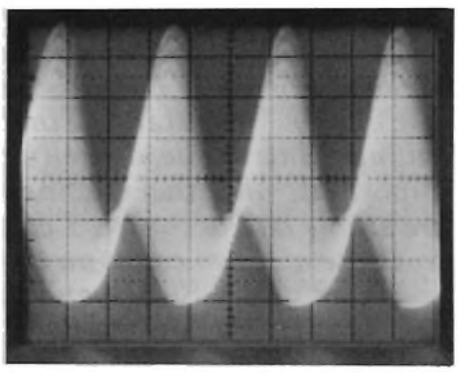


Fig. 5: The SC61's rock solid sync completely eliminates the jittery, fuzzy, unclear waveforms that are so common to conventional scopes.

Keith Postel, an electronic supervisor at Mercy Hospital in Cedar Rapid, IA, and Peter Stafani, a manufacturing engineering technician for Sony Professional Products in Fort Lauderdale, FL, are two of the many customers who have found our triggering exceptional.

"The SC61 is the stablest scope I have ever used. There is no need to fiddle with controls. Just set it and forget it."

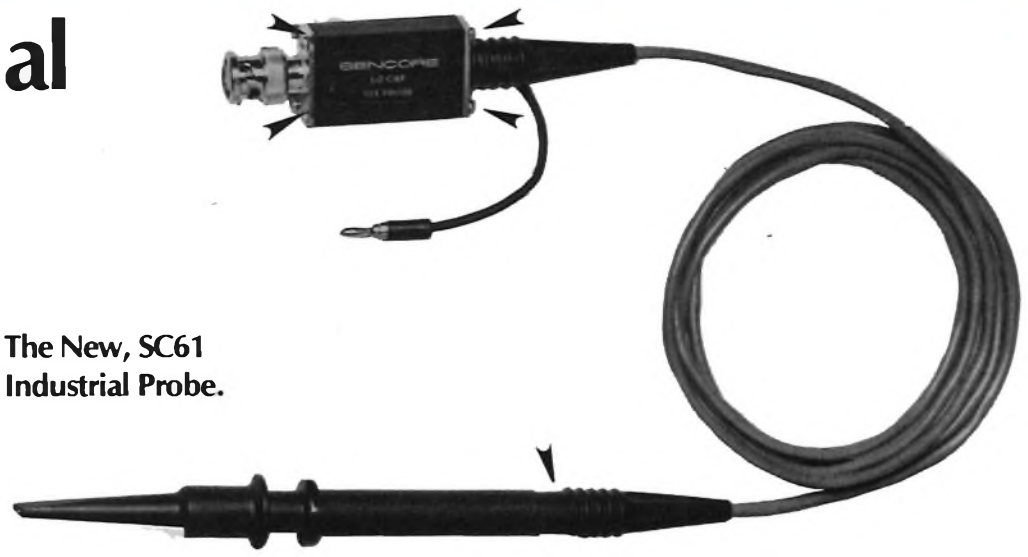
"For fast accurate troubleshooting of high speed digital circuits, the triggering is exceptional..."

Keith Postel *Peter Stafani*

Try It, With No Risk Involved

We just covered three main ways how the SC61 increases productivity, and there are many more. Perhaps the time you save by not fiddling with the trigger controls will be your big productivity booster. Maybe it will be the one probe measurement or the digital readout. Whichever feature it is, we know that the SC61 will double your productivity — we guarantee it. Call your Phone Sales Engineer today, and ask about our 30 day money back guarantee. We're sure you'll soon be saying that your SC61 is "a dream come true."

Announcing The Industrial SC61 Scope Probe



The New, SC61 Industrial Probe.

The new SC61 Industrial Probe can be opened for repair by removing the screws indicated by the arrows.

The SC61 has become a very important piece of test equipment for technicians and engineers in all walks of the electronics field. However some of our quantity users in industry and government have had a special need to be able to calibrate and completely repair all of their own equipment on site. The SC61 more than satisfied these requirements with one exception, the SC61 probes were not field repairable.

This prompted our industrial/government customers to request us to take a look at the probes and see if we could make them easier to repair. We knew this would not be an easy task, but we understood their need and agreed to see what we could do.

In redesigning the probe, our engineers had to carefully consider voltage rating (the scope probe has to withstand at least 2000 volts), frequency response (the probe connects to the best peak-to-peak meter available) and human engineering (it must be functional, durable, and look good). Of course all of this had to be in a package that could be repaired in the field.

After hours of design and prototyping, we were able to present our Industrial/Government customers with the Industrial SC61 probe, pictured here.

Both ends of the Industrial SC61 probe open up, allowing the components inside to be easily replaced. Now, if a part inside the probe ever needs replacement, it can be done without sending the probe back to the factory. The redesign also allowed us to increase the strength of the probe lead, along with the voltage breakdown.

This new probe was designed for these special quantity users. However, we are now making this probe available to all SC61 owners. The industrial SC61 probe is totally compatible with your existing SC61. The price of the new industrial SC61 probe is only $125 per probe. For more information, contact your Phone Sales Engineer at 1-800-843-3338.

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An All New Portable 1 GHz Counter — Outperforms All Others On The Market — For 1/3 Less Than The Nearest Competitor.

Save $197.50
See special #4 on page 14.

THE FIRST UNCOMPROMISING 1 GHz COUNTER. Until now, 1 GHz counters have always meant trade-offs of some sort, like bench use only, or short battery life in portable units, or insufficient accuracy. Well hold on to your antennas — because these compromising days are over. Thanks to several breakthrough innovations in frequency counter design, the FC71 is the first counter that provides totally uncompromising, 1 GHz portable performance for 1/3 less than the nearest competitor. Here's what the FC71 offers:

- **Versatile 1 GHz Range**
- **FCC accurate — even at 1 GHz**
- **Exclusive 9.5 hour battery operation!**
- **Super Sensitivity: 5mV average**
- **.01 Hz Resolution in one second**
- **Completely RF immune — we guarantee it!**
- **IEEE 488 bus-compatible**
- **Exclusive Crystal Check & Ratio Test**
- **All for 1/3 less than the nearest competitor!**

"Our No-Nonsense Offer To Our Customers"

There are alot of other counters offered by alot of other manufacturers — some with some big names and reputations. We're the little guys — with a better idea in portable 1 GHz frequency counters for the industrial, broadcast, communication, and service markets. We know of no better way to prove this to you than a 30 day self demonstration, at your job site. Our claim is simple.

FC71 Challenge Guarantee

Try an FC71 for 30 days. If you aren't completely satisfied for any reason, return the FC71 for a full refund, including freight both ways. No questions asked.

Whatever you do, try this counter, before you buy any other. You'll be glad you did. Mail or call today for a detailed brochure, to discuss applications, or to order, call toll-free.

Counter Feature	FC71	Fluke 7220A	Racal-Dana 9919	Philips PM6676	Philips PM6672	HP5385A
Frequency Range: 1 Meg ohm Input	10 Hz - 100 MHz	10 Hz - 125 MHz	10 Hz - 100 MHz	10 Hz - 120 MHz	1 Hz - 120 MHz	10 Hz - 100 MHz
50 ohm Input	10 MHz - 1 GHz	100 MHz - 1.3 GHz	80 MHz - 1.1 GHz	100 MHz - 1.5 GHz	70 MHz - 1 GHz	90 MHz - 1 GHz
Time Base Accuracy: Type	uP compensated	Oven	Oven	Oven	Oven	Oven
Temperature	≤ 5 ppm 0° - 40° C (usable -25° C to 50° C)	≤ 1 ppm 0° - 40°C	≤ 13 ppm 0° - 45° C	≤ 1 ppm 0° - 50°C	≤ 1 ppm 0° - 50°C	≤ 1 ppm 0° - 50° C
Aging	≤ 5 ppm/yr	≤ 1.2 ppm/yr	≤ 1.1 ppm/yr	≤ 5 ppm/yr	≤ 5 ppm/yr	≤ 36 ppm/yr
Sensitivity: 1 Meg ohm Input	5 mVRMS	10 mVRMS	10 mVRMS	10 mVRMS	10 mVRMS	15 mVRMS
50 ohm Input	5 mVRMS 14 mVRMS at 1 GHz	10 mVRMS 40 mVRMS at 1.3 GHz	10 mVRMS at 1 GHz	10 mVRMS 30 mVRMS at 1.5 GHz	15 mVRMS 25 mVRMS at 1 GHz	10 mVRMS
50 ohm Input Fused	Yes	Yes	No	No	No	Yes
Resolution: @ 100 Hz	0.01 Hz/1 Sec	0.1 Hz/10 Sec	0.1 Hz/20 Sec	0.0001 Hz/1 Sec	0.0001 Hz/1 Sec.	0.000001 Hz/1 Sec
@ 10 KHz	0.01 Hz/1 Sec	0.1 Hz/10 Sec	0.1 Hz/20 Sec	0.01 Hz/1 Sec	0.01 Hz/1 Sec	0.0001 Hz/1 Sec
@ 100 KHz	0.1 Hz/1 Sec	0.1 Hz/10 Sec	0.1 Hz/20 Sec	0.1 Hz/1 Sec	0.1 Hz/1 Sec	0.001 Hz/1 Sec
Crystal Check	Yes	No	No	No	No	No
Ratio	Yes	No	No	Yes	Yes	No
IEEE Interface Available	Yes $625	Yes $850	Yes $835	Yes $465	Yes $465	Included
Battery Life	9½ hrs.	5½ hrs.	3½ hrs.	"Varies with Option"	"Varies with Option"	3 hrs.
Price (Includes All Options Indicated)	$995 $1055 w/batt.	$1525 $1925 w/batt.	$1550 $1825 w/batt.	$1705 $1955 w/batt.	$1880 $2130 w/batt.	$2200 $2500 w/batt.

NOTE: All information taken from manufacturers' published specifications. No claim is made to their accuracy. Specifications subject to change by individual manufacturers.

Only the FC71 comes standard with an FCC accurate timebase. All other counters shown require an optional timebase to meet FCC accuracy which is included in the prices shown below.

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A Breakthrough In Counter Timebase Design Means Portable, FCC Accuracy

Here's why the FC71 is the only FCC accurate frequency counter at 1 GHz with 9½ hours continuous battery operation.

by Paul Nies, Application Engineer

The accuracy of a frequency counter depends on the stability of its timebase. For this reason, frequency counters must contain an oven timebase if they measure frequencies to FCC accuracy, especially if the frequencies are above 800 MHz. Until now, only oven timebases could provide the necessary stability. But their extreme current drain also reduces the longest possible battery life to less than half a day. The FC71's microprocessor compensated timebase however, has changed all that.

A Counter Must Be Accurate

A timebase is the bottom line consideration when purchasing and using any frequency counter. It is the heart of the counter. As important as RF immunity, resolution and other counter features are, they are of little value unless the counter has a timebase that can provide accurate measurements.

The accuracy needs of your counter depend on its application. The area where accuracy is perhaps most important is frequency documentation. Accurate counters are needed to adjust and verify the output of transmitters, ranging from low power two-way radios to very high power commercial broadcast transmitters. Since the FCC requires that all these transmitters be kept within certain tolerances, as shown in figure 1, a counter used for frequency documentation must be at least as accurate as these tolerances. To allow for aging and other errors, most technicians desire a counter with an accuracy that is at least two times better than the frequency tolerance they are documenting.

What Is A Timebase?

A timebase is very simply an oscillator that is designed to run at a very constant frequency. Figure 2 illustrates how the timebase is essential to the operation of a frequency counter. Here we see that the timebase frequency is fed into a counter gate. Also applied to the counter gate is the unknown frequency we want to count. To count the unknown frequency, the counter gate is opened up for an exact amount of time. The length of time the gate stays open corresponds to an exact number of cycles from the timebase oscillator.

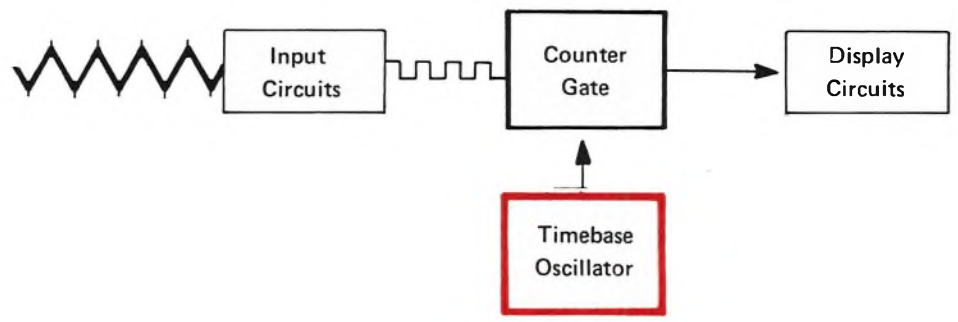

Fig. 2: All frequency counters rely on the accuracy of the timebase oscillator to keep the counter gate open for an exact period of time.

Because frequency is a simple function of time, the number of cycles of unknown frequency which occur while the gate is open are counted and their frequency is quickly determined.

This simple illustration shows the critical role the timebase plays in a frequency counter's accuracy. Because the counter gate is open for a certain number of clock cycles, you can see that if the timebase oscillator slows down the counter gate stays open too long. Similarly, if the oscillator speeds up the gate closes too soon. In either case the frequency counter will display the wrong frequency because it used the wrong time period to calculate the unknown frequency.

Crystal Timebases

The timebase oscillator in a frequency counter always contains a crystal. Only a crystal provides a frequency that is stable and practical enough for the precise timing needed in a general purpose frequency counter.

Ideally the crystal oscillator should operate at the exact same frequency regardless of temperature. It should also stay accurate for an indefinite period of time. But not even the best crystal oscillators are capable of this. Figure 3 shows the accuracies and aging characteristics of various types of timebases. As it shows, a typical bare crystal oscillator changes frequency at the rate of about 1 PPM for every degree C of temperature change. That is hardly stable enough to make accurate frequency measurements since just a five degree change will throw the counter out of FCC tolerance for every communication and TV broadcast frequency.

Besides temperature accuracy, timebases also have an aging accuracy. This is the amount the oscillators frequency may change over a period of time. As figure 3 shows, the aging accuracy becomes better as the timebase temperature accuracy increases.

FCC Frequency Tolerances (In PPM)

Frequency (MHz)	All Fixed (Base Stations)	Mobile Over 2W	Mobile 2W or less
Land/Mobile (2-way)			
Below 25	100	100	100
25 to 50	20	20	50
CB	50	50	50
50 to 450	5	5	50
450 to 512	2.5	5	5
806 to 866	1.5	2.5	2.5
Broadcast			
AM	12.1	N/A	
FM	18.5	N/A	
VHF TV	4.8	N/A	
UHF Ch. 14	2.1	N/A	
UHF Ch. 50	1.4	N/A	
UHF Ch. 82	1.1	N/A	

Fig. 1:The FCC requires that all transmitters are held within the frequency tolerances listed here.

Type	Accuracy (ppm 10-40°C)	Aging (ppm/yr)	Cost
Bare Crystal	10-50	3-10	n/c
TCXO	1-5	1-l5	$100-200
Basic Oven	1-5	0.5-2	$200-300
Prop. Cont. Oven	0.1-0.5	0.5-2	$300-600
Ultra Stable Oven	0.03 - 0.005	0.75 - 0.15	$600-1000
uP Compensation	0.5	0.5	$200-300

Fig. 3: This chart shows the accuracies and relative costs of the various timebases available for frequency counters.

TCXO Timebases

To overcome the temperature instability and poor accuracy of a bare crystal, many timebases use a temperature compensated crystal oscillator, or TCXO.

A TCXO contains components such as capacitors and thermistors whose temperature characteristics counteract those of the crystal. Good TCXOs can have accuracies of 1 to 5 PPM over the normal temperature range of 0 to 40 degrees C. This accuracy, however, still isn't quite good enough for all frequency documentation. Another improvement in the timebase is required.

Oven Timebase

The best timebase accuracy is obtained by placing the crystal oscillator inside an oven. This is the method used by all high accuracy frequency counters, except the Sencore FC71. An oven keeps the crystal at a constant temperature and oscillating at a constant frequency. Of course the oven needs to be powered all the time, whether your are making a measurement or not, to keep the crystal warm and ready to make an accurate measurement.

The best oven timebases are proportionately controlled to maintain a very constant temperature. These oven compensated timebases have very good accuracies of 0.5 PPM or better. Some even more accurate "ultra stable" ovens combine a proportionally controlled oven and a TCXO to obtain exceptional accuracies of 0.03 PPM and better.

Accuracy Has Always Meant Tradeoffs

While oven timebases are necessary to provide required accuracy, they have several trade offs. Oven compensated timebases are expensive, as indicated by the costs shown in figure 3. The standard timebase supplied with most frequency counters is a bare crystal — TCXO and oven timebases are options. Thus what first appears to be an inexpensive counter isn't once you add the cost of an accurate timebase. Conventional timebases leave you choosing between cost and accuracy.

Fig. 4: Oven compensated timebases draw power continuously to keep the crystal at a constant temperature.

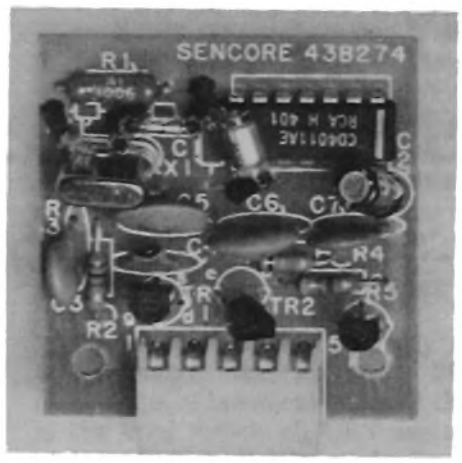

Fig. 5: The FC71's microprocessor compensated timebase doesn't contain expensive temperature compensating components, or a power robbing oven.

Besides cost, a major problem with oven compensated timebases is the large amount of current they draw. Since most counters are used away from the bench more than they are used at the bench, portable battery operation is must. However the batteries in a counter with an oven compensated timebase last less than half a day. Oven timebases, therefore, require you to trade portability for accuracy.

Here's How The FC71's uP Timebase Works

Unlike conventional timebases which attempt to maintain the oscillator at a constant frequency, the timebase in the FC71 allows the crystal to freely change frequency with temperature. This eliminates both expensive temperature compensation components and power robbing ovens. This means that the FC71 doesn't require you to make any tradeoffs.

The frequency characteristics of every individual crystal are repeatable, meaning that every time the crystal is at a certain temperature it will always oscillate at the same frequency. This allows us to program a microprocessor inside the FC71 with the temperature/frequency characteristics of the crystal. When the FC71 makes a measurement it simply senses the temperature and adds or subtracts out the crystals error at that temperature.

During the manufacturing of the FC71, the timebase crystal is pre-aged to insure its reliability and stability. After it is pre-aged, the crystal is placed onto the timebase circuit board, as shown in figure 5. At this point the timebase is completely operational and ready for calibration. To calibrate the timebase, it is placed into a FC71. Then the FC71 is placed into a computer-controlled temperature chamber along with 14 other FC71s which are also ready for calibration.

Inside the chamber an extremely accurate, NBS traceable signal is applied into the counters while the temperature is slowly varied over the entire operating range of the FC71. A computer connected to each FC71 via their IEEE-488 bus port closely monitors the frequency readings on the FC71s as the temperature changes.

After the uncalibrated timebase has gone through the full temperature range, the computer programs a ROM chip with the data unique to each crystal. This data is used by the FC71's microprocessor to compensate for the crystal's temperature characteristics.

The Microprocessor Compensated Timebase Eliminates Tradeoffs

The advantages of a microprocessor compensated timebase are obvious. First it provides the FC71 with an excellent accuracy of 0.5 PPM. But unlike all other counters, the FC71 doesn't require a power-robbing oven. It doesn't even require a warmup time. This means you can operate your FC71 all day long from just a single battery charge without ever losing FCC required accuracy. This is why the FC71 is the only truly portable frequency counter on the market.

Recalibration is Easy

The microprocessor compensated timebase makes recalibration of the FC71 easy too. The FC71 is simply recalibrated by exchanging the timebase module and its associated memory chip with a new, freshly calibrated set. These parts, shown in figure 6 can be quickly replaced in the field. Along with each timebase module you also receive a certificate of calibration and NBS traceability assuring the calibration of your counter for one year. After you have installed the new timebase and memory chip, you can return the old parts to the Service Department for credit.

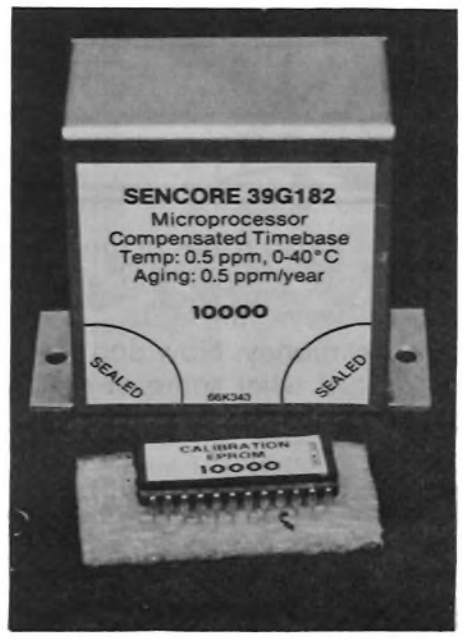

Fig. 6: To recalibrate the FC71 you simply exchange the old timebase and memory chip with a new, freshly calibrated set.

The FC71 is a frequency counter that has the accuracy of a proportional oven, the cost of a TCXO and the portability of a bare crystal. All this made possible by its microprocessor compensated timebases. Call one of our Phone Sales Engineers today and discover just how easy it is to own the only truly portable 1 GHz, FCC accurate frequency counter on the market.

LC53 Customers Tell Us Why . . .

"... The 'Z Meter' Doesn't Cost — It Pays"

In past issues of the Sencore News, we've told you about the many ways the LC53 "Z METER" can save you money. Now don't take our word for it, read what some of our "Z METER" customers have to say.

Research and Development

"The 'Z METER' has boosted troubleshooting efficiency to 100% . . ."

"Leakage and dielectric absorption are more common capacitor faults than off value. After checking a suspicious capacitor for value, leakage and dielectric absorption using the 'Z METER', I have an extremely high confidence level as to whether that part is causing a problem or not. This saves time!"

W. D. McComb
Development Engineer
Libbey-Owens-Ford
Toledo, OH

"The 'Z METER' has boosted troubleshooting efficiency to 100% and down time of equipment to a minimum. Just a quick, 'no-guess' check of a questionable component, and I have an answer as to whether it is within tolerance or not. The 'Z METER' has been a valuable tool in equipment repair and R&D assembly, and has taken away the doubts and questions other similar equipment has given in the past. There will always be a 'Z METER' in my shop."

Jack Collins
R&D Technician
Gillette Research
Rockville, MD

Production Testing

" . . . testing has been speeded up 20% with far less rework time"

"The 'Z METER' is easy to use and has helped to reduce our department's troubleshooting time. We have found that being able to check for leakage and dielectric absorption has reduced troubleshooting time on some units as much as 20%. The LC53 paid for itself in the first week, and I would recommend it to anyone who wanted a fast and easy to use LC meter."

Paul Gessert
Test Supervisor
Harris Corporation Farinon Division
San Carlos, CA

"At Continental, our receiving inspection department may check hundreds of capacitors a week, and still miss several faulty units weekly, costing a lot of rework time on finished equipment. Since we started using a Sencore 'Z METER' this testing has been speeded up 20%, with far less rework time."

William E. Eddy
Test/calibration Coordinator
Continental Electronics Mfg.
Dallas, TX

Bio-Medical

"...I consider the 'Z METER' to be an essential tool in electronic work"

"The 'Z METER' has saved me countless time in determining within seconds whether a capacitor, inductor, or SCR will work reliably in a circuit. It also cuts costs and time by reforming electrolytics to a usable state. Testing SCRs and TRIACs is no longer a chore with the easy hookup and pushbutton testing which fully tests the operation and does not leave you guessing...I consider the 'Z METER' to be an essential tool in electronic work."

Kenneth Pellegrino
Biomedical Electronic Technician
Mass. Eye & Ear Infirmary
Boston, MA

"Our 'Z METER' has been very useful, especially when components are replaced. Just a quick check lets us know everything we need about the replacement part. The 'Z METER' saves us time and money, and at the same time permits us to maintain the high standards this field demands."

Gary L. Webb
Certified Bio-Medical Equipment Technician
La Crosse Lutheran Hospital
La Crosse, WI

Communications

"Now with the 'Z METER'...I don't worry about mistakes"

"Before the 'Z METER' came along, I checked coils and capacitors for value with a bridge. Needless to say, a few times I slipped a digit going thru all the math calculations necessary to decide what value I actually had and made a costly mistake. Now with the 'Z METER', a regular on my bench...I don't worry about mistakes."

Tom Blanchard - WA4UPO
Owner
The Communications Co.
Concord, NC

Quality Engineering

"I would not set up a test/inspection area without a 'Z METER'"

"We have had the Sencore 'Z METER' in our manufacturing plant for about 3 years and have found it to be invaluable for checking coils, capacitors, and diodes on a sampling basis. We have greatly reduced the required inspection time and feel more confident with the results of the inspection...[We] would recommend it [The "Z METER"] for this type of use to any other manufacturing facility."

James F. Taylor
Supervisor of Quality Engineering
The Singer Co.
Anderson, SC

"The 'Z METER' is the ideal test instrument for our receiving inspection, because the 'Z METER' will test a wide range of capacitors at their applied voltage. This has found potentially defective capacitors which most likely would fail in production or worse yet fail during customer use. I would not set up a test/inspection area without a 'Z METER'."

James Glidewell
Quality Engineering
Shiley Inc.
Irvine, CA

Broadcast

"...the easiest and quickest capacitor checker, I have ever used..."

"The Sencore LC53 is by far the easiest and quickest capacitor checker, I have ever used, and in 24 years of broadcast engineering experience, I have seen most of the others. Our 'Z METER' has helped me many times to make quick and accurate repairs on equipment at our television studio and transmitter site. I can honestly recommend it to any one needing a good capacitor/inductor checker!"

Don Conklin
Television Maintenance Engineer
KIVI Television
Nampa, ID

"In the broadcast industry time is money, and the Sencore 'Z Meter' helps me save both. I am able to locate faulty caps with a multitude of 'in-obvious' problems, quickly and with certainty using the Sencore 'Z METER'. In my opinion the 'Z METER' outperforms other cap meters on the market because it not only checks value, but also breakdown voltage, and dielectric absorption, and it does it with superior reliability. No other meter on the market gives me what the 'Z METER' does."

Paul Shulins
Chief Engineer
WPXY Radio
Rochester, NY

Design Engineering

"Our production has increased about 200%"

"Before I bought my 'Z METER', designing inductors was a task I never looked forward to since all I had to check my results was a bridge. The bridge was a good quality one. However, a lot of time was wasted tweaking knobs. My 'Z METER' is fast accurate which makes the task enjoyable."

Brian D. Clark
Engineer
Progressive Electronics
Mesa, AZ

"In our company we manufacture high frequency transformers, and inductors. Before we purchased your 'Z METER', we were using an old style inductance bridge for testing our units. Boy, speaking of slow I really don't know how we ever made any profits! ... we now have about 7 'Z METERs'. Our production has increased about 200%. I don't know how we ever survived without one."

Wayne B. Deshler
Design Engineer
Fernwood Transformer
Belvidere, NJ

Consumer Service

"It can nail a bad part every time"

"I work with coils, inductors, transformers, capacitors, diodes and many other electronic components every day! My time is money! I can't afford guesswork! With the "Z METER", there is no guesswork. It can nail a bad part every time. Value, speed, and dependability made the "Z METER" my first choice. A bridge or value meter just don't make it. In my years of experience, value change of a component only claims 13% of the defective parts, leakage and dielectric absorption claims about 78%. The other 9% were voltage and temperature intermittent defects. The 'Z METER' gets them all."

Kevin E. Amos C.E.T.
Technician/Owner
Sound Expansion
Toledo, OH

"The 'Z METER', as well as the other Sencore Products, is a multi-purpose instrument and is so far advanced in many of its uses that there is just no comparison. Its test features are so time saving that the 'Z METER' doesn't cost — it pays."

A. C. Marshall
TV Technician
A.C. TV Repair
Omaha, NE

"No where, that I know of is there an instrument that has such a wide range of voltages and currents so that transistors, SCRs, diodes, in most cases at their rated voltages, can be tested. I have even had 100% success in testing high voltage rectifiers, which means that it is rare indeed when this component can slip by this machine."

Joseph Vigoda
Consumer Electronics Servicer
Joe's TV-Audio
Hyde Park, MA

"In working with antenna systems, it [The "Z METER"] helps me in finding opens or shorts in the cable or lead-in wires. It is easier to locate a problem without climbing towers or up on house roofs only to find the problem is located at or near the ground. On long runs in rural areas, it is also a great help in locating problems quickly."

David Lemak
Electronics Technician
Dave Lemak Electronics
Pen Argyl, PA

Regardless of the type of work you do, the LC53 can save you money and time. Call your Phone Sales Engineer today and order your very own "Z METER".

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Toll-Free 1-800-843-3338

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NOTE: These quotes are the opinions of the user only. The company name is included for reference only. The companies do not necessarily endorse the product.

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- *Are you missing over half of all capacitor defects because you are checking for value only?*
- *Are you unknowingly installing defective electrolytics that went bad sitting in stock?*
- *Are you substituting inductors as a last resort because you can't check for value or shorted turns quickly?*
- *Are you wasting your money purchasing expensive deflection yokes and flyback transformers for substitution only?*
- *Are you struggling with a time consuming bridge?*
- *Are you frustrated by your inability to check SCRs, TRIACs, or HI Voltage diodes?*
- *Are you unable to tell the distance to an open or short in a transmission line?*
- *Are you hard pressed to clearly detect insulation leakage in printed circuit boards, connector terminals, etc.?*

If any of these productivity cripplers sound familiar to you, it's time you discovered the answer; the triple patented, automatic "**Z METER**".

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Try an LC53 for 30 days. If you aren't completely satisfied for any reason, return the LC53 for a full refund, including freight both ways. No questions asked.

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In A Nutshell! Here Is What The "Z Meter" Is:

- It's the only capacitor tester on the market that dynamically analyzes a capacitor with up to 600 volts applied. It's patented.
- It's a double patented inductor analyzer, with tests not found on any other instrument at any price. In fact, it catches one shorted turn, even though the inductance value hasn't changed. No other bridge or coil tester can make that claim.
- It's an SCR, TRIAC, and hi voltage diode tester.
- It's a transmission line tester that tells you the distance within feet to an open or short in any transmission line.
- It's a hi pot dielectric leakage tester, too!
- Do you know why only the "Z Meter" does all these things? Because it is the only dynamic LC tester on the market. All others don't apply operating voltage and therefore only make static tests.

Our Standards Lab — Your Link To Quality

by Steve Fritcher, Application Engineer

From time to time customers ask about the Certificate of Calibration that we pack with our instruments. In this article we'd like to tell you a little bit about what standards are, what NBS traceability means, and how your Sencore instrument is NBS traceable.

If you have ever asked two people for the time of day, and received two different answers, you've discovered the need for a standard. You see, a standard is a reference which has been agreed upon as being correct.

Sencore needs standards. Without standards, we could not calibrate our instruments. After all, what would we calibrate them to? To insure that our equipment measures electrical parameters consistently with test equipment made by other manufacturers, we need to calibrate our equipment to accepted standards. This not only confirms our equipment's accuracy and quality, but it also assures you that our equipment measures electrical parameters correctly.

Fig. 1 : Every piece of Sencore equipment is backed by our Certificate of Calibration.

To be of any use, a standard must be agreed upon by everyone. That is the job of the National Bureau of Standards (NBS). They review everyone's interest on matters involving the national standards, and then develop and maintain acceptable standards for this nation.

The NBS has defined absolute standards for almost everything including time, distance, weight, and temperature. These standards must be extremely accurate, so recurring natural phenomena are used. However, these absolute standards require highly specialized and complex equipment. For example, the standard ohm is the average 4-terminal resistance of a group of Thomas-type standard resistors immersed in oil at 25°C under a power dissipation of 0.01 watts. This standard is 0.000008% accurate.

Prime Standards

The equipment necessary to measure a resistor to the nearest 0.00000008 ohms is extremely specialized and complex. For this reason, most manufacturing companies don't own their own lab standards. Instead, they use "prime" standards as their reference for calibrations.

Prime standards are highly accurate devices. To maintain consistency with the NBS's standards, they are compared to the NBS's lab standards at regular intervals. This periodic verification insures that the values of the standards are within the tolerances specified by the NBS.

Most importantly, having our own prime standards allows us to keep all our equipment in calibration, all the time. This eliminates down time while our equipment is sent away for calibration, and allows us to provide faster service since we don't have to wait for a calibrator to come back.

Sencore's Standards Lab

Sencore's standards lab houses highly accurate prime standards including standard references for voltage, current, resistance, inductance, capacitance, and frequency. Let's take a brief look at them.

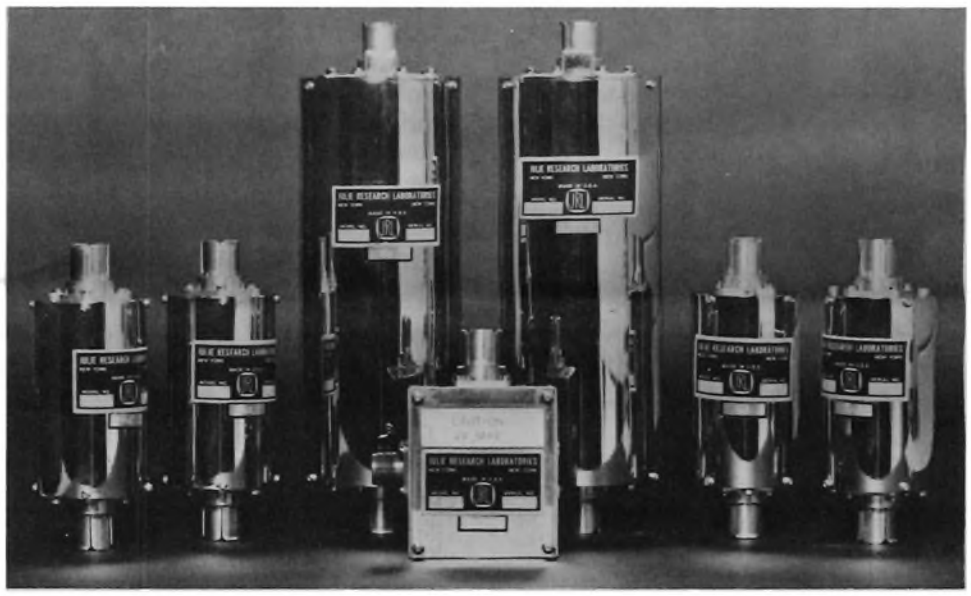

Fig. 3: Our thermal transfer standards allow us to calibrate AC signals using our standard voltage cell.

Our voltage standard is like a common wet cell battery, except it is much more accurate and is not designed to supply any power. Most batteries vary a few tenths of a volt. Our standard voltage cell, however, is always within a millionth of a volt of its documented value. The voltage standard is used for all of our DC voltage, AC voltage, and current calibrations.

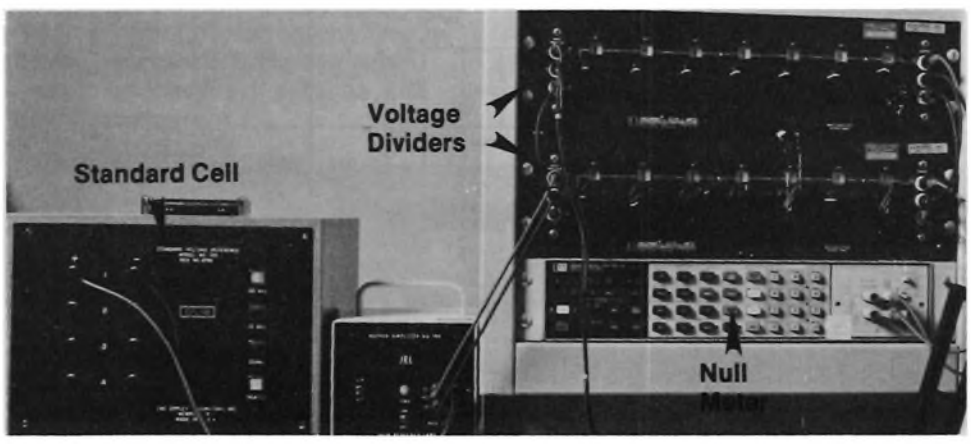

Fig. 2: Every voltage and current calibration in our standards lab includes the use of a standard voltage cell, voltage divider, and null meter.

The standard voltage cell, however, only provides a single DC voltage. This works fine if you only need to calibrate the one volt range on a volt meter. To calibrate different voltage ranges, we use NBS traceable voltage dividers. They allow us to precisely divide any voltage source to any exact value required. To calibrate a voltage source, we set a voltage divider output to equal the standard cell voltage. Then using a null meter, we adjust the voltage source until the null meter shows a null.

For calibrating AC signals we have an NBS traceable thermal transfer standard. The thermal transfer standard is very simply a highly accurate thermoelement which uses a heat conversion process to convert an AC signal into a DC voltage. To calibrate an AC signal, we simply connect it to the thermal transfer standard, and null the resulting DC output against our standard voltage cell.

The standard voltage cell can also be used to make NBS traceable current calibrations. We simply use an extremely precise resistor that is also NBS traceable. Then, according to Ohm's law, a current passing through the resistor generates a voltage which we simply compare to our standard voltage cell.

(continued on page 25)

How To Isolate Vertical Problems With The VA62

by Greg Carey, Application Engineer

This is the final installment of a five-part series showing how the Sencore VA62 Universal Video Analyzer simplifies the troubleshooting of the RCA CTC108 chassis. This time, we will look at the vertical circuits. RCA used similar vertical circuits from the CTC85 through the CTC131 chassis. Other manufacturers use similar designs. Thus, most of these troubleshooting procedures apply to many different chassis.

Vertical problems fall into two general categories; sweep and sync. Each category involves different vertical circuits, so we must discuss them separately. We will start with problems affecting vertical sweep.

Why Vertical Problems Are Tough

Many technicians find vertical problems more difficult to troubleshoot than any other defects. Three factors contribute to this difficulty: 1) Direct-coupled (DC) stages, 2) Closed-loop power supplies, and 3) Interaction with the video circuits. Let's quickly see how each of these factors complicates troubleshooting.

First, direct-coupling eliminates blocking capacitors between stages. Because of direct-coupling, a problem in one stage affects the DC bias in many other stages, making DC voltages difficult to use for troubleshooting.

Second, many vertical circuits use closed-loop power supplies. In the case of the CTC108 circuits, for example, a voltage needed to power the vertical oscillator comes from the vertical output.

Third, some vertical problems cause a blank raster because the vertical and the video circuits interact. Thus, some vertical problems cause the same symptom as video or high voltage problems.

Use Signal Substitution to Isolate the Trouble Stage

Signal substitution lets you quickly overcome all of these problems. As you will recall, signal substitution means you substitute a known-good signal into a circuit you think might contain the problem while watching the CRT for an improvement. If you see an improvement, you know all the stages between the injection point and the output work correctly. If, on the other hand, the CRT shows no improvement, you are injecting ahead of the problem and the defective stage is interrupting your substitute signal. A few pointers makes your use of signal substitution more effective.

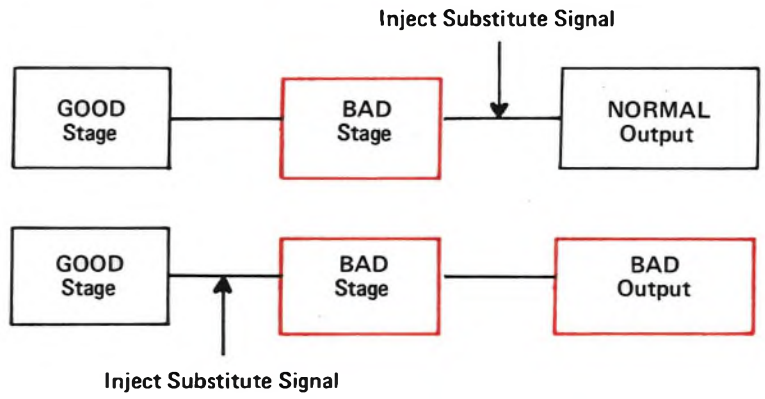

Fig. 2: Substituting known-good signals after the problem (top) improves the output. Substituting before the problem (bottom) produces the original symptom because the bad stage affects the substituted signal.

First, the defective stage is the one that shows an improvement when you substitute at its output and produces the original symptom when you substitute at its input. Use the results of each substitution step to decide where to inject next.

Second, you must always supply a reference signal to the antenna input. This keeps all the good circuits synchronized while you inject a substitute signal into one suspected stage at a time. The substitute signal and the reference signal must both come from the same phase-locked signal source (as in the VA62). Without phase-locking, you will not see an improvement as you inject your substitute signals.

The signal substitution process, as we've described it so far, works the same in the vertical circuits or any other circuits. In the vertical circuits, however, some troubles may affect the DC bias, as explained in the accompanying "Tech Talk" box. Because of this, you may need to use signal substitution in two layers—correcting DC problems first and AC problems second. Here's why.

A problem that affects the DC bias of one stage often affects later stages too, forcing them into saturation or cutoff. Correcting the DC bias first ensures that substituting the AC signal produces predictable results.

Confirm the DC Path Works Correctly

Combine signal tracing with signal substitution when you suspect a DC problem. Begin by using the VA62's digital meter to measure the voltage drop across the emitter-base junction of each transistor. If all transistors show a normal voltage drop (about 0.6 volts), you know the DC path is good and that you can proceed directly to AC signal substitution.

Always connect your meter directly across the emitter-base junction, rather than measuring the voltage (to ground) of the base and the emitter and then subtracting the two voltages. Measuring directly across the emitter-base junction eliminates possible errors caused by the DC meter's response to the low frequency signals found in the vertical circuits.

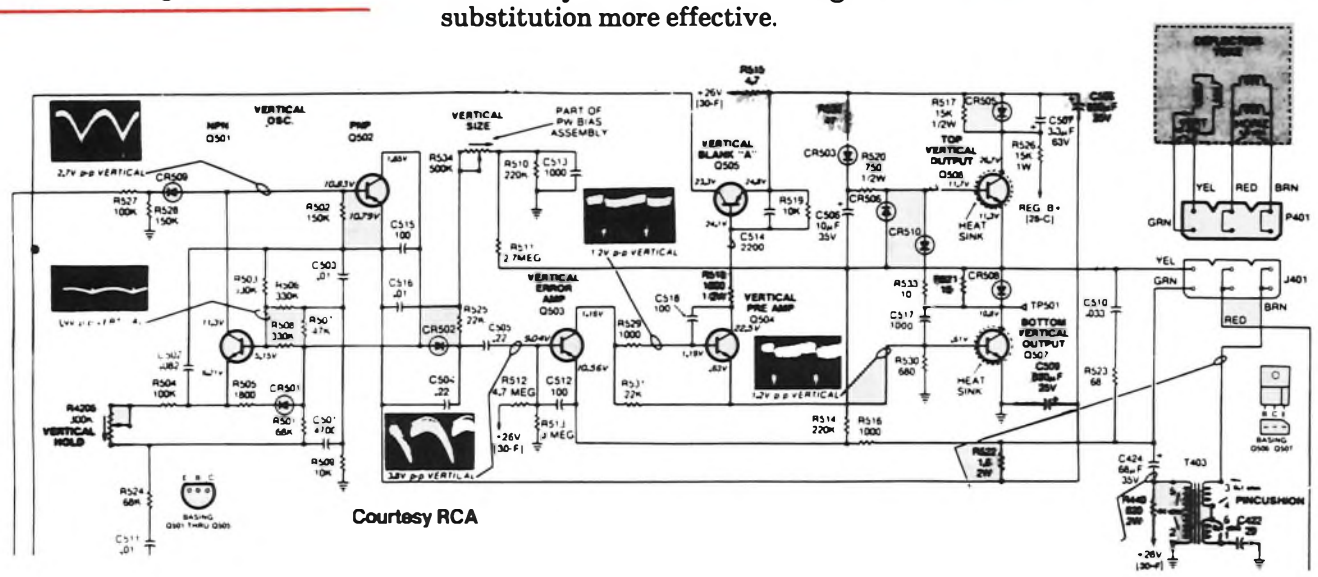

Fig. 1: These circuits from the RCA CTC108 chassis shows three factors common to vertical circuits which complicate troubleshooting: 1) Direct-coupled amplifiers, 2) Closed-loop power supplies and 3) interaction with the video circuits.

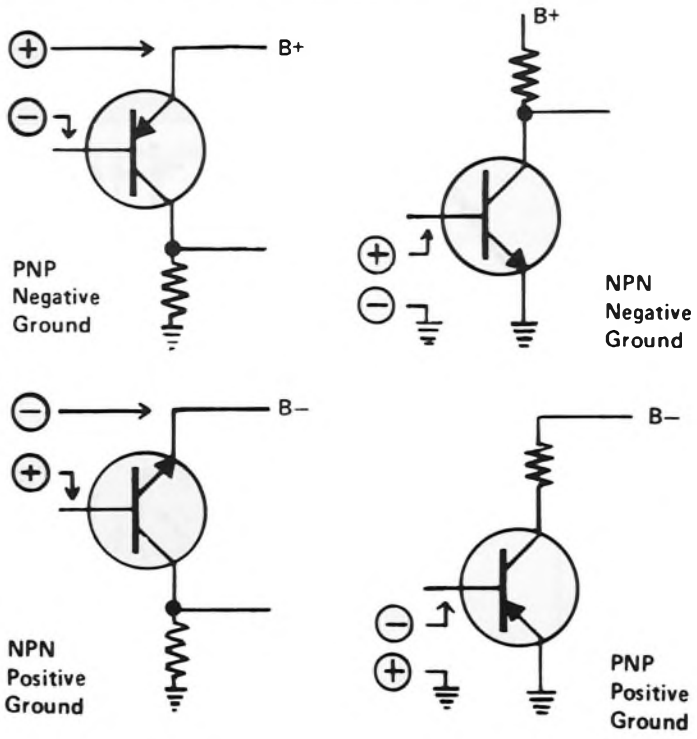

Fig. 3: Always connect the VA62 power supply leads to forward-bias the emitter-base junction if a stage shows low bias before injecting drive signals.

Substituting DC Bias

After confirming a bias problem, use the VA62 DC power supply to correct it. Inject the voltage through a current-limiting resistor while monitoring the bias on the transistor. Match the polarity of the applied DC signal to the type of transistor used, as shown in Fig. 3. In each case, you forward-bias the emitter-base junction, meaning the "+" lead of the VA62 supply connects to the base for an NPN transistor or to the emitter for a PNP transistor.

Always use the correct series limiting resistor to prevent possible damage to the transistor. Use a 1 kilohm resistor for small "signal" transistors or a 100 ohm resistor for medium-power "driver" transistors. You don't need a resistor when biasing the output transistors.

Monitor the voltage drop across the emitter-base junction of the transistor being biased to determine when you have enough bias. Be sure to measure across the junction; not from the base to ground.

If the VA62 does not return proper bias, troubleshoot the DC path. In most cases, this means checking transistors and resistors. Capacitors may affect the DC bias if shorted, but not if they are open or the wrong value.

Substituting the AC Component

When the bias is correct, use signal substitution to troubleshoot the AC path. Most vertical circuits require the "Vert Drive" drive signal. This signal consists of the vertical ramp signal needed by the vertical circuits. Inject the signal and watch for an improvement in the original symptom.

When servicing vertical circuits the word "improvement" becomes important. Injecting into some vertical circuits won't always produce perfect vertical deflection.

To understand why, remember that the vertical deflection yoke requires a **current ramp**, not a **voltage ramp**. The vertical oscillator, however produces a **voltage ramp**. The driver and output amplifiers change the signal to the **current ramp** needed by the yoke.

The VA62 produces an average **voltage ramp** waveshape. Therefore, injecting at points that normally use **voltage** signals results in fairly good vertical deflection, but injecting at points that normally use a **current** signal may produce reduced vertical deflection or vertical sweep with poor linearity. But don't worry. The VA62 voltage-type signal gives reliable results when you know what to expect.

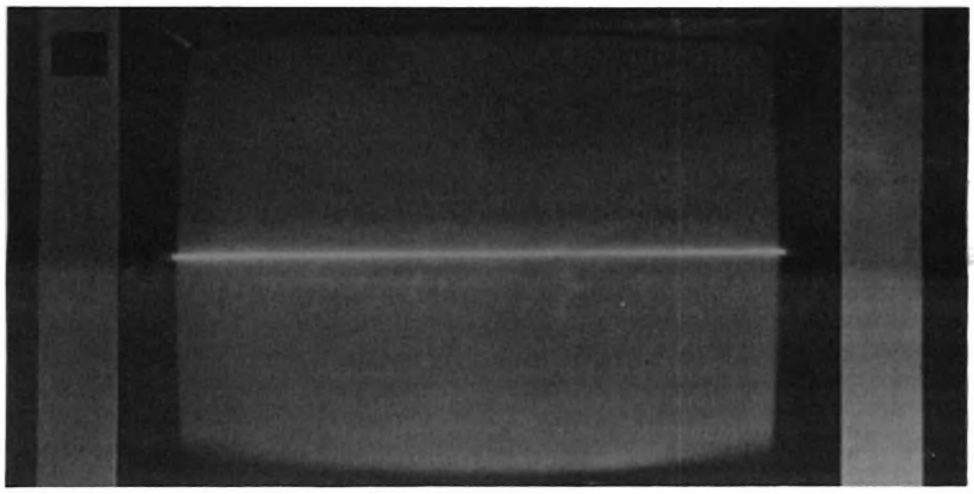

Fig. 4: The original vertical symptom collapses sweep to a single line.

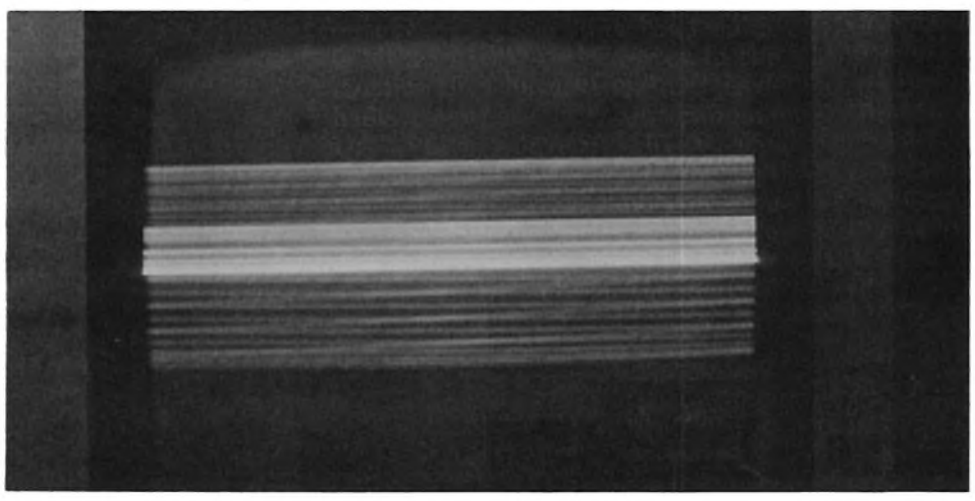

Fig. 5: Injecting at some test points increases the sweep to half screen (either center-to-top or center-to-bottom), indicating an improvement over the original symptom.

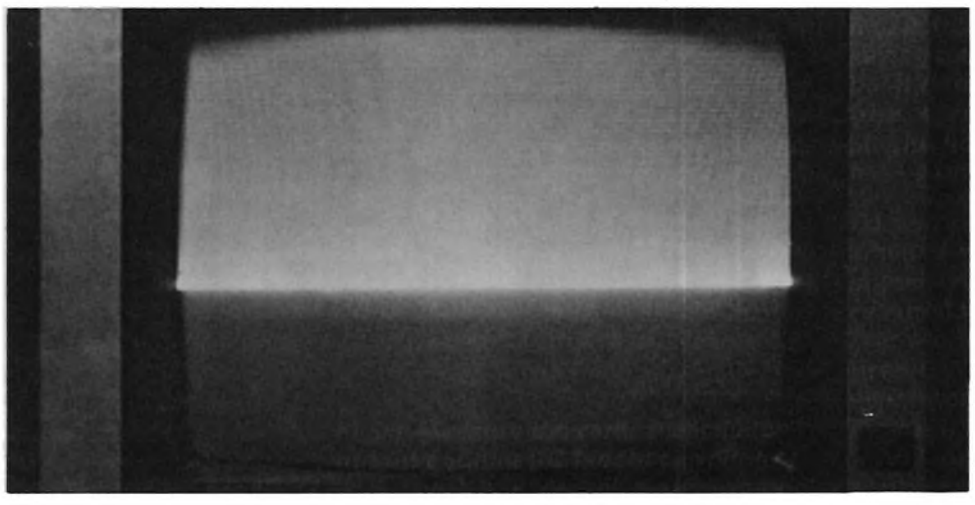

Fig. 6: Injecting in some circuits returns full height deflection with poor linearity — also indicating the expected symptom improvement.

Figs. 4 through 6 show typical examples of what to expect. In each case, the original symptom (see Fig. 4) was a single horizontal line running across the center of the CRT. When injecting at some test points, you will see the thin line expand to about 25% of the screen, as shown in Fig. 5. In other circuits, the substitute signal returns full-screen deflection, but linearity errors causes individual scan lines to become 1/4 to 1/2 inch apart, as shown in Fig. 6. In each case, the expanded sweep tells you that the circuits work correctly from the injection test point to the output.

Refinements in Use of the Drive Signals

A few pointers will help you interpret your results better. First, realize that the two output transistors used in the RCA circuits aren't really "push-pull" outputs as they first appear. The "bottom" RCA output transistor (Q507) provides most of the energy needed for deflection. The "top" output transistor (Q506) only assists the bottom transistor; especially during vertical retrace.

Thus, driving the top transistor provides little useful information. Concentrate on the bottom output transistor and only suspect the top one if driving the bottom stages provides no noticeable improvement in the original sweep symptom.

When driving the bottom circuits, the VA62 signal moves the horizontal sweep downward from the center of the screen when using one polarity of the drive signal. Reversing the polarity moves the sweep from the center upward. Different drive amplitudes vary the amount of deflection from the center. The chart in Fig. 7 shows typical drive levels needed to drive the signal from the center to either the top or the bottom edge in the CTC108 chassis. (Check the DC bias first.)

P-P Volts Needed

To Drive:	Q503	Q504	Q507
From Center Up	−3.2	+0.1	−1.0
From Center Down	+10.2	−0.2	+2.0

Fig. 7: Typical VA62 drive signal levels for the test points in the RCA CTC108 vertical circuits.

If you can move the trace from the center to either edge of the screen, you have problems in an earlier stage. If you cannot drive the output, or if you must use a signal level 2 or more times larger than shown, the problem follows your injection point.

(continued on page 16)

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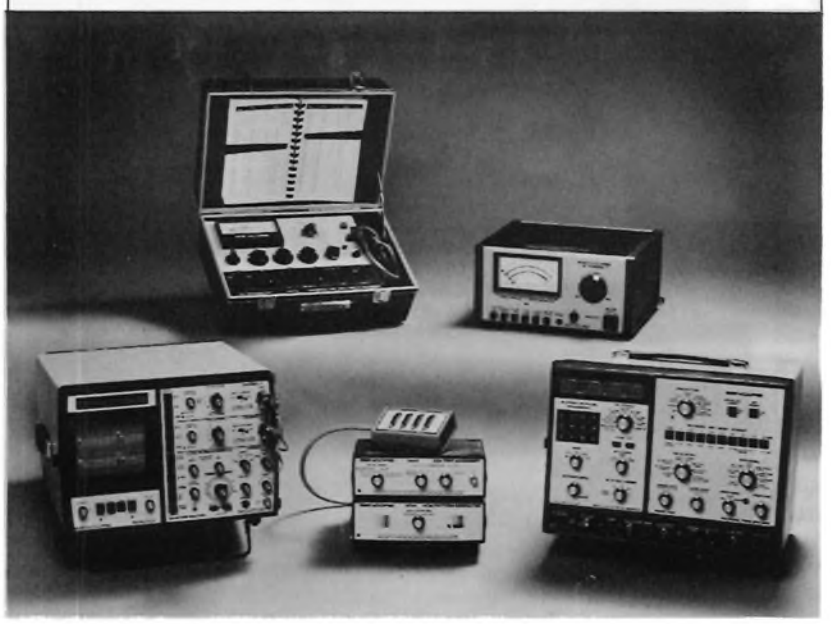

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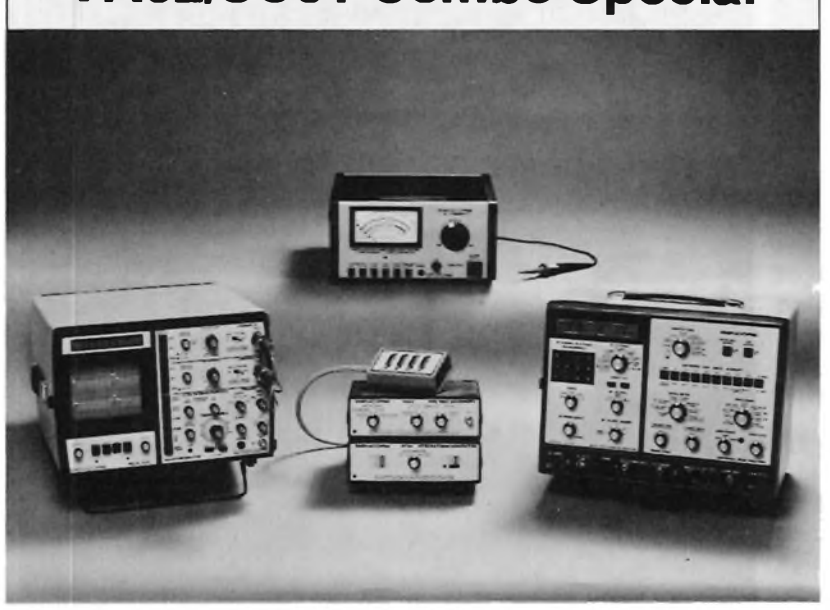

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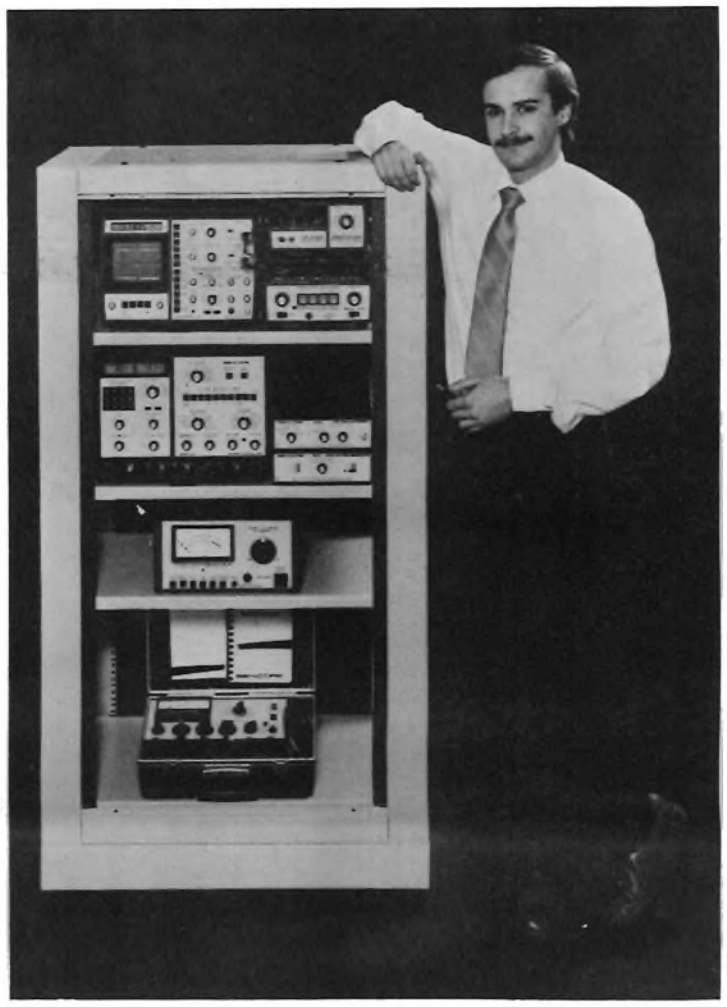

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(continued from page 13)

So, as you see, the VA62 helps isolate problems in the DC or the AC signal paths. Signal substitution positively isolates the trouble to a single stage which you then troubleshoot with conventional methods. Next, let's look at how the VA62 helps isolate problems related to the closed-loop power supply found in some vertical systems.

Troubleshooting the Closed-Loop Power Supply

A dead vertical oscillator always causes loss of sweep. It would seem that you should at least be able to use signal tracing to tell whether the oscillator works. But this is not always the case because the RCA chassis develops an oscillator power supply in the vertical output stage. Thus a problem in the oscillator, the drive amplifiers, the output stages, or the derived power supply all cause the same symptom—no vertical sweep and no oscillator output. Once again, it helps to combine signal substitution and signal tracing to quickly isolate the problem. Here's how.

Use the VA62's external peak-to-peak reading meter to check for an oscillator output. If there is no signal, use the VA62 to drive the output stage. If this produces at least partial deflection, and the oscillator produces an output, you know the oscillator and feedback voltage both work properly and that the problem is between the oscillator and the output stage.

But if the oscillator does not produce a signal when driving the output stage, you know the trouble is either in the oscillator or in the circuits that develop the DC feedback. Use the VA62's autoranging DC voltmeter to check the developed DC voltage. If the test point does show DC (and you have no oscillator output), you have a defective oscillator. If the test point shows no DC, check the derived power supply.

Fig. 8: Measure the vertical oscillator output and the DC feedback voltage with the VA62 digital meter while driving the output stage in order to test the derived power supply.

In each case, signal substitution dynamically isolates problems associated with the feedback voltage. Once you know the output circuits have drive, you can use signal tracing to isolate the specific problem. Now, let's turn our attention to the third complication in the vertical circuits; the interaction between the vertical and video circuits in some chassis.

The Sandcastle Appears Once More

RCA uses a special "Sandcastle" signal to feed several signals into a single pin of the large luminance/chroma IC. As you learned in previous articles, either an open sync separator or a missing flyback pulse causes the Sandcastle to blank the raster. Some failures in the vertical circuits also cause the Sandcastle to blank the video output.

How can you separate all of the Sandcastle problems that cause a blank screen? The answer is by injecting a VA62 drive signal into the Sandcastle test point. The VA62's signal overrides possible Sandcastle problems and shows the true symptom.

To substitute for the Sandcastle signal, move the DRIVE SIGNAL switch to its "Horiz Key Pulse" (horizontal keying pulse) position. Next, move the DRIVE RANGE switch to the "30VPP" position and adjust the DRIVE LEVEL control until the VA62 digital meter shows a 5 volt peak-to-peak signal (positive polarity). Then, connect the ground lead of the DRIVE OUTPUT to chassis ground. (Remember this ground is isolated from all other VA62 outputs so you must connect the ground lead even if you have other VA62 connections grounded.) Finally, connect the "+" lead to the Sandcastle test point ("TP806" in the CTC108 chassis).

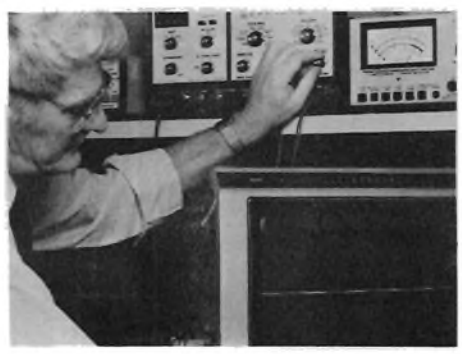


Fig. 9: Injecting the VA62 horizontal keying pulse into the Sandcastle test point unblanks the CRT to show the true symptom. In this case, the single horizontal line tells us we have a vertical problem.

If you see a single, horizontal line when you inject the Sandcastle signal, you know the blank raster resulted from a vertical problem. (If you see an out-of-sync picture, the problem is probably in the sync separator. We cover this later in the article.) In order to free up your VA62 drive output to isolate the problem, bypass the vertical blanking transistor (Q702) with a jumper between the emitter and

base. This turns off the blanking transistor so it does not load the Sandcastle circuits. You will have little trouble remembering to remove the jumper after correcting the problem since the bypassed blanking transistor causes retrace lines.

So you see the Sandcastle circuits only cause a temporary inconvenience. The VA62 lets you confirm a Sandcastle-related problem and a simple jumper wire let you bypass the Sandcastle circuits while you use signal substitution to isolate the original problem.

Test the Output Components

So far, we have seen how to use signal substitution up to the base of the output transistor. If driving the output does not return sweep, you know the output stage is bad. The deflection yoke is a major part of the output stage.

Sencore developed the Ringing test to give quick, accurate results when you suspect a bad deflection yoke. Simply unplug the yoke from the chassis, connect the two test leads from the VA62, and select the "Ringing Test" position of the DIGITAL METER switch. Then, rotate the RINGING TEST switch through its 6 positions while watching the digital display. If one or more of the switch positions produces a reading larger than 10, you have a good yoke. If all six positions show a reading less than 10, you have a bad yoke.

Fig. 10: The patented Sencore Ringing test accurately tests the deflection yoke to complete the tests of the vertical circuits.

At this point, you've learned how the VA62 isolates any sweep problem. Now, let's see how to approach sync troubles.

Isolating Sync Troubles

The second vertical category involves sync problems. When you see the picture rolling vertically, try adjusting the oscillator's frequency with the vertical hold control to see if you can get it to drift slowly — nearly locked on the screen. If not, you know the vertical oscillator has a problem in its timing components.

If you can adjust the oscillator close to the correct frequency, use the VA62 drive signals to isolate the sync problem. The VA62 produces the three drive signals needed to isolate any sync-related problem: 1) Integrated vertical sync to apply at the oscillator input, 2) Composite vertical and horizontal sync to apply at the input of the vertical sync integrator, and 3) Composite video to apply at the input of the sync separator.

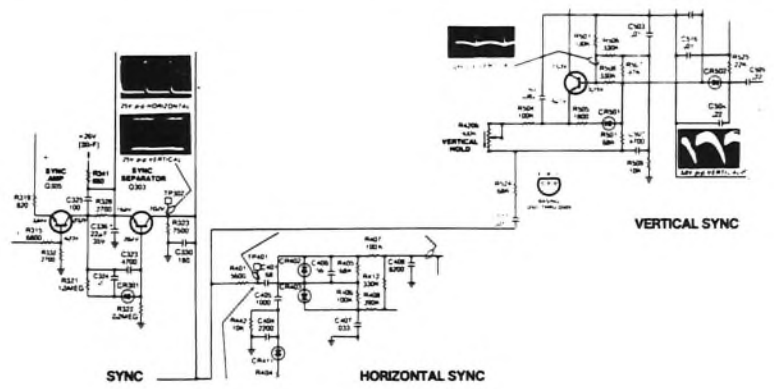


Fig. 11: The VA62 supplies all the special drive signals needed to isolate sync troubles. Here, we show which signal to inject at each test point.

Begin by injecting the VA62's "Integrated Vertical Sync" drive signal at the output of the vertical sync integrating filter while watching the CRT for correct lock-in. *(NOTE: The matching components on the output of the VA62 drive circuits may cause the vertical oscillator to shift its free-running frequency. Re-adjust the vertical hold control to see if the vertical oscillator can be made to lock.)* If you see lock-in, you know the vertical oscillator responds correctly to vertical sync. If does not, troubleshoot the oscillator circuits.

If sync returns when injecting at the oscillator input, move the VA62 drive signal back to the vertical integrator input. This time, use the composite vertical and horizontal sync drive signal. (Remember to readjust the vertical hold control, if necessary.) If you still get sync, you know the integrator works and the problem is in the circuits leading up to it.

Sync problems ahead of the integrator affect both horizontal and vertical sync. The VA62 provides the composite sync signal needed to substitute for test points between the sync separator and the two oscillators.

Problems in (or before) the sync separator often blank the raster because of Sandcastle interaction. Substituting the Sandcastle signal (as explained earlier) returns the raster so you can see the out-of-sync symptom. You don't need to bypass the Sandcastle circuits (as required in the vertical circuits) because each step of signal substitution through the sync separator returns the picture when injecting after the defect.

Servicing vertical problems becomes no more complicated than other circuits when you take advantage of signal substitution. The drive signals let you isolate sweep problems related to DC, AC or component problems. Simply remember to approach each type of possible problem separately.

Signal Substitution—The Answer to Every Circuit Problem

Now, let's wrap up the five-part series on the uses of the VA62 in modern TV receivers. (Contact the Sencore factory for reprints if you missed some of these previous articles.) In issue number 119, we looked at applications of the VA62 in servicing IF troubles—especially those related to the SAW filter and the IC containing the synchronous video detector. In issue number 120, we saw how to isolate problems related to the luminance IC—including common Sandcastle circuit problems. In issue number 121, we saw how to use the VA62's exclusive, phase-locked color signals to troubleshoot problems related to the complex chroma IC. In issue number 122, we learned how to isolate horizontal and high voltage problems—including special tests for the integrated high voltage transformer (IHVT). This time, we've wrapped up the circuits with the vertical and sync circuits.

Tech Talk

Problems Caused By Direct Coupling

Most vertical stages use DC amplifiers because this gives good vertical sweep linearity at a reasonable price. Without direct-coupling, an expensive coupling capacitor would be needed between each amplifier stage. Any imperfections in these capacitors affect the linearity of the vertical sweep signal.

Direct-coupling eliminates the need for these capacitors. One or two high quality capacitors in the vertical oscillator form the basic waveform. The stages following the oscillator then amplify the signal without changing its linearity.

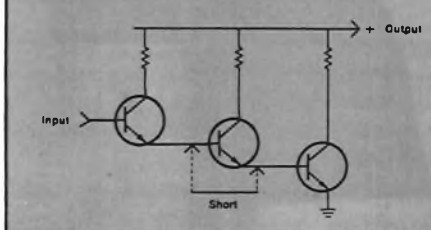
The bias on a DC stage depends on the condition of the circuits at its input and output. All bias voltages appear to be bad when problems develop in any stage. Sometimes the bias can be so far from its normal level that many of the stages are forced into cutoff or saturation. When this occurs, DC measurements become confusing and signal substitution signals cannot pass through the stages — even the good ones.

Consider, for example, a circuit made up of three direct-coupled stages. DC current from the first stage provides the bias for the second stage which, in turn, provides bias for the third stage. Now watch what happens if the second transistor fails (a short develops between base and emitter).

The defect reduces the collector current to zero, eliminating the bias from the third transistor, causing it to turn off. The collector of the third transistor rises to B+, while zero volts drop across the emitter-base junction, making it appear bad when making DC voltage measurements.

The bad transistor also affects the first stage. The collector of the first stage normally reaches ground through the second transistor. When the transistor is bad, there is no path to ground, so the collector voltage rises to the base voltage. This upsets the bias, shifting the base and emitter voltages too.

As you see, the effects of one bad DC stage often reach forward and backward several stages from the actual problem.



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* According to a survey of our customers who use signal substitution.

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Signal substitution is the key. There are two basic methods of troubleshooting a circuit: signal tracing and signal substitution. Signal tracing means you take a scope (or meter) and measure the signal at various points.

Signal substitution, on the other hand, lets you inject known good signals from the VA48 video analyzer into any stage of a TV. If you get a good picture on the screen, you know everything is working from that injection point forward. You then back up stage by stage until the defect appears on the screen. You then know you are injecting into the defective stage. It's just that simple, and until now, the VA48 has been the only analyzer to provide all the signals necessary to inject into any TV stage from antenna to CRT.

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The CR70, The Only CRT Tester Designed To Test Projection CRTs.

by Paul Nies, Application Engineer

Projection television system sales are showing tremendous growth. In fact, sales of projection systems last year were eight times greater than sales a few years prior. The CR70 can be your key to cashing in on their extra profits.

In this article we'll take a look at the key component in a projection television, the projection CRT. As you will see, the CR70 Beam Builder is a necessity in projection television servicing because no other tester on the market is built to test and restore projection tubes.

Figure 1 shows the three basic methods which are used to project a large picture onto the viewing screen. As illustrated, one method uses a single, 3-gun color CRT to produce the large screen picture. This single-tube method is the least common since it produces a picture of limited brightness. In order to make a bright picture most projection systems use 3 tubes. To understand how projection tubes work, lets's quickly review non-projection, tri-color CRTs.

Three Tubes Work Together to Make The Picture

As you know, a tri-color CRT contains individual red, green and blue electron guns. The main elements in each gun are a cathode, a control grid and a screen grid. The cathode emits electrons when it is heated by a filament. These electrons are formed into a beam which varies in intensity according to the video signal voltage applied between the cathode and control grid.

A second grid, the screen grid, helps form the electrons into a still finer beam, and begins accelerating the beam toward the CRT's high voltage anode. The electron beam from each gun strikes its corresponding red, green, or blue phosphor which is located just behind the anode or viewing screen as figure 2 shows. The phosphor gives off light in proportion to how many electrons hit it. The beams are converged to produce a very small dot on the screen. Different colors

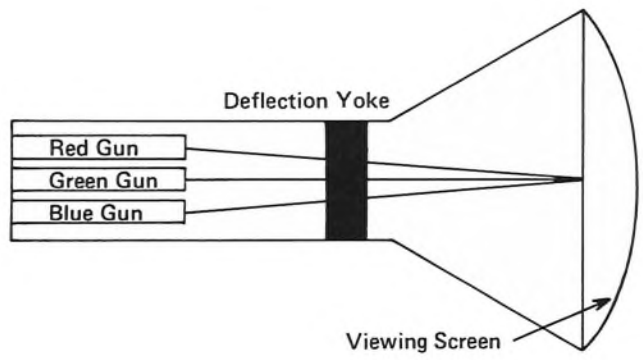

Fig. 2: The individual electron beams in a tri-color CRT are converged at the viewing screen to produce a color picture.

are produced by making the phosphors glow in varying proportions.

To change the overall picture brightness more electrons from each gun are allowed to strike the phosphors. The color tint stays the same as long as the proportion of electrons striking each phosphor remains the same.

You can think of each projection CRT as a single gun in a tri-color CRT, complete with its own phosphor. Instead of being coated with all three phosphors however, the face of each projection tube is coated with just a single phosphor. Each CRT gives off just one color of light, either red, green or blue. The light from each tube mixes with the light from the other tubes at the projection screen.

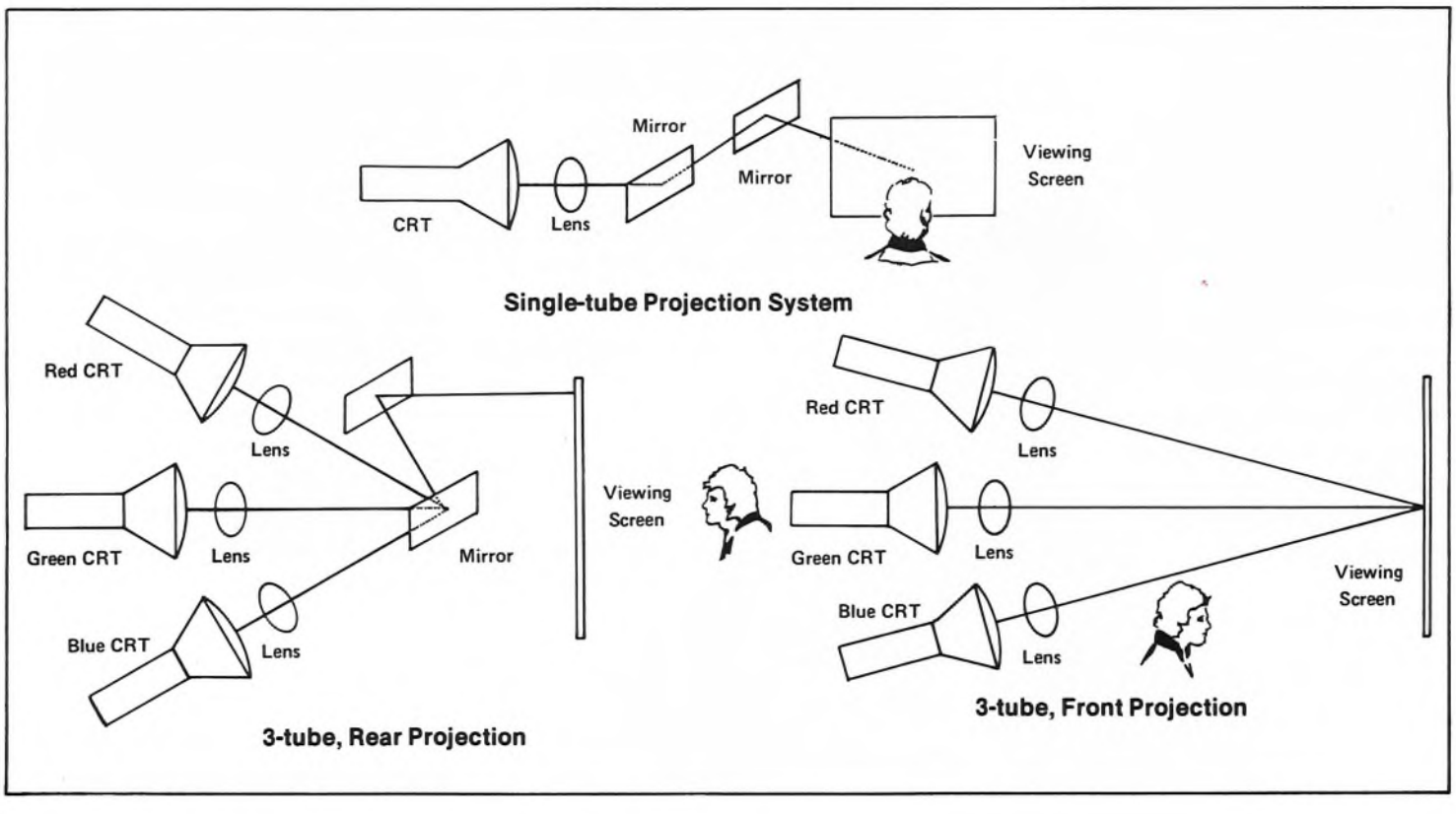

Fig. 1: While several methods may be used to produce the large picture in projection television systems, most projection systems use three separate CRTs.

Projection Tubes Fail

Projection CRT failures are similar to non-projection CRT failures. First, projection CRTs (or the guns in a tri-color CRT) may develop low cathode emission. When the emission falls off the phosphor gives off less light. Soon the picture becomes too dark to watch. Low emission is usually caused by the cathode becoming covered with crud which forms when gases inside the tube oxidize with the cathode material. The crud builds a coating over the cathode which prevents electrons from leaving the surface.

The second, and perhaps the most common problem associated with projection CRT systems also involves emission. This problem is called color tracking. Just as the guns in a tri-color CRT don't always degrade at the same rate, neither do all three CRTs in a projection television system. Equal light output from all three tubes is required to produce white, but if the emission from one tube drops below the level of the remaining two tubes, pure white as well as many other colors cannot be reproduced. Setup controls in the television chassis compensate for small differences in the tubes, but they only have limited range. Often the bad tube ends up being replaced.

Fig. 3: One tube in a projection system with too much emission causes a color tracking problem because its light output is too great compared to the other tubes.

Replacing one bad tube in a 3-tube projection system usually makes color tracking problems worse however as figure 3 illustrates. This is because the new tube has much more emission than the old tubes which still remain in the set. Again we have a problem balancing the light output from the tubes.

You Need a Projection CRT Restorer

One sure way to end a color tracking problem is to replace all three tubes. This is an expensive solution, however, since a single projection tube ranges in price from $135 to over $500. Because of the difficulty in removing the old tube and installing and realigning the new tube, you must add an additional labor cost of nearly $100, bringing the cost of fixing a color tracking problem to as much as $1600! The CR70 solves this problem with progressive restoration.

With progressive restoration you start with a small amount of restoring current and work your way to higher levels as needed to restore the tube.

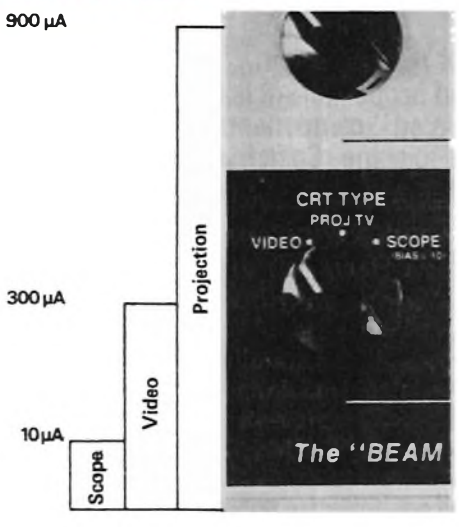

Fig. 4: The CR70 tests all CRTs, regardless of the level of beam current. You simply set the CRT TYPE switch to the type you are testing.

Five levels of restoration is a welcome, reliable alternative and one reason why the CR70 is a necessity for projection television servicing.

Why Projection CRTs Require a Special Tester

Non-projection CRTs supply an average of about 300 microamps of beam current and this is the level which all CRT testers and restorers are built for. As figure 4 shows, projection tubes operate with an average of 800 microamps of beam current and may even supply over 1 milliamp at times. This higher beam current is needed to drive the phosphor hard enough to produce a bright image at the projection screen. Only the CR70 can test these higher current tubes.

The CR70's unique "CRT Type" switch, shown in figure 4, allows you to select high current projection CRTs, medium current video CRTs and low current scope CRTs and test them for rated beam current. The correct bias voltages, restoring current levels, and meter scales are automatically switched in to match the CRT you're testing.

Using The CR70 Is Fast and Easy

To use the CR70 to test or restore a CRT you only need some basic setup information. You can get the setup information out of the setup book, or directly off a schematic. The setup for each tube in a 3-tube projection system is the same. Therefore, as you test each tube you simply need to connect the CR70 socket to each tube without resetting the setup switches.

To test high-current tubes with the CR70 you simply set the "CRT Type" switch to "PROJ". There are a few projection tubes however that do not operate at higher beam current. These tubes are called "Schmidt Valves" or simply "Schmidt" tubes. They operate at 300 uA of beam current as most non-projection, tri-color CRTs do. The Tech Talk box on this page explains how Schmidt tubes work and how you can identify them. If you are testing a Schmidt projection tube, simply set the CRT Type switch to the "Video" position.

Exclusive Tests Tell You Exactly What's Wrong With the Tube

You should always test a tube before you restore it. The CR70 was made to provide the most dynamic, and reliable tests of any CRT tester on the market.

Actually the CR70 provides a series of separate, inter-related tests on the CRT. You perform the tests in the order they appear around the function switch shown in figure 5.

Fig. 5: The CR70 provides a series of separate, inter-related tests which dynamically check a CRTs condition.

By having individual tests you know exactly what is wrong with the tube so you can use the best method of restoration for the particular failure. Other CRT testers just combine the tests into one or two readings.

If you don't have a CR70, you simply aren't ready to service large screen projection TVs. Only the CR70 provides you with five levels of progressive restoration to safely and effectively restore any CRT. Only the CR70 provides dynamic tests to isolate exactly what is wrong with a CRT. Only the CR70 allows you to completely test high-current projection CRTs for their rated operating current. Call your Phone Sales Engineer today and learn how easy it is to get your CR70 "Beam Builder".

Tech Talk

Schmidt Projection Tubes

A Schmidt projection tube is easily identified by its unique structure.

Most CRTs are very similar in their operation. Each focuses an electron beam onto a phosphor surface which in turn gives off light. The light output of these tubes is not as great as it could be, however, because the electron beam strikes the backside of the phosphor while the light comes off the front side.

For normal-view picture tubes, a sufficiently bright picture is produced using 300 microamps of beam current. But in projection tubes, where a lot of light output is required, the beam current must be increased to strike the phosphor harder.

Schmidt projection tubes do not require a higher beam current to produce a bright picture. Schmidt tubes use a first-surface phosphor and a concave mirror to project a bright picture. The light does not pass through the phosphor in a Schmidt tube. Instead the light comes off the same side of the phosphor that the electron beam strikes. Then the light goes back into the tube where it hits a mirror and is projected out.

It is important to know if you are testing a Schmidt projection tube since their setup is slightly different than conventional projection tubes. You can easily identify a Schmidt projection tube. Other projection tubes have a flat, rectangular-shaped face that you can see a raster on when the set is operating. A Schmidt tube, however, has a long, thin neck and a round face. The inside of the tube looks a little bit like a car headlight because you can see the concave mirror. In the center of the mirror is the hole where the electron beam passes through, and suspended in front of it is the small, phosphor target.

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

Save $197.50
See special #6 on page 14.

IN A NUTSHELL, HERE'S WHAT THE CR70 CAN DO FOR YOU.

Test Every CRT — including:
- * B/W and color TVs
- * Projection TVs
- * Video display monitors
- * Data display terminals
- * Even scope CRTs

Guaranteed to be the most reliable tester on the market.
There are other CRT testers, but none as reliable as the CR70. In fact, if during the first 30 days you find even one instance where the CR70 gives you a false reading . . . you may return it for a full refund, including freight both ways.

Guaranteed to restore 9 out of every 10 weak or shorted CRTs safely—yet effectively.
No other Tester/Restorer makes a claim like this—only Sencore. And it's backed with over 30 years experience in the business. Why toss old CRTs when they could be restored?

You'll never have to buy another socket again! (6 adaptors do the job of 64 and save you $700.)
A breakthrough in CRT Tester/Restorer design has eliminated socket problem once and for all! Six adapters is all you'll ever need to test every CRT—now and in the future.

Guaranteed fully protected against overload (from charged CRTs).
The CR70 is protected against CRT discharge with special MOV (metal oxide varistor) circuits that suppress any excessive charge. This saves hundreds of dollars in potential repair bills due to CRTs you thought were discharged—but weren't.

The CR70 is designed to make money for you.
The video, data display, and scope market is expanding. CRTs are the only "heat related" components that still go bad and will for many years to come. Cash in on this lucrative market with the all new CR70.

Write or call today toll-free for our 8 page color brochure.

MONEY BACK GUARANTEE

Try a CR70 for thirty days. If during this time you can't check every single CRT that you run into — or if you don't believe every one of the test results as being reliable, or if you can't restore at least 90% of all CRTs that you check with shorts or low emission — Sencore will cheerfully give you a full refund including freight both ways.

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Canada dial toll-free 1-800-665-4871

Original-Replacement Test Leads Keep Your Instruments Performing

: to drive (a [illegible] vehicle) before buying in order to evaluate performance

test lead (test lēd) *n.* **1.** A slender cord separating a good technician from a shot-gun guessor. **2.** The only connection between a piece of test equipment and a circuit under test. **3.** The most likely part of a piece of test equipment to be damaged because it makes the mechanical contact with the outside world.

test-ed \'tes-təd\ *adj* **:** subjected to or qualified through testing — often used [illegible] bi-

As technicians and engineers, we pretty much take our test leads for granted. They are usually there when we need them—but not always. They get borrowed or lost; stepped on or overloaded; or they just wear out. Once they're gone, that expensive piece of gear does us no good at all. We might try to cobble up a replacement; might *grab* a roll of electrician's tape and stick all the pieces back together. But the "fix" is never as good as the real thing, is it?

The answer to the age old problem is pretty obvious: An "insurance policy" in the form of a spare set of test leads. By purchasing a spare set now, you will avoid costly downtime later. Or, by replacing a lost or damaged set of leads today, you can save all kinds of headaches tomorrow.

The Sencore Service Parts Department can help you bring your test leads up to date for virtually any instrument we've built in the past 35 years. The following list shows the most popular test leads for Sencore instruments. Why not order the ones you want now? Keep your instruments performing to their fullest potential.

UNIT	DESCRIPTION	PART #	PRICE
FE14/16	1 test probe lead 1 ground lead	39G24	12.00
FE20	1 test probe lead 1 ground lead	39G28	12.00
FE21	1 test probe lead 1 ground lead	39G32	18.00
CG22	1 black coiled lead	39G37	10.00
FE23	1 probe lead 1 ground lead	39G40	12.00
CG25	1 black RF cable	NPN	6.00
TF26	1 red-green-yellow cable w/ E-Z clips	39G70	10.00
FE27	1 probe lead 1 ground lead	39G79	12.00
TC28	1 red-green-yellow cable w/ E-Z clips	39G70	10.00
PS29	1 probe	39G80	34.95
	1 blue & 1 black lead	NPN	5.00
	probe tip	68A19	6.00
TF30	1 red-green-yellow-blue cable w/ E-Z clips (specify banana plug or Din plug)	39G84	12.00
CR31A	grey cable with 11 pin socket	NPN	16.00
DVM32	1 probe lead 1 ground lead	39G91	15.00
DVM35/ 36/37	1 probe lead 1 ground lead	39G96	17.50
	red probe tip	68B30	5.00
DVM38	1 test probe 1 ground lead	39G91	15.00
TF40	1 black cable w/ E-Z clips	39G99	10.00
CB41	Sensor	39G101	48.00
CB42	RF cable ass'y.	39G104	7.50
	RF probe ass'y. (isolation)	39G105	14.00
	audio lead ass'y. (grey cable w/ banana plug)	39G106	8.00
	audio lead ass'y. (grey cable w/ phone plug)	39G109	6.00
	RF probe ass'y. (50 ohm terminated)	39G110	15.00
PS43	fused test cable (red) (3 per unit)	39G107R	6.00 ea.
FC45	12V input w/inline fuse lead ass'y.	39G111	10.00
	input probe	39G112	19.75
TF46	black cable w/ E-Z clips	39G99	10.00
VA48	Matching Transformer (300 ohm)	39G72	10.00
	audio lead ass'y. (grey cable w/ banana plug)	39G106	8.00
	fused test lead (yellow)	39G107Y	6.00
	RF cable (BNC to F)	39G117	12.75
	IF input adaptor	39G118	4.00
	1 red, 1 black, 1 blue (specify color needed)	39G120	3.75 ea.

UNIT	DESCRIPTION	PART #	PRICE
CB49	audio cable	39G109	6.00
	audio cable adaptor	39G134	6.00
	RF output cable	39G124	14.00
	RF input cable	39G125	10.00
	mike holddown strap	39G123	4.00
	(R & B) DC volts leads	39G128 (2)	10.00
FC51	12V input w/inline fuse lead ass'y.	39G111	8.50
	input probe	39G112	19.75
	4' cable BNC to BNC	39G137	12.00
	short pick-up loop	39G138	8.00
LC53/ CA55	test lead ass'y.	39G143	19.75
	test lead adaptor	39G144	6.00
	button hold assessory	39G154	6.00
TF54	black test lead w/ E-Z clip	39G99	10.00
DVM56	1 probe lead, 1 red, 1 black	39G147	12.00
	1 TP222		40.00
PR57	1 probe lead	39G148	12.00
SC60A	probe (specify blue or black)	39G149	49.95 ea.
	probe tip	68A42	6.00
SC61	probe (specify blue or black)	39G183	125.00 ea.
	probe tip	68A42	6.00
	voltage probe	39G157	12.00
VA62	300 ohm balun	39G72	10.00
	video cable	39G106	8.00
	75 ohm/BNC RF-IF cable	39G159	15.00
	75 ohm/RCA cable	39G160	4.00
	adaptor "F"/RCA female	39G161	8.00
	adaptor "F"/RCA male	39G162	8.00
	test lead, specify color		
	red	39G174R	3.75
	black	39G174B	3.75
	voltage probe	39G175	12.00
RC145/ 146	2 red leads, 2 black leads	NPN	9.00
FE149	1 test probe, 1 ground lead	NPN	10.00
TF151	1 red, 1 yellow, 1 blue, 1 black test lead, banana plus/ E-Z clip	39G84	12.00
SM152	matching trans 39G43 - replaces 39G22	39G43	10.50
	detector probe - replaces 39G23	39G45	6.00
	RF cable	NPN	12.00
	grey cable w/alligator clips	39G106 (3)	7.00 ea.
	vertical cable	NPN	6.00
SM158	matching transformer	39G43	10.50
	detector probe	39G45	6.00
FE160	1 probe lead, 1 ground lead, 1 3 amp lead	39G33	12.00
CR161	grey cable	NPN	9.00
PS163	probe (sold in matched sets of 2)	39G80	34.95 ea.
	probe tip	68A19	6.00
UPS164	12 GA cable ass'y. 1 red lead, 1 black lead	39G39	12.00
SG165	matching pad	39G43	10.50
	grey cable w/alligator clips	39G106	8.00
	detector probe	39G45	6.00
	auto radio adaptor	39G53	6.00
	RF cable	39G117	12.75
TF166	1 red, 1 blue, 1 yellow, 1 black lead, (banana plug to E-Z clip)	39G51	12.00
RC167	2 red leads, 2 black leads	39G52	9.00
CR168	grey cable	NPN	16.00
CG169	RF cable	NPN	8.00
	matching transformer	39G72	10.00

SETUP BOOKS
For TC114, 130, 142 & 154, Form 957 — $8.00
For TC162, 28, Form 1765 — $8.00
For VA48, Form 1764 — $8.00
For MU140/150, Form 1814 — $10.00
For all CRT Testers (except CR70), Form 3238 — $12.00
For CR70 CRT Tester, Form 3237 — $15.00

TEST LEAD REQUEST FORM

☐ **YES** **I'm ready to order the following Sencore test leads.** _____

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☐ Please send me a complete lead list.
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☐ Visa ☐ MC# _____
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Field Applications Bulletin

Notes on using your Sencore Instruments to their fullest potential including: New applications, circuit improvements and answers to common questions.

by Greg Carey, Application Engineer

How To Test Shielded Vertical Yokes

Designers of CRT deflection yokes have added a new wrinkle to vertical yoke. They've added two pieces of mu-metal to shield the vertical yoke from the audio circuits. An engineer from one major TV manufacturer explained that these yokes will be used in every stereo TV receiver because the stereo circuits pick up buzz from unshielded yokes. We have seen the shielded yokes used in many non-stereo sets, however, including models from Quasar, Sears, Sanyo, and Panasonic.

Call or write for your free copy of Field Application Bulletin 1254 which explains how to ring Shielded Toroidal Yokes.

The metal shield, which is permanently glued into position, causes the ringing test of the VA62, LC53, VA48 or YF33 to show less than 10 ringing cycles for a good yoke. These testers, however, still reliably indicate defective coils if you use 5 as the dividing line between good and bad instead of the normal 10.

Shielded yokes have a unique appearance. First, the yokes always use torroidal vertical windings. The torroidal windings wrap completely around the ferrite core material rather than using a bent "saddle" winding, as in older receivers. Second, the yoke has two metal shields glued to either side. These shields bridge across the two gaps between the torroidal windings.

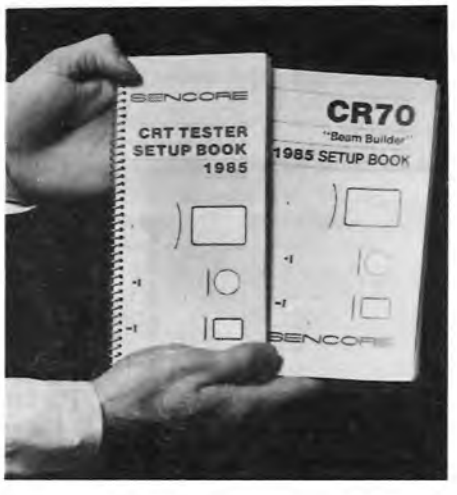
We find that good shielded yokes read 5-6 ringing cycles. Any shorts within the coil drop the number of ringing cycles to 0 or 1. Thus, use 5 as the normal good/bad reference point for the vertical windings only. Continue using 10 as the good/bad reference point for the horizontal yoke windings, as shields don't affect the horizontal.

1985 CRT Setup Books Available

The updated setup books for Sencore CRT testers will be mailed soon, to everyone on our automatic book mailing list. Your name is not on our list if you do not receive your book. Order your new book directly from the Service Parts Department.

The new book lists 560 more CRTs than the 1984 version, including many of the "WTDS" (World Type Designation System) numbers (numbers like A48AAB20X) used in all the new receivers.

Order the correct book. The *CR70 Setup Book* applies only to the CR70 "Beam Builder" CRT Analyzer and Restorer. The *CRT Tester Setup Book* applies to all older Sencore CRT testers (CR31, CR31A, CR168, CR161, CR143, CR13, CR133, CR128A, and CR125). The price for the *CR70 Setup Book* is $15.00. The price for the *CRT Tester Setup Book* is $12.00.



The 1985 CRT Setup Books are available from the Sencore Service Department.

Testing Torroidal Ferrite Coils

A torroidal coil uses a doughnut-shaped core of ferrite (powdered iron) material. The coil wires of the coil wrap around the core in one direction. The LC53 "Z Meter" may read the inductance value of these coils slightly higher with the test leads connected in one direction compared to the other. The amount of shift is minor; typically less than 5% from the value half way between the two readings.

This condition occurs because the LC53 feeds a DC current ramp through the inductor and then measuring the resulting E.M.F. in order to calculate inductance. The highly permeable ferrite core may contain some permanent magnetism. This polarization normally results from prior use of the coil in a DC circuit or may even be the result of manufacturing processes.

A torroidal coil may contain some residual magnetism, causing a small error in the LC53 reading.

The residual magnetism causes a slight increase in the inductance value when the electro-magnetic field from the LC53 current ramp opposes the polarity of the permanent magnetic field. The amount of value shift is generally so small that it can be ignored.

If you wish to eliminate the difference in readings, demagnetize the core using a demagnetizer designed for magnetic tape or tape recorder heads. Or measure the coil with the test leads in each direction and split the difference. For example, one coil measures 24.3 microhenries with the test leads in one direction and 25.8 microhenries with the leads reversed. The total difference between these two readings is only 1.5 microhenries. Subtracting half this difference (0.75) results in a value of 25.05 microhenries.

Testing The Peak-To-Peak Response Of The SC61

Users of the SC61 often suspect the digital readout on their unit is out of calibration because it does not agree with the reading on the CRT. The opposite is actually the case. The digital readout is more accurate than the CRT measurements. In fact, the SC61's peak-to-peak measuring circuits are so precise that conventional methods of testing oscilloscopes are not accurate enough to test their frequency response. This has caused questions for some industrial and government users who calibrate their own test instruments.

To understand why this happens, consider that most oscilloscopes only have accuracy to ±3 dB throughout their operating frequency range. *A 3 dB spread allows measurement differences of 41%.* The SC61 digital PPV function, on the other hand, has a specification of only **0.5 dB from 10 Hz to 30 MHz.** *The 0.5 dB specification represents a measuring error of only 5.9%.* (The tolerance then switches to 3 dB from 30 to 60 MHz to agree with the CRT response.)

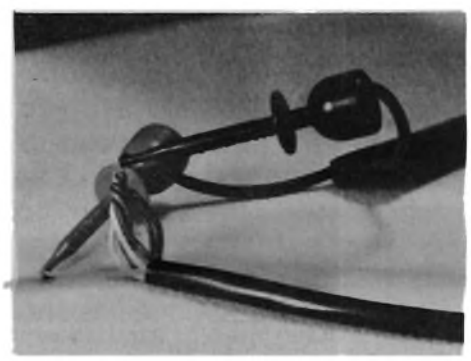
Signal generators accurate enough to test or recalibrate conventional oscilloscopes are generally not accurate enough to use directly for testing the SC61. Sencore has developed special calibration procedures for use by labs which test or recalibrate the SC61. Obtain your own copy of these procedures by requesting "SC61 Calibration Bulletins" on the enclosed reply card or by calling the Sencore factory.

Measuring Unshielded Wires With The LC53

The LC53 "Z Meter" provides accurate tests of coaxial cables when locating the distance to an open (break) or a short. As we've explained in previous Sencore News articles, you measure the capacitance of the cable if it is open or the inductance if it is shorted. Dividing by the average capacitance or inductance per foot results in the number of feet to the problem.

A number of customers have asked if they can apply the same process to unshielded cables as well. Do not use the "Z Meter" tests when working with unshielded cables with 2 or 3 conductors. The open wires pick up too much stray AC which causes the highly sensitive LC53 input circuits to display erratic readings. You can, however, use the "Z Meter" to test cables with 4 or more conductors.

When testing multi-conductor cables, tie all but one of the conductors together to form a shield. Then, test between the single, separated line and the several conductors. You will need at least a 10-foot sample of the cable to determine the capacitance or inductance-per-foot value of the cable, since these will not be published. Details on using the "Z Meter" for cable testing are found in *Sencore News* issue number 120, beginning on page 28.



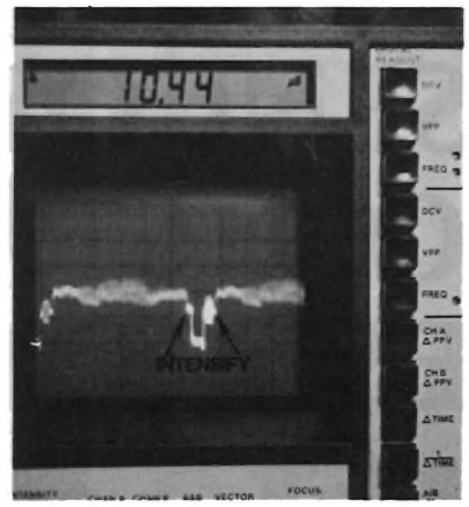
Tie all but one of the conductors together when testing multi-conductor cables with the LC53.

Testing Broadcast Blanking Specs To FCC Tolerance

According to *TV Technology* magazine, debate continues over the current FCC rules requiring all transmitted TV signals to have horizontal blanking within the limits of 10.49 and 11.44 microseconds. At present, the FCC enforces these blanking limits.

Many devices in the video signal path can widen the blanking interval. These devices include frame synchronizers, timebase correctors, special-effects generators, and processing amplifiers. Each can cause the blanking interval to widen beyond FCC limits, even though it was correct at the camera or VTR that originated the signal.

The SC61 Delta-Time function lets you quickly confirm your blanking interval is within tolerance. To test the blanking interval, feed a sample of your signal to either SC61 input. Sample the signal as late in the broadcast chain as possible (or monitor the video output from your modulation monitor). Press the "Delta Time" button. Then adjust the "Delta Begin" and the "Delta End" controls until the intensified area on the CRT just covers the blanking interval and read the digital readout. The SC61 readings have the 0.01 microsecond resolution needed to confirm FCC tolerances.



The Delta Time function of the SC61 quickly tells you if the width of the horizontal blanking interval is correct.

(Standards continued from page 11)

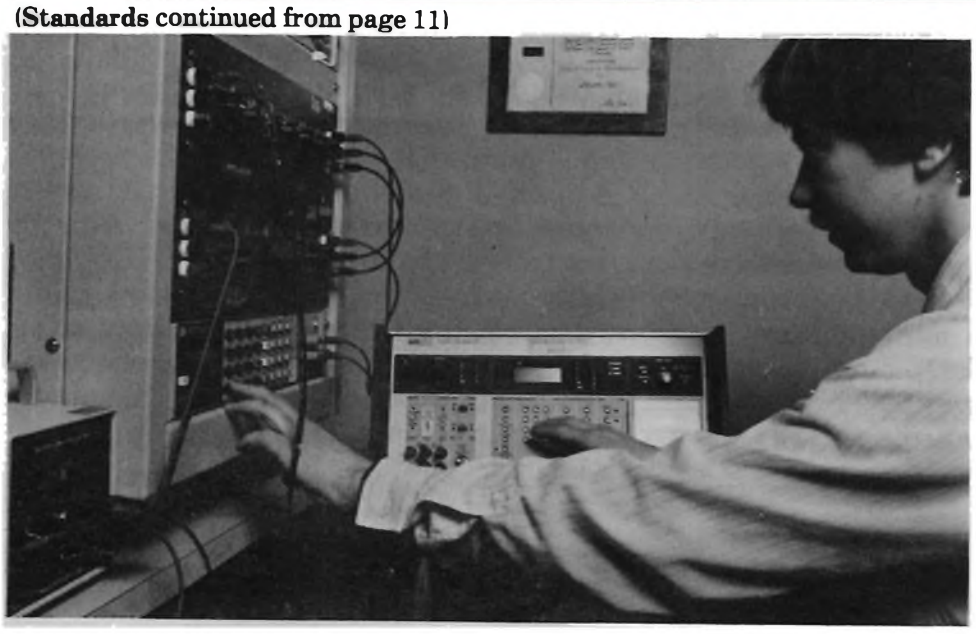


Fig. 4: Each secondary standard used at Sencore is regularly checked against our prime standards.

Our NBS resistance traceability is achieved through highly accurate NBS traceable, decade resistors. Our standard resistors range from .0004% for our 10 ohm standard to .002% for our 100 megohm standard.

The standard capacitors and inductors in our lab are also extremely accurate components. They are verified regularly by the NBS to maintain traceability.

Secondary Standards

Our prime standards are very impractical for daily usage on the production line, since they were not designed for such applications. Used in a production environment, the prime standards would quickly become inaccurate and fail. Our standard voltage cell, for example, would take 2 days to recover if you accidentally shorted its output.

So, to calibrate our production line equipment, we need practical standards that are fast, durable, and easy to use. Secondary standards are designed for these large scale calibration needs. Secondary standards supply a wide range of voltages, currents, inductances, resistances, and capacitances.

How Your Instruments are NBS Traceable

As you have seen, each piece of equipment that we use to calibrate your Sencore meter, scope, analyzer or other instrument is checked regularly against our prime standards in our standards lab. Therefore, we can trace the calibration of every unit that leaves our manufacturing plant or service department directly back to an NBS absolute standard.

We take pride in our equipment. Providing reliable, NBS traceable calibration is the last step in making our high quality, dependable test equipment. After all, that's what you've learned to expect from Sencore.

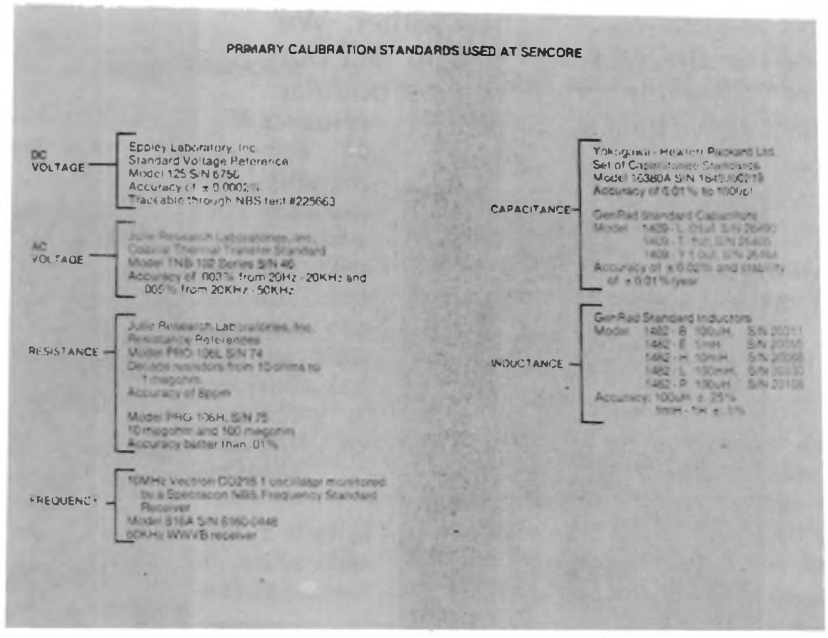


Fig. 5: You can follow the NBS traceability of your Sencore equipment using the listing of our prime standards printed on the backside of the Certificate of Calibration.

SENCORE RECOGNIZES OUTSTANDING EMPLOYEES

During the company's annual Profit Sharing dinner held December 12th, Sencore President R.H. "Herb" Bowden honored thirty-nine Sencore employees. He presented awards for attendance, efficiency and years of service. In addition to these awards, Mr. Bowden also presented awards to several other outstanding Sencore employees.

Service Award

Receiving special recognition at the Profit Sharing Dinner for his years of service was Don Multerer. Don has been with Sencore for 23 years, spending much of the last 20 years on the road conducting service seminars. Don's travels have taken him to every state, except Alaska, and every Canadian Province. Many Sencore customers know Don personally, and affectionately call him "Mr. Multimeter".

Don has seen a lot of changes take place in Sencore since his days as a Jr. Engineer working on the "Handy 36" component substituter. Today, as National Accounts Manager, Don feels that Sencore's best change is the addition of the Telemarketing program. He explains, "It gives us a direct link to the customer. Now the customers have a friend right here at the factory. We haven't forgotten about them either. We still are out there in the field. In fact our current VCR seminars are the most popular seminars we've held in 10 years."

Don Multerer received recognition for his 23 years of service to Sencore.

Managers Choice Award

The Managers Choice award is presented annually at the Dinner. A Managers Choice award is given to a salary employee and an hourly employee who the managers feel deserves recognition for his or her efforts during the past year.

Janice Schmidt was the recipient of this past year's Managers Choice award for hourly employees. Jan is responsible for collecting Sencore's installment contracts. During her 5 years at Sencore, Jan has consistently kept past due accounts well below the industry average. This is a big responsibility, since so many of Sencore's customers choose to take advantage of long-term financing.

"Jan has the capability of resolving account problems while maintaining good will," explains her manager. "She is a very good communicator and brings a 'people aspect' to her work. She is willing to work out problems. Her theme is customer service, where the customer is first and collection is second." Jan's job is important to our customers. After all, keeping our credit losses to a minimum saves Sencore money which ultimately saves you money.

Al Baarson received the Managers Choice award for salary employees. Al has been with Sencore 4 years, the past 3 1/2 years as a Phone Sales Engineer serving the east central United States. In addition to receiving this year's Managers Choice award, Al was named the "Phone Sales Engineer of the Year" for 1984. He has also received numerous "Sales Engineer of the Month" and "Sales Engineer of the Quarter" awards.

Al is a "nice guy" who "sells himself". "I haven't sold a thing in my life," he explains. Al doesn't see himself as a salesman, but rather as a "sales and applications consultant". "I just help my customers find the equipment that they need to do their job properly. I'm here not to sell them something, but to help them out. With the products we have it's not too hard to make their work easier and faster. How much they earn is all dependent on how much they service. If they can't service effectively they won't make any profits, and after all, they are in business to make money."

Sencore President R.H. Bowden (left) presenting the President's Choice Award to Bob Baum. Also pictured are Manager's Choice Award recipients Jan Schmidt and Al Baarson.

Presidents Choice Award

The most coveted award presented each year at the Profit Sharing Dinner is the Presidents Choice Award. The recipient of this award is selected by Sencore's president, R.H. Bowden. This years award took on extra significance because the person who received it is also a long-time Sencore employee and received an award honoring him for his many years of service.

The 1984 Presidents Choice award winner is Bob Baum, Sencore's Vice President of manufacturing. In presenting the award, Sencore president Herb Bowden pointed out that Bob Baum was selected "because of his 30 years of loyalty to Sencore and his outstanding performance in the installation of the total manufacturing facilities in the new addition to the plant." Mr. Baum was also cited for installing many automated systems in the plant that improve efficiency, increase accuracy and produce flexibility.

Bob began working at Sencore in September, 1955. At that time the Sencore factory was located in Addison, Illinois and was quite different than it is now. He remembers it well.

"It's really quite interesting now to think back," Bob recalls. "Our first building was only 2500 square feet. By comparison, one of the lunchrooms in our plant now is 2400 square feet! So you see, it was not at all what we have now...I remember when it rained hard the water would come running in under the front door and bring in a bunch of little frogs. The water would go on through and out the back door, but it left the frogs behind. We sure had a hard time getting those darn little frogs out of the filament checker cases!"

Bob Baum, 1984 recipient of the Presidents choice award has been with Sencore for 30 years.

Though Bob has always been close to manufacturing, his main responsibility through the years has been as a design engineer. Bob has designed over 100 Sencore units and accessories and remembers most of them. He enjoyed designing color bar generators the most, although he admitted that it "wasn't always that easy to get the timing right using tube circuits."

The toughest unit Bob recalls designing was the FS134 Field Strength Meter. "What made the signal strength meter so tough," he explained, "was that we needed a solid state tuner before they were even available in televisions." Bob explained that Sencore always designed innovative equipment. "Sometimes, as in the case of the Field Strength Meter, we had to break new ground."

At first Sencore manufactured "timesavers, things like filament checkers, bias supplies and leakage checkers," Bob recalls. "Our first 'real instrument' was when we added a leakage test to a tube checker and made a bona fide tube tester." Bob continues, "Our products have always been directed to solving problems. Sencore's strength is that we make analyzing equipment that is easy to use.

All of us at Sencore congratulate this years winners and look forward to next year.

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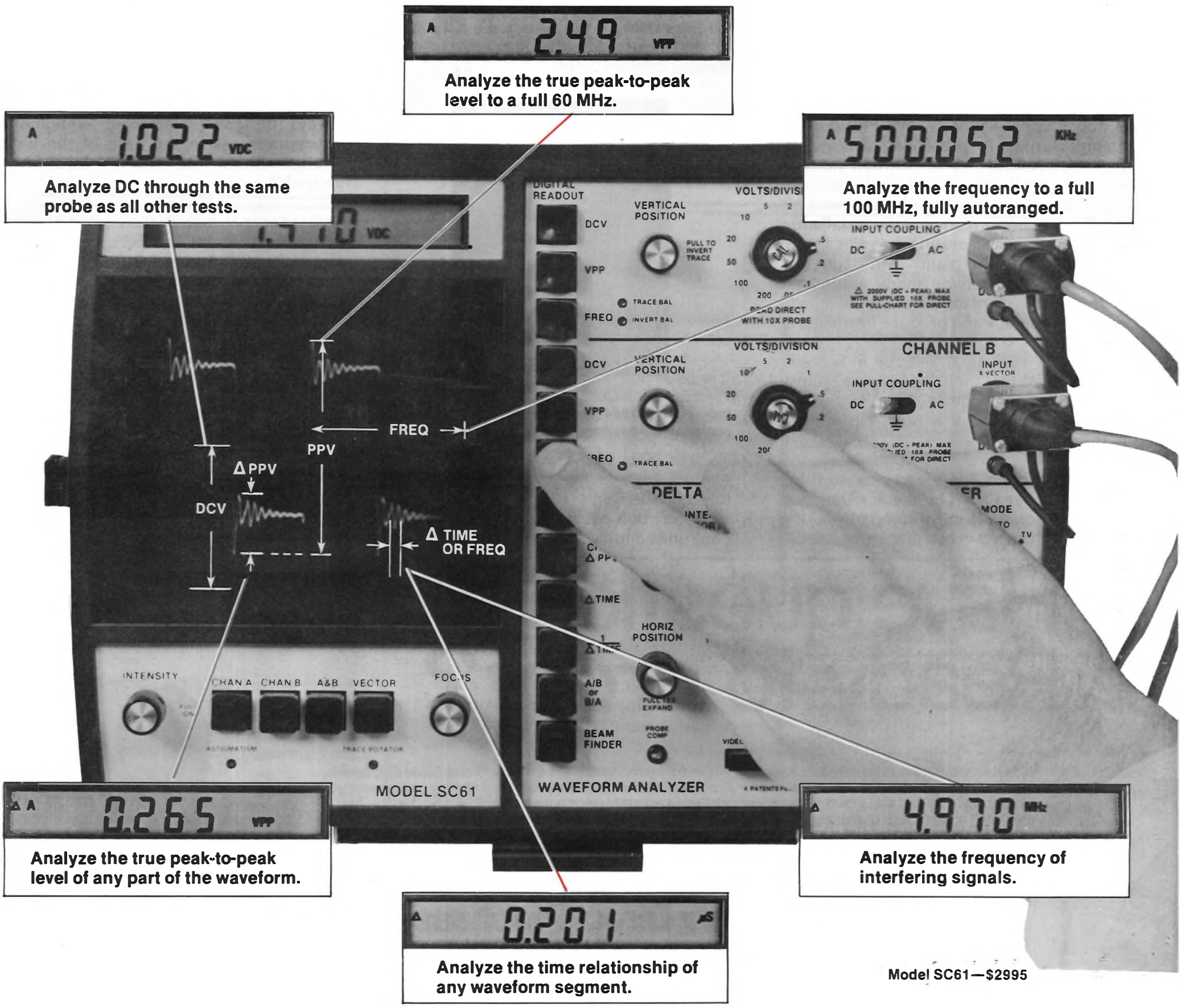

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