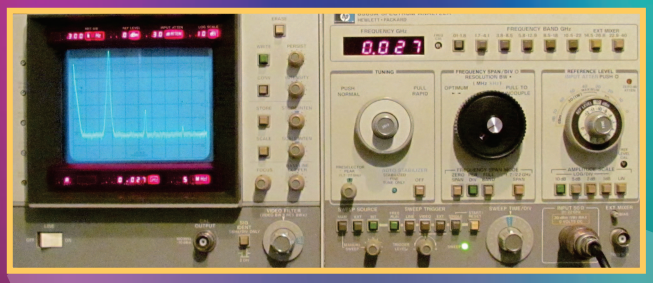
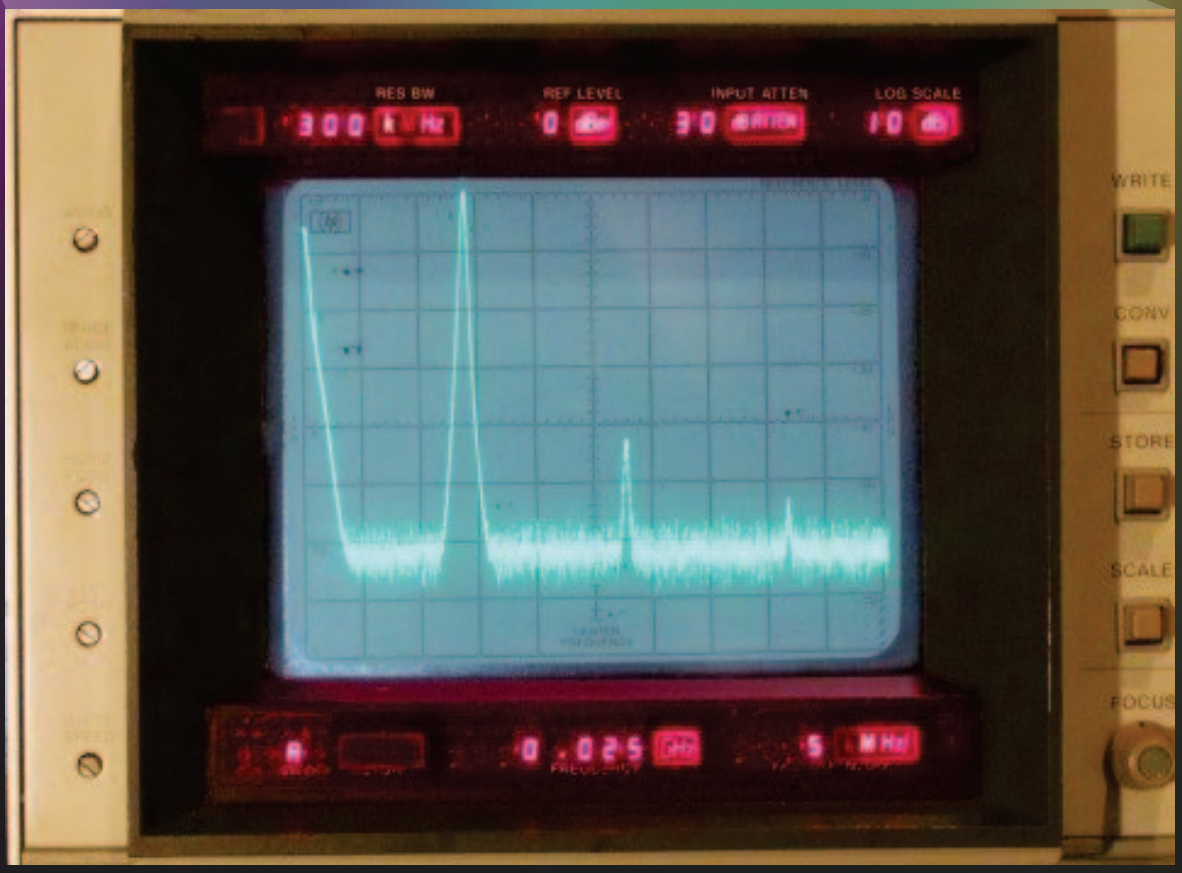
The Signal

OFFICIAL MAGAZINE OF THE COLLINS COLLECTORS ASSOCIATION * Q4 2014 Issue *

Maintenance ~ A Spectral Affair ~





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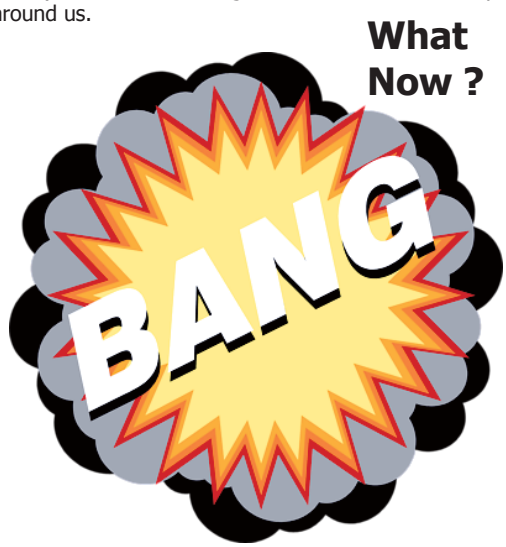
Collins Collectors Association

FROM THE STAFF

by Bill Carns, N7OTQ & Don Jackson, W5QN

From the Desk of N7OTQ

This quarter's magazine efforts just seemed to hang out there in the ether for longer than we would like. When the theme of the spectrum settled in, it came in a strange form. Don Jackson had made his – as usual – fine contribution on the importance of, and how to use, a Spectrum Analyzer. This article, and the other directly related one on the construction of a 50 db sampling probe—as well as another incoming article about Audio Spectrum shaping and perceived "signal quality" (this will run at a later date) started me thinking. I realized that – in a very real way, we are all in the business of managing our use of, and impact on, the spectrum around us.



We are also all involved more and more with the maintenance of our equipment. Whether it's just finding options, and then selecting someone else to do some repairs on our vintage gear, or diving in ourselves in varying forms, maintenance is always looming over the horizon or has already jumped up on the table to stare us in the face.

Over the past 2 years, first the 80th anniversary of the Collins Radio Company (now Rockwell Collins), and then the 20th anniversary of the Collins Collectors Association, has motivated the writing of the *Signal* to focus on the history of our equipment, the people that designed and built it, as well as the company itself.

Everyone seemed to really enjoy that, and there were many compliments, but at the same time, there was a growing whisper of a suggestion that the readership would like to see a return to a more balanced content. Specifically, people were asking if there could be more efforts put into articles and information related to maintenance and restoration of our fine equipment.

The Editor's and Staff of the Signal could not agree more. So, here in this issue, we start back to the middle of the spectrum (there is that word again) of subjects that relate to our collecting of, interests in, and use of Collins radios.

Now, and please read this with intent, here is the rub there. Successful execution of a balance in content requires that there be more contributions from the membership documenting their maintenance and repair or restoration projects. Those of you who are experienced at these things, or even those who are not and put in the efforts to gain that experience, are going to have to document, take some good before, during and after photos, and make a contribution to our efforts here.

There is no way that the *Signal* staff can produce all of the writings required to continue the level of output that we want to provide you with. 'Nuff said on that subject.

As mentioned, this issue starts us down the path of what to do (and how to do it - and with what) when the smoke leaves and things go bump in the night. With your help this coming year, we will get back to articles about that winter project – or fall project – and some good "How to ….." articles on the restoration of our Collins.

Enjoy your Collins, and continue to enjoy your membership and this magazine. Happy Holidays.

de Bill, N7OTQ

email: wcarns@austin.rr.com

From the Desk of W5QN

Season's greetings to everyone, and hope you are all doing well. As usual, I'd like to ask the members to contact me if you have something you think might be worthy of an article for *The Signal*. It can be technical in nature, historical, or anything else you believe might be of interest to the CCA membership. As well, if you would like to submit information for our "In the Shack" feature, please contact me. It's always fun to see what equipment others are using.

Recently there was a mild flurry of activity on the CCA Reflector concerning my S-Meter modification that appeared in *The Signal* a couple of years ago, and recently was reprinted in the July 2014 issue of QST. Unfortunately, I have sold all the PCBs I had, and don't plan to procure any more. However, Don Van Wagner, K4LAJ, is having a batch of PCBs made, so if you are interested, please contact him. I tested one of his prototype units, and it is of professional quality.

Check out the article on a high power signal sampler in this issue. It is a really useful item for working on transmitters, and isn't hard to build. I find it very useful in my shack. It is a head-scratcher to me that a device with similar characteristics is not available to the ham community at an affordable price.

On a new subject, recently I needed to characterize a number of Collins mechanical filters. As you probably know, this is not a trivial task if you wish to use standard test equipment with 50Ω impedance levels. I've built a test fixture that does a decent job of solving this problem, but wonder how others may have addressed the issue. Perhaps this could be the subject for a future *Signal* article. Let me know!

73s - Don, W5QN

email: w5qn@verizon.net

The Signal Magazine

OFFICIAL JOURNAL OF THE COLLINS COLLECTORS ASSOCIATION

Issue Number Seventy Six - 4th Quarter 2014

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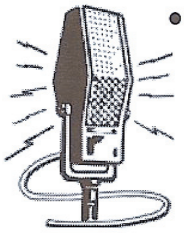

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The *Signal Magazine*

Published quarterly by the

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- 2014 -

In Perspective

2014 is almost in the history books. As you know, this is our 20th anniversary of the official founding of the CCA. As we entered 2014 we laid out some pretty aggressive hopes and plans for the year. I am pleased to report that with just one exception, we have made those plans a reality.

This year has seen the CCA grow even stronger. The membership continues to increase and by all reports people are pretty pleased with the direction that things are taking. This includes not only the direct supporting efforts of our organization by our members, but also some pretty reach-out projects aimed at bettering our group, our hobby and the direction our younger generations take in the future. As planned, all membership records and the database were transitioned to the website and now members can renew right on the website and update any of their data at any time.

In addition, the CCA announced a new level of membership and established a free Associate Member status that provides website benefits and a quarterly "Collins Collectors Association Column" newsletter distributed by email to all associate members. This email "Column" honors the earlier Collins Column internal Collins Radio publication and will provide associate members with a perspective on CCA operations, accomplishments and extracts of some of the *Signal Magazine* contents.

At the end of the 80th anniversary issue production for 2013, we announced that there would be an offering of a bound version of these publications offered to members on a limited edition numbered basis. These plans have been delayed somewhat due to workload on the VOA and events projects. We still intend to offer this publication as we continue to get inquiries. It is our hope to have these available by Dayton in 2015. We'll update you all in the next *Signal* , on the reflector and the website.

The VOA/Collins Model 821A-1 transmitter recovery operation has produced amazing results. The fund raising continues and the work on expanding the future home of the associated displays is moving ahead. The 821A-1 (all 20 tons of it) are nestled in storage in Bloomfield New York waiting completion of the first display. You will be hearing more about this as we move into 2015. Keep up to date by visiting the Collins Radio Heritage Group website at http://www.collinsradioheritagegroup.org/ or going to the Antique Wireless website at http://www.antiquewireless.org/ .

As promised, throughout the year the CCA provided a fun presence at no less than 6 events with dinners, talks and booths (with super attractions) at Orlando, Dayton, Dallas, AWA (Bloomfield) and Pacificon in California. In addition, we had a strong booth and attraction presence at the ARRL 100th Convention in Hartford, CT where Jim Stitzinger brought the Collins Van back for a replay of its earlier visit in the 60s. Folks surely remembered….. and it was a blast from the past.

This coming year we will be doing Orlando, Dayton, Dallas, the AWA convention and California (South - TBD in the fall).

We are looking forward to another great year and, when we close 2015, you can all come to the Bloomfield, NY AWA museum and see an amazing Collins Auto-tune 250 KW AM transmitter up close and personal. Along the way, there will be more surprises about this growing display of the VOA and Collins history. Always….Stay tuned.

A Quick Look in This Issue

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- DYI Maintenance - Getting Started
- Preventative Maintenance - Friend or Foe
- 2014 CCA Report - Election Status

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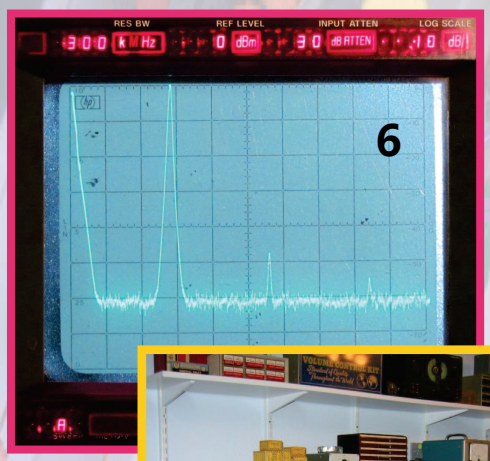

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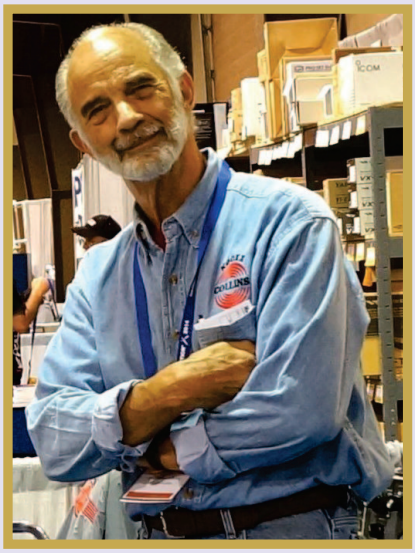


Don Jackson

"Spectrum Analyzer - A Primer" *pg. 6*

Don is just the kind of guy you want to find for a Technical Editor and Author. He is highly qualified after a long career in the Electrical Engineering field where he eventually specialized in receiver design. Better yet, he loves a challenge or a puzzle.

However, his career also took him down the transmitter and amplifier path and even into micro-transmitter design. His knowledge and technical capabilities are evident at all times and he writes often for the *Signal*. As always, it is a pleasure to have him in print.

Scott Kerr, KE1RR

"The Right Stuff" *pg. 9*

If anyone is qualified to write for us on what to look for when stocking your test bench, it is Scott. In addition to being a passionate Collins collector, he is a test equipment collector, and as he likes to say: "I have never met a piece of test equipment that I did not want to play with." Like many of us, he likes to use vintage test gear whenever possible while working on the vintage Collins.

Scott joined our board in 2011 after volunteering to serve as our webmaster. In 2013, he was elected to the board and subsequently elected by the board as our Vice President. In this issue we announce his reelection to the board and rise to the position of President of the CCA.

Scott has an eclectic background including a successful 20 year long career in real estate development, followed by his shift in gears to a technology start-up company doing IT work. Along the way, he served in a professional capacity as the producer of major TV religious and entertainment productions and also acquired a taste for electronics maintenance and history.

All-in-all this is the kind of broad background that we like to see in our CCA leadership.

And….if you ever get a chance, pay him a visit and take a look at a wonderful Collins collection.

Bill Carns, N7OTQ

"It's Broke Jeb", *pgs. 12-14*

As past President of the CCA, Bill is passionate about the conservation, preservation and operation of Collins equipment. He constantly deals with the issues involved in the decisions regarding modifications, conservation, historical perspective and needed maintenance.

He has strong leanings toward preservation but acknowledges ownership and the desire to operate often trump these more philosophical considerations. Here he discusses some fundamental considerations when experience is low, and the need to "operate" arises.

Bill lives in the Wimberley, Texas area and has his collection there on display for visitor when the occasional visitor stops by. All are welcome.

His background is in Physics, Semiconductors and he holds Physics, Arts and Electrical Engineering degrees so he comes by his interest in maintenance by nature.

Spectrum Analyzer - a Primer on What You Need and How to Use It

By Don Jackson, W5QN

Electrical Measurements

When analyzing or troubleshooting our gear, we have a number of instruments at our disposal. If the signal is constant over time, or its amplitude does not vary with time, a simple voltmeter will work. However, if the signal is more complex, and we wish to observe its exact behavior at any given points in time, we need an instrument that looks at the signal in the "time domain". The oscilloscope is such an instrument, and displays the signal in "X-Y" coordinates, with time on the "X" axis, and amplitude on the "Y" axis. Although this information is very useful for many measurements, it does not tell us anything specific about the spectral (frequency) content of the signal. To provide this information, we need an instrument that functions in the "frequency domain", which is where the spectrum analyzer comes in. The spectrum analyzer (SA) displays frequency on the "X" axis and amplitude on the "Y" axis.

The "Y" axis of a standard oscilloscope is always in Volts. However, the SA "Y" axis is usually expressed in decibels. Most commonly, the display is shown in dBm, where "0 dBm" is 1 mW, although "linear" and dBV are also available in some SA units. Using the decibel scale is very handy since this enables the operator to take advantage of the very large dynamic range of the SA. For example, if you set the SA for +20 dBm (100 mW) at the top graticule, you might still be able to see signals at -50 dBm (.01 uW) while simultaneously viewing a +20 dBm signal.

How Does An SA Work?

Early SA units were analog designs that were really just receivers that could be swept in frequency. The local oscillator of the receiver was swept over the desired frequency range with a sawtooth waveform that was also applied to the "X" axis of a display. The output of the receiver was then applied to the "Y" axis of the display. Figure 1 shows a very simplified block diagram of such an SA.

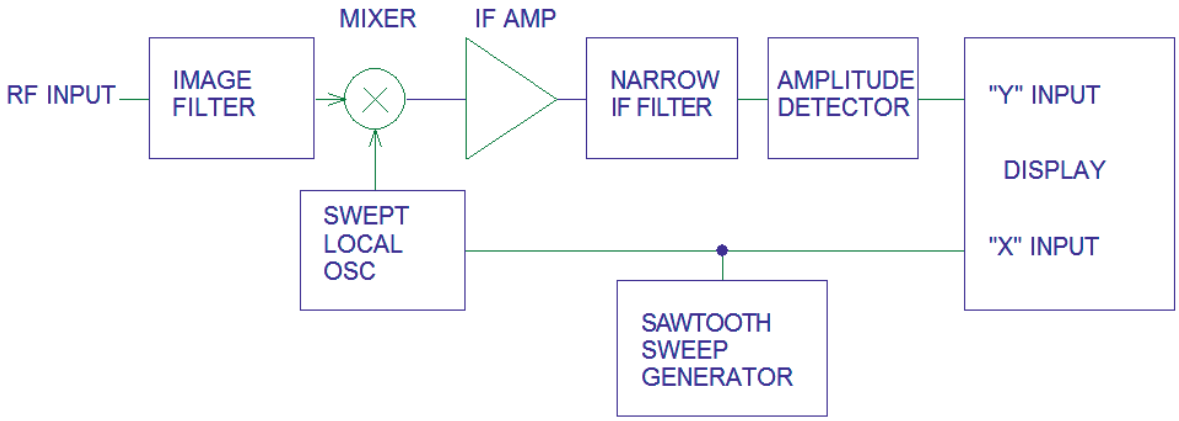


Figure 1 – Analog Spectrum Analyzer Concept

However, all (to my knowledge) modern SA instruments use a mathematical transformation process to achieve the same spectral display. The transformation enables conversion of a time domain version of a signal into its frequency domain counterpart, and vice-versa. It is named the Fourier Transform in honor of Joseph Fourier who initiated the mathematical concepts in the early 1800s. Modern analog-to-digital conversion techniques, coupled with Fast Fourier Transform (FFT) algorithms have allowed SA instruments to be designed and produced that are smaller and less expensive than earlier analog versions.

Why Use an SA?

Simply looking at a transmitter's output on an oscilloscope doesn't tell us much about how well it is functioning. All we see is the signal in the time domain, and very little can be gleaned about spectral aspects such as harmonic content or spurious emissions. However, looking at the transmitter output with a SA, we can see the harmonic output - as well as other undesired spectral content such as internal local oscillator signals, and spurious oscillations. SA instruments allow us to see signals at very low levels, typically 60 dB, or more, below the amplitude of the primary output signal.

What Measurements Can We Perform?

There are numerous observations that can be made using an SA. A few are listed below:

- Transmitter harmonics
- Spurious oscillation evaluation
- Two-Tone linearity tests
- Noise analysis
- EMI analysis

Probably the most important use of the SA is to fully characterize transmitting equipment. Considering that your transmitter signal is going to be out there in the public RF environment, it is critical that you are able to confirm it is putting out a clean signal, with harmonics and spurious outputs within manufacturer and FCC specifications. The SA is THE instrument for this job.

SA Terms and Definitions

Frequency: Center frequency of the displayed spectrum

Span: Width of the spectrum displayed (stop frequency minus start frequency)

Resolution Bandwidth (RBW): Sets the closest frequency separation discernible on the display

Phase Noise: Noise contributed by the SA internal components (primarily the oscillators)

Obviously, you will need an SA that covers the frequency range of your equipment including reasonable harmonics. RBW is important if you plan to perform measurements such as two-tone tests, in which you must be able to measure spectral components that are just a kHz or so apart. For this task, you need an RBW of 300Hz or less.

What Practical SA Instruments Are Available?

For the audio frequency range, your best bet is to download one of many free FFT software programs to use with your computer audio card. The one I've found to be the best for my purposes is from SpectrumLab. It is loaded with features and even has the ability to output various test signals from your audio card. It is possible to use this software to perform two-tone tests on a transmitter. Using a mixer and local oscillator (a frequency synthesizer in my case), I converted the RF output of my S-Line down to the audio band. SpectrumLab produced the two-tone input to the 32S-3, as well as analyzing the audio output from the mixer. The results were quite good. Of course, you must be sure that all levels are adjusted so that additional distortion is not created in the mixer or the computer audio card. (Editor's Note: If there is enough indicated interest in this approach, there may be another article on this technique in the future.)

For the RF frequency range, there are a lot of old analog SA units out there, primarily HP and Tektronix. The HP-141T with the 110MHz or 1200MHz RF plug-in is very nice for amateur use. However, you should make sure the CRT is in good condition, as finding a replacement is likely to be a real challenge. As with all used gear, condition is a huge part of the equation. A decent HP-141T seems to go for around $500, depending on condition. Tektronix also produced a number of SA plug-ins for their oscilloscopes, so that could also be an option.

There are also many FFT SA units available today as USB modules that plug directly into your computer USB port. These are interesting units, and vary in price from less than $100 to over $1,000. I've never actually used one, but it is clear you will want to read the unit specifications carefully to make sure you get a unit that will do what you want. For example, many units do not cover the HF frequency range. Also, many units do not have the resolution bandwidth required for two-tone audio measurements. For example, Triarchy ($529) and RF Instruments ($330) have units with frequency coverage down to 1MHz, but their minimum RBW is only in the 50kHz range. Signal Hound has units that fill the bill, but they are over $900. So, be careful when purchasing.

Another option to consider is the Rigol DSA-815, which came on the market a couple of years ago. It is a stand-alone SA that has most all the features an amateur typically needs. It has an input frequency range of 9kHz to 1.5GHz, and resolution bandwidths from 100Hz to 1MHz. Considering that comparable SA analog units with these features were priced in the $50k to $100k range, the Rigol's price of $1,295 is very reasonable. For an additional $200, you get the "tracking generator" option, which allows the DSA-815-TG to function as a scalar network analyzer. This is very handy for measuring the frequency domain characteristics of 2-port networks such as amplifiers or filters. You can read a review of the unit in the February 2013 issue of QST.

Care and Feeding of Your SA

Whatever your choice of SA, the primary threat to its health is too much input power. Considering the SA is often used to characterize a high powered transmitter, there is a huge potential for blowing out the front end of your SA. It cannot be too strongly stressed that you ensure the power you apply to the SA is within its specification limits. When using an SA to measure transmitter characteristics, you must always use a device that reduces the power to an acceptable level.

On the surface, an obvious way to do this is with a resistive attenuator. A broadband 60 dB attenuator would do nicely to reduce that 1 kW output to 1 mW. However, this is not that easy a solution considering the attenuator will be required to dissipate that 1 kW. For this reason, we don't see very many 60 dB, 1 kW attenuators. You will find an occasional Bird Dummy Load in the 100-500 watt range that has a sampling port output. These can be very useful if you can find one.

The next option usually considered is to use a 1 kW dummy load, with a "capacitive tap" device connected to its input. Such a device is usually a coaxial "T" connector with an adjustable probe that can be positioned close to the center conductor of the connector. This technique is handy, as it can be set to tap off a very small amount of power from the main line to the dummy load. However, this is not a "broadband" device. Since it approximates a small capacitor connected to the coaxial line, its frequency response is that of a high pass filter. If you are only interested in observing a single frequency, this is fine. However, consider the case where you desire to measure the level of various harmonics of your transmitter. The capacitive tap has an output with a "6 dB/octave" frequency response. For example, let's assume you wish to confirm that your transmitter meets its specification of -50 dB for all harmonics. Using your SA, you set a reference level for the fundamental frequency (7 MHz for example) of 0 dB. You now look at the second harmonic (14 MHz) and can see that it is only at -44 dB. Even worse, the 4th harmonic (28 MHz) level is at -38 dB. Although it would appear that your transmitter is out of spec, it actually is not. Taking into account the 6 dB/octave increase in signal level, the 2nd and 4th harmonics are both actually -50 dB below the fundamental. So, is there a better solution than the capacitive sampler?

Assuming we want to sample a high power transmitter output, and feed that sample to a SA with 50Ω input impedance, the best approach is probably to use a sampler designed around a current transformer. These can produce a reasonably flat frequency response over several octaves. You can read about how they work at http://www.g3ynh.info/zdocs/bridges/Xformers/part_1.html and design a suitable sampler yourself. It is also interesting to note that Warren Bruene's coupler design, used in the well-known Bruene directional coupler, uses the current transformer concept. Warren describes details of the transformer in his April 1959 QST article "An Inside Picture of Directional Wattmeters".

I've always wanted such a sampling device, but never got around to acquiring one. Of course, you can purchase one, but they can be very expensive (Magnelab CT-B unit for $590, for example) unless you can find a great deal on a used unit. Being curious and frugal by nature, I decided to try my hand at building a suitable unit. I designed it to handle 1500W input, with a sampled output 50 dB below the input.

Figure 2– Don's Homebrew 50 db Sampler

The sampled output port is designed to have a source of 50Ω to provide a match to 50Ω test equipment. If you are transmitting 1500 Watts, the output of the sampler is 15 mW (+11.8 dBm), which

Spectrum Analyzer (Cont'd)

should be well within the maximum input limits of an SA. Also, since the sample port source impedance is 50Ω, you can add low power coaxial attenuators to the sample port to accurately lower the power even further if you wish.

Although something of a breadboard version, its performance is pretty impressive. The sample port small signal frequency response was measured to be .58 MHz to 145 MHz (at -1 dB down). From 1.7 MHz to 128 MHz, the response is flat within about .25 dB. The .58 MHz low end was very close to the design target. The high frequency end is difficult to predict in the design phase since it is a function of the distributed capacitance of the transformer winding and other subtle affects. However, the 145 MHz result is certainly satisfactory for typical HF use.

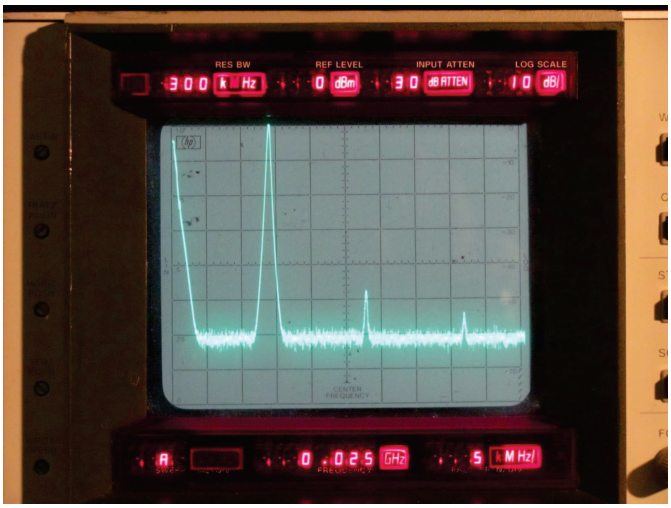


Figure 3 – 32S-3 Harmonic Content using HP 8565A

The mid-band coupling factor was measured to be so close to the 50dB design target that luck had to be involved! Let's just say the coupling factor is very predictable from the design equations. Insertion loss of the main line was measured to be less than .06dB up to 170 MHz (as read from the plot of Figure 7 in the construction article). A more complete discussion of the sampler design and construction appears elsewhere in this issue of the *Signal*.

Figure 2 is a photo of my own SA, an old HP-8565A, which is a nice unit, but is only specified over the 10MHz to 22 GHz frequency range. The lower limits are not exactly optimum for HF use. Nevertheless, I set it up with my new RF sampler to display the output of my 32S-3, operating at 100 Watt CW output on 20m. You can see that the fundamental power level read on the SA display is 0 dBm (1 mW), which is 50 dB below 100 Watts. As well, the 2nd harmonic is 47 dB below the fundamental, and the 3rd harmonic is 55 dB below the fundamental. By the way, the 32S-3 2nd harmonic spec is 40 dB. Also, we can see there are no undesired oscillations or other components in the output signal.

Operating Technique

As with all sophisticated test equipment, you should carefully read the manual concerning its proper use. There are a couple of common errors that operators typically might make when using an SA.

The first applies to analog SA designs, and involves the relationship between Sweep Speed and Resolution Bandwidth. Without going into detail, there is a maximum Sweep Speed that can be used for a given selected RBW. If this Sweep Speed is exceeded, the amplitude of signals on the display will decrease, and the amplitude calibration of the SA will be invalid. For best results, start with a slow Sweep Speed and increase until you see the signal amplitude decrease. Then reduce the Sweep Speed one increment from that point. Although most SA units automatically set the Sweep Speed as the RBW is changed, some may not, or the "automatic" feature may be overridden.

The second potential error applies to all SA designs and is encountered when performing tests involving system linearity. Such tests include harmonic and 2-tone intermodulation testing. The problem is that you must ensure that the SA is not adding its own distortion to the distortion of the device under test. Most SA units have a switchable passive attenuator at the RF input that is usually variable in 10 dB steps. While observing the display containing desired and distortion component, note their relative levels. Now switch the attenuator to a higher attenuation value. For example, you might have started with an attenuator setting of 10 dB. Switch to 20dB attenuation and note whether ALL the displayed signals decrease 10 dB in level. If they do, the SA is not adding significant distortion to the measurement. However, if the distortion products change by something other than 10 dB, the SA is adding to the distortion. You must then continue increasing the attenuator setting until you see proper behavior of all the signals on the display.

Actually, there are third and fourth – all too common - errors that are more, let's say, mundane in nature. All too often, while using a SA, "it" happens. You either get the attenuation wrong – easy to do, or you transmit into your SA without the sampler in line after using the SA and tracking generator to work on your transceiver-receiver side. Only a large dose of care will prevent these two last occurrences.

Conclusions

Without a doubt, a spectrum analyzer is a very useful piece of equipment to have on the bench. It provides a way of looking at signals in the frequency domain that an oscilloscope cannot. As such, the SA is very useful for a wide variety of tasks, and nearly indispensable for transmitter work. Be sure you understand what you want from the SA before investing money. And, to protect that investment, be absolutely sure you do not damage it by applying too much input power.
Cheers,

de Don, W5QN

Author's Note: As this article progressed, I finally bowed to temptation and bought myself a Birthday and Christmas present combined. I am now the proud owner of one of Rigol's offerings.

The Rigol Model DSA815-TG (the –TG signifies it has the tracking generator installed) shown here was acquired and used to repeat many of the measurements already taken. You can see more of what this machine can do in the article on the construction of the 50 db sampler in this issue. Suffice to say here that the Rigol products bring new meaning to the words "Bang for your buck".

The Right "Stuff"

By Scott Kerr, KE1RR

It is a fact of life that some of our 50 to 80 year old radios that we collect and enjoy are going to need some maintenance sooner or later. Sadly, the number of qualified repair offerings continue to decline.

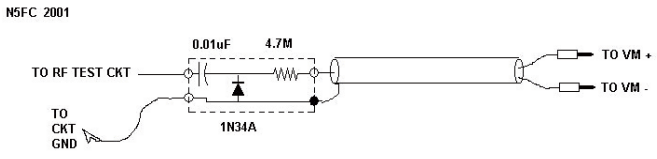
If you watch the Collins reflector it seems that almost every week a new Collins fan has decided to restore or repair his or her prize possession. While the reflector is great for specific problems, we thought that a review of the equipment necessary for a basic and intermediate test bench would be appropriate and an aid to those wishing to get their foot in the door or expand what they already have.

Like many collectors, I got back into the hobby after the career was on its way and the kids were grown. Seems that I realized all those radios that I dreamed about early in life were now within my grasp and I gradually fell down that slippery slope to becoming a Collins collector. My first acquisition was a KWM-2. It arrived at my office and I could not wait to get home, listen and then get it on the air! That night it was unboxed, plugged in and fired up. Twenty meters was hopping and I sat amazed at the wonderful sound coming out of the speakers. That lasted about 3 minutes until I smelled an acrid smell and then saw my KWM-2 releasing its smoke into my ham shack! It would be some time until I heard the M2 again.

Luckily I had restored a few brand X boat anchors and had a modest test bench area set up. I could also draw on my experience as a kid working on tube ham radio equipment, and then many years of pro audio work. So the M2 went down to the garage test bench where I had what I consider the basics of the things needed to work on Collins radios. **These basics include:**

Digital Multimeter – (Which of course will supplement that period correct Simpson) While not 'period' correct and not absolutely essential, they have gotten so cheap that it would be unwise not to have one. While Fluke is the name brand, the cheap imports can be had for under 50 bucks and almost any of them are more than accurate enough for resistance and AC/DC voltage measurements. I cannot imagine not having one in the shop. Search Amazon for multimeter and you will find choices from $9 to $150 for the Fluke. While you are shopping, get some extra test cables with alligator clips on the end. This will add an extra hand or two when doing measurements! I have the older Fluke Model 8050A test bench unit bought used for $25 and it is my favorite on the test bench. I see them for $20-$50 at almost every big hamfest. Highly recommended.

VTVM – OK why go old school when I can purchase an accurate multimeter? Isn't that why you see all of those old VTVM's at every Ham Fest? The reason you want an "original" VTVM is that few things can beat one for its ability to not load down a circuit while doing a measurement. It also can do RF voltage checks when equipped with the proper probe. I had purchased the same VTVM that I had as a kid for ten bucks at a hamfest, the RCA Junior VoltOhmyst. I then made a simple RF Probe (see the Figure xx) for a couple of dollars and it served me well for a few years until I made an upgrade.



CLASSIC RF PROBE

Reads RMS Equivalent Voltage in test circuit, if Voltmeter is 10-11 Meg Input Impedance; Reads 4X RMS Equiv Voltage if VM is 1Meg Input Impedance (Set VM to measure DCV)

RF Signal Generator - If you are going to be serious about aligning and trouble-shooting ham equipment then this is an indispensable piece of equipment. Good units are going to be expensive but the fact of the matter is that perfectly serviceable units were manufactured by Eico, Heath, Elenko and other companies that will work just fine. These seem to go for $25 to $100 at the hamfests and a quick search of our favorite auction site found nice units in that price range. The problem is that we are used to digital displays that read the unit's frequency. How can you be sure that you are actually using 14.263 MHz if all you have is a dial with a marker? Well there is a way to do it (hams did it for years!) … a problem easily and cheaply solved!

Frequency Counter – The calibration of your low cost signal generator is easily solved with a frequency counter. At the same time, you then have a means to check crystal oscillator output frequencies and monitor other sources in your rig, like the PTO. Search eBay for Heath Frequency Counter and you can usually find them for 10-30 bucks. I have actually picked up some really nice HP units from the 5300 line for $25 - $50 at hamfests. This is something that can make that signal generator very accurate and will find many many uses around your shack!

O-Scope – This is the thing that seems to scare away many new troubleshooters as it can seem complex and expensive. The truth is that the scope is my favorite piece of test equipment. Along with my VTVM I often use a scope when doing alignments. But what about accurate RF voltage measurements you ask? Learning how to measure RF voltages on a properly calibrated scope is easy, and I find that 'seeing' the signal can give me many clues about performance that a VTVM just does not show. I recently had a 75S-3 that had strange audio problems. 5 minutes with a scope and I found the problem, a bias supply with WAY too much ripple. I replaced the bias filter cap and then I was done. A 50 or 100 MHz analog HP scope can be had for $100 or less at most hamfests. I would not work without one. You just do not need a digital scope with more bandwidth than 50MHz to work on Collins A or S line equipment.

Dummy load – you should have a dummy load at the bench (and one in your shack – You don't tune up on the air during the 20 meter net do you???). Make sure you find one that is sized to the equipment you will be working on.

Tools – One thing you learn is to buy quality. I am partial to Xcelite since it is a brand I have used for over 30 years and find the quality to be top notch. Yes, you pay more, but you then have a tool that lasts a lifetime if it is taken care of. You will need both slot and Philips screwdrivers, needle nose pliers, wire cutters (both small and large),

Continued on Page 19

Your CCA - 2014 - A Fourth Quarter Report

General Business - The health of the CCA has never been better. The membership is at an all time high and the financial position sound. Membership now includes the new Associate Membership class for those that do not want, at this time, to receive the *Signal.* We hope at some point that they will decide to try us out on that, but in the meantime, it is nice to know that they are enjoying the website and their new "wallpaper". Even leaving aside the number of new Associate Members, the membership reached an all time high this year.

Our relationship with the AWA and our alliance that has resulted - the Collins Radio Heritage Group - has increased our impact on the hobby and allowed us to accomplish some objectives (like the VOA transmitter save) that we would have been unable to do without it. It has also not hurt our visibility and that has helped our membership grow. All-in-all, what a great 20th birthday year. Again - Many thanks to Bill Wheeler, our founder.

We are looking forward to an even better 2015 and being able to leverage this progress and continue to grow. As you will see below, we have a full schedule of events for the year and this will give many more of you an opportunity to meet your CCA management personally as well as get together with other members that also attend. We are proud of what the group has accomplished and it is only with your continued support that this will continue.

In short, - in a time when many large clubs are struggling for members, hurting financially and having difficulty recruiting leadership - it is really satisfying to see the CCA not only growing, but growing significantly.

PACIFICON - 2014 - Pacificon was our final event for 2014. It was again held in the bay area during September. The local team, headed by Werner Vavken, WB6RAW, did a great job of presenting the CCA at a show booth at Pacificon, as well as putting together another fun dinner. At the dinner, Dennis Kidder, W6DQ and CCA Board Member, and Jim Stitzinger, WA3CEX, past CCA board member, presented a talk on the extraction of the Collins Model 821A-1 HF transmitter from the VOA site at Delano, California. As a side note, there continues to be a lot of interest and need for updates and fund raising on this project, so you may see additional presentations this year at one or more of our events.

Below, Jim Stitzinger tells the group some of the exciting details of the Collins Model 821A-1 recovery at the VOA Delano site.

Scan to see more about the CCA

Jim also, again, brought his restored Collins Radio Company S -Line promotion van to the area for members to enjoy during the show. We never get tired of that Jim, and thank you so much for your efforts. Werner looks right at home in that van.

Election Results - - - - Meet Your New Board Members

Following the posting in the last issue of the *Signal Magazine* of the need for board elections and the subsequent timing of the process , nominations were received for the two slots that were up for election. James (Jim) Hollabaugh, W6TMU, was nominated for Board Position 1 (Previously held by Bill Carns) and Scott Kerr was renominated for Board Position 2 previously held by him.

Nominations were closed at the end of November. Due to the fact that there was only one nomination for each slot, no balloting election was required.

It is with great pleasure therefore that we announce that Jim Hollabaugh and Scott Kerr have become your new board members to serve two years through November of 2016.

Following this nomination, and board slot fulfillment process, the board of directors held the required election for President.

Above - Scott Kerr, KE1RR, was unanimously elected President of the CCA and will now serve in that capacity through 2016.

This position is well deserved. Scott has provided consistent support for the previous CCA leadership and served one term as Vice President in 2013/2014. He also is the webmaster and IT support guru for the CCA and brings you the CCA website.

He has been a active and significant collector of "things Collins" over the past 5 years. He is also passionate about the people, history and equipment of Collins Radio and Rockwell Collins.

He runs his own IT support company in the Dallas, Texas area where he serves a broad spectrum of businesses including Fortune 1000 International Enterprise firms. His company does system implementation, programming, system design and engineering, network design, service and support. He has a long track record of, first Real Estate development, and then IT Business development spanning 40 years.

Scott shared that his vision for the next two years includes focusing on member support particularly in the A-Line and S-Line areas. This focus will encompass preservation, restoration, maintenance and operation. Welcome Scott!

Above - James (Jim) Hollabaugh, W6TMU relaxes in front of his beautifully displayed S-Line and other Collins equipment.

Jim was elected to your CCA Board of Directors during this past election and we welcome him and look forward to working with him in this new capacity.

Jim is a practicing attorney in the bay area and also has done yeoman's duty as our Collins Collectors Association 20 meter Net Manager for many years. He will also continue as Net Manager.

We appreciate Jim's service in the past and look forward to what we know will be some great years ahead as Jim, and the other board members, steer the ship.

2015 at a Glance - We are all looking forward now to another successful year in the CCA. 2015 will see us with a full calendar of events spread across the country and we look forward to seeing as many of you as possible at these "Live Shows".

In addition, the CCA, as well as the related CRHG, have an important challenge ahead as we support the AWA in their funding drive to raise the money for completing their building addition and VOA display build-out. This building addition and the subsequent planned display construction was driven - in large part - by our rescue of the Collins Model 821A-1 HF autotune 250 KW 22 ton HF shortwave transmitter from the VOA facility in Delano California. We are all looking forward to closing out the year with a visit to that new transmitter display in Bloomfield, New York.

Along the way, we will have our main meeting and get-together in Dayton in May, our 3rd annual Orlando Hamcation dinner and booth in February, Dallas HamCom in June with our always fun dinner there, the AWA meeting in New York with our CRHG alliance partner - the AWA, and then our end of year West Coast meeting and dinner which, although not pinned down yet, I understand will be in Southern California this year.

See our Events Calendar on the website and stay tuned. - CCA -

It's Broke Jeb - What Now?

First, with a small friendly grin and all due respect, if you are asking that question – and we do hear it asked – you probably as a first course of action should enlist help from someone with more experience.

Where to start when you have an apparently dead unit depends on what it is but there are some common denominators. Let's start with those.

If it's dark and just plain won't turn on:

It may sound silly, but plug something else into the plug where you had the radio plugged in and make sure you have power.

Give the unit a good inspection to make sure that everything is there and that your 5 year old grandson has not pulled the fuse holder out to play with it. Seriously, make sure the fuse is there, it is the correct size and ohm it out with a good continuity checker. I have seen fuses that looked perfect and were open.

Next: With the power supply attached if it is separate, and with everything unplugged, turn on the power switch and check the resistance between the hot and the neutral power plug blades. While you are at it, check to make sure the ground stud – if there is one - is actually connected to chassis ground. If the resistance between the hot and neutral blades is somewhere in the 10s to 100rds of ohms range, then you probably have a good primary circuit on the power supply. If that reading is open, you have a bad plug, AC cord, or power switch – or even worse a blown or open primary on the power transformer. There could also be strapping issues on equipment with remote or voltage options. Regardless, you now know where to start looking. Manual time.

If you got a normal resistance reading consistent with the DC resistance of a power transformer primary, then all is good up to the transformer.

Let's assume the primary circuit checked out and the unit was still dark. The power transformer is now highly suspect. By dark, we mean no noise and no panel lamps showing – no activity at all. Confirm this by checking the lamps and also using a good AC voltmeter to look at the LV secondary and the filament (and lamp) winding AC voltages with the unit turned on.

With a completely dark and quiet rig, it is highly likely that you have now found the problem.

It is a receiver and lights up but will not play:

First, (and you have read the manual – right?), make sure the unit is connected correctly, the speaker or headphones connected, the mute function is in operate mode and that the antenna is connected. Some receivers have rear mounted chassis connections for external muting or other control functions and these can be tricky to deal with.

Let's assume you have the rig connected correctly now and that it lights (Lamps and filaments lit) and that the receiver does not work. Here is where having read the manual and understanding the architecture of the receiver and the conversion scheme is going to help you. It is not test bench time yet.

Make sure the receiver is turned on, it is in operate, and not standby, mode and set it to AM mode for now. Band Switch to a lower band like 75 meters, Calibrator on, frequency to the middle of the band and set on an even exact 100 kHz dial setting. Now we are going to use your dead receiver as a test set.

Turn the RF gain up all the way. BFO "Don't Care". Rotate the AF Gain all the way up to the max. You should hear a small amount of hum. No receiver has a perfect 100 db down hum spec. If you hear hum and you can change the level with the AF gain control, the B+ is working at least some, the final AF Audio Amp is working and the audio stages before the final audio amp and after the volume control are probably OK. If you hear hum in the speaker, but no signals and you cannot make the audio hum bigger with the volume control, the problem – at least one of them – is located in between the gain control and the audio output amplifier.

Now, with the audio AF gain all the way up, (some hum apparent in the speaker) turn on the BFO or the Product detector and you should hear an increase in broadband or white noise, indicating the oscillator is running. This is just a basic check and just note the result. This noise is generated by the oscillator and is a product of the IF broadband noise and the oscillator noise. If you hear it, it is a good indicator that, not only is the oscillator running but that the product detector is passing signals.

Now, let's go to the front end of the receiver. The calibrator is on. Tune across the calibrator and see if the S-Meter reacts and you can peak the S-Meter on the nose of the calibrator signal. If there is no reaction on the S-Meter, then the calibrator signal is not making it through the RF amp front end stage or the calibrator is not working. If you have hum in the audio, you have B+. If you have B+, you should have a calibrator. If the receiver is totally deaf, then it is unlikely that there is a simultaneous failure of the receiver and the calibrator. Let's assume the calibrator is working. Now you know that the failure is somewhere between the RF stage and the IF stage just prior to the product detector. That leaves a lot of territory.

While tuning for the calibrator, turn the RF gain all the way down. The indicated S-Meter reading should rise to almost full scale. This S-Meter reading is actually just an indication of the DC level of the AGC line. In some equipment it is a little more indirect – like the bridge circuits in the S-Line series, but the theory still applies. If you turn the RF gain all the way down (CCW) and the S-Meter does not rise to almost full scale, you have an AGC problem and this indicates the main issue may be in that area of the receiver. Remember that the applied AGC (usually to the RF stage(s) and the first couple of IF stages) is a combination of fixed internally generated AGC bias and then the derived variable signal strength related AGC signal.

Now, we have snooped on the audio, the BFO/Product Detector, the Calibrator, the RF gain stage and the AGC line. Let's bring in some reinforcements. Turn on another receiver that is physically close to the one that is in trouble. Using your manual, find the frequency of the HF injection oscillator and find the injection frequency for the band that you have selected. Tune the good receiver to that frequency and use a gimmick to wrap a wire around the injection oscillator tube and clip it to the antenna jack of the good receiver. Make sure you can hear that injection oscillator running. Mute the bad receiver or turn it off temporarily to make sure you know what you are listening to. Now you know the HF fixed first conversion (we are assuming dual conversion) oscillator is running. Now, tune the good receiver to the PTO frequency range, connect the same kind of gimmick and run the PTO through its range and you should get a birdie blip as the PTO crosses the frequency of the good receiver. You now know you have, or do not have a good PTO. While you are doing this you can also listen to a harmonic of the xtal calibrator and you know for sure it is running.

Things are starting to fall in place now. If you have two good oscillators running and you have AGC action and noise from the BFO and Audio controllable hum, you now know that the problem lies in one of the mixers or the early IF stages.

Now that you know where to look, open the lid and just for taking the simple route, make sure that the tubes are lit in the suspect area (explore the temperature carefully if in doubt – some run very dark). If they are all running in the now identified suspect area(s), try a quick tube sub for the stages in doubt. There should be no more than three or four.

If this fails, you still have it narrowed down. Get your tube extenders out and pull the tubes in the suspect areas one at a time and go through the tube voltage and resistance measurements from the manual table of Rs and Vs for each tube pin. Pay particular attention to the supply voltages during these checks and that will sort out whether you may have a general power supply issue. Most Collins manuals have this tube pin resistance and voltage chart.

If you have a scope or an RF millivolt meter, and you have not identified the problem by now, while you have the tube extender in the socket(s), explore the RF signals on the grids and plates starting from RF to IF and make sure you see the appropriate signal that you can turn on and off with the calibrator.

And that is the way you use a dead receiver to diagnose itself. After you are finished, and if it is not a tube, you will need to go to the next level that assumes you have some repair experience and a modicum of test gear. It is now time to open the receiver up and get down to business.

Now, let's take a look at what happens when you have a dead transmitter.

If it is completely dark, see the comments above regarding a completely dark receiver. They all apply. Then, it is bench time. Isolate the power supply. With an S-Line, unplug the power supply and carefully and double checking, identify the AC switch lines in the power supply connector and make a jumper for those female pin holes. First, with the PS not plugged in, go through the primary checking steps mentioned above. You have checked the fuse and now the primary, so it is time to plug the supply in and with the AC switch lines jumped, use a VARIC or a Surge Suppressor with a switch to control the AC power.

Turn the supply on and carefully explore the DC outputs (HV, LV, Bias and Filament) to see if the supplies are all there and working correctly. Having explored the supply, and knowing its condition, you can turn your attention to the transmitter itself. If you are working on a combined PS Transmitter like the 32V series, then your supply checking job is the same, just start by isolating the supplies and pulling the rectifiers and thoroughly checking the supplies before going on to the transmitter.

Now, we take a bit of a different approach. After making sure that the supplies are good, and doing a very thorough visual inspection, other than the most high level tube checking and substitution we are going to stop here. Transmitters should be worked on only by folks that are more advanced than those that need this article. There are safety issues, technical test equipment issues and just plain training to do the job properly.

If you do not know how to proceed from here, please get help from someone that does. You are going to need good test equipment, a troubleshooting background and the technical knowhow to use them.

For other than the most cursory of repairs, and particularly if you have been significantly working on RF stages, I suggest that transmitters should always be checked on a spectrum analyzer before putting them back in operation.

If you have found this article enlightening and want to go further with transmitter restoration and repair, I encourage that, but encourage you to get a mentor and get the training to do it right.

Graphic Credit - WB4HFN Website—Collins Repair

New to Me - Where to Start ?

The answer to that question is, of course, "At the beginning".

Before you ever consider running a piece of equipment that is new to you (and this includes one that has been on your shelf for 15 years), you should do some very basic things.

Then, before you even touch the radio, take a moment and sit down and read the operator's manual. Particularly review the sections on installation, Operation and Theory of Operation and Maintenance. I can't tell you how many people have come to me asking what is wrong with a perfectly good radio because they did not know how it worked, had not read the manual, and had not installed or operated the equipment correctly.

If you are not familiar with the fundamental operation of the equipment – keep going until you are. If need be, get a mentor, or step back and do a little basic radio theory studying. This entire effort will reward you in spades even if everything works and you are just going to go ahead to install and operate a working radio.

Good – That being done, you are ready to take a look at your "new" challenge. The operative word here is "look"!

So, how to do that? First, clean it. Unless you are just trying to find out if a less than pristine piece is even worth putting any effort into, stop right here and clean it. You are going to do that anyway, so do it now. It will reveal many secrets as you go and it will make the inspection and maintenance job easier - and besides, it is motivating for me to see the result. I am not talking major restoration – if that is needed, just get it clean. More on cleaning in a different writing.

Now, it's clean. Time to start the inspection. Take the cabinet off and get ready for some serious observations. As you remove the cabinet components, make a To Do list of things to be replaced or polished up or fixed as needed.

First, pull and carefully inspect and compare the actual installed fuse values for all fuses to the required values in the manuals and subsequent service bulletins. Make sure you understand the history of the fusing. Install the correct fuses. It is very common to find the incorrect value installed. Sometimes it is out of a previous "necessity" due to lack of availability, and sometime – worse yet – it is due to some idiot installing a 20 amp fuse in a 5 amp application because it was blowing and they wanted to do a little power-on trouble shooting. VERY BAD idea.

I once bought a cheap KWM-1 that was a cosmetic doll, but supposedly had let the smoke out of its power supply transformer. I was told the unit did not work and that the power transformer had "burned up". The price was right. Long story short, the owner had given the transmitter to a ham friend that "had more skill than the owner did at repair" and this worthy had put a 20 amp fuse in the power supply main fuse port to run it long enough to do some measurements. BAD IDEA. The transformer had let out its smoke pretty badly. The guy then had quit there telling the owner he had a bad transformer and returning the equipment - which I then bought.

My inspection found the 20A fuse which promptly got replaced with the correct value. Careful winding inspection and measurements looked pretty normal. Measurement of the caps looked normal. The power supply – completely separated from the KWM-1 - was then AC switch jumped and brought up on a Variac. Guess what? It played like a champ and still does to this day. Collins uses high quality transformers – Thank goodness.

Now, obviously the transceiver itself was highly suspect. The unit was opened and visually inspected. Looked perfect - and like new in there. Hmmmmmmm. Then, the schematic was refreshed in my head, and a few critical measurements were made at the power connector. B+ to ground. Filament string. . . etc. Wow… ZERO ohms to ground.. More quick measurements on all pins showed zero ohms (and I mean HARD zero) to ground everywhere. Dang – never seen that before.

Now, more inspection found nothing but the normal Collins workmanship. Internal tube resistance chart measurement and pin to ground measurements showed hard ground everywhere…and I mean everywhere. More inspection and more head scratching.

Then, in the course of very critical inspection I bent a disc ceramic out of the way of looking at another test point and walla – the culprit. The culprit was that 20 amp "Diagnostic" fuse used by Mr. Repairman. Out from inside of the braided spaghetti tubing that shrouded the main harness, was just the slightest amount of green copper corrosion goo rearing its ugly head. Pushing back the braided harness protective tubing revealed a complete melt down of the harness where the heat was contained by the spaghetti tube. The insulation was burned off, the wires all fused together, and the harness was toast and zero ohms to ground on all lines. While that transformer was smoking under that load (and holding Mr. Repairman's attention), the harness was burning up.

Fast forward through a complete teardown of the chassis components to get to the main harness. Correct rebuild of the harness using the correct color coded wire and spaghetti tubing, and then rebuild of the set using almost all the originally carefully removed components, and the unit can be seen in operation today in my shack.

Enough said? Do not ever up the size of a fuse. Find the problem first. In the course of the teardown, I found the original problem. Either in some exploratory work, or just from movement and shock with time, a B+ disc ceramic cap had gotten bent further over letting its hot lead touch a ground point. It was just an intermittent B+ short that had started the entire episode and just some simple inspection and diagnostic measurements would have located a very easy to fix problem. Just bend the cap back out of the way.

Now, on to the **Second** step in the inspection process. We all know what that great Collins Radio quality workmanship looks like. Start at one corner of the underbelly, and work your way across and over to the other corner looking for signs of the last guy that was in there.

Make a note of areas where the rig has been repaired. Which stage and what was done. Look for cold solder joints. Look for things that you just would not want to leave there. Find out where the rig has been repaired and make a list. Get to know the rig from the inside out.

If there are things on that list you do not understand – make a note. If there are things that you know should be fixed before you ever run the radio – fix them. That is, fix them if you are qualified. More on that also later.

Specifically, make sure that the line cord is safe and the grounds are good. Notice I did not say make sure there is a three wire AC line cord. Many of the older pieces of Collins have two conductor line cords. Some of those cords are in remarkably good and beautiful condition due to their original quality and good storage and considerate use over time. Let's keep as many of those original as we can on historic pieces. Just make sure you have a good AC ground on the chassis. You should have that anyway for lightning and RF safety reasons.

Never bend a rubber older line cord in a tight bend and wrap it up or store it. Stress and ozone will do a number on it and you will lose it. Never leave a cord in the sunlight behind a radio. (And while we are on that subject, be conscious of where sunlight is shining on your old plastic dials, or they will yellow. This includes coming in through the

rear of the radio through the vents and shining on the dial from the inside. My KWM-1 desk sits in front of a window and the sun shines through the back on those nice old dials. I use a towel over the radios when they are not in use and the towels hang over the back.

If the AC cord is unsafe, replace it with a three wire quality cord of the proper appearance.

Alright, we have checked for proper fusing. We have cleaned up the rig. We have done a very thorough inspection and first pass emergency repair and we have made sure the AC line is good and safe.

Now, what we do next depends on what you absolutely know for sure about the history of the radio. Was it supposed to be working? Do you trust what you know? How long has it been in storage since it was "working"? Transmitter or receiver? Internal or external power supply? Bottom line, the next thing we are going to do is make some measurements and find out if the power supply lines look normal. After that we will apply some power – carefully.

If it is a power supply, measure from the AC inputs to ground and make sure everything makes sense there. Look for leakage from internal noise and RF suppression bypasses that are often across the AC line. Also look at the output lines or pins and check the resistance to ground and or across isolated supply pairs. Use the schematic to do an equivalent circuit to find out what it should be. This will mostly be determined by bleeders and voltage dropping networks. Note that when you first apply ohmmeter leads to power supply output leads, you will get an unstable and changing reading due to the filter caps charging. Let this settle and then take the reading.

It is a superb idea to always short out all filter caps in a power supply before working on the supply or connecting test leads. This will protect you and your Fluke. ALWAYS short out high voltage capacitors before you work on a HV supply. This includes HV caps that have been sitting on the shelf. If left un-shorted they can build up a charge just sitting there for a long time.

If you find a B+, Bias Supply or other supply line that looks low resistance, find out why before powering up the supply. Suspect a leaky or shorted capacitor, damaged shunt resistors or bleeders or even problems in the metering circuitry. Physically look at all electrolytics for swelling or popped vents.

P.S. *NEVER TRUST bleeder resistors* to have clamped a supply to zero. Bleeders can open up. It's very common.

If your unit under repair is a transmitter or receiver that has an external power supply, turn your observation measurements around and look into the power plug. Check across the filament lines. That will be a very low resistance and a function of the tube line-up, but it will not be zero. You can get a real good idea of what it should be by looking at the filament string wiring and pulling out your handbook and looking at the filament currents involved and doing a little Ohm's Law math.

Look at the schematic and calculate the resistance to ground of the B+, the Bias and other supplies. This is easier than it sounds. There is, with the filaments off, or tubes out, usually almost no load on the B+ and Bias lines. There may be an occasional voltage divider network to ground and that should be noted and the equivalent found. Lower than expected reading are grounds for further snooping and usually indicate leaky bypass or electrolytic caps. Again, you may see some drifting readings at first due to caps charging. Let that settle before taking a reading.

OK, you now have supplies and units that at least should not make serious smoke. It's time to pair things up and do the bench "install" wiring that you need to run or key your units. After taking care of that business, plug the supply into a VARIAC and start by bringing the unit up to about 40 % of full AC line and let it sit there for a while as your eyes and nose do some judicious snooping.

If you are bringing up an older unit that has Mercury Vapor rectifiers in it, I suggest that you either seriously age the tubes with just full filament power on them before starting, or that you start by substituting a more modern non-mercury tube. Or, you can do what I do, and always trouble shoot with solid state diodes. I do not bring the unit up to full AC input until those are removed and then replaced with tube rectifiers with their higher series voltage drop. This process – one way or the other – takes the ambiguities and danger of Mercury Vapor flash-over out of the equation - and that is a good thing.

Let's stop here for a moment and say some things about reforming electrolytics. This is a controversial subject depending on who you talk to. There are those who would just replace all those "old" electrolytic caps that have been in the equipment since maybe even the 40s or earlier. It is common to see people offering Capacitor Kits for each model and recommending replacement. The position of many who are experienced at maintenance and deal with the older Collins is that complete re-tubing, or complete recapping is almost never called for.

There are many 40s or 50s and later Collins Radios running with the original electrolytic capacitors in them. Leaving aside the occasional culprit Black Beauty paper or dipped Silver Mica caps that now have known failure modes and deserve a preemptive strike, the electrolytics are statistically hanging in there. Electrolytics – over time – suffer from two main deterioration modes. They can, given manufacturing defects, poor storage or mistreatment, dry out and that is irreversible. The components that Collins used were of the highest quality, and many were Mil grade. They are very capable of going this long without serious drying. If they have been overheated, stored for long periods at high temperatures, or otherwise damaged, drying can be accelerated. The main deterioration mode is depolarization. The electrolyte depolarizes. When this happens, the electrolyte goes up in conductivity increasing leakage and leading to higher dissipation (DC) in the cap. Depolarization can be non-uniform with in the physical layers of the cap. This leads to hot spots if the caps are run, and hot spots lead to further damage and increased leakage. Depolarization is completely normal. It happens in all electrolytics. It was recognized very early on and it was recognized that even NOS caps depolarized on the shelf. Many people do not know that this is normal and that there is a mil spec on how to reform electrolytics before they are used after long storage – in or out of a radio.

NOTE: If reforming is done to the mil spec, reforming is very effective and essentially brings the cap back to "As New" condition. Bringing a radio up on a Variac, or depending on the operational voltages that occur during normal use, to reform caps is not effective. While regular use is very helpful and severely retards depolarization (that is one reason we should use our radios regularly), it does not solve the problem.

Correct reforming involves controlled incremental increases in applied voltage to a KNOWN leakage current level, waiting and monitoring the decay of this leakage, increasing the applied voltage again to the leakage limit and again waiting for it to decay and then continuing this process until the applied voltage reaches the rated MAXIMUM applied voltage for the cap as built. Notice that the reforming must go to maximum rated and not just to the "Working Voltage". Older caps particularly have two ratings… Working and maximum. The old adage should be repeated here also that you should never use an electrolytic in an application where the actual applied voltage is significantly below its "Working Voltage" rating. Doing this limits the self-reforming and encourages eventual depolarization. Cathode bypass electrolytics are commonly found in this underused situation and, indeed, they fail more often.

Let's get back to reforming. The Mil Standard Spec MIL-HDBK-1131, can be found on the CCA website and is a gold mine of knowledge. It will give you the allowed leakage for a given capacitance and voltage rating and it will tell you what level of leakage to allow during reforming. Over the years, the spec has been rewritten many times, mostly driven by the practicality of the new more modern electrolytes and

Continued on Page 23

The Service Line

Build a Quality RF Sampler

by Don Jackson, W5QN

We know that it would be very handy to have an RF sampler to use with our Spectrum Analyzer (SA) or any other device with 50Ω input impedance.

You may ask why the frequency response need be as high as 90 MHz. For many HF measurements, we only need a 30 MHz response, but we may want to measure the harmonic content of a 30 MHz signal. In this case, we need a reasonably flat frequency response up to at least the 3rd harmonic, which is 90 MHz.

Let's summarize the specs for the sampler.

- 1500 Watt maximum input power
- Coupling Factor of 50 dB (for no damage to an SA)
- Frequency response from 2 MHz to 90 MHz
- Sample port source impedance of 50Ω
- Output port and sample port terminations are both 50Ω

We could purchase a commercial sampler, but they are quite pricey. So, let's look at building our own. David Knight's (G3YNH) article (http://www.g3ynh.info/zdocs/bridges/Xformers/part_1.html) has a great deal of design information, but his examples only consider circuits with a single terminating resistor of 50Ω. The use of a single resistor in the circuit is ok for many applications, but using two resistors (Rt and Rs) provides an additional degree of freedom in the design. This helps considerably, particularly with achieving good high frequency response. The schematic of the sampler is shown in Figure 1.

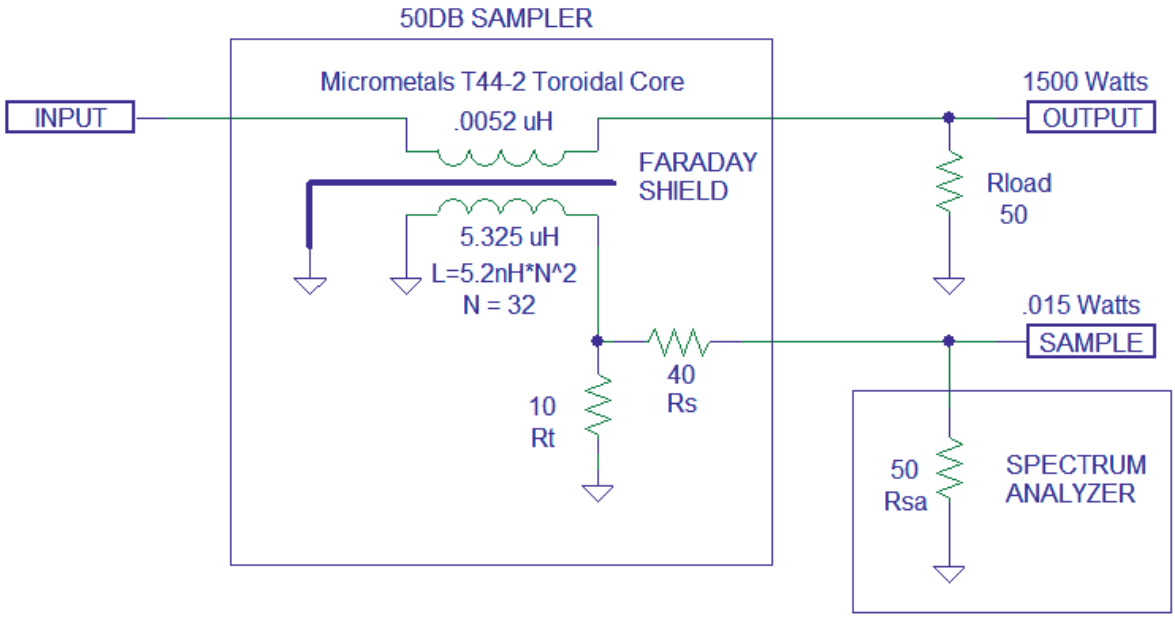


Figure 1 – Schematic Diagram

I set about deriving the equations for the sampler, expecting the result to be fairly complicated for determining values for the number of transformer turns, and the values for Rt and Rs. To my surprise, a page of equations boiled down to a very simple relationship:

$$Rt = 100*N*SQRT(Ps/Po)$$

Where N is the number of turns on the secondary of the current transformer, Po/Ps is the ratio of the main output power to the power at the sample port. The number of turns on the transformer primary is "1", since the main line simply passes through the center of the toroid core. The value for Rs is always (50 - Rt). Using this equation, and assuming N= 32 turns and Ps/Po is .00001 (-50 dB), we calculate Rt = 10Ω, and Rs = 40Ω. You may ask why two resistors are used instead of just a single 50Ω resistor. To answer this, let's solve the above equation for N:

$$N = (Rt/100)*SQRT(Po/Ps)$$

If Rt is 50Ω (Rs becomes zero) and Ps/Po is still .00001, N calculates to be about 158 turns. The number of turns has increased by almost a factor of 5. This is bad news for the high frequency response since the distributed capacitance is increased and the length of the wire is also increased.

Service Line (Cont'd)

That's enough background information. How do we build the sampler? One consideration is to make the physical distance between the input port and output ports as small as practical. The connection between these two ports is not a 50Ω transmission line, so the shorter we make the distance, the less inductance is present, and the better the high frequency performance. Although not super-critical, I found the shortest practical distance between the two Type-N connector flanges to be about .8". Therefore, that defined the width of the enclosure for my sampler. A width much smaller than .8" will make it difficult to install the toroidal transformer and Faraday shield. The length of the enclosure need only be long enough for Rs and a BNC connector. Figure 2 is an external view of the sampler, while Figures 3 and 4 are close-ups of the internals that will hopefully help you in construction. You might notice that my Rs is actually a parallel combination of 270Ω and 47Ω, which I happened to have in my junk box. A value of 39Ω will work fine though.

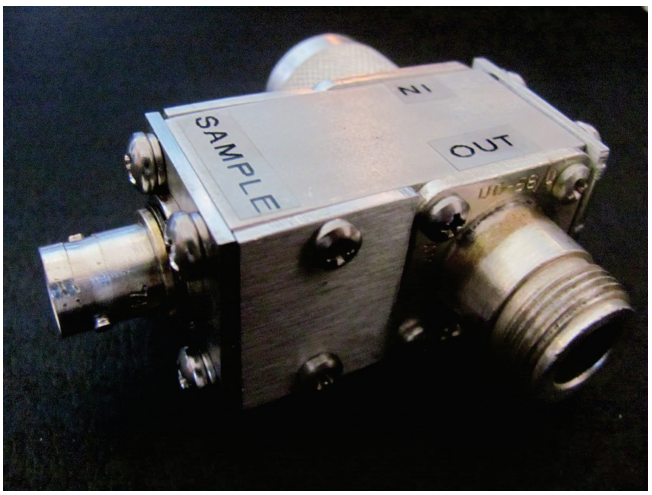
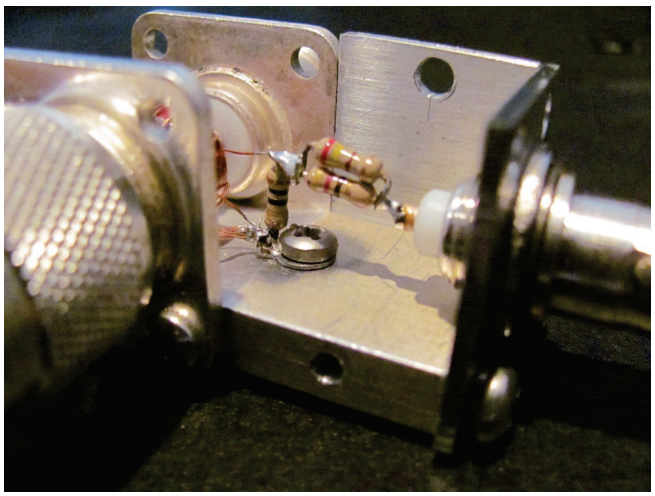


Figure 2 – Sampler External View
Figure 3 – Sampler Side View



The transformer is constructed by winding 32 turns of 30AWG enameled magnet wire on a Micrometals 44-2 powdered iron core. This core can be ordered online from Amidon Corporation. Wind a single layer of wire on the core, taking reasonable care to leave a little space between each winding. This will help minimize the distributed capacitance of the transformer.

The Faraday shield is an important feature in the design. We would like the sampler output signal to be dependent only on the magnetic coupling of the transformer. However, at higher frequencies, there is electrical coupling from the main line to sample port due to capacitance between the transformer windings and the main line. We want tight magnetic coupling in the transformer, but not the capacitive coupling. This is where the Faraday shield comes in. It provides electric field isolation without affecting the magnetic coupling. In G3YNH's article, he shows an implementation of the shield using 50Ω flexible coax. Note that only ONE END of the coax shield is connected to ground, so don't be fooled into thinking you have a 50Ω transmission line from input to output. However, his implementation is meant for lower frequencies than we want, so I used a slightly different implementation. My sampler uses a short piece of RG-402 (.141 inch O.D.) semi-rigid coax, which allows more precise control over construction of the Faraday shield. Cut a piece of RG-402 so that the center conductor of the coax can be soldered to the input and output connectors. (Do not solder the RG-402 in place yet.) You will find that the transformer is a bit of a loose fit over the RG-402. It is best if the transformer fits snuggly over the RG-402, so build up the gap by wrapping layers of Teflon pipe thread tape around the RG-402. The desired result is that the transformer will hold itself in place when inserted over the RG-402. If you like, you can add a drop of polystyrene "Q-Dope" (from GC Electronics) to hold the transformer in place. Set the transformer/Faraday shield assembly aside for the moment.

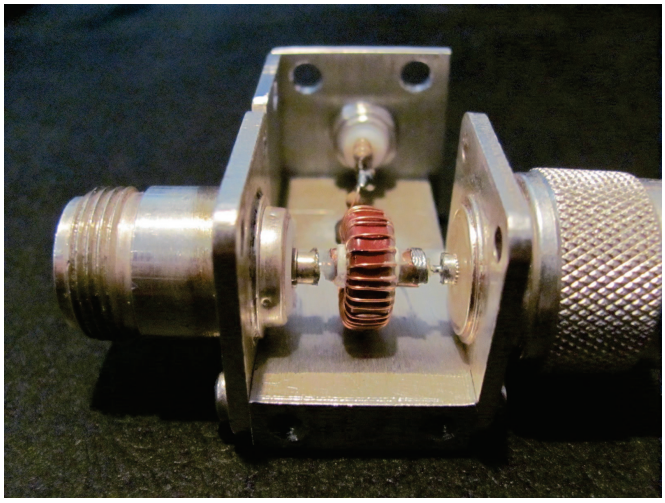


Figure 4 – Sampler End View

Install the input, output and sample port coaxial connectors onto your chosen enclosure. I used female N (Mouser 523-82-368) for the output connector and a male N (Mouser 523-49000) for the input, but you can use other suitable RF connectors. Now you can install Rt and Rs in place, taking care to make all connections as short as possible. A good method is to install an insulated standoff (with good RF characteristics) at the point where the transformer leads will be. Install a short ground lug under the standoff, where one of the transformer leads and the ground end of Rt can be soldered. At the top of the standoff, Rt, Rs and the other transformer lead will be connected. (Note: I didn't have a standoff short enough to fit, so I used the junction of Rt and Rs as a "standoff".) IMPORTANT! I learned the hard way that both Rt and Rs must be installed so that they have no parallel mechanical component with reference to the main line. Figures 3 and 4 will help understand the correct method. If you do not install them properly, the resistor will form a coupler to the main line. If you have the instrumentation, I suggest that you test your installation before proceeding with the sampler assembly, using the following method. Temporarily install a straight piece of wire between the input and output connector pins. (Do not place the transformer on this wire.) Connect a signal generator to the input port, and set it for a level around +10 dBm and a frequency of 30MHz. You should terminate the output port with a good 50Ω load. Connect a Spectrum Ana-

lyzer to the sample port. If the resistors are properly installed, you should see a signal at the sample port that is at least 90 dB lower than the signal generator level. On my sampler, I measured 104 dB. By the way, with Rt erroneously installed nearly parallel to the main line, the isolation was closer to 50 dB. Lesson learned!

Now it is time to install the transformer with the Faraday shield. Carefully drop it into place, soldering the center conductor of the RG-402 to the input and output connectors. Solder a short piece of braid from the shield of the RG-402 (nearest the INPUT port) to the ground lug. I used a piece of size .030" solder wick from Chemtronics for good conductivity and mechanical flexibility. Note that it is the connection of this braid that determines which of the N connectors becomes the input port.

Lastly, connect the transformer wires, one to the standoff, and one to the ground lug. You are now ready to perform some preliminary tests. The first is to ensure the coupling factor is close to 50 dB. Assuming Rt is accurate, the coupling factor is determined only by N, the number of turns on the transformer secondary. In my case, the coupling factor was within .1dB of the 50 dB design target. Another good test is what I call the "load/no load" test. Ideally, if you disconnect the 50Ω termination from the output port, the output at the sample port should drop to zero. This is because no current should be flowing in the main line, thus there should be no output at the sample port. However, due to a variety of things, but primarily capacitive coupling from the main line to the transformer windings, energy is present at sample port, even with no termination on the output port. This phenomenon worsens with increasing frequency, and is the main reason for the Faraday shield. As a test, connect a signal generator to the input port, set for 30 MHz and +10 dBm output. Terminate the sampler output port with 50Ω and measure the sample port output with a spectrum analyzer. Remove the termination and note the drop in the sample port output. As a reference, my experiments showed a 12 dB drop in a sampler without the Faraday shield installed. With the Faraday shield, the drop improved to about 38 dB. A final check on operation is to short the output port to ground. If the signal generator has a 50Ω source impedance, grounding the output should double the current, so the signal at the sample port should increase by about 6 dB.

There is a small amount of asymmetry to the design created by the grounding of the Faraday shield. What I mean by this is that the input and output ports are not perfectly interchangeable. Swapping the input and output ports reduces the high frequency response somewhat, but the response is still adequate for most monitoring applications. Figure 5 shows the high frequency response of my sampler with normal input/output connections.

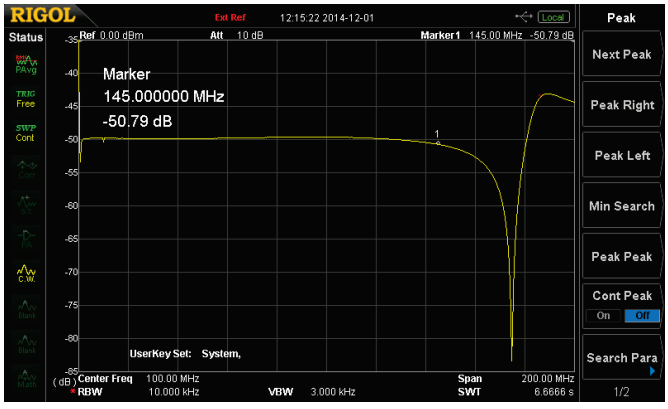


Figure 5 – High Frequency Response of Sampler

The response at the sampled port is 1dB down from 50dB at a frequency of 145 MHz, which is easily good enough for HF work.

The low frequency response of the sampler is shown in Figure 6. The 1dB down frequency on the low end is about 580 kHz, very close to the calculated value.

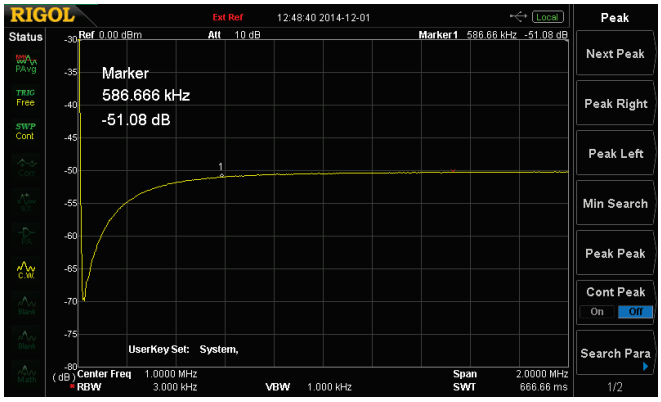


Figure 6 – Low Frequency Response of Sampler

Figure 7 below shows the insertion loss of the main line. Note that the scale is .1dB/division.

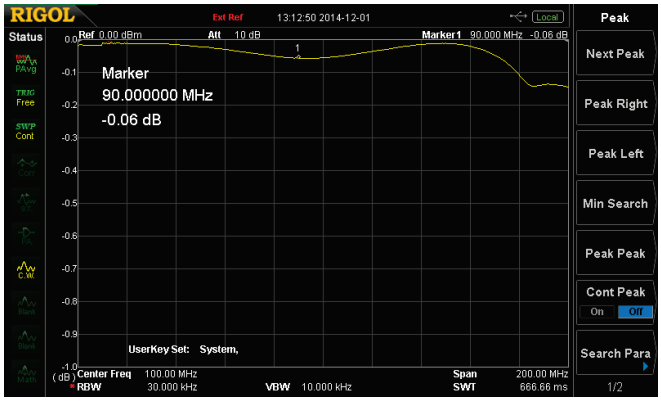


Figure 7 – Main Line Insertion Loss

Resistors Rt and Rs should be carbon film for good RF performance and small size. At 1500 Watts input, the power dissipated in Rt is only about 300 mW, even under the "worst case" condition when there is no termination at the sample port. So, a 500 mW resistor rating is fine. The power dissipated in Rs is considerably less than that of Rt.

Although calculations of magnetic flux density in the transformer core indicate it is operating well within the limits of the core, even at 1500 Watts, I do not have the equipment to quantify distortion that might be added by transformer core saturation affects. I've used the sampler to measure harmonics at the output of my 30L-1 and don't see any obvious problems. However, it would be great to measure the harmonic content of a 1500 Watt CW carrier using the sampler, then compare that to a measurement using a high power resistive attenuator. If anyone has the equipment to do that, I'd love to hear the results.

I created an Excel spreadsheet that allows you to choose different parameters for the sampler, including different powdered iron core sizes. It also calculates many other parameters should you be inclined to design a sampler with different characteristics. Let me know if you'd like a copy via email.

Have fun and treat that SA with care!
de Don, W5QN

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The Right "Stuff"
(Cont'd)

wire strippers, allen wrenches, Bristol wrenches and a soldering iron. Add a good pair of tweezers to boot. While a pencil iron that plugs into the wall will do an OK job, the soldering stations with the ability to vary the iron temp is much preferred. Weller is the name brand but Hakko and others make good units. You will also need a solder sucking bulb and some solder braid to 'unsolder' components. A couple of cheap dental picks and clicking hemostats make life much easier also. You will also need the proper alignment tools. You can purchase the Philmore 63-8420 and 63-8454 ($5.45 and $5.52 respectively online) alignment tool sets and you will have the proper sized tools. DON'T USE THE WRONG ALIGNMENT TOOL OR YOU WILL RUIN A COIL ASSEMBLY.

Upgrading and moving up as you grow.....Someday you will.

I have had to admit to myself that I have never seen a piece of good quality vintage or modern test gear I did not want to have. Kind of goes with the Collins 'addiction' I guess. As you grow in your experience you will want to add to, or upgrade, your test gear and tools.

RF VTVM – the class act and the gear that Collins recommends for troubleshooting is the HP410 B or C. While the C looks sexy, I really like my B rather than the C. Be very careful when purchasing one as you need to be sure and get the RF probe that has the miniature vacuum tube in it. There are a number of poorly working units that get traded and you find that repairs are difficult. If I had it to do over again I would purchase a refurb'd unit from http://www.kiss-electronics.com/ and make sure I started with a fully rebuilt and calibrated unit. This is the 'Gold Standard' of vintage VTVM's and well worth the money. Kiss is run by a retired highly qualified HP engineer and she rebuilds the units quite cost-effectively.

Better O-Scope – I have several units – among them, a modern 500 MHz 4 channel digital unit, a USB computer interfaced 50 MHz and others. However, I find that I use my used HP 2253 2 channel 100 MHz analog scope purchased at a hamfest for under $100 95% of the time. Accurate, easy to use and reliable. Upgrading does not need to be expensive. If I were to purchase a new unit I would look hard at the Rigol units. Price point is good and they make great products.

Multimeter – Fluke – enough said!

RF Signal Generator – Lots to choose from, but the older HP units are fabulous. Not cheap but pick up a 8640B or 8660 B OR C and you will have something that will last longer than most of us. I was able to pick up a more modern 8647B recently and love it. Shop carefully and make sure that you are getting a good calibrated unit. Be careful when neutralizing a big transmitter to unhook the generator from the antenna line before firing it up! Ask me how I know this……

Frequency Counter – HP used or Rigol new. The used HP units have really come down in price and should outlast you.

Spectrum Analyzer – Not very many cheap units here but a piece of test gear that will tell you more in a few minutes than anything else. The used HP 8553B and variants work great but make sure that you get a unit that works well. Also make sure you get the tracking generator that matches your unit ALONG WITH THE CABLE BETWEEN THE TWO. The tracking generator makes that Spectrum Analyzer much more functional. Rigol makes a GREAT unit that has a built in tracking generator for about a $1495. See more about spectrum analyzers in this issue.

Grid Dip meter – I have a James Millen vintage unit with all the plug-ins. It was a nice surprise present from a fellow ham and indispensable when working with any tuned circuit. I found that the add-in for the MFJ 259 antenna analyzer to be less than a desirable way of satisfying this need.. To be honest, I would almost put the Grid Dip Meter on the "Basic" list above.

Capacitance Checker - The Sprague Tel-Ohmike is a wonderful unit that will check for leakage in caps. Not easy to find, but a nice one comes in handy when deciding if a cap is the problem. I am not in the "replace all the caps because they are old" camp.

Tube Tester – There are the TV-7, the Hickok testers and then everything else. Here is something that is getting pricier each year if you want quality. Be careful of HamFest finds for a lot of money – make sure that you are getting something that works as the switches in these things are getting old, sockets get tired and functionality intermittent. This is something that I have not upgraded to. I have a lesser quality tester that is workable and have a lot of tubes. JUST BECAUSE A TUBE TESTS OK ON A GOOD QUALITY TESTER DOES NOT MEAN THAT IT ISN'T PART - OR ALL - OF THE PROBLEM!! This is especially true of transmitter PA finals. There is nothing that beats substituting a known good tube in a problematic stage of the unit under test. That said – I would love to have one of those old stand up testers from a 1960's drug store! Would look great in the shop and a wonderful storage place for all the tubes!

There are lots of other gadgets and test equipment that make the diagnosing and repair easier. This is a summary of the basics and first steps to upgrade and I think you will find that equipping your bench with quality vintage test gear is almost as much fun as collecting Collins. There is a saying in the woodworking world – 'All new projects should require the purchase of a new woodworking machine.' This might apply here also.

If you get the urge to get some test gear and have questions, give one of the board members a call and they, or I, will be glad to help.

Scott Kerr
KE1RR

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In the Collins Shack
of Manuel Echeandia Castaneyra, KP4YK ~ Puerto Rico

Manuel Echeandia Castaneyra is a study in perseverance. You can see it in his career path, and in his shack.

Starting with an Electrical Engineering degree from the University of Puerto Rico in 1972, he worked first as a Scientist Assistant with the U.S Atomic Energy Commission and then for the University while he worked on his MSEE. He then matriculated to industry where his career took him to Product and Engineering management responsibilities in Puerto Rico and Peru.

He is retired now and living part of the year in Puerto Rico and part in Peru where his family lives. He has has been a ham since 1975, and has great collection of Collins equipment as you can see in the photos. His first station was a pair of Heathkit units - the HW-32 and HW-22. Later he acquired his first Collins gear, the Gold Dust Twins, which have remained his favorite Collins items ever since then. Nice step up! Now however, he most commonly gets on the air with his Collins S-Line and 30S-1.

Manuel enjoys building and restoring his own equipment, including antenna tuners, linear amplifiers, antennas and other items. He recently has restored the 30S-1 and added that to his operation. As an electrical engineer he is well equipped for these tasks.

In addition to amateur radio, his hobbies include playing the harp. Check out his beautiful instrument in one of the photographs. He also enjoys cooking, traveling, being a grandfather, and playing string instruments in family activities. Nice shack and test bench Manuel.

In addition to the nice offering of Collins, Manuel has a very nice test bench to be proud of.

Thoughts About Bacon

It is 4 AM here in Texas and, at 3 AM, I was overcome with a nagging desire for bacon and eggs and hash browns. That has now happened.

Boy, do I hate surprises at 3 AM! I jumped out of bed and threw on my sweats. First off, the oven was lit off and the frozen hash browns readied for duty. Good so far.

Then, I went to the fridge and out came the new one pound package of bacon from the meat drawer. While knifing open the package, I was silently grumping about the constant progression of bacon over my lifetime from a strip of meat with some fat running through it, to what we have now – a strip of fat with a hint of meat running through it.

The sad tale of value reduction and price point pricing in our country came to mind. But then – the real shocker. When did a pound of bacon start weighing in at 12 ounces? Dang, I thought that sale price was a good deal!

It was bad enough when a gallon of ice cream got smaller while the "price point" stayed the same. It was even worse when they took that 3/4 of a gallon that we were still paying the same price for and blew it full of air. They thought I wasn't looking, but when that all went down, I happened to live at 8000 feet in the mountains and the store I bought ice cream at was at 4000 feet. Suddenly I couldn't get home without the lid flying off my ice cream.

All this was racing through my mind this morning as I was cooking my bacon. Then, another conundrum. I was now dealing with a skillet that was full of melted bacon fat. Where was my coffee can that I used to keep in the refrigerator for storing bacon fat for white gravy and other yummy cooking needs. Gone. I had foolishly thrown out the last old metal one when I moved to Texas – right after the coffee industry transitioned to plastic coffee "cans". They're cheaper I guess.

As the eggs cooked in too much bacon grease (I tilted the pan), and I pondered the fact that I had just paid the same price for 12 ounces of bacon when I thought I was getting a pound, I found myself growing fonder of my Collins – if that is possible.

Loss of value in our lives is all around us as we struggle to maintain the "good life" in an economy where, although the index of inflation doesn't look too bad, we realize that – if the inflation numbers do start to look bad – the government just takes the expensive stuff like food and fuel out of the index and then "realign" the other components.

All of this musing was then linked in my 4 AM mind to the often heard fear that, with the passing of "our generation", the value of our radios is bound to go down. Funny – I have been hearing that for at least 20 years. The reality is quite different. Not only have the prices held their ground – they have gone up during the time that I have been collecting and using Collins. This is a sampling of some 25 years now.

More impressive is the fact that a pound of Collins still weighs a pound and the average price of a single piece of gear (less the *It's Very Rare* effect) seems to hover right around the same number where it sold almost 50 years ago.

These wonderful offerings of engineering excellence (by and large) still offer the same performance that they did when they were originally offered for sale. They can still be repaired some 50 years later. Try that with the new radios. You will be lucky to find someone who will even work on the new ones 20 years from now.

Specifically, let's look at a KWM-2. This is a typical functional Collins block and pretty representative product from the Collins stable. Introduced in 1960 at about three quarters of a kilobuck, you can still get that for it today.

In 1960, you could buy a nice car for $2500 and home prices averaged about $13000. That made a KWM-2 ring in at about 30% of a new car or 6% of a new home. Average income in 1960 in the USA was $5300 per year.

Today, that medium home will set you back on average a quarter of a million dollars (up a factor of 20 since 1960) and the new car (WiFi, Blue Tooth, GPS and Television included) a mere $30,000 (up a factor of 12 from '60). That makes the KWM-2 now ring in at just over 2% of a new car and less than a half of a percent of a new home. The average income has risen to just under $50,000 (a factor of just 9).

While these buying power facts may seem depressing – and we are feeling that – it sure is nice to look at that KWM-2 and consider:

Wow, it does still weighs in at a "full pound", it still does one of the best quality jobs known to man of talking between point A and point B, and…. it now only costs us between 1 and 2 percent of our income or 2 percent of a new car.

So, let's not get wrapped around the axle about our Collins losing value.

Bacon – yes! Collins, No! What a great value…… and looking better every year – Unlike bacon & Eggs.

References:

http://www.thepeoplehistory.com/70yearsofpricechange.html
http://www.census.gov/const/uspriceann.pdf

New to Me (Cont'd)

the construction technology. The spec has gotten simpler and less informative. The older versions from the war period and right after are the most informative and also the most applicable to our components. Try and find as old a copy as you can get.

I would suggest first trying to reform the caps in any supply or radio you bring up. If successful (to the mil spec and not just to a quickie VARIAC job – very hurtful sometimes), you will have an original radio that will play for many many years to come and you will not have to molest your baby. But, if the caps will not reform to spec leakage at RATED voltage, then it is replacement time.

It is worth noting that from my personal experience, there are almost 80 pieces of Collins gear operating here from time to time. My collection, use and maintenance of Collins has spanned now almost 30 years. I have replaced less than 6 or 7 electrolytics and I have mil-spec reformed a lot of leaky caps successfully and then watched them play happily for 20 more years. Yes, I replace black beauties. I do this preemptively sometimes, and other times I wait for symptoms. Yes, I replace suspected Silver Micas when they have high DC bias on them. I never preemptively replace electrolytics. This entire electrolytic replacement thing is highly overrated and often done by people whose technical skills, and the resulting appearance, are not up to Collins Standards.

This is a good place to take a break. The new to you radio has now been inspected, the fuses are correct, it has been cleaned, and it has been inspected and checked for cursory power related problems and brought up to rated AC input one way or the other. Hopefully, given how that all happened, no smoke yet.

Now it is time for some functionality checks and that gets to be a much broader subject with more branches on the tree. Stay tuned.

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Hope you find Collins in your Christmas stocking or under the tree. May you face the "New to Me" question often in the New Year.

- - - - - - CCA PRIVACY POLICY - - - - - -

The Collins Collectors Association (CCA) is very committed to keeping the personal information that the members entrust us with safe and secure. Here are the details:

Your information is used to keep track of renewals, and to mail out the *Signal Magazine* and other membership mailings. The officers and directors of the CCA have access to that information and is not ever published to the members.

Your personal information is not sold to third parties.

We continue to use PayPal for membership payments because PayPal does not share your credit card or banking data with us and transaction financial data is not stored by us. Each transaction has a PayPal transaction id that we can use to refer to the payment in conversations with the payor and PayPal if need be.

We do not accept credit card or ACH payments except through the automated web interface for that reason – but may start using a PayPal terminal at CCA events. If so, we would never write down or store your financial data.

There is no way for one member to find the data for another. It is our policy to never give out any personal data from the website – even if it is already considered public. If we are asked for a way to contact a member, we will always contact the member involved first before even acknowledging that they are a member. In other words, we will share absolutely nothing – not even the fact you are a member – without asking you first.

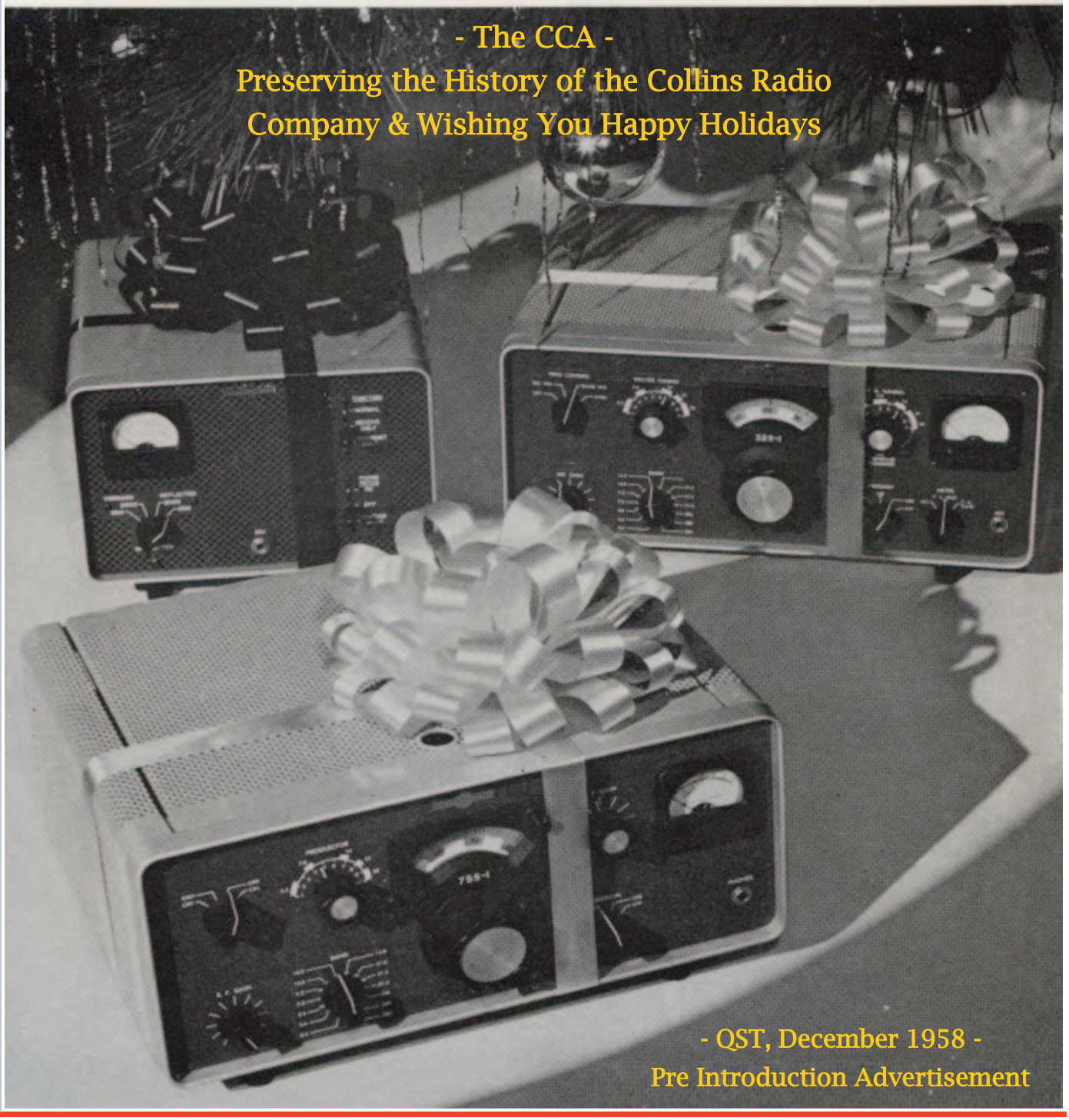
In summary, we respect your privacy, and make it a point to keep your information private and secure.

Scott Kerr
CCA IT/Web Design and support

- - - - - - CCA PRIVACY POLICY - - - - - -

COLLINS S LINE

No finer way to please



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Preserving the History of the Collins Radio Company & Wishing You Happy Holidays

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Collins Collectors Association