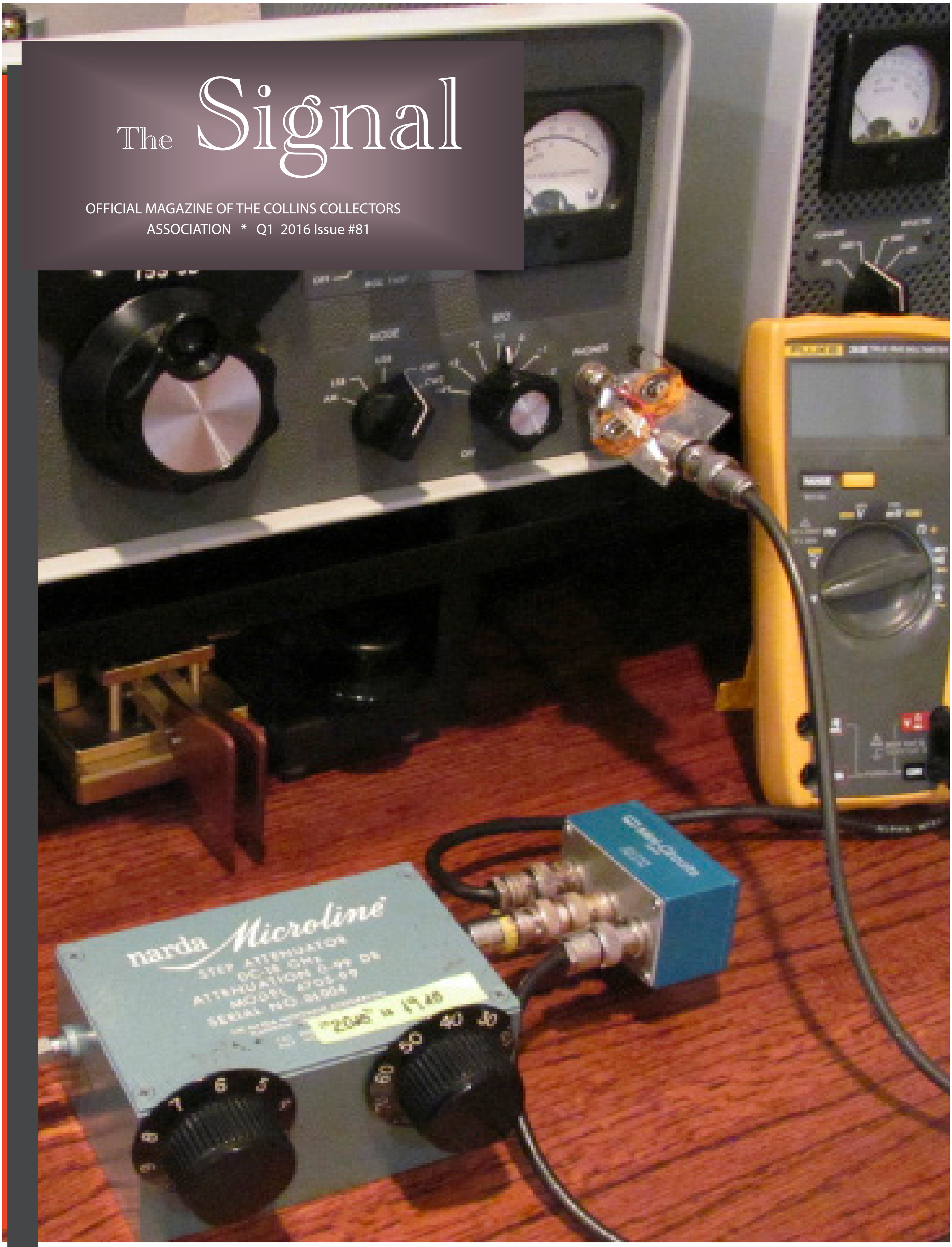
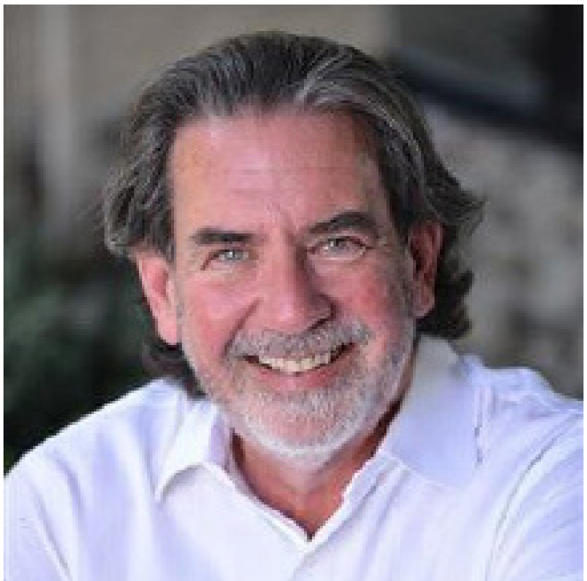
The Signal

OFFICIAL MAGAZINE OF THE COLLINS COLLECTORS ASSOCIATION * Q1 2016 Issue #81



$7.50 USA $8.00 Canada 700 円日本

Collins Collectors Association



From the President's Desk…

Well this has been an eventful quarter for the management of the CCA. This is the time where we prepare for our annual gathering at Dayton. We are going to hold a banquet again at the Barnsider Restaurant (last year's venue) – and we have a fabulous speaker this year, Michael M. Collins, PhD. Michael, Arthur Collins' oldest son, will be speaking with his unusual and fascinating insight into the Arthur A. Collins Family and the Collins Radio Company. Michael will also be presenting the recently released video: The Arthur A. Collins Legacy: A CULTURE OF INNOVATION.

Michael, along with Rod Blocksome and Lawrence Robinson, will be taking questions that will include the AACLA (the Arthur A. Collins Legacy Association). We will be in the same booth this year and look forward to seeing each of you at the booth and at the Banquet. Thanks Jim, WA3CEX, for again chairing the Dayton gathering!

As I discuss in the 'From the Editor' column, we have a change at the Signal Magazine as Bill decided it was time to step aside after his years of service to the CCA. When Bill asked me to come on to the CCA management team several years ago he shared his vision of an expanded Signal Magazine to cover the history of the company and its products. The CCA 20 year anniversary was approaching and Bill felt it was important to document as much as possible. At the same time we expanded our events calendar to include local Collins events exposing more Collins enthusiasts to our organization and a complete redo of the web site that included bringing membership data online (sorry about the growing pains that caused). This ended up being a winning strategy and we saw the membership soar to levels it had not seen in years. We had a pretty good financial reserve to work with and decided that this was a good use of those reserves. Now that we have accomplished our goals and with postage and printing costs increasing at a rapid rate, we have to pull back on the size of the Signal so that we can we can stay within budget. We are in good financial shape and want to stay that way!

I am encouraged by the number of first time Collins owners who are showing up on the reflector and contacting me via email. I know that we are seeing some of our older members downsizing but our ranks seem to be growing with this influx of new members. Many of these do not have any experience with tube radios so we are going to be working on ways to pass on the knowledge that so many of you have with our RX section of the web site and with Signal articles directed at those new to troubleshooting older equipment. Many of you are contributing to this effort and we welcome more input!

Looking forward to seeing you at Dayton!
73,
Scott Kerr – KE1RR
President

Scan to see more about the CCA

The Signal Magazine

OFFICIAL JOURNAL OF THE COLLINS COLLECTORS ASSOCIATION ©

Issue Number Eighty One - 1st Quarter

The Signal Magazine

The Collins Collectors Association
P.O. Box 1269
Wimberley, TX 78676-1269

www.collinsradio.org

You can renew your membership or join the CCA on our website using the "JOIN US" link.

From the Editor

With Bill Carn's retirement I find myself in the position of being the Editor of the Signal Magazine for a short time while we transition from Bill to another team. Wow – what a hard act to follow!! Bill has done a masterful job of taking a well written newsletter and turning it into a quality publication. Over the last few years, we made the decision to expand the size of the Signal Magazine to cover the history of the company and its products. As I discussed in the 'From the President' column we are now in a position where we need to shrink the size of the magazine due to budget pressures and while we regroup and form a new Signal Magazine team.

At this time, our team includes Technical Editor Don Jackson W5QN, Historical Editor Jim Stitzinger WA3CEX, Layout Editor D Josephine Toynette, and myself as Editor in Chief, Scott Kerr KE1RR. This month's issue includes some very interesting work by Don regarding receiver dynamic range. The impact of Service Bulletin 1, and especially Service Bulletin 2, on 3rd Order Dynamic Range (DR3) is described for S-Line receivers. Although the SB2 discussed in the article was created for the 75S-3B/C, it can be applied to any S-Line receiver, including the 75S-1. Implementation of this Collins modification typically produces a 20dB improvement in DR3. He actually installed SB2 in one of my S3's, improving its DR3 from 59dB to 79dB! This is an article that any S-Line receiver owner will want to read!

Dick Weber K5IU, writes about his experiences in dealing with the 'Canned' Capacitors in the S Lines. While replacing most of the caps is a fairly easy and straightforward job – these 'cans' provide real challenges in any older radio so this article is useful in any of the Collins radios. Great work Dick!

Our 'In the Shack' this quarter focuses on Jenks Garrett K5YNZ. Jenks is a long time 20 meter net control and has worlds of experience in the collection, restoration and repair of Collins. I stopped by Jenks' home in Tin Top, Texas this last weekend to shoot the pictures for this and was again impressed by the three towers, each over 100 feet tall and enjoyed sitting around talking 'Collins' with Jenks! On one tower is a large Quad and the other two support a delta on 80 meters. I am sure that anyone who has joined us on a few Sunday afternoons on 14.263 has heard the strong signal that Jenks puts out and has enjoyed his patient leadership at net control. This is a first in a series where we would like to focus our 'In the Shack' on showing the faces behind the voices that you hear each week.

Finally, we have decided to include a recap of last year's financials and membership. This is information that used to be shared to the membership and the board feels that it is important for us to be completely transparent when it comes to how we are doing. This is something that we are going to share during the first quarter each year as a recap of the previous year.

Editor in Chief,

Scott – KE1RR

Dynamic Range & the S-Line Receivers

By Don Jackson

This article discusses definitions of "dynamic range" in receivers, with emphasis on "3rd Order Dynamic Range". Considering that dynamic range is an important parameter of HF receivers, measurements and theory are presented to show how the dynamic range of S-Line receivers is improved by installation of the Service Bulletins (SB1 and SB2) created for the 75S-3B. Although SB1 is only applicable in its entirety to the 75S-3B/C, SB2 can be installed in any S-Line receiver.

What is Dynamic Range?

The term "Dynamic Range" (DR) has a number of meanings, and can be confusing. The simplest definition of DR is the difference, in dB, between the weakest desired signal a receiver can detect and the strongest without exceeding a specific level of distortion. If it were not for Automatic Gain Control (AGC), this would be a number in the low tens of dB. Another definition is termed "3rd Order Dynamic Range", which we will abbreviate as DR3. Classically, it is defined as the difference between the "weakest" signal a receiver can detect, and the power level of two out-of-band signals that produce an in-band 3rd order Intermodulation Distortion (IMD3) product equal to the "weakest" signal. Although there are different definitions of "weakest" signal, the most common one is an input signal that has a power equal to the equivalent input noise floor of the receiver. It is this definition that will be used in this article. DR3 is primarily a measure of how well a receiver can receive a weak signal in the presence of strong out-of-band signals. Keep in mind that the "weakest" signal is a function of IF bandwidth and receiver Noise Figure, so you must take these into account, especially when comparing DR3 using different IF bandwidths.

The specific test discussed in this article consists of two signals (or tones), one at an RF frequency that produces a 415 kHz (F1) signal at the IF, and a second signal that produces a 435 kHz (F2) signal at the IF. IMD3 then produces two additional undesired signals, one at 2*F1-F2 (395 kHz), and another at 2*F2-F1 (455 kHz). Obviously, the undesired signal at 455 kHz creates a problem since it will interfere with desired signals that also appear at 455 kHz. Figure 1 shows the relationship of the input tones, noise, IMD3 product and DR3.

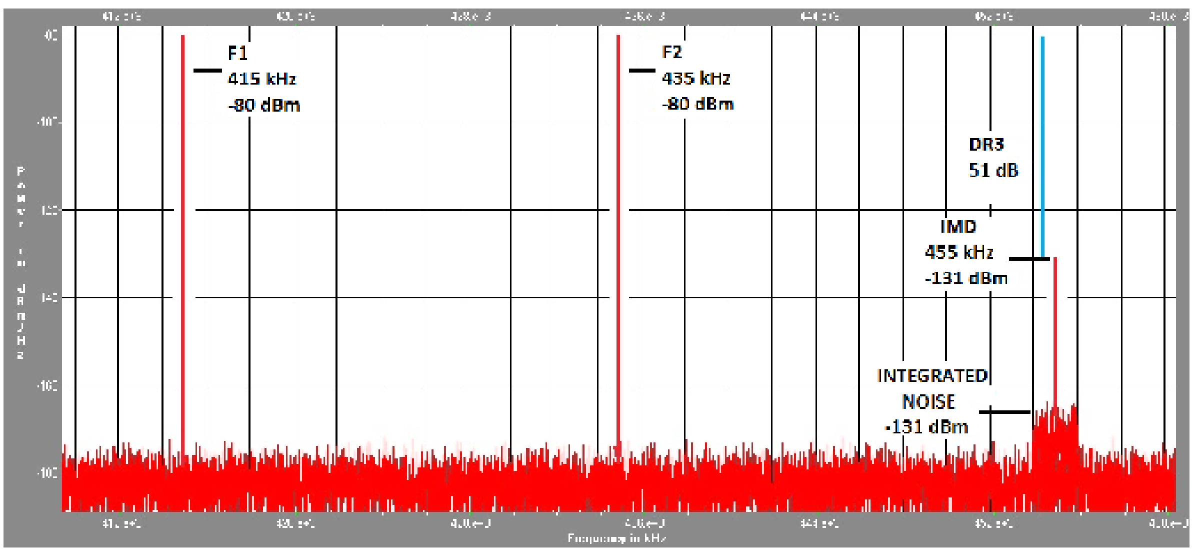


Figure 1 – Two Tone Dynamic Range Spectrum

In Figure 1 the two input signals can be seen at 415 kHz and 435 kHz. Third order IMD produces the undesired signal at 455 kHz, which is seen in the center of a noise pedestal created by the 2 kHz bandwidth of the IF filter. The noise pedestal in this example represents the theoretical noise that would be created at the input of a receiver with a 10dB Noise Figure. The noise density in the 2 kHz filter bandwidth is therefore 10 dB higher than the theoretical noise density of -174 dBm/Hz seen throughout the rest of the spectrum. The total "integrated noise" power in the 2 kHz filter bandwidth is then -131 dBm (Pnoise = -174+10+10LOG(BW)). For the test, the amplitudes of the two input tones are increased until the distortion product at 455 kHz is equal to -131 dBm. This sounds complicated, but it's really not. It is equivalent to measuring receiver sensitivity at "Signal=Noise". You can easily accomplish this by measuring the audio output of the receiver (in SSB mode) with a true RMS voltmeter, and increasing the tone level until the audio increases 3 dB over the level with no input tones. In this example, DR3 is approximately:
DR3 = -80 dBm - (-131 dBm) = 51 dB.

Figure 2 is a simplified block diagram of a typical receiver, which consists of an RF amplifier, preselection filters, mixer stages, and a final IF filter.

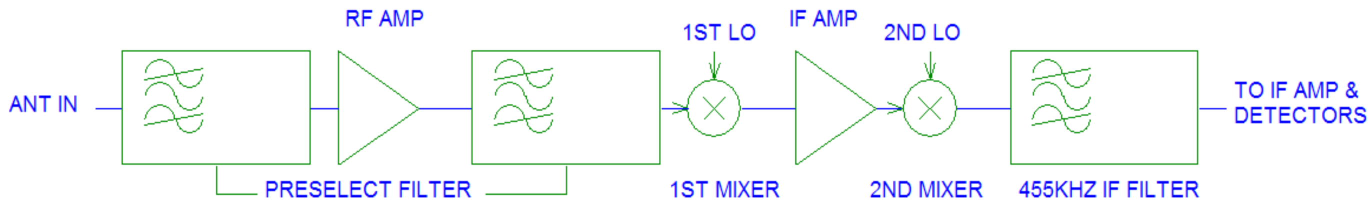


Figure 2 – Receiver Block Diagram

If the receiver has input preselection filtering that is of sufficiently narrow bandwidth to reduce the level of one or both of the input signals, this will improve the DR3 of the receiver. In the case of the 75S3B, the preselection filter corresponds to the antenna input and RF amplifier tuning implemented by the slug rack. However, this selectivity has little effect on our DR3 test, except on 80m, and, to a lesser degree, on 40m.

In a typical receiver analysis, we would expect the IMD3 problem to be created in the active amplifier and mixer stages prior to the 455 kHz filter. Usually, IMD3 of the final mixer stage prior to the IF filter is the one that dominates DR3 performance. After all, the mixing stage is non-linear by nature. As well, the IF filter has no internal active amplification and one might assume it should produce no distortion. We will see, however, that this is not a good assumption.

How SB1 Improves DR3

What got me thinking about DR3 in the S-Line receivers is the data compiled by Rob Sherwood of Sherwood Engineering. He has collected the largest amount of data on amateur receivers that I am aware of. You can access this data at his website at www.sherweng.com/table.html. He ranks all the receivers in order of best DR3, so it is clear that DR3 is a very important differentiation between receivers. His data includes several Collins receivers, but what caught my eye was the difference in DR3 (tone spacing of 20 kHz) between a 75S3 (75 dB) and a 75S3B (88 dB), a 13 dB differential. Unfortunately, Rob could not recall which IF filters were installed when he took the measurements, or which Service Bulletins had been installed. If available, he normally uses a 500 Hz filter, but thought he might have used a narrower crystal filter as well. Despite this unknown, I wondered why the big difference in DR3? My assumption was (Rob confirmed this for me) that the 75S3B he tested was a late model that had SB1 installed. The 75S3 he tested was original, and therefore had substantially different "front end" (from the RF input to the IF filter output) circuitry. Checking the schematic of a 75S-3 against my own early "PreSB1" 75S-3B, I found the front end circuitry of these two receivers to be virtually identical. Since the front end characteristics determine DR3, Rob's 75S-3 data should be similar to DR3 data taken on my PreSB1 75S3B.

One thing to keep in mind about distortion of all kinds is that it generally increases with signal level. Reducing the signal level at the IF filter will reduce the distortion, and SB1 does this by lowering the gain of the RF front end, from antenna input to the 455 kHz IF filter output. With SB1 installed, the RF gain is typically reduced by about 15 dB. This number can vary due to tube differences and other subtleties, but consider this an average gain reduction. In a system with ideal 3rd order IMD behavior (increasing the tone levels by 1 dB results in an increase in the 3rd order products of 3 dB), a 15 dB gain reduction would produce approximately 2/3*15dB=10 dB improvement in DR3. Rob's data indicates an improvement of 13 dB. Given that inconsistency, I wondered if there might be something else going on here. Might there be another component impacting IMD3 distortion of the system?

I began to wonder if the IF filter might also be producing measurable distortion. Searching for more information, I contacted the Rockwell-Collins plant in Tustin, CA, that manufactures mechanical filters. I was referred to Don Havens, a Collins engineer who worked on mechanical filter designs for 40 years until his recent retirement. Although Don didn't have a lot of experience with the "out-of-band" DR3 measurements I was most interested in, he did confirm that the FA filters could contribute distortion to a system. The magnetostrictive "transducers" have inherent non-linearities, and use permanent magnets to bias the components into a reasonably linear operating region. In this case, the transducer converts electrical energy to mechanical energy, and vice versa. In addition, the distortion introduced by the filter does not behave according to "ideal" 3rd order IMD. Rather than the usual 3:1 increase (in dB) of the IMD product with increasing input level, the mechanical filter has a ratio of about 2.6:1. This oddity means a system in which the filter has a significant distortion impact cannot be accurately analyzed using typical "3rd order intercept" analysis. This was enough information to justify further investigation.

Since I did not have any other IF filter with which to compare the standard FA, I contacted Trey Garlough at International Radio (Inrad). Inrad produces plug-in replacement IF filters for the S-Line. The Inrad filter assemblies also use Collins mechanical filters, but they are of a modern design that use piezoelectric transducers rather than the magnetostrictive transducer used in the older "FA" filters. The modern filters also are designed for a much lower termination impedance of 2k Ohms. This impedance is quite different from the 50k-100k impedance of the FA filters, so the Inrad assemblies include additional components that create the proper impedance for the modern filters. Trey kindly supplied me with one of their 2000 Hz (#720) bandwidth filters for comparison testing.

Test Results

Of course, the real test is what happens in an actual receiver. My own 75S3B is an early WE unit that is "Pre-SB1". Bob Kellow, W5LT, loaned me his 75S3B, which does have SB1. Neither receiver has SB2. So I now had both types of receivers on which to conduct tests. My testing was conducted on 40m, as I was limited to 80m and 40m by my signal generators. First, I measured the gain of the two receivers from antenna to IF filter, and found the gain differential to be reasonably similar to the gains inferred from signal levels on the schematics. Then, I repeated Rob Sherwood's DR3 test (20 kHz tone spacing, which is also used by the ARRL). My DR3 numbers were about 10 dB lower than Rob's, even with a theoretical accounting for the fact that I used 2 kHz (approximately) filters and he used much narrower filters.

With a "Pre-SB1" receiver and an early "SB1" receiver in hand, as well as an FA SSB filter and an Inrad SSB filter, I set about measuring DR3 for each of the 4 possible combinations of SB1 and filter type. For each receiver type, I tested 8 FA SSB filters, and used the average of the 8 DR3 readings in the graph. The results are shown in the Figure 3.

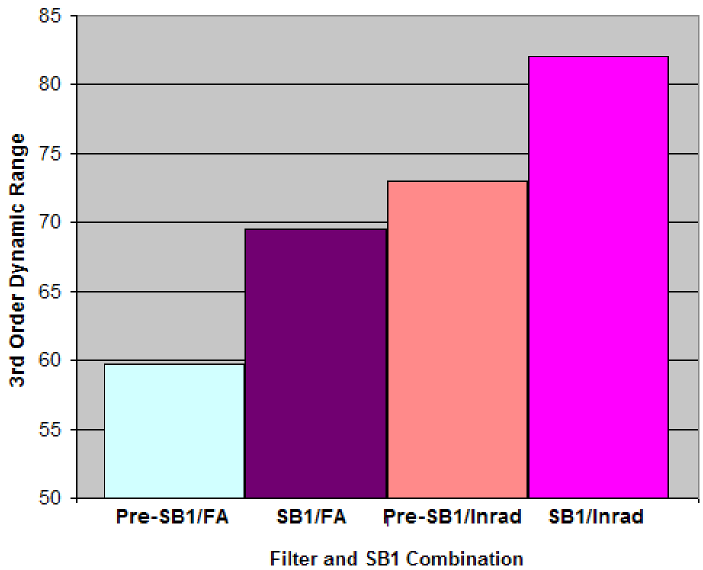


Figure 3 – Dynamic Range Comparisons

A few things are of importance. Most importantly, you can see that use of the Inrad filter results in considerably better DR3 compared with the FA filter, proving that the FA filter does indeed add to the total IMD3 of the receiver. In a Pre-SB1 75S3B, DR3 improves by about 13 dB simply by changing to an Inrad filter. Note that this improvement is even greater than the DR3 improvement that would result if SB1 were installed, and the original FA filter used. Also, note that installing the Inrad filter in a 75S3B with SB1 results in a DR3 improvement of about 22 dB over a Pre-SB1 unit with an FA filter installed. In addition, note that with the same filter installed, the difference in DR3 of a Pre-SB1 and SB1 receiver is very close to the 10dB improvement theoretically predicted by the 15dB reduction in front end gain. (In an ideal 3rd order system, DR3 improvement is 2/3 of the gain reduction, assuming the Noise Figure remains constant.)

As further confirmation of the IMD3 comparison data between the FA and Inrad filters, I constructed a filter test fixture and measured IMD3 on the filters. The results agreed with those found in the receiver. For the same IMD3 output level, the Inrad filter could handle a 13dB higher input level than the FA filter. For this test I used a Rigol DSA815TG analyzer.

Filter Ultimate Rejection

During testing of the filters in my test fixture, I compared the ultimate rejection of the Inrad filter compared with the Collins FA filter. In my filter test fixture, which is designed to create 50k source and load impedance for the filter under test, the ultimate rejection of the Inrad filter measured considerably worse (typically 25dB or so) than the FA. This was troubling since the filter response shown on the Inrad website (see http://www.inrad.net/product.php?productid=19&cat=103&page=1) for their Collins replacement filter indicated a better ultimate rejection than I saw in my test fixture. I called Trey Garlough again to get an explanation. What I learned from Trey is that the filter characteristic shown next to the 75S-3B filter is not that of the actual shipped filter on their PCB with the additional impedance matching components that transform the 75S-3B impedance down to the 2k impedance required by the Rockwell/Collins filter they are using. The filter characteristic is for the Rockwell/Collins filter alone in a 2k test fixture. The degradation of the ultimate rejection of the complete Inrad assembly is understandable since any series leakage capacitance, for example, will couple much more voltage (theoretically about 28dB) from filter input to output in a 50k system than in a 2k system. When you purchase a #720 filter from Inrad, for example, they ask you for the radio you are using it in. They then add a letter designation after the "720" to indicate the matching components required for that particular radio. The "720" designation only defines the Rockwell/Collins filter used in the filter assembly. I find the filter characteristic plot a bit misleading since my assumption was that this is what I should see in a 50k test circuit. Alas, that is not the case. However, the ultimate rejection deficiency of the Inrad filter isn't as great a problem as might be expected because the 75S-3B has a number of LC tuned circuits in the IF chain that add to the overall ultimate rejection.

Can SB2 Improve DR3?

It would seem that Service Bulletin 2 (in this article, SB1 and SB2 refer to the 75S-3B SBs), which moves T4 from the AM filter to the output of the 2nd mixer, might help DR3 by acting as a "roofing filter" in front of the mechanical IF filter. After all, any attenuation of the input tones prior to the IF filter should help. I've always been hesitant to consider installing SB2 in my early 75S-3B because SB2 states that it not be installed unless SB1 was previously been installed. Since SB1 requires a lot of chassis drilling and locating the somewhat difficult to find T9, I wasn't too excited about installing SB1. Nevertheless, I didn't see a really good reason why SB2 couldn't be installed without SB1, and a discussion with Dennis Brothers confirmed this.

My first step was to measure as many receivers as I could get my hands on for comparison. I already had Bob's (W5LT) 75S-3B, which had SB1 only, and my own 75S-3B that had neither SB. Dick, K5IU, then loaned me a 75S-3C that has both SB1 and SB2, and a 75S-3A with SB2. Since the RF front end circuitry of the 75S-3/A is virtually identical to an early 75S-3B, these receivers are legitimate candidates for installation of SB2. Note that Dick's 75S-3A has an FA filter installed in place of the stock SSB filter. Scott Kerr added a stock 75S-3 to the collection of test receivers. After looking at the initial test data, I installed SB2 in my own 75S-3B. Then, discussion with Bob and Scott led to installation of SB2 in their receivers. All this led to collection of data on quite a few receiver configurations. Figure 4 is a chart comparing test results of all the receivers. IMD was measured on 40m with 20kHz input tone spacing, and input sensitivity measured at (S/N=1). Using these numbers, DR3 was calculated. Gain from antenna to IF filter output was also measured.

Receiver	My 75S-3B	Scott's 75S-3	W5LT 75S-3B	My 75S-3B	Scott's 75S-3	My 75S-3B	Dick's 75S-3A	Dick's 75S-3C	W5LT 75S-3B
SB1/SB2	None	None	SB1 only	None	SB2 only	SB2 only	SB2 only	SB1 and SB2	SB1 and SB2
IF Filter	Collins FA	Collins 526-9337	Collins FA	Inrad 720	Collins 526-9337	Collins FA	Collins FA (!)	Collins FA	Collins FA
Bandwidth (Hz)	2000	2000	2000	2000	2000	2000	2000	2000	2000
Test Results									
Noise Floor (dBm) (AGC OFF)	-137	-137	-137	-137	-137	-137	-137	-137	-136
Noise Figure (dB)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	5.0
Pin @ IMD=Noise Floor (dBm)	-78	-78	-67	-63	-58	-57	-56	-56	-48
RF Gain (Ant to IF filter O/P)	64	64	48	64	61	60	57	43	46
DR3 (dB)	59	59	70	74	79	80	81	81 (low PTO)	88

Figure 4 – Comparison of 3rd Order Dynamic Range for Different S-Line Receiver Configurations

The results in the chart of Figure 4 are very interesting. The left hand block contains data on all receivers without SB2, while the right-hand block contains data on receivers with SB2. The colored data sets show corresponding "before" and "after" addition of SB2. Inspection of these particular receiver configurations shows that installation of SB2 should typically improve DR3 by about 20dB.

You will notice that DR3 of every receiver with SB2 is better than any receiver without SB2. It also happens that with SB2 installed, it makes no difference whether an FA or Inrad filter is installed. This indicates that the dominating source of IMD has been moved from the IF filter to the active stages in front of the filter, primarily the 2nd mixer. The "(low PTO)" notation on Dick's 75S-3C indicates that its PTO has an issue. The drive to the 2nd mixer was measured to be about 5dB lower than it should be. DR3 for this receiver should have been about the same as the 88dB measured in W5LT's receiver, but is 7dB lower, underscoring that low PTO (or any local oscillator) level will degrade the IMD performance of a mixer. The low PTO level is also a likely contributor to this receiver's lower than expected RF gain.

Figure 5 compares the frequency response of my 75S-3B front end (antenna to IF filter input) without SB2, to the response after SB2 was installed.

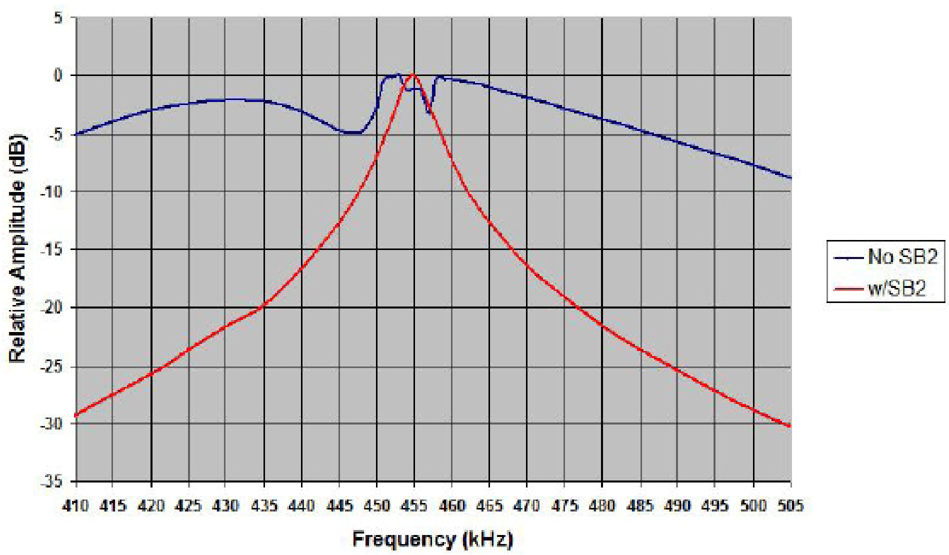


Figure 5 – RF Front End Selectivity With and Without SB2

Figure 5 clearly shows why DR3 is improved so dramatically by SB2. A tone 20kHz away from center frequency is attenuated a minimum of 17dB, while a tone 40kHz from center is attenuated by at least 21dB.

Installation of SB2 is fairly simple, and the only consequence is a gain reduction of about 3 dB on average. As with the gain reduction estimate for SB1, this 3dB should be taken only as a typical number. As you can see from the chart of Figure 4, this does not affect the sensitivity of the receiver. And, there is still enough gain adjustment in R57 (IF Gain) to allow the AGC threshold to be set at 2uV, and typically much lower if desired. However, if you have my S-Meter PCB modification installed (see Q1 2012 Signal), you may have some difficulty setting the S-Meter as you would like. For example, if you wish to set the meter for 50uV at S9, and 4dB/SU, this implies you need enough total receiver gain to achieve an AGC threshold of about .8uV. My receiver is able to do this, but it may be marginal for other receivers. Alternately, you can set the S-Meter up differently.

The latest version of SB2 from the CCA website specifies 6pF capacitors for both C32 and C92. I used 12pF for C32 and 6pF for C92, which are the values used in the 1975 manual for the 75S-3B. By the way, if you have a Frys nearby, they have suitable 6pF and 12pF disc ceramic capacitors.

One potential downside I contemplated with installing SB2 without SB1 is that the impedance at the plate of the 2nd mixer is increased by a factor of about 3 compared to a non-SB2 unit. This means the signal voltage is higher at the plate than with SB2 installed, creating the possibility of distortion in a desired received signal. Installation of SB1 reduces the gain of the RF section, compensating for the increased 2nd mixer plate signal, but without SB1 there conceivably could be added distortion. To test whether the increased signal level at the 2nd mixer plate was actually an issue, I input SSB signals to my non-SB1 (with SB2 added) receiver that were high enough to peg my S-meter, and could detect no audible distortion. No problem! However, if you are really paranoid about this potential issue, you can increase the value of C83 (RF amplifier output circuit) to decrease the gain. Dennis said C83 was sometimes used as a "select in test" component for gain adjustments. Another possible concern was that the input to the IF filter would not be terminated in an impedance as high as was the case before adding SB2. In all cases where I could do a "before" and "after" comparison of IF filter responses, I found any change in filter frequency response to be insignificant.

Conclusions

SB1 for the 75S-3B is somewhat difficult to install considering the holes that must be drilled in the chassis and procurement issues with T9, but does improve DR3 because gain is removed from the receiver front end (antenna to filter input). To compensate for this, gain is added to the IF section via modification of the Q Multiplier circuit.

Due to the non-linearity of the magneto-restrictive transducers used in Collins FA mechanical IF filters, they are a dominant factor in the DR3 of S-Line receivers without SB2 installed. For these receivers, use of the Inrad filter module, which uses a modern Collins mechanical filter with a piezoelectric transducer, results in a significant improvement in DR3. The resulting DR3 depends on whether the 75S-3B includes SB1.

However, even better DR3 results can be obtained by simply installing SB2. It is an easy mod (compared to SB1) and costs very little. With SB2 installed, the use of a Collins FA filter or Inrad filter makes no difference in the DR3 performance. DR3 is then dominated by active circuits prior to the IF filter, primarily the 2nd mixer. As proof of this, after installing SB2 in Scott's receiver, I noticed it had a DR3 of only 74dB, which is considerably below the other receivers with SB2. Upon inspection, I found that Scott's receiver was the only one of the five test receivers that had 6U8A tubes in the mixer stages. All the others had 6EA8s. Swapping out Scott's 6U8A 2nd mixer tube with a 6EA8 brought DR3 up to the 79 dB value in Figure 4. This tube difference would not have been noticeable in the stock unit, but with SB2 installed, 2nd mixer IMD performance becomes dominant.

Installation of SB2 into an early non-SB1 receiver can typically improve DR3 by 20 dB. In my receiver the improvement was about 21dB over its original configuration with an FA filter. The best DR3 results are obtained in a receiver with SB1 as well as SB2, in which the improvement over a non-SB1 receiver was measured at about 29dB. If you intend to modify your receiver, and test DR3, be sure you also check that you are using 6EA8 tubes for the mixer stages, and that your PTO and Xtal Osc levels are correct. Test data show that these items are likely to impact DR3.

Some readers may ask why I didn't include DR3 measurements with 2 kHz tone spacing, which is another standard DR3/IMD test. One reason is that with spacing that close, SB2 will have little effect. A second reason is that one must have state-of-the-art low phase noise signal generators to do that test. "State-of-the-art" is definitely not a description of my test equipment!

Thanks to Bob Kellow (W5LT), Dick Weber (K5IU), and Scott Kerr (KE1RR) for loan of their receivers. Also, thanks to Bob Jefferis (KF6BC) for his considerable efforts as a technical partner and sanity checker.

Cheers,
Don, W5QN

Renewing C6's Function in 32S-3s While Preserving the Rig's Appearance

By Dick Weber, K5IU

Over the years I've recapped a number of 32S-3s including replacing C6, which is a two section, electrolytic can capacitor. With several of these 32S-3s I used replacement can capacitors that didn't look like the original. Just recently I've renewed C6's function in three of my 32S-3s by installing two separate electrolytic capacitors while leaving the original C6 installed, but with it electrically disconnected. With this approach, the original can capacitor is left in place retaining the rig's original appearance and C6's electrical function is provided using new parts.

I know there are 32S-1/3 owners that have used separate capacitors under the chassis to upgrade C6. This is not a new idea. On the other hand, there are a number of owners who have replaced all other aging capacitors in their 32S-1/3s, but have been reluctant to replace C6 due to the scope of the replacement effort compounded by not being able to readily find a suitable C6 replacement. As it turns out, disconnecting the original C6 and hooking-in two separate electrolytic capacitors is not difficult, which I will show later.

Figure 1 – Available Replacement Can Capacitors for C59 and C6

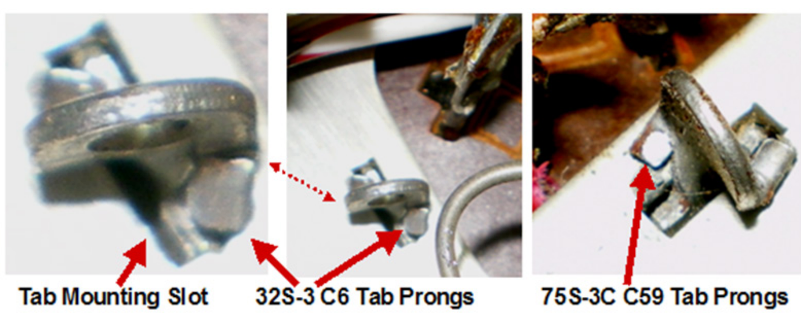
There are some additional benefits to using separate capacitors under the chassis. The effort of removing and replacing the C6 can is eliminated and the cost of parts is about three to four dollars as compared to about thirty-five dollars for a replacement can capacitor. At one time, Antique Electronics Supply (AES) had available C59 for the 75S-1/3/3B, which were built with the same tooling as the can capacitors used by the Collins factory, but no more. At this time, AES has no replacement can capacitors for any Collins rigs, much less a C6 look-alike. Regardless if you would like to use a new can capacitor, you can buy a C59 version for the 75S-1/3/3B and a C6 version for the 32S-1/3 as shown in Figure 1. You can find these on eBay as part of recapping kits.

An alternate approach that may be viable for some classic radios and boat anchors is to rebuild its can capacitors. The process involves removing the old capacitor from the rig, taking it apart, installing and hooking up individual capacitors, reassembling the unit, and then reinstalling it. Don Jackson, W5QN directed me to a good YouTube video that shows how to do this kind of rebuild. You can see it at, www.youtube.com/watch?v=WOlH5hVajco. The title is "Recapping Electrolytics From Below."

I didn't consider rebuilding C6 because I knew I couldn't remove the old C6 without tearing up the locking tabs, which would result in not being able to reinstall it later. This is because of the extent to which the C6's locking tabs had been twisted during installation at the factory. Figure 2 shows the locking tabs in this particular 32S-3 and C59 in one of my 75S-3Cs. If your locking tabs look like these, I suggest extreme caution in trying to untwist them with the expectation of not breaking one or more. In my case, I used a 32S-3 parts rig for practice that had similarly twisted locking tabs. The problem is once the little prongs on the locking tab are fully out of the tab mounting slot, it is difficult, if not impossible, to get them back in the slot when the locking tab is untwisted. Also when the tabs are twisted as shown, the tab material becomes brittle from being cold worked, which adds further risk when untwisting them.

In many cases can capacitors can be removed without tearing up the locking tabs such as C94 shown Figure 3, which is in a parts 75A4 I have. You can see that the locking tabs have not been twisted enough for the prongs to come out of the tab-mounting slot. In addition, the tabs were not twisted to the extent as those shown in Figure 2 resulting in less cold working of the tab's material. In this case, I had no trouble straightening the four tabs, pulling the cap out, and reinstalling it. I did this twice with no problems.

Figure 2 – 32S-3 C6 and 75S-3C C59 With Highly Deformed Prongs and Locking Tabs



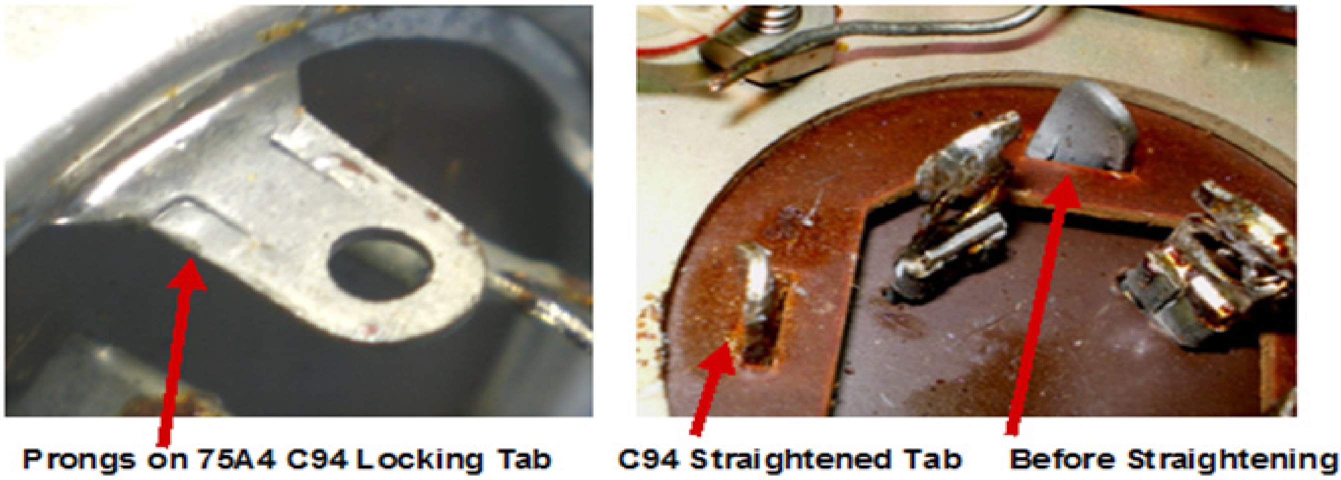


Figure 3 – C94 From a 75A4 Showing Prongs and Tabs Not Severely Deformed

In my case, rebuilding C6 in this particular 32S-3 was not a possible path. This then left two options: either replace C6 with a replacement as shown in Figure 1 or add separate capacitors under the chassis while leaving the original C6 in place. To me this was an easy choice. Using separate capacitors preserved the rig's original appearance while renewing C6's function. It was also less expensive and easy to do.

I said earlier it is not difficult to replace C6's function with two individual electrolytic capacitors, but there is a little trick to create a little more room to do this by how the new parts are mounted. Here's how to do the upgrade.

Figure 4 shows the key components related to C6, V11, and terminal strip lugs we will use. The first steps are:

1) Remove R7 mounted between C6A and Lug Y.
2) Remove the lead between C6A and Lug X.
3) Remove the lead between C6B and pin 7 of V11.

After these steps the area surrounding C6 should look like the picture in Figure 5.

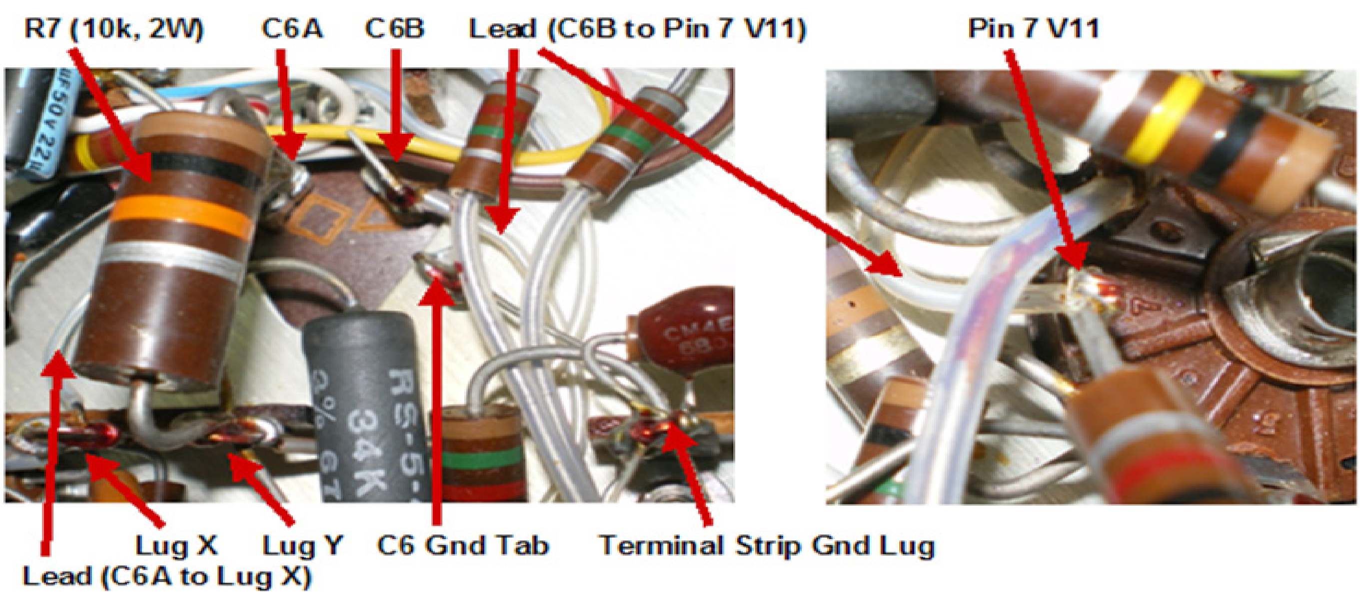


Figure #4 – C6, V11, and Surrounding Components

Figure 5 – R7 and Leads Removed / Ready for Installation of New Parts

The next step is to install a new R7 between Lugs X and Y. I used a metal oxide, 10K Ohm, 2Watt resistor that is physically smaller than the original R7. In addition, it has smaller diameter leads also making it easier to install. The new C6A is mounted with the positive lead hooked to Lug X and its negative lead is hooked to the Gnd Tab of the original C6. (At the factory, C6's Gnd Tab was hooked to the Gnd Lug of the nearby terminal strip to ensure a solid connection to ground as shown in Figures 4 and 5.) The newly installed R7 and C6A are shown in Figure 6.

After looking at several capacitors to use for C6A, I selected one with a larger diameter and shorter axial body length so it would be easier to fit in. I used a Nichicon, 10 uF, 450-Volt capacitor. You can buy these from Mouser, their part number 647-TVX2W100MCD. As far as R7, I used a resistor I had on hand that I bought from Antique Electronic Supply a number of years ago. It is one of their R-F series, 2 Watt metal oxide resistors. Mouser part number 282-10K-RC is a 10K Ohm, 2 Watt metal oxide resistor that is equally suitable.

The last step is to install a 25 uF, 50-Volt electrolytic capacitor for C6B. The positive end of the new C6B is hooked to pin 7 of V11 and the negative end is hooked to the terminal strip Gnd Lug as shown in Figure 7. Due to the number of components hooked to this lug, I suggest you use a soldering heat sink on the lead of CR8 to prevent possible over heating during soldering. The capacitor I used came from Mouser, their part number 75-TVA1306.

The only remaining tasks are to check your soldering and check to see no leads are shorted to other leads or components. And be sure to use Teflon sleeving on component leads where you can.

Easy, huh?

Figure 7 – C6B Installed Between Pin7 of V11 (+) to the Terminal Strip GND Lug (-).

In the Collins Shack

I got bit by the radio bug in the summer of 1959, the summer before my freshman year in high school. The one old ham in my hometown of Itasca, Texas took me under his wing. Sid was very patient with me and I got my novice license. Soon, I was on the air with an old Hallicrafters reciver, and DX-35 and an 80 meter dipole. My call was KN5YNZ.

Later, after my dad drove me to the FCC in Dallas for the third time, I passed the 13 wpm and got my General and became K5YNZ. In 1962, I sold my show calf, went to Electronic Center in Dallas and bought a new RME 4350A receiver and got a Viking 1 from a nerby ham.

It wasn't until after college and law school, Walt Jackson would call me when someone wanted to trade in any Collins gear because they didn't really want it.

In the 80's, I started accumulating Collins gear in ernest. Now I am "trying" to stop acquisions.

I still enjoy operating the excellent Collins rigs and have really enjoyed the many friends I have been able to make through the CCA.

Jenks Garrett, K5YNZ

In the Collins Shack

In the Collins Shack

MEMBERSHIP AND FINANCIAL REPORT

The CCA Board of Directors has decided to publish End of the Year Financials. Last year we were continuing to participate in local events other than Dayton and publish larger than average Signal Magazines. As can be seen from the numbers below, most of our expenses relate to the printing and postage of the Signal Magazine. Postage and printing costs continue to rise so we are committed to publishing a quality Signal Magazine but reduce its size so that we can stay on Budget. We also had a few web site upgrades along with the cost of our sponsorship of the CCA reflector.

The CCA has adequate reserves and the board has decided on steps to trim the budget for 2016 so that we can build more reserves.

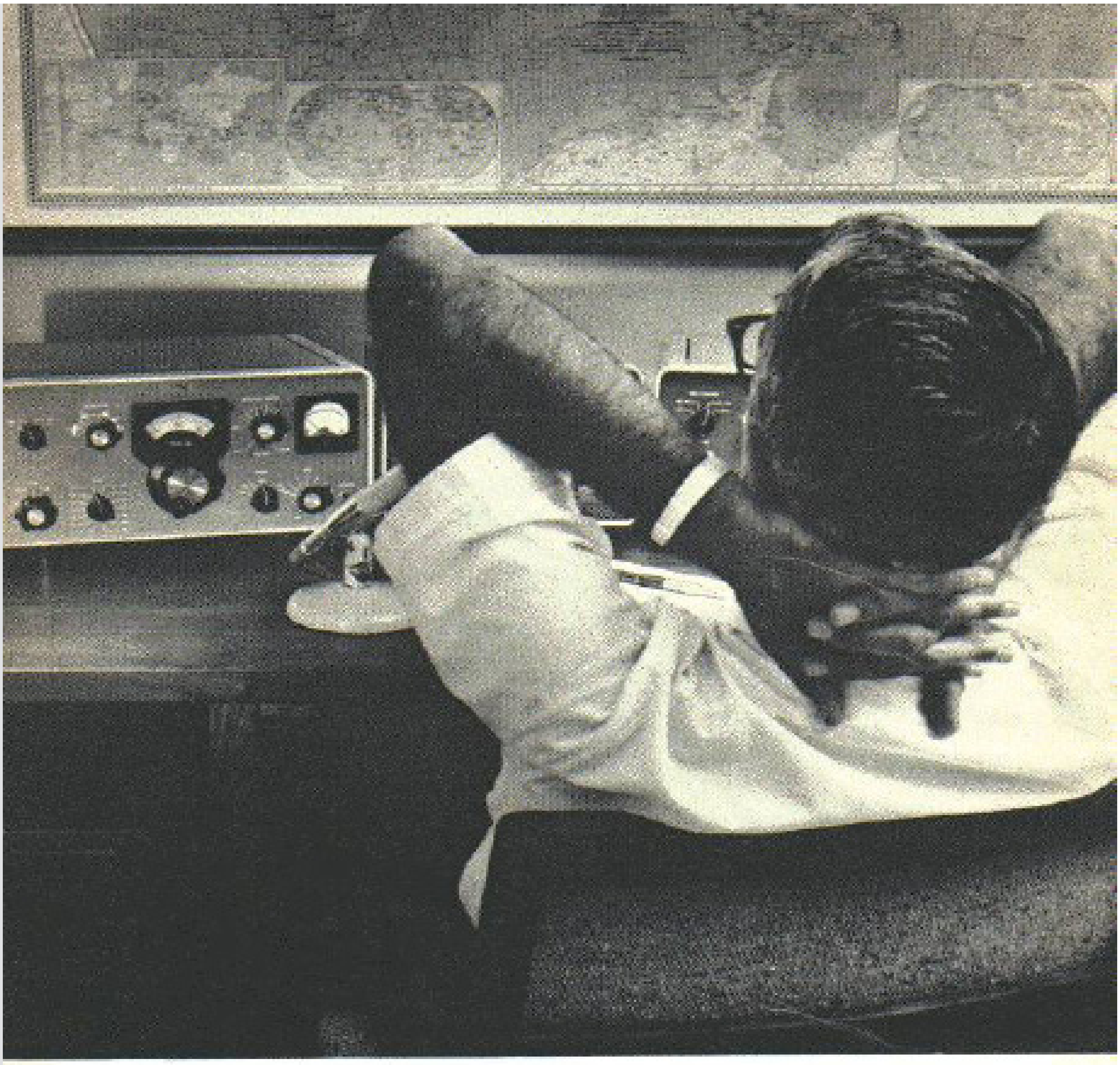
Membership continues to grow. We mailed close to 900 copies of the Signal Magazine for the fourth quarter of 2015 plus we have over 300 Associate members. We are seeing continued renewals and new members for 2016. This growth in Membership has been a result of the hard work over several years by a large team of people.

PRESIDENT,
Scott KE1RR

January - December 2015

Income		
	Dayton Income	$2,194.81
	Member dues	$24,849.94
	Misc Income	$50
	Savings Interest	$1.64
Total Income		$27,096.39

Expense		
	Dayton	$2,472.47
	Other Events	$2,585.86
	Internet	$2,102.69
	Signal and Postage	$20,741.13
	Misc. Expense	$832.91
Total Expense		($28,735.06)
Net Income		-$1,638.67



HANDS OFF

Tired of twiddling and twiddling with the tuner to dig out a solid signal . . . of chasing QSO's up and down the band?

The answer is Collins' 75S-3B Receiver. Most stable front end and sharpest selectivity offered in a ham receiver.

COLLINS