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- Membership Certificates to be mailed Q2

Dream Machine aka Collins 204F-1 Linear Power Amplifier



From the Editor's Desk

by Bill Carns, N7OTQ

Update: *I am writing this after I first wrote the below Editor's Column a couple of months ago. I want to apologize for the lateness of this issue. I am particularly upset because I like to get the Q1 issue out in plenty of time to have it to the readers before Dayton planning time. This has been a difficult couple of months for me here. In March, a pipe broke in my attic at the other end of the home from the master bedroom - and the entire middle and south end of the home was flooded. The entire area had to be stripped to the framing and then drying equipment brought in and then rebuilt. All of our possessions and furniture are in storage in San Antonio and the rebuild is happening as I write this. Until now, I had to be very involved in the process and I had limited access to the home. Now I am forced to leave completely while they rebuild and finish the oak flooring that was damaged. I am trying very hard to get this to press before we have to leave the home completely for two weeks. See the President's column for more comments, but suffice to say that I will not be making Dayton this year. We expect to be back in the home in mid June and I may make Dallas. The below comments were written before the great flood hit.*

Well, I finally succumbed to pressure and started to make a master listing of all issues and articles that have appeared since I took on the job as Editor and Publisher of the *Signal Magazine* in 2007. I have been in the mode of going back through the electronic com-

puter files and looking for an article when someone wants to know when an article ran. But, that job is getting way too tedious. There are just too many files now.

I was shocked. This will be the 18th issue that has been published since the change in *Signal* "staff". Almost 20 issues! - and, if asked, I think I would have guessed that maybe there had been 10 or 12. The time just has gone by so quickly. The Master List of contents should be finished in a couple of weeks and when that happens I will either publish it on the website or make it available in some fashion. There have been a lot of requests.

During the passage of time here, I have completed my move from Arizona and am pretty well established in the new shack building that I built. Most of the equipment is operational. I have fallen (again) prey to starting to play and work on other projects, so all of the operating positions are not completely finished, but most are. There are 14 operating positions now. I still have to finish bringing up the KWS-1 desk with its KWS-1, KWS-1K and 2 75A-4s - and I also need to finish the KWM-1 desk. My latest two projects are closing up. I have about completed the restoration of my "new to me" 204F-1 dual 4CX1500B 2.5 kW super 30S-1 and I also have completed bringing on air a 718U system consisting of a 671U-4A HF Receiver/Exciter, 514A-7 Control Head and associate Power Supply and Amplifier Interface. Some writings about that little jewel will appear here shortly.

The 204F-1 will get some time in this issue along with a great close-out article from Don Jackson about his recommended modification (non-destructive) to the 75S- 3B receiver to provide better S-Meter linearity. While you all know that I am not a big fan of modifications, I am going for this one and my target receiver is on the bench waiting for its turn.

Meanwhile, life goes on and we are now preparing for Dayton 2012 and for the second Dallas Ham Comm event as well as the joint meeting with the Antique Wireless Association in August - More about those events later.

I was very pleased about the reaction to the partial reprint of the S-Line era catalog that was included with the last *Signal* issue in Q4 2011. We are going to try and get back to doing more of that sort of thing so you all can get copies of good resource material.

Bill Carns, N7OTQ
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Dayton - Please Note:

The CCA Dayton booth will be in a new location this year. It is in the same isle as it was and it is directly across from the old one. This move was caused by an error on the part of the organizers, but we may like this orientation better. Just come to the old booth and then turn around.....See you there. Booth 487



Dayton 2012

CCA to Hold its 19th Annual Event at the Dayton Hamvention

Starting on Friday, May 18th, the CCA will again be setting up shop at the Dayton Hara Arena for the 2012 Hamvention.

Collectors from all over the world will get together to find their latest most coveted prize, as well as to share the camaraderie of the experience with their friends. This year should be a banner year, given the recovery in progress and the indications that we have gotten from our many friends around the country.

This year, as in the past years, the CCA will not only have a booth in the exhibition hall, but we will share our experiences and have our annual dinner at the Ramada Plaza Hotel on Wagoner Ford Road. Please see the Collins Collector Association website at collinsradio.org for all of the details and your easy sign up for the banquet.

Now is the time to mark your calendar to attend the Dayton Hamvention® 2012. The CCA has reserved a block of rooms at the Ramada Plaza Hotel Dayton North for 2012, and their contact information is below. BE SURE to state you are with the Collins Collectors Association to claim your room from our specially reserved block with the special rate of \$118.00 per night! This is a uniquely located hotel convenient to the Hamvention at Hara Arena. To make your reservation and join in all of your friends and the CCA festivities, contact the hotel directly at (937) 278-4871. Ask for Sam, the desk manager and ask for the special CCA rate.

Also, NOW is the time to make your reservations for the Annual Collins Collector's Association Awards Banquet to be held Friday Night, May 18, 2012. Social Hour and libations begin at 6:00 PM with the Official CCA Banquet Dinner commencing at 7:00 PM sharp! The cost for the entire banquet is \$38.00, payable by check or PayPal. There will again be a cash bar.

The main feature for the evening will be a special presentation by Lawrence L. Robinson, KC0ODK, on the "Operation Collins ART 13 for the World's Only Flying B-29 Aircraft" Lawrence is a Senior Engineering Manager at Rockwell Collins and the Curator of the Rockwell Collins Company Museum in Cedar Rapids. Rod Blocksom, who handed over the Museum to Lawrence, will be introducing him!

Also featured at the CCA Banquet will be the smallest Transmitter Collins ever built which fits in part of a KWM-2A tuning slug case and was put together by Jim Macanni, W0HUP who spoke at our banquet last year. Come and see this first ever displayed transmitter and learn its frequency, power rating, and applications!! You can take a picture of it in your hand if you like!!

Your friends will all be there. The lucky will win fabulous door prizes, and there will be many special surprises for those who attend: **MAKE YOUR BANQUET RESERVATIONS NOW!!**

Please note that our booth location in the arena has changed just a little. We will be in booth 487 this year. This booth is exactly right across the aisle from where we have always been.

Come and enjoy the great time that we always have and take a shot at this year's door prizes. We all hope to see you there.

Automatic Gain Control Theory and Operating Conclusions

Part 4 – Improving S-Line S-Meter Linearity

by Don Jackson, W5QN

Introduction

In Part 3 of this series of articles on AGC, I mentioned that a modification to the 75S-3B should greatly improve the function of the S-meter. Analysis of the circuitry showed the AGC curve controlling the attenuation of the receiver gain is quite linear, at least in my receiver. What I mean by “linear” is that the slope of the attenuation curve in dB/Volt is constant over the useable RF input power range of the receiver. Unfortunately, this linearity is severely degraded by the circuitry used to convert the AGC voltage to a current for driving the S-meter. The result is an S-Unit (SU) that varied from about 3dB/SU to 6dB/SU on my receiver.

What Determines S-Meter Linearity

We would like an S-Meter that has a constant SU value over the entire range of the meter. A typical S-

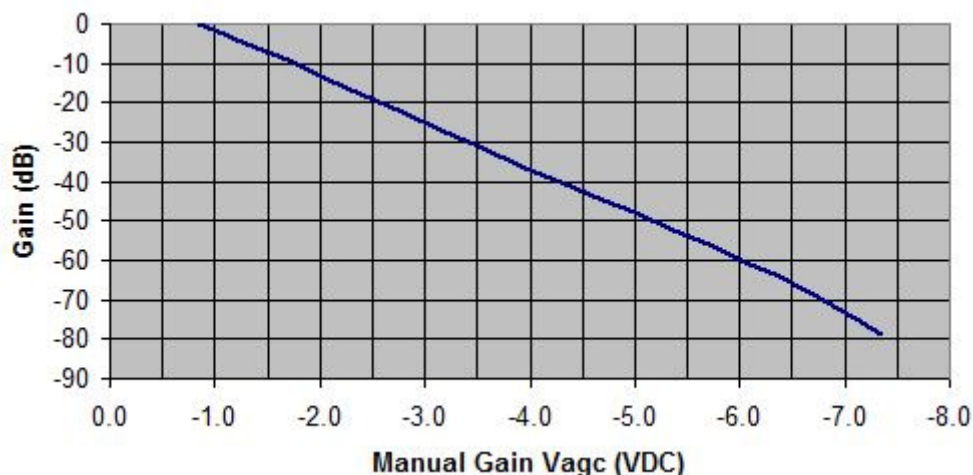


Figure 1 – Normalized Receiver Gain vs. AGC Voltage

Line receiver has an average value of 4dB/SU, but that value varies a great deal over the meter range. The S-Meter would be perfectly “linear” if the value of an SU were the same over the entire range of the

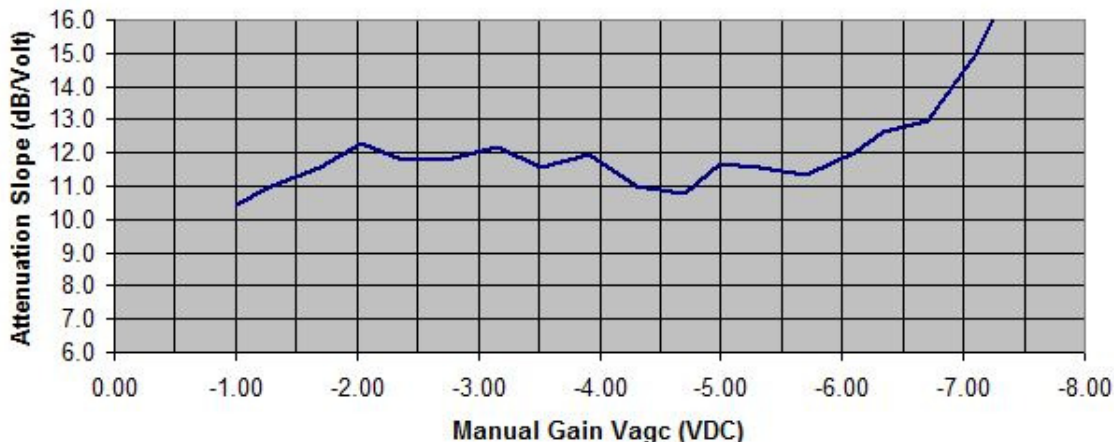


Figure 2 – Open Loop AGC Attenuation Slope (dB/Volt)

AGC Theory and Operating Conclusions Part 3 – Making it Better (Cont'd)

meter. Since the S-Meter primarily measures the AGC voltage to determine its meter reading, it is clear that the attenuation curve of the AGC circuitry should be a linear function in dB/Volt. Figure 1 shows the signal attenuation as a function of AGC voltage, V_{agc} . This measurement is “open loop” with the AGC switch set to OFF.

Figure 2 shows the incremental slope of this curve over the entire range of the AGC Voltage.

The average slope is about 11.5dB/Volt, so the slope of the curve departs from this average by about $\pm 0.6\text{dB/V}$ ($\pm 5\%$) over the primary range of the AGC voltage.

A second requirement for meter linearity is that the translation of V_{agc} to S-Meter current be linear. In the S-Line receivers this is accomplished by a clever bridge circuit that uses variations in the screen current of V6 and the cathode current of V7 to drive the meter. Although this circuit is fairly simple and eliminates the need for a vacuum tube DC amplifier, the result is not very linear. Figure 3 shows the meter current plotted as a function of V_{agc} . It is the non-linear behavior of this function that could be improved upon.

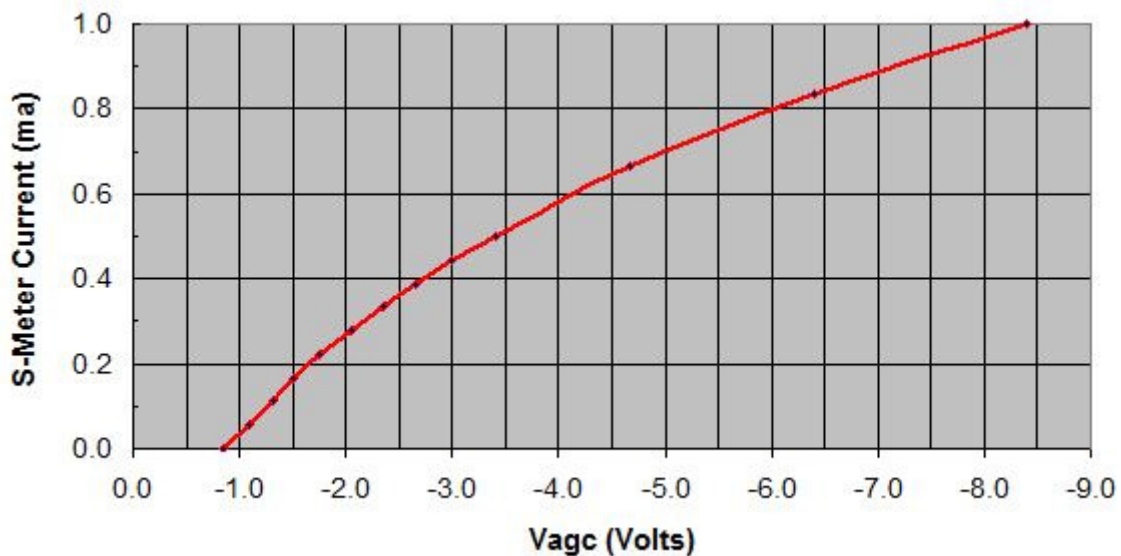


Figure 3 – Original 75S-3B S-Meter Driver

It should be noted, however, that even if the above characteristics are perfectly linear, the linearity of the S-Meter is not guaranteed during normal “closed loop” operation, when the AGC loop is closed. This is because in the closed loop case, V_{agc} “tracking” of the RF input level is a function of the feedback gain. Figure 4 shows this dependence, using data from the basic steady state equations presented in Part 1 of this series.

In Figure 4, V_{agc} and the S-Meter driver circuitry are perfectly linear, but the AGC feedback gain (FB) is varied above and below the typical value of .88 for S-Line receivers. Only when the FB gain reaches about 4 does the meter closely track the V_{agc} attenuation curve. With a FB gain of .88, the value of an SU varies between about 4.9dB/SU at S1 to 4.5dB/SU at S9. The FB gain in the S-Line receivers could be increased by increasing the sum of R25 and R88, but this has the drawback of proportionately increasing the sensitivity of S-Meter “zero” drift as the grid current of V6 and V7 varies. I would not recom-

AGC Theory and Operating Conclusions Part 3 - Making it Better (Cont'd)

mend doing this. Besides, the contribution to the overall meter linearity due to insufficient feedback gain is not large compared to variations in the linearity of the AGC voltage attenuation curve.

So, how much improvement can we get in S-Meter linearity by replacing the original meter driver circuitry with a more linear circuit?

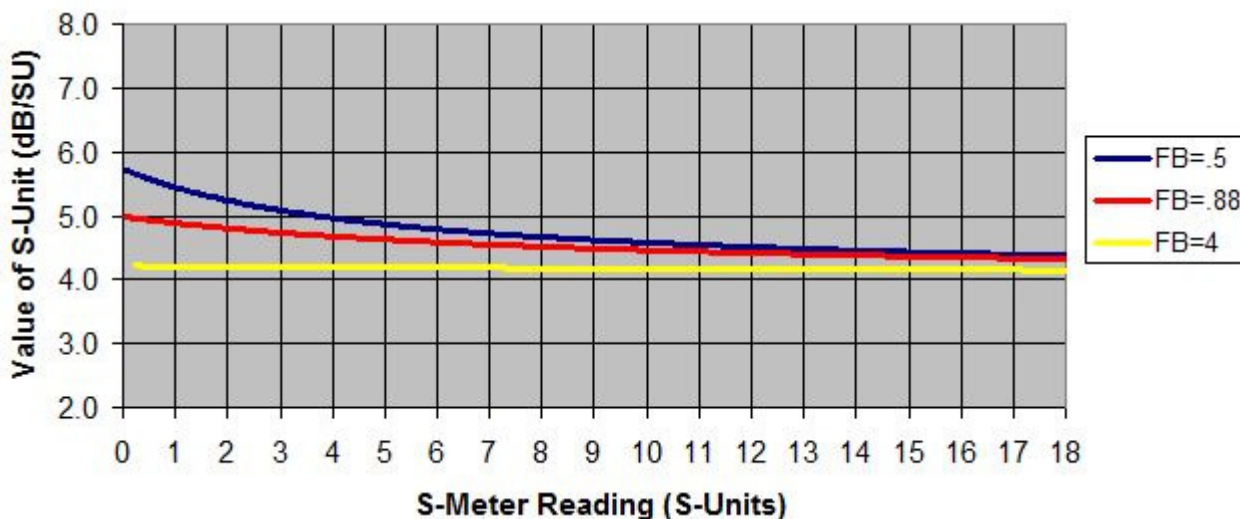


Figure 4 - Linearity Dependence on Feedback Gain

Circuit Description

The schematic for the new meter driver circuit is shown in Figure 5. No voltage gain is necessary. The circuit is basically a very high input impedance voltage follower that directly measures the AGC voltage and uses it to drive the S-Meter.

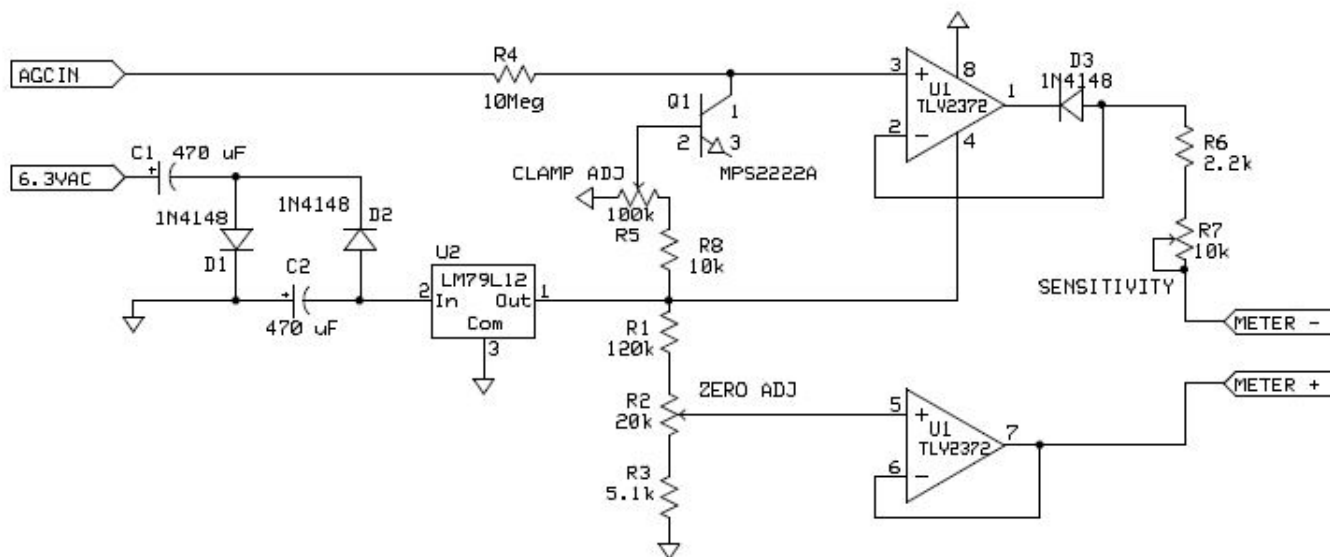


Figure 5 - New Meter Driver Schematic

AGC Theory and Operating Conclusions Part 3 – Making it Better (Cont'd)

Power input comes from the 6.3VAC feeding the S-Meter lamp, and a voltage doubler converts this to approximately -16VDC to power the electronics.

A TLV-2372 dual Op-Amp provides a very high impedance measurement of the AGC voltage. The two amplifier outputs drive the S-Meter with a potentiometer, R7, in series with the meter to set the desired sensitivity in dB/SU. The sensitivity can be adjusted from about 2dB/SU to 7dB/SU. Be aware that you can't use any old Op-Amp since the input and output voltage of the amplifiers must be able to accommodate -8V, which is very close to the positive rail of 0V. Choose a unit, such as the TLV-2372, that has input and output capability all the way to the supply rails.

Potentiometer R2 provides a zero adjustment for the S-Meter. Voltage regulator U2 ensures a stable -12VDC for the circuit. The typical output voltage at the wiper of R2 is -8Volts. The zero function operates differently from most. Diode D3 transforms the amplifier into a "precision rectifier". The result is that the S-Meter cannot be driven below zero. The reason for adding this feature is that if the AGC SLOW capacitor value is increased by a large amount in order to increase the AGC decay time (as I did in my receiver), switching from Standby to Operate can result in a negative meter deflection transient that requires a couple of seconds to recover. The addition of D3 solves that problem, but changes the behavior of the S-Meter during the zeroing process, since the meter can no longer go negative. (see Alignment procedure later in the article)

Another feature of the circuit is a clamping function. In the original 75S-3B, muting the receiver or placing muting it will pin the S-Meter rather aggressively. My meter pins so hard it occasionally sticks at maximum. Also, in standby mode the AGC voltage must be allowed to increase to about -25Volts, which is well above the maximum -12VDC voltage supplied to the amplifiers, and could damage the amplifier. Components R4, R5 and Q1 solve both these problems. R5 is set to prevent the meter from being driven above full scale, and ensures the amplifier is protected from the -25V input. Resistor R4 provides sufficient isolation to allow the AGC voltage to increase to -25V, but also protect the amplifier. In order that R4 (10Meg) does not effect the measurement of the AGC voltage by U1, the input impedance of U1 and the clamp circuit must be very high. U1 has an input current of 10pA, which translates to an input impedance of about 1,000,000Meg. The collector-base junction of transistor Q1 is used as a very low current leakage diode. Although you can purchase a special "low leakage" diode, it is satisfactory to use the collector-base junction of an inexpensive transistor for this function. The result is that the output voltage of the amplifier is within a few millivolts of the AGC input, even with R4 in series with the input.

Installation

The circuit is constructed on a PC board designed using the ExpressPCB software tools. The PCB assembly mounts directly onto the terminals of the S-Meter using its original hardware. The original meter leads are not used and are stored on a couple of bolts at the bottom of the PCB. There are only three wire connections necessary for installation of the board. Two power leads are connected to the meter lamp solder lugs. The third connection is to the AGC voltage, available at a lug on the AGC Mode switch. With a steady hand, it isn't necessary to take the receiver out of its cabinet during the installation. If desired, the PCB can easily be removed and the receiver put back in original condition. Figure 6 is a photo of the breadboard circuit mounted to the rear of the S-Meter. See next page for Figure 6.

Setup Alternatives

Once the new circuit is installed, the receiver can be set up in a wide variety of ways. There are three parameters we are concerned with: 1) Input AGC threshold, Pt, in dBm, 2) Meter Sensitivity, S,

AGC Theory and Operating Conclusions
Part 3 - Making it Better (Cont'd)

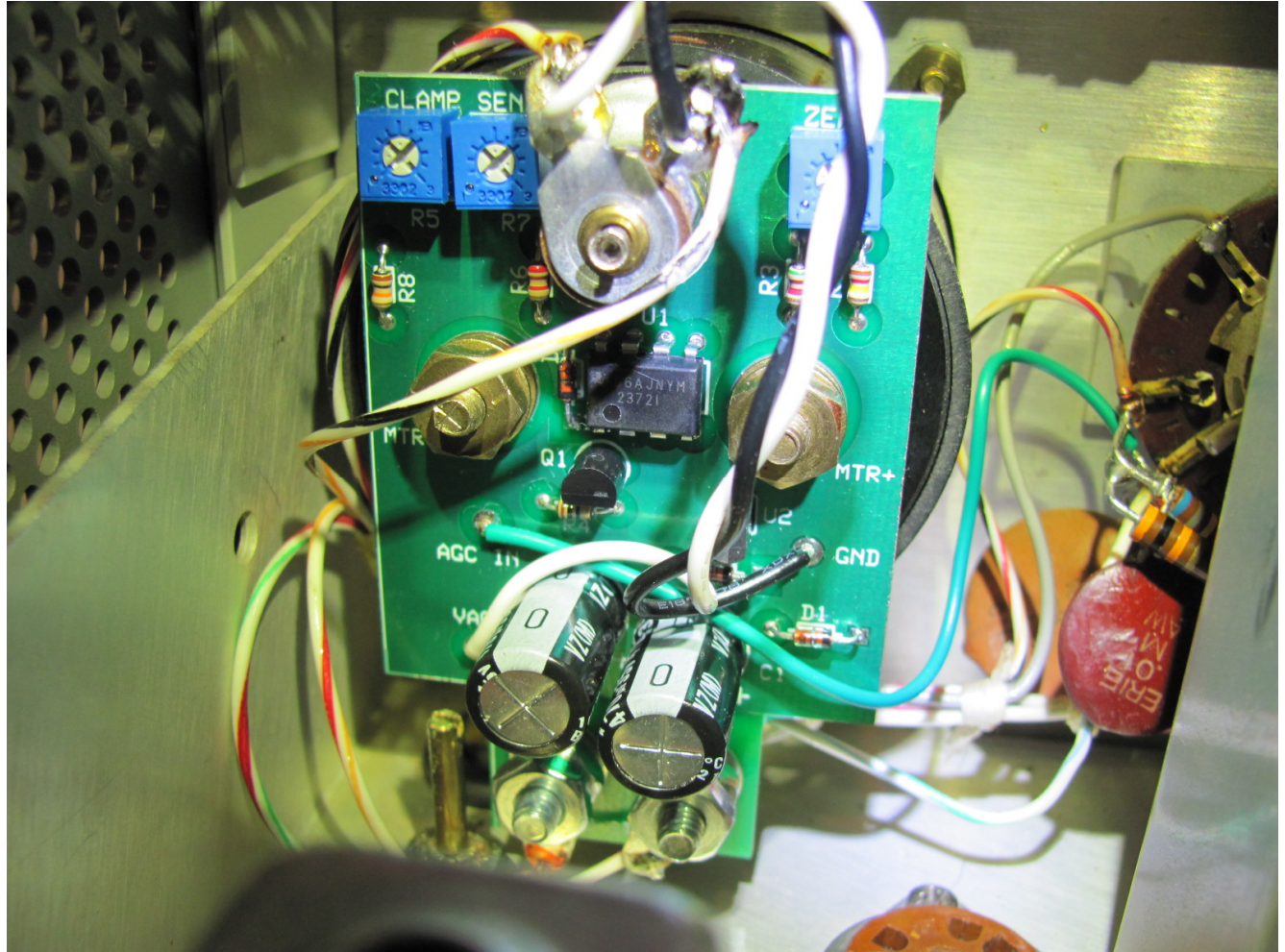


Figure 6 - Circuit Board Installation

in dB/SU, and 3) Input power, P9, in dBm for a meter reading of S9. Assuming the meter has a constant sensitivity, S, the three parameters are related by the equation:

$$P9 \text{ (dBm)} = Pt \text{ (dBm)} + 9*S \text{ (dB/SU)}$$

Note that you may only choose two of the three parameters as the third will be determined by the equation. Let's assume we set "S" to a desired value using the pot R7 on the new circuit board, and set "P9" using R57 on the receiver. Although there are an infinite number of parameter choices we can make, they can be narrowed down considerably with a few common sense assumptions. For on-air comparative measurements, we want "S" to be a whole number, such as 3, 4, 5, or 6dB/SU.

Setting "S" to 3dB/SU causes the input power range from S0 to S9 to be only 27dB. Choosing 6dB/SU is nice because this is the value recommended by the IARU (International Amateur Radio Union) for an SU, but to set the receiver up for the IARU recommendation (which also specifies P9 to be -73dBm or 50uV), the receiver must have sufficient gain to achieve a Pt of -127dBm (.1uV). My receiver does not

AGC Theory and Operating Conclusions

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have that much gain, and I suspect nobody else's S-Line receiver does either.

Setting 4dB/SU is easily achievable, even using the IARU value for P9 of -73dBm (50uV). Also, 4dB/SU is close to the average value seen in a stock S-Line receiver. The 75S-3B manual suggests that P9 should be about 100uV, but choosing 50uV makes the meter work down to lower signal levels, makes a true S9 reading easier to achieve, and meets the IARU recommendation for an S9 reading.

Setting 5dB/SU is an option and expands the S0 to S9 meter range to 54dB. However, the required gain of the receiver becomes a bit marginal. Moving Pt to -67dBm (100uV) helps this situation should you choose a 5dB/SU setting.

In my opinion, the most important parameter of the S-Meter is a consistent dB/SU value. Nearly all on-air reports are relative readings comparing antennas or amplifiers, so consistent dB/SU sensitivity over the S1 to S9 range is the primary consideration. Considering that "P9" and "Pt" change with receiver gain (temperature, band and frequency within the 1st IF), consistency of Pt and P9 is pretty much a pipe dream with the S-Line receivers. My receiver gain varies about 6dB depending on band selection, and another 4dB depending on where you are tuned in the 1st IF passband, for a total of 10dB variation. Assuming you set R57 for an S9 reading of 50uV at your average receiver gain, S9 might vary from 28uV to 89uV depending on what frequency you are on. And, this doesn't even take into account gain variations due to ambient temperature, aging or what happens to the gain when you plug the XTAL OSC cable in for transceive operation.

Alignment Procedure

Alignment is easily done with a calibrated signal generator. Start with the three pots fully CCW.

With no input signal, adjust the ZERO pot until the meter just reaches zero meter reading.

Choose your desired input power (P9) for S9, and sensitivity (S).

Calculate the input power for (P1) for S1. $P1 = P9 - 8 * S$. (Example: P9 = -73dBm (50uv) and S=4dB/SU. Then $P1 = -73dBm - 32dB = -105dBm$)

Input P1 to the receiver, and adjust R57 (IF Gain) for S1 on the meter.

Change the signal generator output to P9, and adjust SENS pot for a meter reading of S9.

Repeat Steps 4 and 5 until both readings are achieved without further adjustment.

Set the receiver RF Gain fully CCW. Adjust the CLAMP pot for a full scale reading.

Test Results

Figure 5 is a graph showing the value of an SU over the entire S-Meter range. The plots compare the linearity of the S-Meter of my 75S-3B, with its original meter driver circuit, to the receiver modified with the new meter driver circuit. The new circuit was set up for a meter sensitivity of 4dB/SU in order to get an "apples to apples" comparison with the original circuit. To show the linearity of the S-Meter above S9, I have equated the "60dB" tick mark to S12, "80dB" to S15 and "100dB" to S18.

Figure 7 – Value of S-Unit, Original vs. Modified

With the original meter driver the value of an SU ranges from 2.9dB at S3 to 5.7dB at S9, with the value becoming much larger above S9. With the new meter driver circuit, the variation of an SU falls within a $\pm 0.3dB$ window over the S1 to S9 meter range.

Conclusions

The new meter driver eliminates a major cause of S-Meter non-linearity, the meter driver circuit. It is clear that the new meter driver improves the usefulness of the S-Meter by creating a more constant dB/SU characteristic over the range of the meter. With this modification, you can give on-air antenna or

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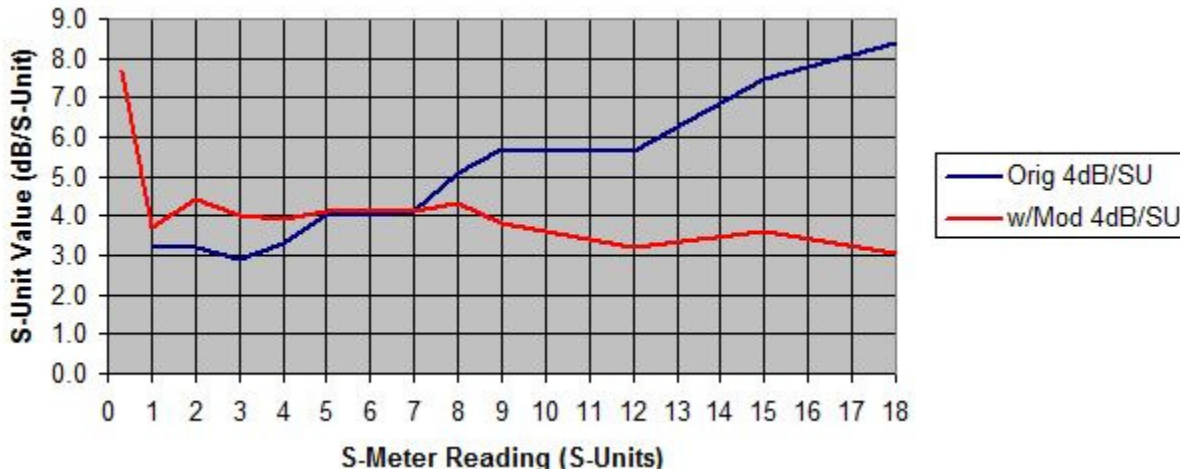


Figure 7 – Value of S-Unit, Original vs. Modified

amplifier comparisons with decent accuracy. The modification is very easy to install and can be easily removed. Features of the circuit include the ability to set the meter to a variety of dB/SU sensitivities, and a clamp that prevents the meter from pinning as a result of mute/standby, initial power-on, or extremely strong input signals. Any remaining meter non-linearity is primarily due to the AGC voltage vs. attenuation characteristic, which is a function of the specific V2, V6 and V7 tubes installed. If, after installing this new circuit, your meter linearity isn't similar to the performance shown in Figure 7, you might try different tubes. Before installing the new circuit, I would suggest measuring the "before" Pin vs. S-Meter characteristics so that you can see the improvement in linearity. You will need a calibrated signal source to this.

I created a PCB layout using the Express PCB software, and purchased 26 boards. Let me know by email if you have an interest purchasing a complete, tested assembly for this circuit. I'll work up some pricing.

Cheers and 73s,
Don W5QN - w5qn@verizon.net

Author Information:



Don Jackson, W5QN, of Garland, Texas is one of the CCAs more prolific writers. His articles always challenge us to learn and grow, and they certainly provide a wealth of understanding. We hope you have enjoyed this series on AGC and S-Meter performance. I have learned a lot.

Don is retired from a 40 plus year career as an electrical engineer, where he specialized in HF and Microwave Receiver design. He graduated in 1966 with a BSEE from the University of Florida and started his career with Texas Instruments.

He is fairly new to Collins collecting and has a 75S-3B, 32S-3, 30L-1, 312B-4 line-up which he uses as his main station. Don was first licensed in 1960 while in high school and started ham life with an Allied R-100 kit receiver and a Heathkit DX-40.

When asked what his favorite piece of Collins gear was, he named off the 75A-4. I sure hope he has found one by this time. Thanks once again Don for your fine contribution!

W4AX KWM/HF 380 Memory Board - Kiron Board Replacement



Editor's Note: *Many people do not realize that their KWM 380 would be an entirely different radio if it were not for the Kiron Board functionality. They also do not realize that the Kiron board has a finite lifetime due to the battery built into the Kiron Chip.. We are reaching the end of life for these chips and replacements are difficult and expensive to find. Thanks to Mack's fine work, there is now an alternative solution.*



Figure 1 W4AX Memory Board

The W4AX Memory Board

The KWM-380 was first released in 1979 and was the last amateur radio released by Rockwell/Collins. The final production run of the radio was 1986. It embodied cutting edge all solid state technology and operators found it very easy to operate on both SSB and CW.

The radio is computer controlled and uses a Motorola 6802 central processing unit (CPU). This CPU has 128 bytes of volatile memory and Collins used this limited memory to enable the storage of up to 10 frequencies. The issue that frustrated many users is that the memory was erased when the power switch was turned off. The radio also always started initially on 15 MHz. Collins does provide a means to

apply +5 VDC externally to keep the CPU operating when the power is turned off which prevents the memories from being erased. In 1989 the Kiron board was released to address this shortcoming. It was a very innovative solution that allowed non-volatile memory storage and the radio to return to the last operating frequency used. The original Kiron board is almost impossible to locate currently, is very expensive, and many have failed. The failure is caused by battery failure in the internal Kiron memory.

This project began over a year ago when Butch, KOBS, and I were talking at the Dalton Hamfest. Butch explained that his HF-380 was not retaining its stored memory settings. At the time I didn't own a KWM-380 and was unfamiliar with the radio. I ex-

amined the schematic with Butch, did some research, and suggested a simple schematic to externally power the Kiron chip. However, I was hooked on the radio by now and decided to purchase one. That led me to think more about the lack of Kiron boards and their failure rates. I decided to design my own board to perform the same functions.

My objectives were to build a modern card using currently available components that would enable the storage of up to 100 frequencies in memory and allow the radio to power on at the last frequency used. All frequencies would be controlled using an external keypad in keeping with the original Collins design. It was important that all settings were stored in non-volatile memory so they

W4AX KWM/HF 380 Solutions (Cont'd)

would be retained during extended power off periods.

The W4AX Memory Card design began with a thorough understanding of how every logic circuit on the KWM-380 A8 control card functioned. When you examine the schematic you discover that there are unused portions of U3 and U4, which are memory mapped back to the 6802 CPU, which can be used to control an external memory card. If you examine Table 1 in the A8 Control Card section of the KWM-380 service manual you will see there is not a 0 shown on the row with address 1 0 0. That now becomes an unused output on U3 and U4 to control the memory card. This equates to a hexadecimal address of 8000 when programming the assembler code for the 6802 CPU. Therefore, if U3 or U4 failed, the memory card would no longer function correctly. This may become important in later years if you need to troubleshoot your radio. The final challenge was adding the additional code to the original KWM-380 control code to enable the memory storage. This required more memory address space than was used in the original radio and hence address line A11 (pin 20) of the 6802 CPU was used to add additional addressable space in the external Program once Read Only Memory (PROM) chip on the memory card.

The W4AX memory card implements the unused control lines and address space of the original KWM-380 control card. It uses a non-volatile (NVRAM) battery backed up memory chip

and a programmable read only memory chip. There are two lithium batteries in the current card and each is independently selected by internal circuitry in the NVRAM in case one battery fails.

out this original interface card is also very difficult to source. Keypad sources, which are also readily available, are shown on my website if you don't already own one.

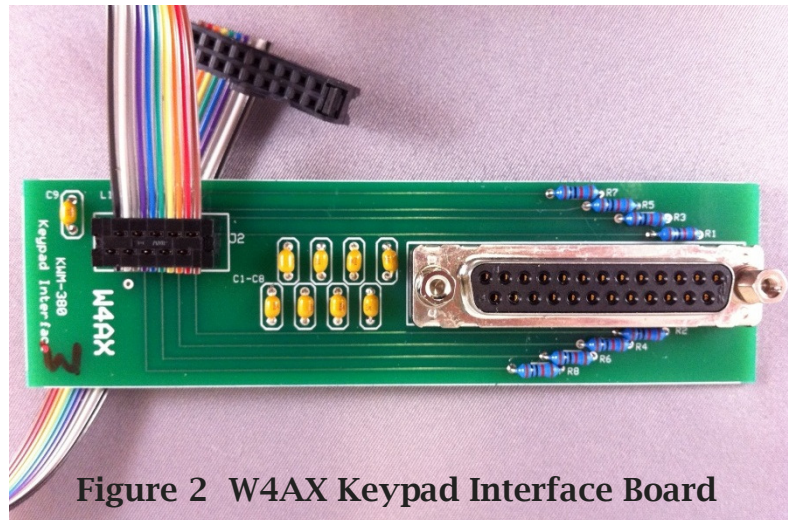


Figure 2 W4AX Keypad Interface Board

These batteries are also isolated from the NVRAM chip when external power is applied. The batteries are made with state of the art technology and should provide an exceptionally long life. All address and data lines are brought from the A8 control card externally to the W4AX memory card. The aforementioned A11 address line and two control signals from U3 and U4 are also brought via jumpers to the memory card. The magic is done in the 6802 assembler code that resides in the non-volatile memory chip. An external keypad card is required to fully utilize the programming features of the memory card. To facilitate adding a keypad I also developed a keypad interface card using the information found in the A14 section of the service manual. Paul, W5NTQ, encouraged this development. It turns

These boards are immediately available now with next day shipping via USPS both domestically and internationally. The parts are readily available from multiple sources. They are available in HF-380 and KWM-380 (WARC) versions. The memory cards were thoroughly tested by four KWM-380 experts before general availability. Each card is tested in my HF-380 prior to shipment.

More information can be found about these two cards at <http://w4ax.com:8080> .

I look forward to speaking with you on the bands and there will demo boards available at the CCA booth # 487 at Dayton 2012.

de Mack McCormick, W4AX

In the Shack of Bill Wheeler, KODEW

Some things come easy, and some come hard. Writing this was one of the easier stories to put in print because it is such a pleasure to display this wonderful shack. Not only is the presentation great, but just having Bill here as the shack feature is a privilege. Bill Wheeler, KODEW, is the reason that we have our Collins Collectors Association. Many of you may not know that Bill started the CCA in 1994 following establishing the Sunday Afternoon Collins net because of all of the interest that was out there in Collins radios.

Bill is a retired educator and is active locally in Missouri in his city government. He not only founded the CCA, but he served for many years as the President and then on the Board of Directors. He is an avid restoration enthusiast and has written articles for the *Signal Magazine* over the years on some of these projects. Bill and I share a common interest in not only the Collins gear, but also the Collins broadcast equipment and he also runs a 20V-3 on 75 meter AM.

As I am sure that you know, Bill has again been appointed to the CCA Board of Directors and has also been appointed permanent President Emeritus of the CCA. Thank you Bill for your years of service, and also thank you for sharing your shack with us.



**Left:
AM Central: The AM
Voice of Missouri**

**Right:
A-Line Operating
Position Ready for Action**



In the Shack of Bill Wheeler, KODEW



**Left:
Nice A-Line and S-Line
Display and Operating
Positions**

**Right:
More S-Line
Choose your Poison
& Get on the Net**



**Left:
Bill Wheeler,
KODEW,
At the Mic**

Wrong Again! - Part 1 of 3 or Bringing up that “Working” 204F-1

By Bill Carns, N7OTQ

Introduction

For many of you reading this it will be your first introduction to - and first knowledge of - this beautiful amplifier.

With its 2500 watt PEP power limit, the 204F-1 is probably the largest and most potentially powerful Collins amplifier that can be said to be really applicable to amateur service. It is amazing what this amplifier sounds like at 1500 watts PEP when you are using a good antenna



Figure 1. Introducing the “Dream Machine” 204F-1 full up!

This shot and the front page say it all .

That Wattmeter is sitting solid on 2.5 kW output - and it had been sitting there for 20 minutes when this photo was taken. No loafer, this!

For those of you not familiar with this beast, the pictures speak for themselves as to the physical beauty aspect of the amplifier. It is akin to a 30S-1 on steroids and just closing and opening the doors will convince you that quality was the watchword when these were designed and made. Door closure will remind you of listening to a fine Mercedes door closing and opening.

The specifications and the electrical nature of the amplifier are very reminiscent of the 30S-1. The same screen supply and biasing arrangement is used in the 204F-1 (and the 204H-1 single channel 2-30 mHz auto-tune big brother) and the tube compliment is similar to a S-Line driving a 30S-1.

The amplifier was developed by Collins at the request of the Air Force to be a bigger alternative amplifier for the KWT-6/URC-32 system which came as a low level exciter or as a 1 kW PEP PA similar to the

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KWS-1. As such, the 204F-1 was design to run key down teletype at 2.5 kW carrier 24/7, and that folks - is a serious 2.5 kW amp.

Collins 204F-1 Linear Power Amplifier	
Electrical Characteristics	
Frequency Range:	2 to 30 megacycles
Tuning:	Manual Adjustment using Panel Controls and L & C Tap Changes
Power Output:	2.5 kilowatts PEP or 2.5 kW Continuous Average Power
Bandwidth:	16 kilocycles wide at 1 db points
Input & Output Impedances:	50 ohms nominal
Excitation Re-	0.1 watt nominal, 0.2 watts maximum from external source
SSB Distortion:	35 db Signal to Distortion worst case
Power Required:	200 to 250 Vac, 50-60 cps at 6 kva

Figure 2. Electrical Specifications

We do not know exactly how many were made total - but at its peak, there were over 100 in service just at Offutt Air Force Base near Omaha. In addition, there were many others in service with the military and commercial customers. We estimate that at least several hundred were manufactured.

Because of its intended teletype operation, the 204F-1 is spec'd out at 200 mW input maximum to obtain 2.5 kW pep output power into a 50 ohm load and will do this all day long.

It has a Channel 1/Channel 2 switching capability centered around one humongous channel contactor that selects one or the other set of duplicated PA components. There are also 2 smaller Ch 1/Ch 2 relays in the Grid Compartment deck that switch in the appropriate tuning Ls and Cs for the driver stages.

BE ADVISED.....When you power up the disconnect (plug the unit in) the main channel contactor (which is outside the ON-OFF power control loop) will immediately set itself to the selected channel with a VERY LOUD bang.....It is startling, so be ready for it....Otherwise you will think you have had some kind of failure.

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Figure 3. PA Compartment with Dual 4CX1500Bs and Cooling Chimneys in Place

The tube compliment is straight forward and consists of a 6CL6 driving 2 6146s driving two 4CX1500Bs (or as originally sourced 2 ea 4CX1000s).

The multimeter is very thorough and everything you ever wanted to know is right there in front of you.

Depending on the output option installed at the time of purchase (related to the antenna steering), there are either one or two Bruene couplers installed in the top compartment and there is a built in wattmeter that will monitor both channels even when there are two separate antennas installed.

Now, this amount of gain in one amplifier could be troublesome, but thanks to an excellent design, there are no apparent stability problems with this sweetheart. As you might imagine from the duty cycle specification of 100 %, the components are more than robust for this power level and, if properly maintained, this amplifier will last you several lifetimes in amateur service. Running at 1500 watts pep in SSB service, it is just idling along. Well serviced to start with, you can expect excellent reliability.

And, if maintenance is needed, most of the amplifier can be easily accessed through the two top and bottom front doors and then by pulling the driver compartment drawer out. This driver compartment subassembly comes completely out of the amplifier and, with the construction of an extender cable or a power supply harness, the entire driver deck can be worked on at the bench.

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Figure 4. Driver Compartment Partially Open



This must be done with the door interlocks cheated and there is a word of warning necessary here. Cooling air flow depends upon the doors being closed. You must always be aware of the status of the finals (In or Out - it just takes filament power to cook them) before running the amp in maintenance mode to get the supplies up. When in doubt, pull the PA tubes and then you will not have to worry about cooling. You will also have to cheat the overhead air sensor switch because with the top door open, high volume air will not be flowing out of the top vent and the safety will preclude you running the amp. I use a system where I always red flag any interlock that I cheat - so it does not get forgotten later.

By the way, when you pull the driver deck, make sure that you first remove the knob on the multimeter function switch. This switch stays behind on the chassis and you will strip the knob off of the shaft and it will go to the often concrete floor. This is hard on knobs and easy to do. The other two knobs stay on the driver deck, so you do not

Figure 5. Left: Lower Power Supply Compartment with Easy Access

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have to worry about them.

The High Voltage is 2700 Volts and the Screen Voltage is 300 Volts, so total applied "plate voltage" to the 4CX1500Bs is 3000 Vdc and they are ready to light off and go. Like I said, a 30S-1 on steroids. You are going to find a lot of similarities.

The plate current is limited to 1.6 Amps by an internal plate current sensor and safety circuit. I have often seen this circuit disabled by misguided operators, but I definitely do not recommend this approach.

Yes, 2 ea 4CX1500Bs will whistle right up to 5 kW (if no ALC is applied and overload protection circuits are defeated) and that is very useful margin when operating the amp key down at 2.5 kW, but do not be so tempted. There are many other issues to consider if you want to turn this into a 5 kW amp and I am not even going to go into them here. If you want that kind of illegal power, then go get a HF-8020 and have fun. Reading the rest of this story will reveal why you should not go down that road.

Driving the amplifier in amateur service is easy. There are stock (aka Bird) 30 db 100 watt power attenuators that will get you right in the ball park with a flat out S-Line transmitter, or you can use any number of Collins commercial airborne HF rigs (A future article is coming on driving the 204H-1 with a 618U-4A airborne receiver/exciter that is designed to drive PAs that are looking for 200 mW input for full power).



Figure 6. Custom 27 db 120 watt power attenuator constructed for S-Line driver operation. Shown during testing.

Whatever you use, you are going to be surprised at what a difference a full blown 1.5 kW PEP makes when it is coming from an amp with all of that head room. There is no compression other than what you provide at the audio level and it seems to make a heck of a difference.

So seeing - as I am sure that you can - that I am in love with my 204s (both of them) - why the title of "Wrong Again". Read on in

the continuation of this article in the next issue and you will see, but I will be surprised if a large number of readers don't go on a hunt for one of these amps when they are done reading. I will say a little about the market and pricing at the end of the article series.

Parts 2 and 3 of this article will describe the restoration and trouble shooting of this beautiful amplifier and then the process of bringing it up to full operational status.

From the President



This has been quite a challenging quarter (and a month) for me. As I said in the Editor's column, we had a pretty bad flood due to a broken pipe in our home here and my world kind of turned upside down.

For those of you who know much about me, you know that I like to build buildings—along with collecting and restoring Collins. It is even a bonus if the buildings will house my Collins.

I never thought I would be rebuilding my home, but here we are.

It should be another month and a half and everything will be put back together. Suffice to say, I would like to get my hands on the previous owners, or their handy man, who installed a new water heater and used an 8 inch iron pipe riser in the copper plumbing system.

The resulting impact on my hobby activities including, unfortunately, my writing and art work for the CCA has been severe. Also unfortunately, this has impacted you, the reader and member. Because of the loss of the facility here, and the loss of available time for yours truly, this issue is very late and the Membership Certificates will have to be mailed out in Q2 instead of with the Q1 issue as is customary. I do apologize, but there is just nothing that I can do about it.

Meanwhile, the day to day operation is in good hands as always and we are keeping up with the workload for membership processing and for the Dayton, Dallas and AWA happenings. This is thanks to the great work of the other board members, specially Jim Stitzinger, our membership chairman, Pete Zilliox and Karl Bowman. I also need to send special thanks to Scott Kerr, who you perhaps do not know. Scott is a relatively new member to the CCA, but he has stepped up to the bar and done yeoman's service in the past and now is carrying a large part of my daily load.....Thank you all for this help.

Unfortunately, due to the circumstances above, I will not be able to attend Dayton this year, but you all will be in good hands. I will miss the get-togethers and I will also miss the camaraderie, which is the real reason that I go.

I am particularly disappointed that I will not be at Dayton this year, because we (the Board of Directors) have a very nice surprise lined up for announcement at this banquet. I would love to be there to see your faces and I know that I will enjoy what is coming. In addition to this announcement and happening, there will also be a nice surprise waiting for everyone at the new booth location. Believe me, you do not want to miss either one of these new benefits of being a CCA member. There have been understandable delays, but some really good and fun things are about to happen.

I am seriously attempting to get things back in order here in time to attend Dallas. Not only do I want to see you all and this fun event again, but I am darn sure tired of not being able to use my house or have a normal life. Take care and stay away from iron pipe.

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