THE SIGNAL

Collins Collectors Association

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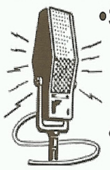
OFFICIAL JOURNAL OF THE COLLINS COLLECTORS ASSOCIATION

Remembering Bud K7RMT

Join Us on the Air!



- •Sunday 14.263 mHz at 2000Z
- •Tuesday 3805 kHz at 8pm CST
- •Thursday 3805 kHz at 8pm CST
- •Friday (West Coast) 3895 kHz at 10pm CST
- •Sunday 10m AM 29.050 mHz at Noon CST
- •1st Wednesday AM 3880 kHz at 8pm CST

Sunday for Technical, Buy, Sell & Swap
Tues., Thurs., Fri., & Sunday for Ragchew

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From the Editor's Desk

by Bill Carns, N7OTQ and Co-Editor Joe Nyberg, WILJN

Well, this has been another tough issue. I seem to have trouble facing the reality of losing members. That kind of happening, and writing about it, is very difficult for me. This issue has been particularly hard because of the loss of Bud Whitney, K7RMT. Bud passed away in early September and I have been dreading writing about him ever since.

On one hand, it is easy to write about Bud, and what he meant to us, but in the balance, I find myself in denial and pushing back from finishing the task.

Then, last week, we learned of the passing too, of Jim Monk, W0JJL. Jim has also, like Bud, been a fixture of the CCA and our nets. The information on Jim came too late to make the Q3 publication, so more will be written next issue about W0JJL.

Other than the loss of members this quarter, it has been a great quarter. Another 2012 event for the CCA has emerged. The AWA (Antique Wireless Association) will feature a theme centered around Collins Radio at its annual convention this coming year. Each year they choose a theme and this year it is Collins Radio. There will be several Collins and CCA displays there as well as at least one featured speaker on Collins Radio. There may be more. The event will be in August of 2012, and it will be held in West Henrietta near Rochester, NY at the RIT Convention Center. The AWA Museum is close by and that is definitely worth a visit too.

Also during 2012, we will be holding our usual Dayton event, followed by the second year of Dallas Ham Com in June and then we will be adding a West Coast event next year as well.

For those on the East Coast, there will be an event added in 2013. Ideas of when and where this should be held are definitely welcome at this point.

I want to again thank Don Jackson for his outstanding contributions on the mysteries of AGC in our receivers. The offering in this issue finishes up a two part theoretical discussion of AGC. In the Q4 issue there will be a discussion of what all of this means from a practical standpoint, what we should be looking for from a good receiver relative to the various operating modes and conditions, as well as some recommendations and trade-offs regarding modifications. I know that I am really enjoying Don's educational articles and I hope that you are too.

I would like to try and stir up some interest in a particular subject area here. At the end of last year, because you see so little written about the very early days at Collins Radio and particularly the equipment of the prewar years, we did an article on the equipment from the beginning of the corporation up until 1939. When I did this I also had an ulterior motive. I was in hopes that writing that article would pull some potential articles out of the woodwork.

I know that some of you have early pieces from this time period, as I do, and I also know that behind each one of these is a story. There may be a story about how you found it, or a story related to the history, and or development, of that particular piece or model. So, here is my challenge. How about sharing those stories with the rest of us? I think that most of us would like to know more about the early equipment. I learned a lot when I did the research for the article that I did. I suspect that, if you were to do one on one of your pieces, that your enjoyment would be enhanced also. For sure, we would like you to share your story with us - so we can learn, or participate in your treasure hunt.

So, how about it? Anyone out there have a nice old piece of black panel Collins Radio from the prewar years? How about letting us in on the story? I am sure our readers would love it and I can sure use the material…. Hint Hint!

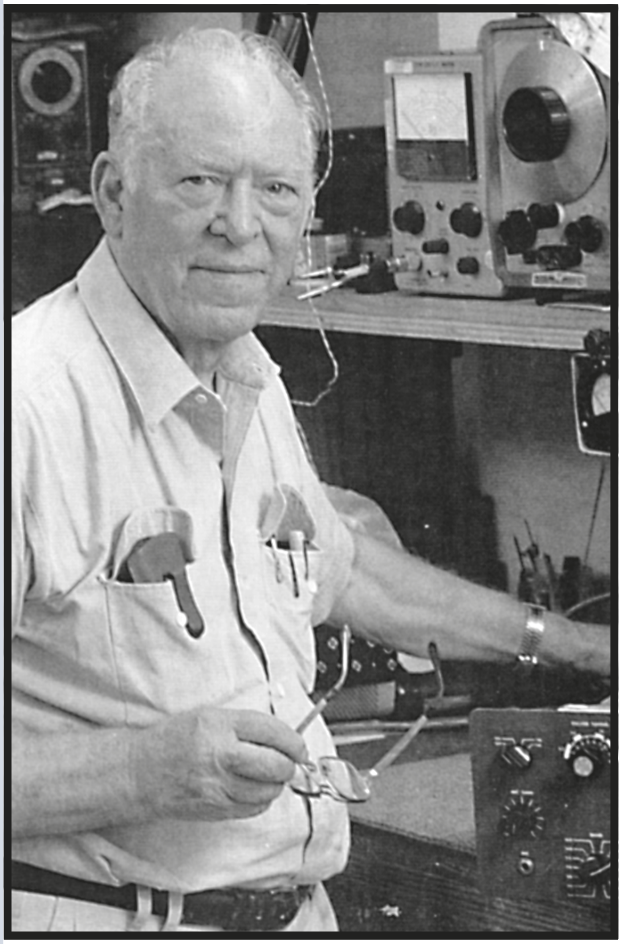
Photo Credits: K7RMT

Finally, I want to thank Jay Miller for providing some older black and white photos of Bud that had previously been printed in a 90s era Signal. In addition, my thanks to N9PY, Torre, for his photos of Bud taken during a visit with Bud in 2010. To Bud's son Stanley, thanks for the party photo. Much appreciated—All.

So, keep that material coming in. I appreciate it, and so do the readers. Have a great quarter and we will see you next issue.
Bill, N7OTQ wcarns@austin.rr.com

———————CCA————————

Bud Whitney, K7RMT - SK Cover Story



Bud at his test bench with the ever present S-Line under repair. circa 1990

This is one story that I never thought I would write. It is also a story that I never wanted to write. All of that said, it is my honor to write about a man who was certainly a legend, and that most of us only know half the story on. I never thought this would be written, because all of us thought of Bud as the Eveready Bunny. He had faced so many challenges in his later years medically, and he just kept overcoming them and going on as if nothing had happened. He just kept on being the "Budster" we loved, cooking his BBQ, loving his wife and family and fixing our Collins.

Reese (Bud) Whitney, K7RMT, was - and is - my friend. In fact, he is a large part of the reason that I moved to Wimberley, Texas, where Bud and his lovely wife Jan lived. I first met Bud years ago – I do not remember how many, but it was not long after I got involved with the CCA in the early 90s. It may have even been earlier.

Bud was one of the early, and continuous, contributors to the fledgling CCA 20 meter Sunday afternoon net. I had a KWM-2A that needed attention, and I did not have the time to repair it. I had heard Bud on the net, so I called him and he agreed to fix the M-2A. Off it went to him. Long story short, over the next month he kept me up to date as he fought the gremlins in an otherwise mint looking radio. When he was done, and satisfied, he called and told me it was coming home, and he told me how much I owed. Now, by that time, having done a lot of repair work myself, I had a pretty good idea how many hours he had worked on it. I was shocked at how low the bill was and I told him so, and that it was not enough. His response was, "That is all that I am comfortable charging you", and that was my real introduction to the Budster. We became fast friends. The KWM-2A is as hot as ever and still working, by the way.

Over the years since then, I visited Bud and Jan about every two years, usually staying at their home and enjoying Jan's wonderful Chinese food and Bud's BBQ, of which he was justifiably proud. We shared many stories, and hours in his shack and in his test bench area in the garage.

After I moved here, he was a regular "port of call" and the friendship continued. I thought I had heard his stories and his history and thought I knew him pretty well. After his passing, and as we all shared stories, I realized how much I did not know, and what an absolutely full, and adventuresome life Bud had led. I already knew how good a man he was, but I just kept finding out more about that too.

I think that most of us that knew him thought that we knew who he was. We sure all liked him, but I do not think that there is any one of us that really knew the whole story. This article will certainly not be able to do his life justice, but there will be a follow on biography that I hope will. This is just a start.

Bud Whitney, K7RMT - SK (Cont'd)

Suffice to say that Bud was loved. He was a world phenomenon. He was so capable, and almost always self-educated in so many skills, including his people skills, that he was just impressive.

Most of you know that Bud was the "Go To" guy for KWM-2/2A repair and that he was always ready and willing to share his knowledge on the nets or on the phone. I am not sure how many of you know how extensive his repair experience was.

After repairing and using S-Line (Mostly M-2A and Amplifier stations) in Asia, Bud and Jan "Retired" to the Wimberley Hills area of Texas and his second career of repairing amateur's Collins equipment started and it was to last the better part of 30 years. During those 30 years, Bud was rightfully proud of the fact that he had serviced (usually completely overhauled) over 500 516F-2s and hundreds of M-2/2As. He did not keep track of the M-2s, but he put a little sticker on each 516F-2 and he kept the other half of the sticker for his records. Like I said, over 500 stickers. And, Bud was more proud of the fact that during that period of repairing power supplies, only a couple ever had problems and those were not related to workmanship. Bud was a stickler for details. He might have quit charging on the bill, but he did not quit working on the unit until it was correct.

Bud and I did not always agree on how to "repair" Collins. I am a purist. I change things when they break and I replace with new old stock or the correct CPN whenever I can. Bud was a "Functional" repair perfectionist. He always used the latest and best components and he changed out high failure rate prone original components while he was in there. We often had good natured discussions of one philosophy (preservation) vs. the other (long term reliability). That being said, he gave my M-2A the "works" in about 1992 and, as I said, it is hot and going strong to this day. I love it.

For those that do not know Bud's rich history, I am going to repeat here (paraphrase with some quotes) from the preface to the S-Line Repair guide that Bud published several years ago. This preface was told by Bud to his good friend R. Smith Schuneman (Smitty - W0DRU).

Bud was born in Kendall, Kansas but he moved with his family to a small town in Idaho at a young age. While in school in Idaho, one of his teachers – L. D. Patterson – introduced him to ham radio. L. D. taught a radio class and, for one project, every student donated a buck which went to buy old radios. These were the salvaged for parts and then each class member built a regenerative receiver. Bud's radio was built in an old metal chalk box, and when he had it working, he took it home and played it for his parents. It was the first radio broadcast they had ever heard.

Bud finished high school in Idaho and got his first real job working on a placer gold mining crew. Shortly thereafter, his family moved to Coos Bay, Oregon. Bud found work in the local ship yards and learned how to weld. This was the first of his many skills.

During this time in Coos Bay, Bud met his first real Elmer, David Irvine (W7MJE – Now SK). David helped Bud learn more about radio theory and construction.

When WW II was declared, Bud enlisted in the Navy where his mechanical experience earned him a Machinist Mate rating. He served his active duty in the South Pacific and up along the Pacific Rim on a LCS Mine Sweeper.

At the end of the war, he resumed his work in the Oregon shipyards until a friend persuaded Bud to join him in the Lumber Business….(Read that Logger). While he was thus employed, he yearned for another hobby, and he took up gunsmithing. Typical of Bud, and with his background in things mechanical and his penchant for craftsmanship, this grew into his full time job and new profession. He became very well known for his beautiful custom rifles.

Bud Whitney, K7RMT - SK (Cont'd)

His interest in radio had persisted though, and once again, he needed a new hobby to relax with. By December of 1961, Bud had earned his Novice and had gone on to get his general call, K7RMT. Bud had learned the code by copying CW on a SP-600 JX Hammarlund receiver that he had taken in trade from another ham for one of his guns. Thus he started a long and illustrious career in amateur radio. Next Bud built Heathkits – which is one fine way to develop soldering and construction techniques.

In 1963, while in his early 40s, Bud made a decision that would change his life, and lead him to Asia and his current wife Jan. He accepted a commercial assignment in South Vietnam working for a company doing pier and dock construction for the US military. He was hired for his experience in the Oregon Shipyards and his knowledge of radio repair and his Amateur Radio License. Once there, he was in charge of the operation and maintenance of 45 marine and shore stations (Amateur and commercial) which were located across Indonesia, Viet Nam, Thailand, and Singapore. Bud designed the network and stations, specified the equipment and installed it and then maintained all of these stations. Bud said that they used Collins because the Collins gear was the only equipment that would stand up to the atmospheric and environmental conditions in that part of the world.

At that time, Collins Radio had a technical representative stationed on Okinawa. His name was Martin Fenton, KR6LU. Bud consulted regularly with Martin in order to keep the complex network of equipment up and running. In the process, Bud grew in his knowledge of Collins and their equipment. Bud often commented that: "I was hard put to keep it all running with my short time of experience as a professional in the business of my hobby. Martin was invaluable to me, and I gained much needed experience on Collins radios with his wonderful help."

Bud at his test bench with the ever present S-Line under repair. Circa 2010

For the next 20 years, Bud served primarily overseas working in Viet Nam and then aboard off shore drilling platforms. He had one of his narrowest escapes, when after warning the rig captain about not leaving shelter during a typhoon (based on his experience in that area during the war), the captain came out from behind the shelter of an island, and the rig capsized and sank leaving all hands in the sea. A primitive helicopter rescue was to save his life along with the other hands.

During this approximately 20 year time period, Bud held amateur radio licenses from Indonesia, Singapore, New Guinea, Kuwait and Bahrain. During his time in Singapore, Bud met and married his wife Jan. She had been working for Henry Radio as a liaison with the Singapore government.

In 1983, Bud, Jan and Stanley, Jan's

Cont'd Page 6

Bud Whitney, K7RMT - SK (Cont'd)

son, left Singapore and built their current home here in Wimberley Hills, Texas. Since Bud was then 64 years old, the assumption was that he was moving towards retirement. That was not to be the case. When the house was built, Bud had included a nice workshop area in the garage and this became his Collins repair shop. Bud then started his next "retirement career" repairing other ham's Collins radios. This last career would occupy almost all of his time for the next 20 plus years. Bud specialized mostly in KWM-2/2As and 516F-2s, but he also did a lot of 30L-1s and other S-Line gear and an occasional A-Line.

**Bud, where he was the most comfortable.
At the mic with his friends. 2010**

Included on the property when the home was constructed, was an impressive array of antennas including his "death ray" Telrex 5 element 20 meter monobander on a 36 foot boom. From his shack on the hill in Wimberley, Bud's signal was hard to miss. With this operating position, Bud maintained a daily presence on 14.253 mHz with a fascinating group of friends that ranged from Australia to the Caribbean, and up to Maine, including Florida, Kentucky and Iowa. Bud also was a constant contributor to our 20 meter CCA nets always ready to volunteer his knowledge of Collins. He also used this station to keep in touch with his son in Nevada with a regular schedule.

Bud was a gentleman's gentleman. He was loath to use profanity and was always there to talk to. He was always good at what he did, and he did it with pride and a work ethic that we could all learn from. We will all miss him terribly and I know that you will too.

I visited Bud in the hospital the day that he died. As I was saying, what turned out to be my last, Good Bye – Bud took my hand and he pulled me down to him and said "Don't forget me." I assured him that I would not, and told him we loved him. I believe that Bud really wanted to stay a part of our lives. He will for sure. I wish he could know how much he will be remembered and how well he is thought of……

Forget you Bud? Not likely Sir – ever.

**Bud & Jan at Bud's 90th Birthday Party
October 24th, 2009**

THE SIGNAL

Collins Collectors Association

Automatic Gain Control Theory and Application
Part 2 – Dynamic Analysis
By Don Jackson, W5QN

I. Introduction

Picking up where we left Part 1, in Part 2 we'll now investigate the dynamic performance of the 75S-3B AGC loop. A simulation model will be presented and the various circuit functions discussed.

II. The Dynamic Model

In Part 1 we developed a good theoretical model to help us understand how a typical receiver AGC system works under "steady state" conditions. Now we will investigate how the system works with dynamic input signals. By "dynamic" signals, I am referring to input signals that rapidly rise or fall in amplitude. These can be "step functions", pulses or other signals that vary in amplitude. Below are terms and definitions we will use in our AGC discussions.

Step Function – An input signal that rises or falls in amplitude with near-zero rise/fall times.

Pulse – A signal that rises and falls in amplitude with near-zero rise/fall times.

Attack Time – The time required for the receiver gain (and AGC voltage) to settle after application of a step-function input increase. Attack time is generally not a selectable function. The definition of "settle" varies, but the exact definition is not pertinent to our discussion.

Decay Time – The time required for the receiver AGC voltage to settle after application of a step-function input decrease. A fast decay time is suitable for AM, whereas a slow decay time is preferred for casual SSB or CW.

Pumping – The behavior of the receiver gain (and AGC voltage) between SSB speech pauses or CW characters in which the gain rapidly increases after the signal disappears. Selection of a "FAST" decay time properly produces "pumping", whereas a "SLOW" decay time is intended to eliminate pumping.

Hang – A term sometimes used to describe the undesired behavior of "hanging up" the receiver at a low gain for the length of the decay time after a signal pulse of high amplitude and short duration (like a static crash) is applied to the receiver.

Hold – Similar to decay time, except that the gain is held constant during the hold time. When the hold time is over, the decay time begins. Selectable hold times are often a part of modern receiver designs.

Figure 1 below is a basic circuit often used to create separate AGC attack and decay times.

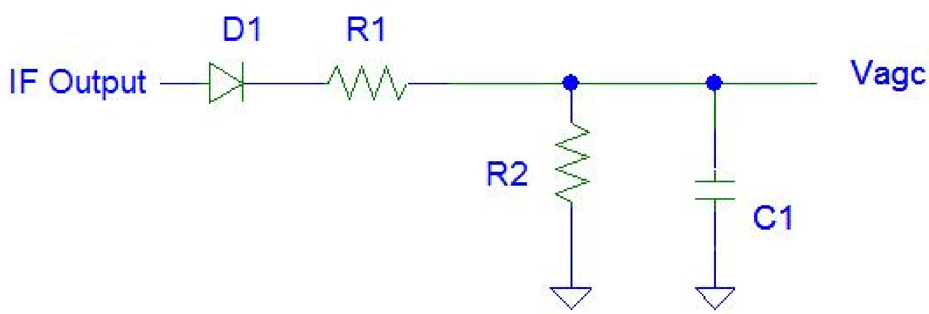


Figure 1 – Basic Circuit for Separate Attack and Decay Time

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AGC Theory - Part 2 Dynamic Analysis (Cont'd)

by Don Jackson, W5QN

Diode D1 functions as the AGC Detector, converting the peak IF signal to a DC voltage. A single capacitor, C1 is used in the circuit. Resistor R1 and capacitor C1 set the attack time, which comes into play when the receiver input level is rapidly increasing. C1 is charged up by a current through R1. However, when the input level rapidly decreases, C1 cannot discharge through R1 due to diode D1. C1 is forced to discharge through R2, which is typically much larger than R1, creating a long decay time. The resulting Vagc voltage is then used to control the electronic attenuation stages in the receiver.

III. Stability Considerations

Stability of the AGC loop is always a consideration. After all, AGC is a feedback loop and can oscillate if conditions are right. If you have all the gain and phase characteristics of each device, you can theoretically perform a mathematically rigorous stability analysis to determine its stability. However, I don't have that information, nor do I have the inclination to tackle it. What we do have is "rule of thumb" for AGC stability stated by Ulrich Rohde in his book "Communications Receivers". In a chapter discussing the effects of IF filters on AGC, he states:

"If the AGC attack time is smaller than the delay, such delays can cause AGC instabilities. It is important, therefore, to make sure that the AGC attack time is longer than possible delays or else to avoid delays in the system so as to use a short attack time."

I have heard recommendations for the attack time to be as much as ten times the time delay in the loop, but can't recall exactly where. In the 75S-3B, it is primarily the narrow IF filters that create time delay in the circuit. As the bandwidth of a filter narrows and its number of sections increase, the time delay becomes longer. In the Spice simulation, I include an approximation of the Inrad 300 Hz bandpass filter, as well as the Inrad 2000 Hz bandpass filter. I chose them because Inrad has published amplitude data for their filters on its website. The 300 Hz filter is a 7-section design that appears to have a Butterworth (no ripple) shape, while the 2000 Hz filter is an 8-section unit that appears to be a .5dB ripple Chebychev. Spice analysis of a 300 Hz filter with this amplitude characteristic indicates a step-function time delay of about 6 ms, while the 2000 Hz filter has a delay of about 1.2ms. Therefore, the 300 Hz filter is the limiting factor in the attack time speed. Another important characteristic of narrow filters is that they not only produce a time delay, but they also slow the rise time of an input pulse.

Note that there are two loops in the 75S-3B AGC circuit to consider. The primary loop feeds back to the IF stages, V6 and V7. This loop has very little time delay and therefore can function with a fast attack time without stability problems. The second loop feeds back to the RF stage, V2. This loop includes the IF filters and is of concern for stability considerations.

IV. 75S-3B Open Loop Time Constants

Given the stability requirement, it is informative to look at the behavior of the AGC time constant circuitry by itself in an open loop configuration. Figure 2 is a simplified schematic of the 75S-3B AGC time constant circuitry in my early WE Collins 75S-3B schematic. This circuit can be simulated with Spice to determine the timing of the voltages applied to the various gain stages. The differences between my early WE receiver and a late model receiver with SB1 modifications will be addressed later.

Vagc is negative, meaning the receiver gain decreases as Vagc goes more negative. Figure 3 shows the open loop attack time results of the Spice simulation. Note that there are components associated with V2, V6 and V7 that make the time constants different for each stage.

AGC Theory - Part 2 Dynamic Analysis (Cont'd)

by Don Jackson, W5QN

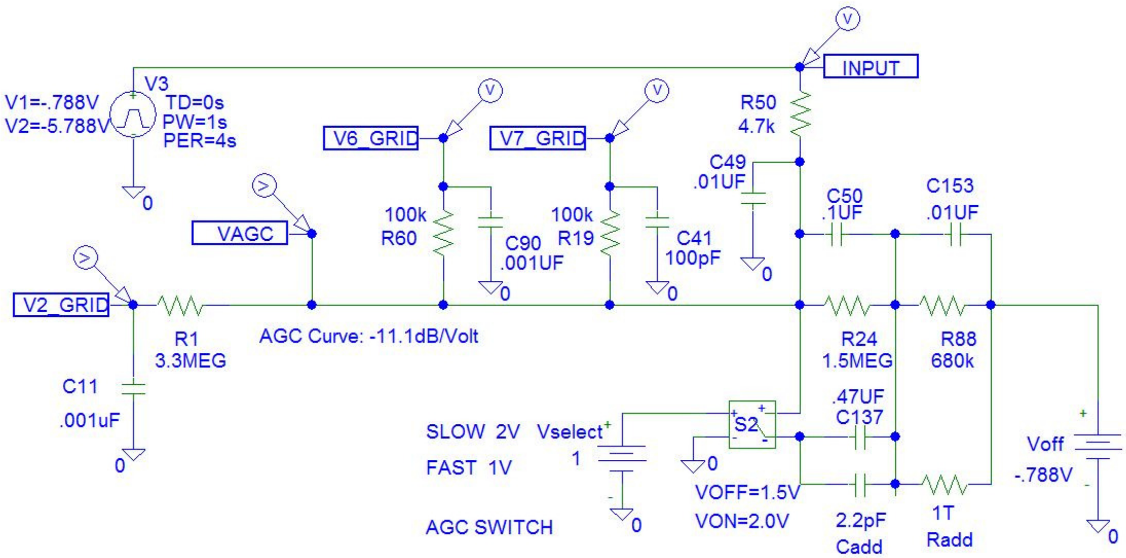

Figure 2– 75S-3B Time Constant Circuitry

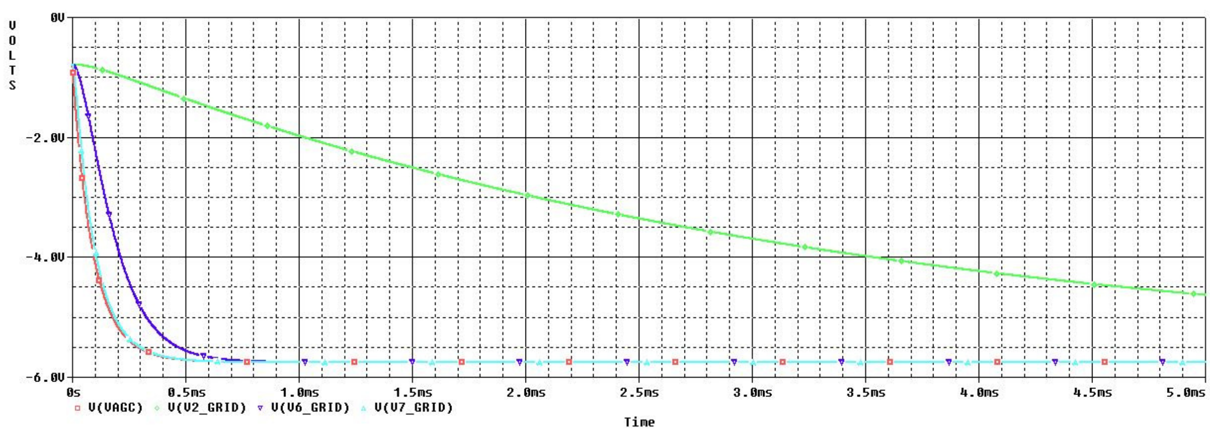

Figure 3 – Open Loop Attack Time Constants

The attack time constant of the circuitry feeding V7 (light blue) is approximately 100us, virtually identical to Vagc (red). The attack time for V6 (blue) is a bit longer, due to the addition of the R60/C90 time constant to its attack time. These time constants are acceptable because there is very little time delay in the path between V6 and the AGC detector. RF amplifier V2 (green) has a significantly longer time constant "added" to the primary Vagc time constant. This is required because the IF filters with significant time delays are within the AGC loop containing V2. Therefore the attack time constant feeding V2 must be longer than those for V6 or V7. The 300 Hz filter has a delay of 6 ms, and Rohde says the attack time must exceed the filter delay for stability purposes. Note that the V2 attack time is marginally close to this minimum value. Not obvious is that the capacitor controlling this attack time is C11, which appears at first glance to be merely a DC block in the RF path, but it actually serves a dual function.

Some discussion of the fast V6 and V7 attack times is warranted since Rohde states: "In practice it is

Cont'd Page 10

AGC Theory - Part 2 Dynamic Analysis (Cont'd)

by Don Jackson, W5QN

not desirable for an AGC to have too fast a reaction time. In such a case any static pulse, ignition noise, or other impulsive interference with very fast rise time, would be detected by the AGC detector and would desensitize the receiver for a hold time required to discharge the AGC filter capacitors."

My interpretation of Rohde's statement is that it applies to a basic AGC circuit such as that of Figure 1. For Figure 1, it is true that any short input pulse that charges the shunt capacitor will desensitize the receiver for the long decay time. However, the Collins 75S-3B uses a circuit that has a second RC parallel combination in series with the primary shunt RC components that set the decay time. This circuit has a couple of very useful advantages over Figure 1. One advantage of this circuit is that the decay capacitor does not charge up very far with a short input pulse. This means that it is not only acceptable to have a fast AGC attack time, it is desirable. With a fast attack time, and the slower signal rise time created by the narrow IF filter, the AGC loop can track a rising IF pulse input signal in real time as it increases in amplitude without significantly charging the decay capacitor. This solves the annoying desensitization problem to which Rohde refers, and also reduces the level of "pops" at the receiver output. (Note that this pulse tracking mechanism only works with V6 and V7 because the attack time for V2 must be much too slow.)

Another advantage of the circuit is that the attack time is primarily set by the R88/C153 pair, in combination with C49. Increasing the size of shunt decay capacitor C24 does not significantly effect the attack time as it would in the circuit of Figure 1.

As is often the case, however, there is no "free lunch", and there is a negative side of using the 75S-3B AGC circuit. It creates the oft-mentioned complaint that there is very little difference between selection of FAST and SLOW AGC decay times. Fortunately, changing a couple of component values in the circuit can greatly improve this behavior, as we will discuss later.

V. Closed Loop Simulations

The Spice model for this analysis is shown in Figure 4.

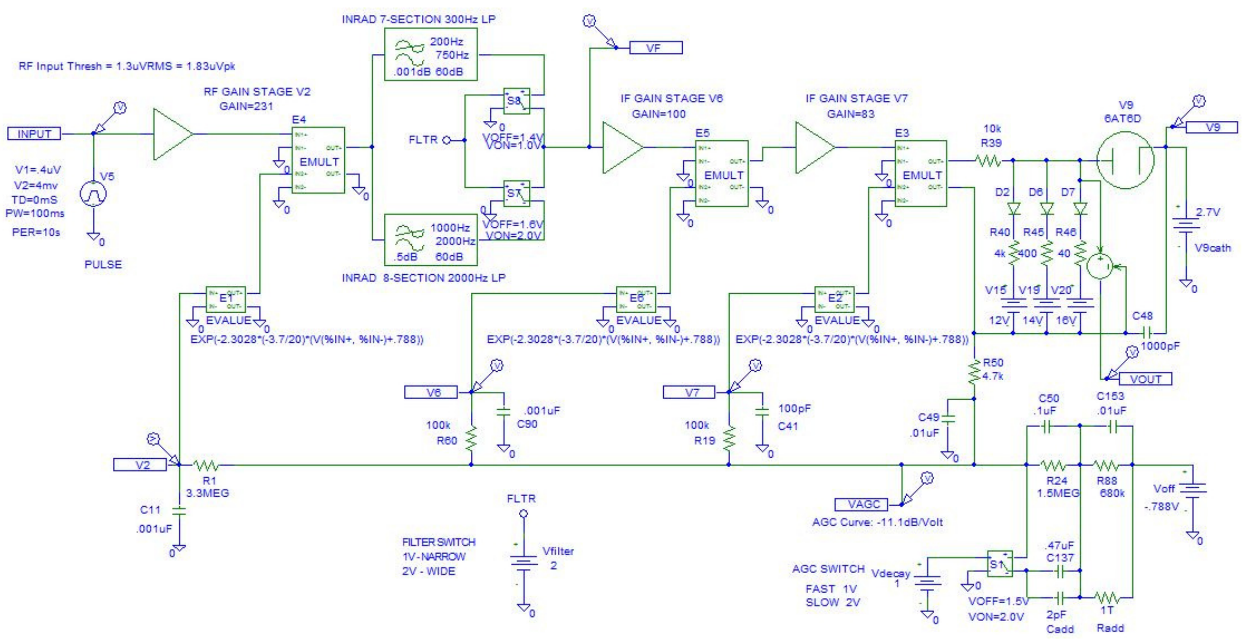

Figure 4 – Closed Loop Spice Model

AGC Theory - Part 2 Dynamic Analysis (Cont'd)

by Don Jackson, W5QN

Looking at this schematic, some explanation is in order. Note that the input is not an AC signal, but is DC. As well, the "IF filters" are actually lowpass filters in the model. This translation from AC to DC is mathematically rigorous. Consider it a linear mixing of the receiver circuitry down to DC. For example, a 150 Hz lowpass filter has exactly the same phase and time delay characteristics as a 300 Hz bandpass filter that is designed with identical amplitude characteristics. The center frequency of the bandpass filter is irrelevant to the analysis. A DC input of 10uV to the receiver is equivalent to an AC input of 10uV peak. There are several reasons for modeling in this manner. First, the Spice bandpass filter model does not work for high center frequency to bandwidth ratios. Second, the simulation time for the DC model is about 20 seconds, compared to nearly an hour for the "AC" model constructed at 455 kHz center frequency. In addition, the Spice program I use is limited to 50 components, and a pair of 7-section L-C bandpass filters alone would eat up 28 of those components. I have compared the "DC" model to the "AC" model and found the results to be virtually identical.

Modeling the max gain for the 3 gain stages V2, 6 & 7 as derived from the signal levels on the schematic (assume that each stage has a Gain/Vagc slope of -3.7 dB/V) results in a total slope of -11.1 dB/Volt.

Let's consider what happens when the signal applied to the receiver initially steps higher in amplitude. This behavior is much more complex than the decay time analysis because the AGC loop is closed during the attack period, whereas the loop is open during the decay period. There are several possible regions of operation during the attack period. The first is what I would call an "initial impulse". This is a large, short duration output pulse that may occur at the start of the attack period. Its amplitude may be very large if the attack time is too slow, allowing the output to increase to its saturation level before the AGC loop can take control of it. The second region is what is usually thought of as the "attack time". It is the behavior of the loop as the AGC voltage settles to its final value. Since the loop is closed, the settling behavior is complex, with Vagc possibly "overshooting", "undershooting" or "ringing" as it approaches its final voltage. The attack behavior is determined by the input step amplitude, the attack time constant circuitry, the time delay of the IF filter, and the individual time constants applied to the grids of V2, V6 and V7. A third region occurs if Vagc overshoots its final target. If overshoot occurs, the loop opens up during the overshoot time and the decay time constants take over, resulting in a slow rise in the output signal to its final value. Needless to say, this is a complicated system in which many parameters interact to produce the final result. The desired response is "critical damping" in which Vagc reaches its final value as quickly as possible without overshoot or ringing.

Now let's run some closed loop simulations to get a handle on how the receiver behaves with step function changes in input level. We start with the standard component values of my early model 75S-3B. For these simulations, the input signal is a pulse function. The receiver input level starts at .4uV peak (-98dBm), and steps up to 4 mV peak (-38dBm). We will look at the behavior of Vagc and Vout. To help avoid confusion, Vout is always in black, while Vagc is in red.

Figure 5 below shows the peak IF output and AGC voltage with the 2000 Hz filter.

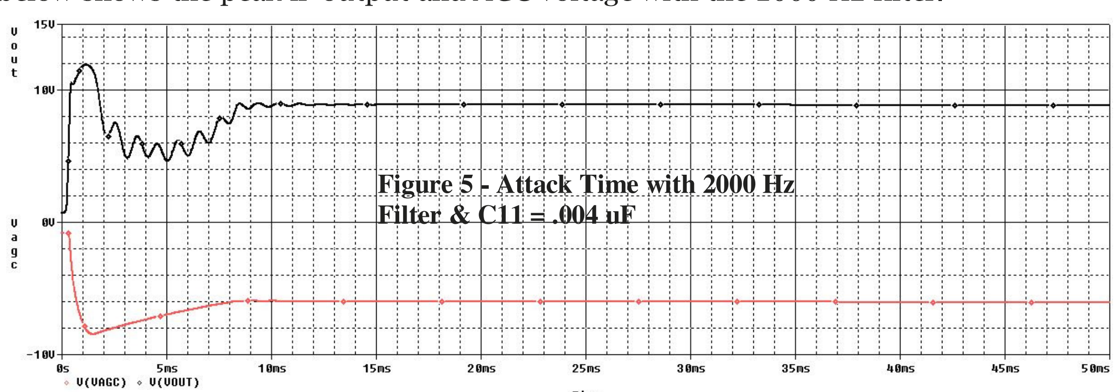

Figure 5 - Attack Time with 2000 Hz Filter & C11 = .004 uF

Cont'd Page 12

AGC Theory - Part 1 Steady State Analysis (Cont'd)

Figure 5 indicates Vout is overshooting its target value. This is because the voltage controlling V2 is changing too fast for the V6/V7 loop to track it accurately.

VI. Circuit Modifications

What can we do to improve the attack and decay time performance of the 75S-3B receiver? First, consider the attack problems shown in Figures 9 and 10. Given the stability criteria discussed in Section III, we can see that the attack time constant for the RF stage V2 is perhaps marginal, resulting in the overshoot we see in Vout. Increasing C11 from .001 uF to .004 uF improves this problem by slowing down the V2 control voltage. Figure 6 shows the simulation with this modification to C11. The Vagc overshoot in Figure 6 is not the type caused by marginal loop stability. It is a result of the slow change in Vagc as V2 begins to take on its share of the total attenuation during the initial 20ms or so.

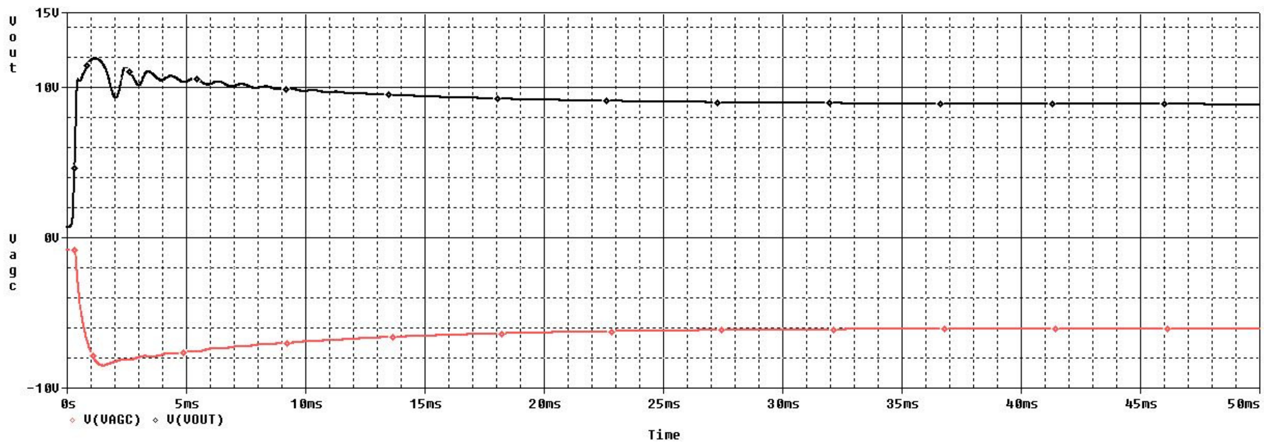

Figure 6 – Attack Time with 2000 Hz Filter & C11= .004uF

Secondly, there is little difference between FAST and SLOW AGC decay time, so modifications have been suggested to make the S-Line receivers behave more like other receivers. The modification suggested by several others is simple and effective, involving addition of a resistor in parallel with R88. The resistor value isn't critical, and I've seen values between 100k and 10k suggested. The question is how to determine an optimum value for R88. To my mind, it boils down to a tradeoff between minimal AGC "hang time" for short input pulses, and a long decay for SSB/CW operation. Let's look first at the behavior of Vagc with a 1ms input pulse input, and with a CW burst (4 dits) input using the original circuit in SLOW mode.

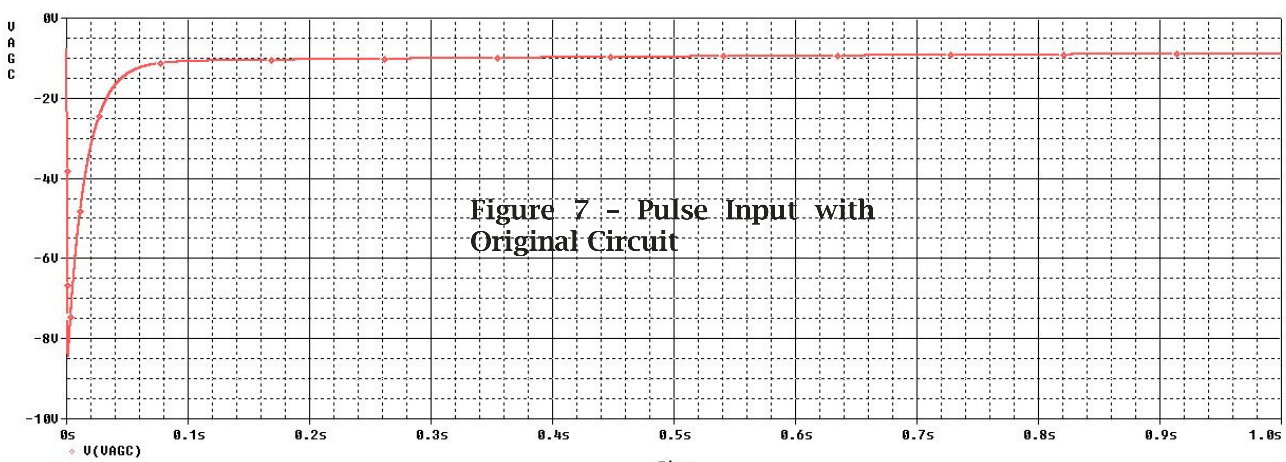

Figure 7 – Pulse Input with Original Circuit

AGC Theory - Part 1 Steady State Analysis (Cont'd)

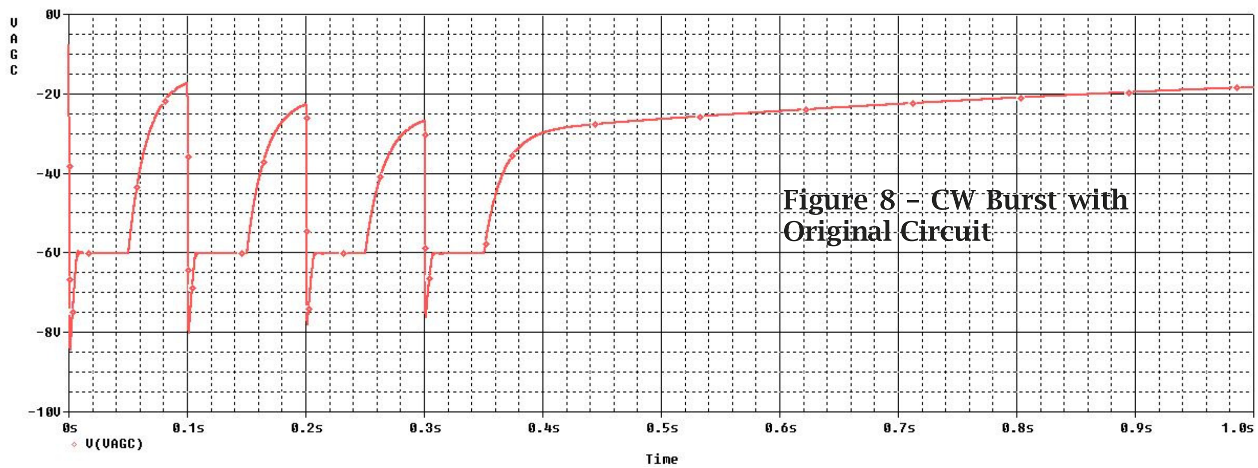

Figure 8 – CW Burst with Original Circuit

Figures 7 and 8 show that the original circuit recovers quickly with a pulse input, but as often pointed out, the decay time is short, even in SLOW mode. The gain drops over 30dB within 80ms after the last CW dit. What if we use the basic AGC circuit of Figure 1? This can be easily simulated by shorting out R88, resulting in Figures 9 and 10 below.

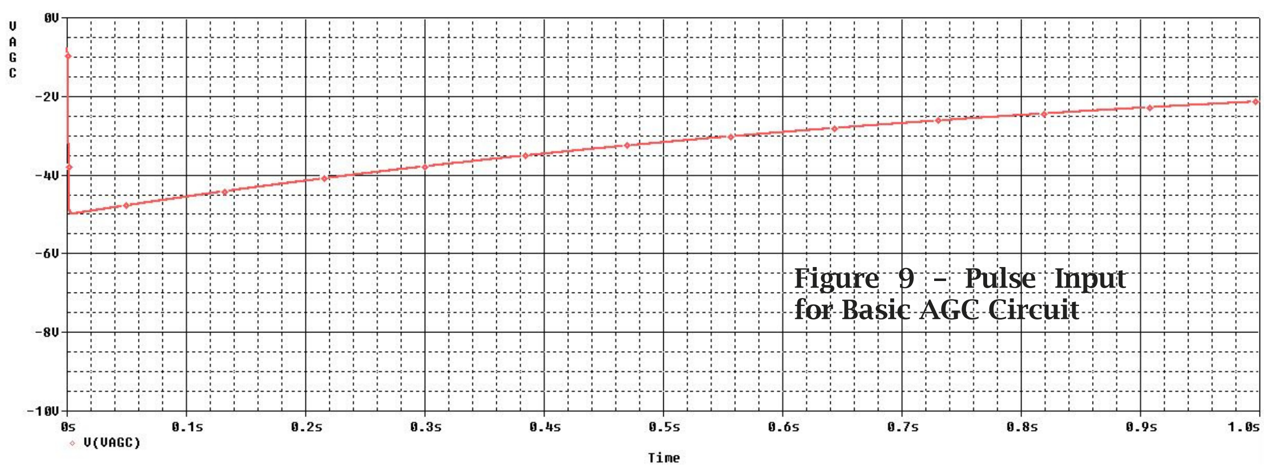

Figure 9 – Pulse Input for Basic AGC Circuit

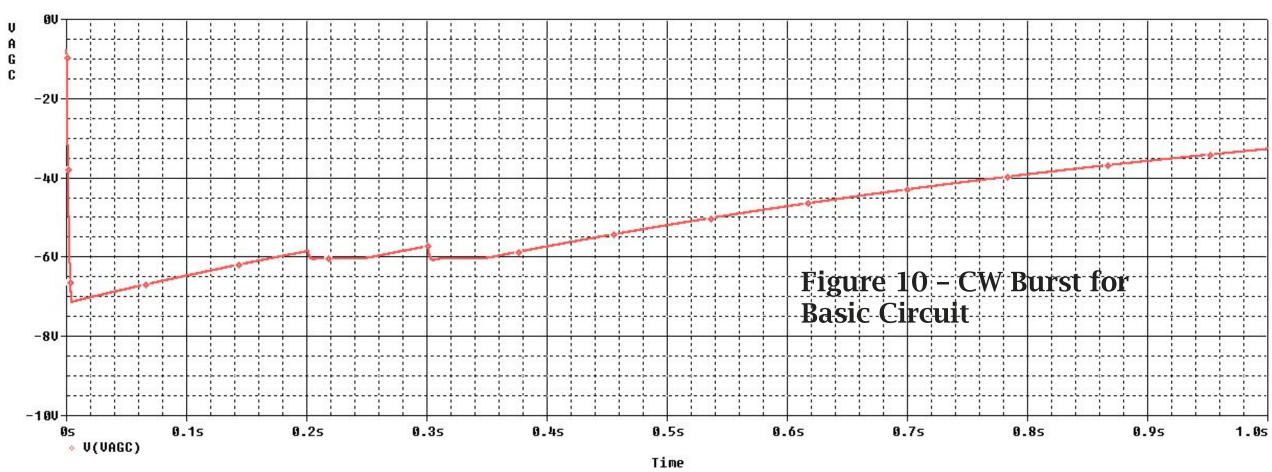

Figure 10 – CW Burst for Basic Circuit

The results of the basic circuit show the "hang" problem with a pulse input, but the decay time is what

Cont'd Page 14

AGC Theory - Part 2 Dynamic Analysis (Cont'd)

we would like to see. The desired value of R88 must be somewhere between zero and 680k. I found that adding a 100k resistor across R88 (87k total value) produced the best tradeoff between the original circuit and the basic circuit. Figures 11 and 12 below show those results.

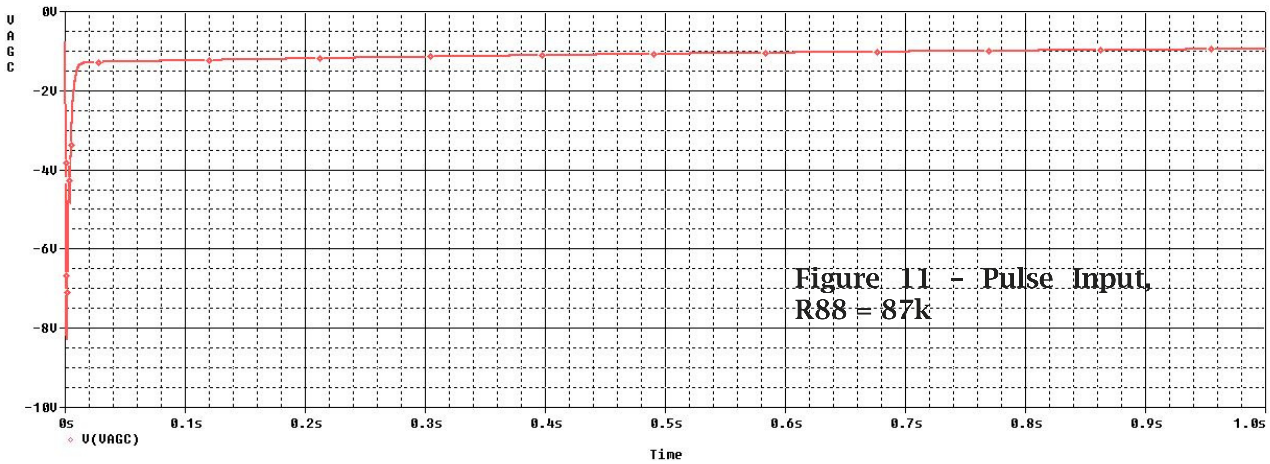

Figure 11 – Pulse Input, R88 = 87k

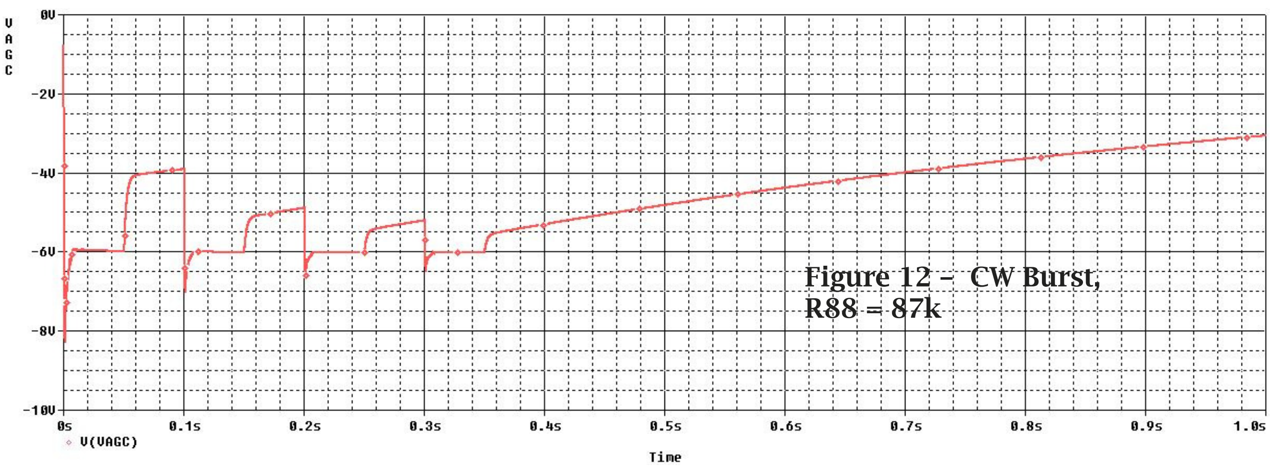

Figure 12 – CW Burst, R88 = 87k

The last modification is to add capacitance in parallel with C137 in order to further lengthen the SLOW decay time. My choice was to add 2uF, although the value may be chosen according to operator taste. When I added this cap, however, I found that the optimum value for R88 changed to about 30k. The result is shown below.

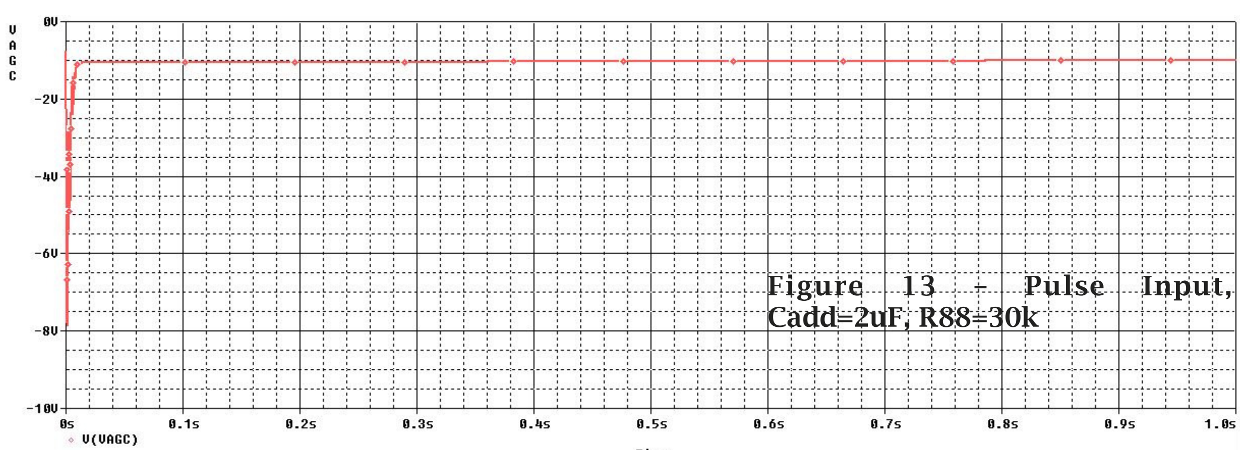

Figure 13 – Pulse Input, Cadd=2uF, R88=30k

AGC Theory - Part 2 Dynamic Analysis (Conclusion)

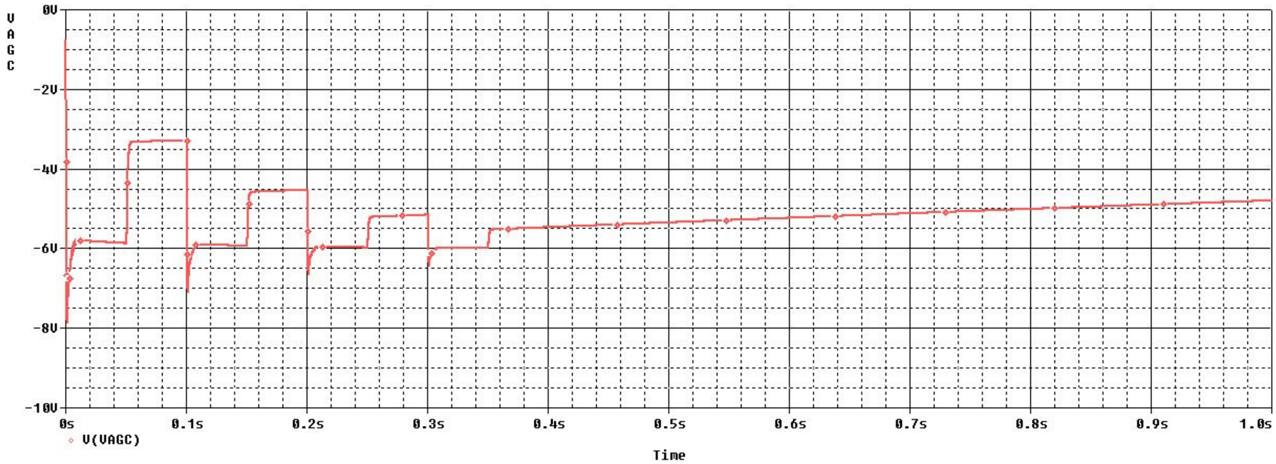

Figure 14 - CW Burst, Cadd = 2 uF, R88 = 30k

There are some AGC circuit differences between my 75S-3B and later models. SB1 adds C163, a .01uF cap which is a bypass for transformer T10. This bypass, in conjunction with R19 (100k), creates an attack time constant for V7 of about 1ms, ten times longer than my 75S-3B, which compromises the ability of V7 to track narrow, fast rising input pulses. I suspect this was an oversight by the SB1 designers, but I can't be sure. Another addition to modern 75S-3B versions is the circuitry around RF amplifier V2. This circuitry appears to create separate attack and decay times for V2 (similar to Figure 1), that are added onto the primary AGC time constants. I am not clear on the purpose of this circuitry and would be happy to hear from someone who has the story on this.

V. Comparing Measured Data to the Theoretical Models

I do not have a storage oscilloscope or camera that would allow me to capture the behavior of my 75S-3B for this article. However, I used my oscilloscope to observe attack and decay times, and in every case found the general behavior matched reasonably well with the Spice model. Vout can be viewed at the audio output, but the high impedance of the Vagc line means care must be taken when measuring this voltage.

VI. Conclusions and Comments

AGC loops are, in my opinion, perhaps the most complex circuit design task a receiver designer must tackle. The behavior of the closed loop presents many problems and tradeoffs that must be addressed.

Attack time is the time required for the AGC loop to settle after an input signal rapidly increases. Decay time is the time required for the AGC loop to settle after the input signal rapidly decreases. Decay time is usually set many times longer than attack time for CW and SSB reception.

Should you make these changes to your 75S-3B? Changing C11 to .004uF improves the attack time performance on my 75S-3B, as observed on the oscilloscope and audibly. However, I don't regard this mod as particularly important under typical operating conditions. The most significant operational modification is adding a resistor in parallel with R88 to improve the behavior of the SLOW decay time. Additional capacitance in parallel with C137 may be added according to your taste.

Cheers,
Don W5QN

From the President

It is hard to believe that another quarter has gone by - and almost another year. It has been a really good year for the CCA. Membership is continuing to recover after the economy dealt us a little reduction in 2010 and the addition of Dallas Ham Com to our list of events for 2011 has been well received. In 2012 we will be adding a west coast event to the permanent calendar, and then in 2013, we will add the east coast or Florida – I am not sure which. We are looking for ideas there. However, in 2012, the CCA will be join with the AWA to put on a CCA/Collins theme weekend at the August main Antique Wireless Association (AWA) convention. This event will be posted on the CCA website soon as well as appearing on the AWA website. There will be at least two feature talks at the convention, as well as Collins equipment in operation and on display.

I noted also that the hamfests that I have attended have been increasingly well populated with both buyers and vintage equipment.

While this has not been a particularly good year for me from a health standpoint, I am happy to say that my good health has returned and no damage done. I am getting caught up with daily life and also getting a chance to work on my Collins a bit more. I want to thank all of you that have sent expressions of concern while I was trying to recover from that lung infection.

One of the results of that is that there will be a couple of articles forthcoming on some interesting equipment as 2012 unfolds. I have had the pleasure of, again, working on the 204 family of amplifiers. This time it is a newly acquired 204F-1, the manual tune version of my 204H-1. Both of these amps are what I consider the Mercedes Benz of the Collins Amplifiers and just a wonderful example of classic Collins quality and amplifier design at its best. I like to call the 204s a 30S-1 on steroids.

Here is a picture of the 204F-1 with its driver compartment out of the rack and me inspecting my work on the PA grid bias and multimeter back panel area. This area required some rebuild, and it was not an easy task. A future article will detail this rebuild and the process of bringing this beautiful amp back to stock condition and then bringing it up on the air.

One of the other future articles here will cover the assembly of a 718U-x driver system using a 617U-4A Receiver-Exciter. This will then be used to drive the 204H-1 autotune version and then the current driver for this amp (the 32S-2/75S-2 Operating Position) will be switched over to drive the new 204F-1. I do believe that will be a handsome pair.

Enjoy Your Collins ! and see you next quarter. Bill, N7OTQ

————————CCA ————————

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