

**JOHNSON COUNTY RADIO
AMATEURS CLUB, INC.**
P.O. Box 93
Shawnee Mission, KS 66201

FEEDBACK

FEBRUARY 2020



Above - Cal, Bill and Ted
preside on January 24.

Left - first timer Janelle Vogler,
KEØYXH

Below - first timers Dick Renzi,
KEØYUF and Doug Vogler,
KEØYNS

Photography by NØCVW



MARCH MEETINGS

February 14 -- Update on Mesh
Networks -- Bill Gery, KA2FNK

February 28 -- Public Service Events

The Johnson County Radio Amateurs Club normally meets on the 2nd and 4th Fridays of each month at 7:00 PM at the Overland Park Christian Church (north entrance), 7600 West 75th Street (75th and Conser), west of the Fire Station.

Much of the membership travels to the Pizza Shoppe at 8915 Santa Fe Drive for pizza buffet and an informal continuation/criticism/clarification of the topics raised at the meeting ... or anything else.

LEAVE THE CHURCH, TURN RIGHT (WEST) ON 75TH. TURN LEFT (SOUTH) ON ANTIOCH. TURN RIGHT (WEST) ON SANTA FE. THE PIZZA SHOPPE IS JUST PAST THE SONIC ON YOUR LEFT.

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-> FEEDBACK <-

*A publication of the
Johnson County Radio Amateur Club, Inc.*

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Fearsome February Feedback

A reasonable case could be made that Febraury's weather should inspire dread. Though typically cold and icy, a thaw might create a slushy mess. Alternatively, this "Aquarius" might view the month as being the time people commemorate his aging. Though reasonable, such guesses miss the mark. Your editor's apprehension is wholly a function of the Febraury Feedback.

Having edited the Feedback for several years, your editor began to notice some repetition in the President's Corner. Bill, having been JCRAC president for longer than your editor has edited the Feedback, figured it out first. The club's annual cycle of events means that last year's column will look remarkably like next year's column. (Look for us to be getting an "early start" on Field Day next month. You read it here, first!)

Feedback layout works the same way. Typically, your editor takes the issue from the preceding year and replaces the old content with new content. Over the course of several years, it has become evident that February is an awful month to put together the Feedback.

The club had but one meeting in November and December. That's by design. Of late, the club has had but one meeting in January. Sometimes it's a weather event. Sometimes it's church unavailability but, as Rosanna Rosanadanna observed, "it's always something".

The signature unpleasantness of February Feedback preparation is that the fabulous Jaimie Charlton's usually delightful Hambone crew invariably finds itself in some sort of quandry that requires the use of a zillion mathematical equations. Leaving aside the intrinsic difficulty a liberal arts major has proofreading those things, they simply refuse to sit still and line up nicely on the page.

If any reader thinks he would to experiment with being editor-for-a-month, your Editor happily volunteers to relinquish next February.

PRESIDENT'S CORNER

We will start lining up the suggested programs from the



January meeting. At pizza we talked about how we could do some kit building. More details to come on the kits.

Public service support is spinning up fast, events are been published on Larry's List.

Also be sure to verify that you as receiving the email which have migrated to group.io.

Volunteers are always needed for public service events. These events prepare us for disasters. Select a couple events to support and contact the event ham coordinator. Better yet, think about being a coordinator for an event. Being an event coordinator is another way be prepare for disaster.

- Bill Gery - KA2FNK

Johnson County Radio Amateurs Club - January 10, 2020

Meeting Date: Friday, January 10, 2020.

Because of the unavailability of the Church, the JCRAC met for pizza at the Pizza Shoppe at 7:30.

There was no formal meeting.

Johnson County Radio Amateurs Club - January 24, 2020

Meeting Date: Friday January 24, 2020. The meeting Started at 7:00PM.

Attendance: Self introduction with name and call sign. 25 signed the check in sheet. This was followed by the Pledge of Allegiance.

There were No Minutes from the last meeting as we met for pizza at the Pizza Shoppe.

The Treasurer's report, as follows, was read and accepted unanimously.

Cash on Hand	\$ 90.00	Repeater Operating Reserve	\$ 1,509.83
Checking Account	\$ 93.59	Memorial Fund	\$ 310.00
Savings Account	\$ 13,611.62	Active Members	148
PayPal Account	\$ 175.29		
Total	\$ 13,970.50		

Old Business:

- We welcomed all 1st time visitors to the meeting.
- Repeater Update – All are working well.
- Field Day 2020 – This year's Field day will be June 27 – 28. We are working with Shawnee Mission Park to secure the same location we had last year.
- Bill Gery, KA2FNK and John Raydo, K0IZ will be working on a total re-write of the Club's By-laws.
- Eddy Paul KY0F name has been added to the Silent Key Plaque hanging inside Associated Radio.

New Business:

- Rod Rodriguez, K6TBJ has tickets to this year's Ararat Shrine Hambash on April 18. He is personally offering a discount. See him for the details.
- Bill Gery, KA2FNK is working on a local MESH Network. Bill reported there is an email group on Groups.io. It is called KCmesh.

Reports:

- 6 m – 2 individuals recently had a QSO.
- 10 m SSB Roundtable – 4 participated on January 9.
- 40m SSB Roundtable – 2 participated on January 8.
- Fusion Digital 440 net – 21 Check-ins on January 8 and NR for Check-ins on January 1.
- 2m Wheat Shocker net – 19 Check-ins on January 9 and NR for Check-ins on January 2.
- HF Activity – Japan and South Africa on 20m FT*NR.

Announcements:

- LaCygne Hamfest – February 1.
- Ararat Shrine Hambash – April 18.
- ARRL is launching a new magazine titled "On the Air". It will start in January 2020 and published on a bimonthly basis. On the Air will offer new and beginner-to-intermediate-level radio amateurs a fresh approach to exploring radio communication.
- See Larry's List for upcoming Events.

Business meeting adjourned at 7:25 PM.

Program:

- The Program for this evening was a planning session for Programs for 2020.

Hambone and the Reflected Power Blues

"A fine start of the new year this turned out to be," moaned Hambone to his buds who were all sitting around in their fraternity's lounge/party/eating/ drinking room.

"Yeah, that professor Flask is just as bad as everyone says," added one of the guys popping open a cool one even though it was a wintery 25 degrees outside. "What kind of a jerk gives a two-question quiz on the first day of his Electromagnetics 112 class? What'd you get on it, Hammy?"

"F, just like everybody I asked. You, too?"

"Yeah, the same. So now we're all starting off the class with 'Fs'."

At this point in the self-pity wallow fest, Dude, Hambone's younger brother walked into the room, opened the refrigerator and removed a tall cool one. The difference between Dude's drink and the frat boys' was that the first word in the name of Dude's drink was Root.

Dude is not a member of the fraternity nor even in engineering school. In fact, he's still in high school. But the fraternity brothers tolerate his presence because he helps clean up the place and is generally nice to have around.

"So, what's this one right one wrong thing goin' on?" asked Dude. Hambone responded, "Be glad you don't have old professor Erlennmeyer Flask. He just gave a two-question quiz and we all flunked. Flask said it was just a

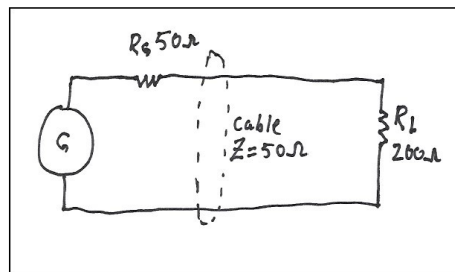
review and an application of principles we learned last semester. Yeah, right."



"That sucks!" said Dude. "Application of principles always means something bad is coming. I know that and I'm not even in

college. Do you remember the questions?"

"Oh yes," said Hambone as he began to draw a sketch.



"There were two questions, number one was 'what is the VSWR and percent of the power is reflected from the load if the frequency is 20 MHz' and number two is 'what is the VSWR and reflected power if the frequency is 0 MHz, DC?'"

I got both questions wrong. For the first question I said the VSWR is 2:1 and 50% of the power is reflected which he said is wrong."

"That's what I said, too," piped up one of the other frat boys.

"Well," continued Hambone, "Old man Flask said the reflected power should be 36%, not 50% for both RF and DC. And now, for a take-home quiz, we have to prove it."

"I don't know the answer, but I think you should ask Uncle Elmer," said Dude.

"We can try. Unck doesn't usually help with homework," said Hambone. "But maybe he'll at least give a hint on this one."

**** *Later, in Uncle Elmer's basement ham shack* ****

The boys, Hambone, Dude and three frat brothers after telling their tale of woe all gathered around Elmer anxiously waiting for him to speak.

Elmer, on the other hand, said nothing as he poured himself a cup of coffee and returned to his bench. He did not offer coffee to the boys.

After taking a sip, Elmer finally spoke, "I don't usually help my nephews with their homework. If I do, I should get the grade because I've done the work and they've learned nothing. The same goes for you fellas.

Erlennmeyer Flask is a good friend of mine and he is not playing a trick on you. He always says it's easy for students to memorize formulas and even learn the basic principles behind all this radio and RF stuff. But what they have a hard time learning is how to actually use it.

I bet if I saw your papers, I would see a bunch of formulas scribbled all over where you plugged in numbers and got reasonable answers, at least to the VSWR part of the question. That one was easy because Early, er, Professor Flask spoon fed you the numbers in the drawing."

see HAMBONE on page 6

from HAMBONE on page 5

“You’re right, Unck. Mine sorta looks like that, but I got everything wrong” said Hambone as he handed his paper to his uncle.

“Mine, too,” added one of the boys. “But what do you mean about understanding and using underlying principles?”

Elmer continued, “You guys have studied and understand DC principles of voltage and current and resistance and Ohm’s law and you have done the same for AC. But you consider them to be two different things. Now, you’re learning about RF and cables and reflected power and, in your minds, you think it’s something new. It isn’t. In fact, you were probably aware of reflected power before you even heard of Ohm’s Law.”

“No way, Unck!” blurted Dude. “Ohm’s Law was the first electrical thing I learned besides not to put a finger in a light socket.” Everybody laughed and nodded in agreement.

“Not quite,” said Elmer. “I’m sure you’ve all been to the beach on a windy day and seen the waves roll across the water only to rise up and break when they got to the shore.” The boys all nodded in agreement.

“And you remember the lifeguard or your parents warning you about the under tow that could carry you out into deep water.” Again, the boys nodded in unison.

“Well,” announced Elmer, “You’ve just experienced all there is about waves, reflected power and discontinuities.” With that, Elmer set down his cup and started for the door.

“Unck, wait, I don’t get it,” shouted Hambone. “You haven’t explained anything.”

“Oh, but I have,” said Elmer turning back towards the boys. “You guys are so busy thinking inside the box that you fail to see what is right in front of you.

In my beach example, the wind blowing over the water corresponds to the generator in Professor Flask’s question. The water itself is analogous to the cable that is transporting the waves from the generator. The sharply rising beach is the unmatched load or discontinuity, the tall breaking waves are the reflected voltages and the under tow is the reflected power. See, you knew it all the time!”

“Okay, okay, Unck, maybe I have been trying to just memorize my way through this course. I don’t really understand all those formulas with sines and exponents and pi and stuff. It just confuses me,” sighed Hambone with the other guys nodding in agreement.

“Well, if you want to be electrical engineers, sooner or later you must learn that, as you say, ‘stuff’. But, maybe not today. There is another way to understand wave reflections that you might find easier.”

“Yeah, Mister Elmer, we want easier,” said one of the frat boys.

“Okay, let’s start with your drawing. Instead of that generator generating a 20 MHz sine wave, let’s say it generates a very short pulse of 100 volts. The pulse is so short that it ends before its leading edge even gets to the load. Notice the generator’s internal resistance is 50 ohms and the cable’s characteristic impedance, or

resistance, is also 50 ohms. Also notice they are in series and form a voltage divider so only 50 volts appears at the terminals where the cable connects to the generator. Do you see that?” asked Elmer.

“It’s just Ohm’s Law applied to the generator’s internal resistance and the cable’s characteristic impedance!” shouted one of the boys. “It’s DC all over again! I bet there is a current pulse of one amp flowing down the cable.”

“You’d win that bet,” replied Elmer.

“I’m not seeing any waves or reflections,” said the ever-skeptical Hambone.

“Just wait until our pulse gets to the far end and hits the 200-ohm load, said Elmer. “That’s when the fun begins.

Since our cable is lossless, when the pulse gets to a point just before the load, the voltage is still 50 volts and the current is still one amp.

At this point it is important to note that we are defining the impedance of the cable by using Ohm’s Law that says the resistance is equal to voltage divided by current, not by the cable’s part number specification. We applied a 50-volt pulse to the generator end and caused a one-amp current pulse to flow in the cable. Therefore, according to Ohm’s Law the input resistance of the cable must be 50 ohms.

$$R=V/I = 50 \text{ volts}/1 \text{ amp} = 50 \text{ ohms}$$

This is why the real name for the impedance of any transmission line is ‘surge’ or ‘impulse impedance’. It is the applied voltage divided by the resultant current at the first

see HAMBONE on page 7

from **HAMBONE** on page 6

instant the voltage is applied. After that, all bets are off. But I digress.

Finally, bam! The pulse, which is still 50 volts and one amp, hits the 200-ohm load. But, 50 volts can't push one amp through the 200-ohm load so what happens?"

None of the boys could answer the question, but Dude tentatively raised his hand and said, "Reflection, like the waves on the beach?"

"Yes," said Elmer. "And this is where math comes in."

"Oh no," moaned Hambone.

"Oh yes, but only simple algebra, no exponents or pi or trigonometry.

You remember on the beach how the water splashed up and then and some amount of it ran back causing the under tow? If you looked closely, you'd see that the total height of the water at the moment it encountered the beach was the height of the original wave plus the amount that was going to be reflected.

Well, we're going to put a number on that reflected amount and call it the *reflection coefficient* and nickname it, K. The reflection coefficient, K, is simply the percentage - expressed as a decimal - of the original voltage wave that gets reflected back. For example, if $K=0.25$, 25% of the voltage is reflected back. Are you still with me?"

The boys all nodded in agreement but remained suspicious because Elmer had a reputation of trickery.

"Okay, let's move on. Please note that I have nothing up my sleeves,"

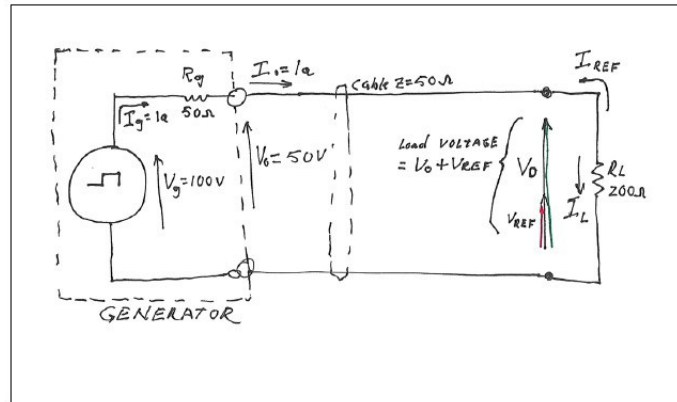
said Elmer grabbing his yellow pad and pen.

"Let's redraw your drawing and add some detail to it. No magic here. I'm just showing the voltages and currents at the load where it's all happenin'.

Notice that the voltage at the load, V_L , is made up of two voltages, the original voltage which I have named V_0 (remember, that is 50 volts in the problem) and a reflected voltage which I have named V_{ref} .

We don't know the value of V_{ref} , but we do know it is some percentage of V_0 so we will define it:

$$(1) V_{ref} = K V_0 \text{ where } V_0 \text{ is in volts.}$$



That means that the total voltage at the load is:

$$(2) V_L = V_0 + V_{ref}$$

Which, by the magic of simple algebra, we put #1 into #2 and get:

$$(3) V_L = V_0 + K V_0$$

We can simplify #3 and rewrite it,

$$(4) V_L = V_0(1 + K)$$

This is exactly the same as #3, I just simplified it. This is the actual voltage that appears at the terminals of the 200 ohm load.

"Are you guys still with me?" asked Elmer.

The boys said they were, although some looked like they were unsure.

"Okay, now let's talk about current.

Since we have a voltage at the load that is higher than the original pulse voltage of 50 volts – but we don't know how much higher because we don't know the value of K – that voltage must cause a current to flow back towards the generator.

In other words, our reflected voltage is causing a reflected current to flow backwards in the circuit. We will call that reflected current, I_{ref} . Because it is flowing against the original pulse current of

1 amp, it subtracts from the original current.

So, if we call the original one-amp current pulse, I_0 , and if the reflected current, I_{ref} , is pushing back against it, then the current going

through the load

must be the original current minus the reflected current. We will call the current going through the load I_L . So, let's make all these definitions look mathy:

$$(5) I_{ref} = -K I_0$$

Where I_0 is in amps. It is negative (-) because it is going against the original pulse current.

$$(6) I_L = I_0 - I_{ref}$$

This load current is the original 1 amp pulse minus the reflected current.

see **HAMBONE** on page 8

from HAMBONE on page 7

Substituting #5 into #6,

$$(7) \quad I_L = I_0 - K I_0$$

Which is the current actually going through the 200 ohm load.

Now, simplifying #7 like we did above,

$$(8) \quad I_L = I_0(1 - K)$$

Which is exactly the same as #7 except rewritten.”

“Geeze, Unck, is this ever gonna end? I’m sure tired of all these equations and things,” moaned Hambone as he looked around for additional support from the group.

The support not forthcoming, Elmer replied, “That’s a pretty cavalier attitude for someone who just failed this problem on a test. If I were you, I’d be quiet and see how to solve it the next time it shows up.”

“Yeah Hammy, shut up!” came a voice from the back. “I don’t want to get another ‘F’. You know that Ole Man Flask will use this problem again.”

Elmer continued, “We’re getting near the end. Take a look at this little piece of mathamagic. We have managed to define the resistance of the load using only the original voltage and original current and K.”

“I’m sorry, Unck, I just don’t see it,” replied a subdued Hambone.

“This is what I mean by not seeing the big picture. So far, we have used only simple algebra and Ohm’s law to solve a problem that you guys all though was some sort of complicated RF thing. That alone is pretty cool, isn’t it?”

Not waiting for an answer, Elmer explained, “In #4 we found, V_L , the voltage appearing at the load, using only Ohm’s Law, the original voltage, V_0 , and our made-up constant, K.

Then, using the same process we found, I_L , the current going through the load.

Now we will use Ohm’s Law again to find the load resistance using only, V_L , I_L , and K.”

“Why don’t you just use the 200 ohms from the problem?” asked Dude.

“We are looking for a general solution that applies to all loads and cable impedances. That’s what your homework is, isn’t it?”

Moving on, we’ll name the load resistance, R_L . Yes, it’s 200 ohms in this particular problem, but we’re looking for a general solution.

R_L = load resistance in ohms

Using Ohm’s Law, , we put in our values from above,

$$(9) \quad R_L = \frac{V_L}{I_L}$$

where R_L is the load resistance in ohms. We find that the load resistance equals the load voltage divided by the load current.

Next we put equations #4 and #8 into #9 and get,

$$(10) \quad R_L = \frac{V_L}{I_L} = \frac{V_0(1 + K)}{I_0(1 - K)}$$

which is the load resistance in terms of the cable resistance, R_0 and K.”

“Nice, Unck,” said Dude. “But I don’t see it. I see your K, but not R_0 .”

“Maybe it’s clearer if I rewrite #10 like this making the R_0 part stand

out. Remember, R_0 equals V_0 divided by I_0 ,”

$$(11) \quad R_L = \left(\frac{V_0}{I_0} \right) \frac{(1 + K)}{(1 - K)}$$

“I see it now!” shouted that voice from the back of the pack. “That V_0/I_0 is really the cable resistance! It was hidden in there all the time.”

“Yes!” shouted Elmer. “Now you’re getting the big picture. We can rewrite #11 to make that clear.

$$(12) \quad R_L = R_0 \frac{(1 + K)}{(1 - K)}$$

And, using only simple algebra, we can solve #12 for K which we can use to solve the original problem.”

Not waiting for any questions, Elmer’s marker flew over his yellow pad as he solved the equations at light-speed leaving only the following lines:

$$R_L(1 - K) = R_0(1 + K)$$

$$R_L - K R_L = R_0 + K R_0$$

$$- K R_L = R_0 + K R_0 - R_L$$

$$- K R_L - K R_0 = R_0 - R_L$$

$$- K(R_L + R_0) = R_0 - R_L$$

$$- K = \frac{(R_0 - R_L)}{(R_L + R_0)}$$

$$K = \frac{(R_L - R_0)}{(R_L + R_0)}$$

see HAMBONE on page 9

from HAMBONE on page 8

“Remember, K is the fraction of the original voltage that is reflected back. So, let’s plug in some numbers from the original problem. We’ll use 50 ohms for the cable impedance, R_0 , and 200 ohms for R_L :

$$K = \frac{(R_L - R_0)}{(R_L + R_0)} = \frac{200\Omega - 50\Omega}{200\Omega + 50\Omega} = \frac{150\Omega}{250\Omega} = \underline{0.6}$$

which means that 60% of the original voltage is reflected back by the load.

60% of 50 volts is 30 volts. So, $V_{ref} = 30$ volts.

From your class I hope you remember that VSWR is max voltage divided by min voltage. In this case, the maximum voltage occurs when the original voltage adds to the reflected voltage and the minimum voltage occurs when the reflected voltage subtracts from the original voltage or:

$$VSWR = \frac{V_{max}}{V_{min}}$$

$V_{max} = V_0 + V_{ref}$ where V_{max} is the maximum line amplitude in volts. This is the incident voltage plus the reflected voltage.

$V_{min} = V_0 - V_{ref}$ which is the original voltage minus the reflected voltage.

Putting in our numbers:

$$VSWR = \frac{V_{max}}{V_{min}} = \frac{50V + 30V}{50V - 30V} = \frac{80V}{20V} = 4 = \underline{4:1}$$

which is the answer to part 1 of your problem.

Of course, you could save a little time by using:

$$VSWR = \frac{(1 + K)}{(1 - K)} = \frac{(1 + 0.6)}{(1 - 0.6)} = \frac{1.6}{0.4} = 4 = \underline{4:1}$$

“That’s nice Unck, but what about reflected power? That’s the part we got wrong,” said Hambone.

“Hambone, once you’ve got all the above stuff, that’s really easy. Remember, the original pulse is 50 volts and one-amp zipping through the coax.

Using that old power formula:

$P = \text{Volts times Amps}$

We could say that, for the duration of the original pulse, it represents an original power of P_0 where:

$P_0 = 50$ volts times 1 amp or 50 watts”

“Okay Unck, how do we find the reflected power?”

“Hammy, just step back and look at the big picture, again. You can use another version of the power formula that I hope you remember:

$P = V^2/R$

If you don’t remember that formula, you can derive it by putting Ohm’s law into the above power formula.

To find the reflected power, you can find the power going into the load and subtract it from the original power. What is left is the reflected power.”

“I get it,” came a voice from the back of the ever-growing pack of students. “You start with fifty watts, some amount goes into the load and what’s left is the reflected power!”

“That’s exactly right!” Shouted Elmer.

“We know from #2 above that the load voltage, V_L , is the original voltage plus the reflected voltage,

(2) $V_L = V_0 + V_{ref} = 50 + 30 = 80$ volts appearing at the load.

R is just the load resistance of 200

ohms. So, the power absorbed by the load is,

$$P = V^2/R = 80^2/200 = 6400/200 = 32 \text{ watts absorbed by the load.}$$

Whatever isn’t absorbed by the load gets reflected back so, the reflected power is:

$$P_{ref} = 50 \text{ watts} - 32 \text{ watts} = 18 \text{ watts.}$$

So, you see, by going back to the basics and using just Ohm’s Law and some algebra, we answered Professor Flask’s questions. No trig and no exponents, just common sense.”

“Gee, Mr. Elmer, you make it seem so simple. You just solved a complicated RF problem using plain old DC stuff,” said one of the frat boys. “But what about the second question asking what is the VSWR at 0 MHz or DC? “That doesn’t make any sense, does it?”

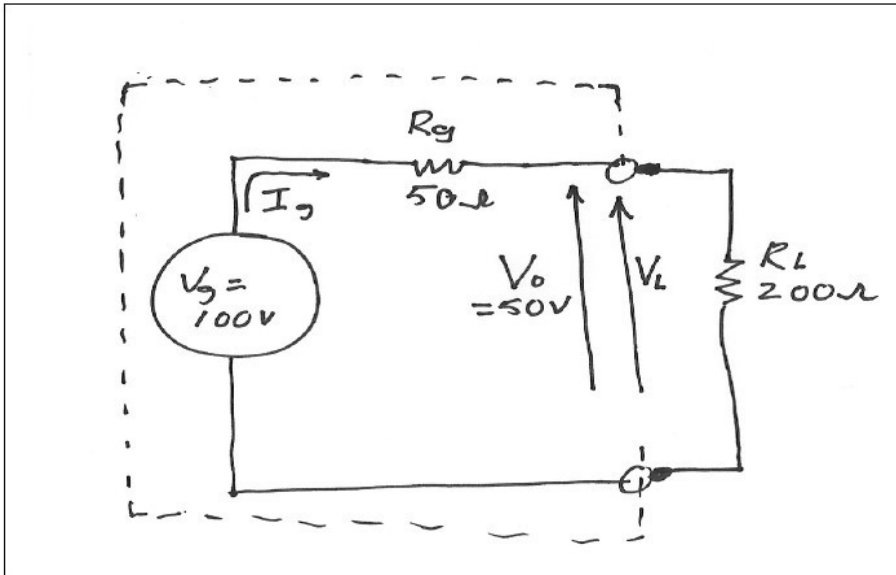
Hambone added, “I said VSWR make no sense with DC on my quiz and old man Flask marked it wrong. What gives?”

“I don’t know what his thinking was, but mathematically it does make sense. The reason you didn’t see it is because you think DC and RF are totally different things. They are not.

Notice that so far we haven’t used the 20 MHz frequency or anything having to do with the length of the cable, that’s because they are irrelevant. Professor Flask just threw them in to see if you’d bite and you did.

Since they are irrelevant, let’s redraw your circuit and leave them out.”

see HAMBONE on page 10



Author's note:

A special thanks to Tom N0GSG for properly formatting the equations and to Charlie N0CVW, Bill, WA0CBW and Don W0DEW for catching my typos and grammatical transgressions.

from HAMBONE on page 9

This time we connect the load directly to the generator terminals. According to Ohm's Law, the generator is supplying:

$$I_g = \frac{V_g}{R} = \frac{100V}{(50\Omega + 200\Omega)} = \underline{\underline{0.4A}}$$

so there is 0.4 amps flowing in the load.

That current causes the voltage, V_L

$$V_L = I_g R_L = (0.4A)(200\Omega) = \underline{\underline{80V}}$$

so 80 volts will appear across the load. This is the same voltage as above which means that the power delivered to the load is 32 watts, also the same as above. Pretty slick, eh?"

"Okay, Unck, but what about the reflected power and VSWR?"

"That's easy, Dude. We just use the formula we found for the reflection coefficient, K:

$$K = \frac{(R_L - R_0)}{(R_L + R_0)} = \frac{200\Omega - 50\Omega}{200\Omega + 50\Omega} = \frac{150\Omega}{250\Omega} = \underline{\underline{0.6}}$$

The load resistance, R_L , is still 200 ohms, but we now must use the generator's internal resistance for R_0 . Even here, with no cable, the reflection coefficient is still 0.6, same as above. That results in the same VSWR:

$$VSWR = \frac{(1 + K)}{(1 - K)} = \frac{(1 + 0.6)}{(1 - 0.6)} = \frac{1.6}{0.4} = 4 = \underline{\underline{4:1}}$$

You can find reflected power using the formula:

$$|K|^2 = \frac{P_{reflected}}{P_{incident}}$$

$$P_{reflected} = |K|^2 P_{incident} = (0.6^2)(50W) = (0.36)(50W) = \underline{\underline{18W}}$$

The same as above.

There you have a reflection coefficient, VSWR and reflected power for a DC circuit. I will leave it to you guys to figure out the power part."

With that, Elmer walked upstairs, stretched out on his couch and took a nap.

"See, I told you there was trick. With my uncle there's always a trick," said Hambone.