The

REPEATER

The OFFICIAL newsletter of the Rogue Valley Amateur Radio Club

W7OEK

Volume 2010, Issue 1 **January 2010**

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Next Club Meeting

Thursday, January 7, 2010, 7:00 PM
Red Cross Building, 60 Hawthorne St., Medford, OR
Across from Hawthorne Park
Program: ***Swap Meet***

President's Letter

Happy 2010 to all.

As stated earlier, the January 7 meeting will feature a swapfest, so bring your trading stock and wallet.

Also keep in mind that we expect to hold Amateur Radio Exam classes, probably starting in early February. Pass the word!

The class of license will be determined somewhat by demand, although I think it's time to offer general or extra class to encourage some of our previous techs to upgrade. Students are encouraged to purchase study books (from ARRL or HRO.) Your president is available to answer questions at the above phone number.

I am soliciting offers to present ham radio

(Continued on page 2)

Secretary's Report

RVARC 3 DEC 09 MINUTES

1. Herb Grey W7MMI officiated at our annual Christmas dinner which was held at the New Far East restaurant in Medford starting at 1800L.

2. The first order of business was socialize and eat.

3. After everyone finished eating Herb turned the meeting over to our vice president Don Bennett KG7BP for the gift exchange. Which he did with his wife's help.

4. Herb then gave a short recap of the years events.

(Continued on page 2)

President's Letter, Continued

related programs at our meetings (I have never been overwhelmed with too many.)

73, Herb W7MMI

Two Meter Repeater Frequency

In order to provide a common place to find fellow RVARC club members on two meters, we recommend using the K7RPT 147.62 / 02 repeater as a calling and monitoring frequency. This is an open repeater (no tone or PL access required). The repeater listens on 147.62 MHz and transmits on 147.02 MHz.

Secretary's Report, Continued

5. Herb announced that the first meeting in 2010 would be a swap meet at the Red Cross building.

6. He adjourned the gathering at 1945L.

7 16 people attending this function.

Submitted by Jacob O. (Jack) Schock, WA7IHU

Baluns

Nothing seems to invite discussion more than the subject of baluns in amateur radio. This month we'll start to look at what a balun is, what it does, the types of baluns, why we may or may not need one, and how to describe the performance of a balun.

The term 'balun' is a contraction of the phrase 'balanced-to-unbalanced'. What does a balun do? In the simplest terms, a balun allows you to connect an unbalanced source, such as a transceiver or amplifier to a balanced antenna (fed with twin-lead or ladderline).

In somewhat less simple terms, a balun is a device that has minimal differential-mode loss, and maximum common-mode isolation. First let's explain what differential-mode and common-mode (currents) are.

What happens if we connect the coaxial cable from our radio right to a dipole? Anything bad? Well not necessarily. In a coaxial cable, three separate currents flow: one current in the center conductor, one exactly opposing current on the inside of the braid, and one current on the outside of the braid. The current on the center conductor and the inside of the braid are known as 'differential mode' currents. They are exactly equal and opposite currents, and thus there is zero net electro-magnetic flux surrounding the cable as a result. The third current, that on the outside of the braid, is not matched by any other opposing current in the cable. It's known as the 'common mode' current—a current that results in a net overall radiation from the cable.

We can say a similar thing about ladderline: the differential-mode current is the exactly equal and opposite currents in the two conductors whose net radiation is zero. The common mode current is the net current

(Continued on page 4)

2010 Dues are Due

2009 memberships expire at the end of this month (December) 2009. Dues for 2010 are due starting January 1st, I will hand out renewal information sheets starting at the January meeting. Last year they were mailed along with the newsletter, but the return rate was poor.

On the information sheets, you just need to note any changes in address, email, telephone number, ARRL membership, etc. They are used to help us keep our database up to date, correct any errors, track changes, and keep our ARRL-affiliation status current. Hopefully this is a low-effort way for club members to update their status.

Please consider if you can go to email-only newsletter, as currently it costs the club $1 per month per posted paper newsletter. The electronic version is in color, has better quality photographs, active hyperlinks, and you should receive it about a week earlier than the mailed version.

Membership dues are:

Senior (age 62 and above):	$15
Regular:	$20
Family:	$20
Student:	$10

Please make checks payable to:
Rogue Valley Amateur Radio Club

You can give check or cash to our treasurer, Lud at any meeting, or mail checks only to:

Rogue Valley Amateur Radio Club
c/o 3950 Southview Ter.
Medford, OR 97504

that's flowing in the same direction in the two conductors—it results in radiation from the ladderline.

Anytime there is a net current flow along a conductor, that conductor radiates a signal just like an antenna. In the case of coaxial cable, it means that the common-mode current causes the coaxial cable to act as an antenna wire (although a pretty thick one) rather than as a feedline to some other antenna. If that feedline is in your shack, then it's like having an antenna right in the radio room, and that can cause a lot of problems. When there is common-mode current in a ladderline it causes radiation from the ladderline as though the two conductors are shorted together.

It's easier to visualize the 3 separate currents in coaxial cable, while there are mathematically 3 currents in the ladderline, but the effect is exactly the same.

When the antenna is a dipole, sometimes one side of the dipole will be closer to the feedline than the other side of the dipole. In that case, coupling can excite current on the outside of the braid of the cable that is not matched by currents inside the cable. It's sort of like hanging a vertical wire next to your dipole and wiring it to just one side of the dipole. In essence, the outside of the feedline plus the dipole acts like a 'T' antenna.

The two currents inside the feedline are shielded from the antenna fields, but the outside of the coaxial cable acts like a wire right in the field of the antenna.

Having a 'T' antenna (fed at the top of the T) results in some combination of vertical and horizontal radiation. The antenna may also become noisy—it can pick up all sorts of local signals nearby (such as from electronic devices inside the house).

A surprisingly similar situation occurs when we use ladderline to feed a dipole. If we were just to directly connect the ladderline to our radio, then one conductor would be grounded by the radio, and the other conductor would connect to the radio antenna 'hot' pin. This has the effect of turning our antenna into a bottom-fed L antenna with a grounded wire nearby. Again, some of the radiation (and receive signal pickup) is due to the close presence of the antenna to the house and it's noisy electronics.

A balun is a device that converts the source of RF from unbalanced to a balanced source. In the case of coaxial cable it chokes off the current on the outside of the braid, in the case of ladderline, it tries to force the two wires of the ladderline to exactly equal and opposite currents.

The following diagrams break apart the differential mode and common mode voltage sources. It turns out we can always do this without changing the circuit function because of the superposition principle.

Figure 1 shows a grounded unbalanced source connected to the feedline. Vdm is the differential mode voltage.

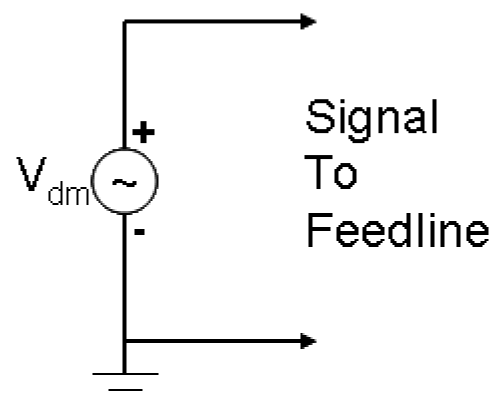

Figure 1— Unbalanced source differential mode voltage.

(Continued on page 5)

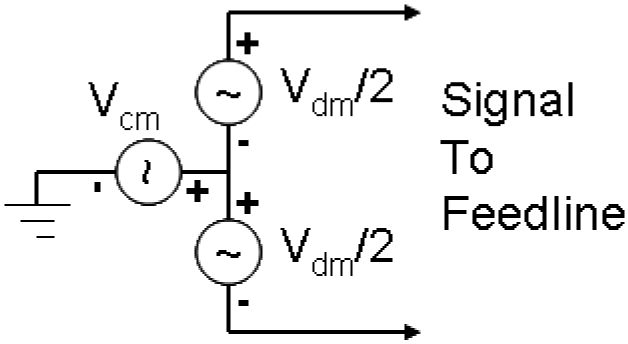

Figure 2—Exactly equivalent to Figure 1 when Vcm = Vdm/2.

Figure 2 shows the source broken into it's component pieces, the common mode voltage and the differential mode voltages. For an unbalanced source, the common mode voltage is half the differential mode voltage. In that case, Figure 1 and 2 are precisely equivalent. The + and - show the instantaneous polarity (phasing).

A 10 watt unbalanced source into a 50 ohm unbalanced load gives a voltage of E = Sqrt (PR) = 22.3 volts RMS, or 63 volts peak-peak. This is equivalent to a common mode voltage of 31.5 volts PP, and a differential mode voltage of 63 volts PP in Fig 2.

Now we can say what more precisely what we want the balun to do: Not diminish the differential mode signal at all, but completely quash the common mode signal.

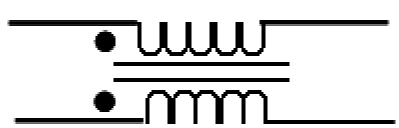

Figure 3—1:1 Current-mode balun. Each winding has the same number of turns, and the turns are bifilar or coaxial.

Figure 3 shows a 1:1 current-mode balun. This device has the property that a differential mode signal causes equal and opposite currents through the two windings, and thus equal and cancelling magnetic fluxes in the core. For the differential signal the magnetic core is pretty much invisible, and the device operates as a transmission line with low loss for those differential currents.

However, for the common mode signals, the two currents are in the same direction through the device. In that case we can treat the balun as through it were a series inductor. In fact, the current divides between the two windings, and for those currents we can treat the circuit as though the two windings are connected in parallel.

In reality, this common-mode inductor is far from perfect. It has parallel capacitance between the near and far end of the wire (due to proximity and due to the capacitance of the core material) and some parallel resistance due to the loss of the core material. The net result is that it forms a parallel-resonant circuit in series between the input (left) and the output (right).

For the differential-mode signal, the device has almost no effect, while for common-mode signals it presents a large series impedance consisting of a parallel RLC network towards the common-mode load impedance.

What are the differential mode and common mode load impedances?

The differential mode load impedance is the dipole antenna across the end of the two-feedline conductors. It's where we want our power to flow. The common-mode impedance is the parallel connection of the two feedline conductors (ladderline acting as one wire) forming a T antenna with that dipole (with center insulator appearing shorted together) at the end. The other half of that common mode antenna is the ground system of our shack !!! (Very, very, very bad).

(Continued on page 6)

Baluns, continued

For the common mode signal, the balun is the center insulator, and the feedline is a single wire acting as one half the antenna, and the system ground acting as the other half of the antenna. This is what brings RF into the shack, and constitutes a noisy receive antenna.

Now we can see the final common mode circuit. Vcm is the source, Vdm=0, and Zcm is the common mode load. When the balun choking impedance is high, it's difficult for current to flow into the common mode load. The way we can measure this is that the voltage on the two feedline conductors are equal and exactly opposite, AND the sum of the two voltages at any instant in time is zero. That is, the two voltages are equal and opposite compared to ground.

Recall, our unbalanced source had a net instantaneous voltage of 31.5 volts compared to ground, while our balanced load requires a net instantaneous voltage of zero volts to ground—the voltages are always exactly opposite. The balun common mode impedance forms a voltage divider with the load common mode impedance. The higher the balun common mode impedance, the better job it does suppressing the common mode load voltage.

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