ROUNDTABLE

The Denver Radio Club Newsletter

April 2010 Since 1917

PRESIDENT'S MESSAGE

By Gerry Villhauer-W0GV

Hello DRC Members,

We have sure been experiencing that Colorado Spring weather. Snowing so hard you can't see across the street in the morning then sun and blue skies in the afternoon. What a great place to live. If you have been coming to meetings you are aware that we have a problem that most clubs wish they had…we are outgrowing our meeting place. Getting a meeting place that fits our needs and price range is not easy. We have had a couple suggestions from members for possible new locations. This was a topic of discussion at the last board meeting and we are actively looking at the possibilities of two locations. Our goal would be to find a suitable location before the summer heat gets here. Thanks to Bob Zimprich, KB0BZZ, for accepting the appointment of Liaison to The Salvation Army. Read more about Bob in this issue of the Round Table.

Thanks to Paul WA2YZT, for the great program and presentation on HDTV and the Mototrbo digital radio system. He sure raised a bunch of interest in the Mototrbo. I know of a couple members talking about purchasing one. Paul also offered a tour of KCNC CBS 4 transmitter site to the group. We are planning that for a summer month to assure good weather.

Internet Linking for Radio Amateurs will be the program for April and presented by Bob, KC0CZ. Ever wanted to get started with Echolink and did not know where to start? Internet Linking does have several options and we will be describing the Echolink and touching a little on IRLP. Just how does it work? How does my voice get from point A, your station, to point B, across town or around the globe? He will be demonstrating the latest in technologies using the iPhone and iPod Touch. Bring your questions.

I would like to welcome and thank new DRC members: Darin Hardwick, KD0KSU, Amberley Hardwick, KD0KSV, Jay Hokanson, KE0ZR, Randy Kincaid, N0IVY and Curt Miller, K0HFL. Please check in on the nets, come to the meetings and activities and remain an active member.

See you all at the meeting April 21st. at the St. Joseph's Episcopal Church, 11202 West Jewell Ave., Lakewood, CO. That is about two blocks West of Kipling on West Jewell. And remember to check our website, www.w0tx.org, for lots of important information about the DRC. The Elmer Session and Tech Meeting start at 6:30 pm followed by the Regular Meeting and Program at 7:30 pm.

Gerry, W0GV
President

Happy April Fool's Day!

INSIDE THE ROUND TABLE

March Meeting - What'd I Miss	Pg 2	Up Coming Events & Puzzle Answers	Pg 8
Tech Committee Report	Pg 2	Calendar	Pg 8
No SWR Meter? No Problem.	Pg 3	DRC Information	Pg 9
The W6RYX Antenna	Pg 4	Puzzle	Pg 10

MARCH MEETING - WHAT'D I MISS

By Bill – W6OAV

Sixty three folks attended this April's meeting! Gerry, W0GV, began the meeting with attendee introductions. After the introductions, Oscar, K0SSE, gave an overview of the upcoming scheduled DRC field day activities. He asked everyone to mark their calendars and to plan to participate. The meeting was then turned over to Dave, WG0N. Dave, after giving a short overview of the history of TV, introduced the guest speaker, Paul Deeth, WA2YZT.

Paul is the Transmitter Maintenance Supervisor for Denver KCNC-TV. Paul began his presentation with an overview of various amateur radio digital nodes. He briefly covered D-Star and P25 modes. Paul then gave a more in-depth overview of the MOTOTRBO digital system. This system uses Time-Division Multiple-Access (TDMA) technology which allows two independent users on a single 12.5 kHz channel. It can also operate on both analog and digital modes. MOTOTRBO has too many other features to mention here.

After the overview, Paul gave a live demonstration of MOTOTRBO using the repeater he had setup in the corner of the room. After passing out four transceivers, he had two users setup a call on one channel and the other two users setup a separate call on a second channel, both of which were sharing the same 12.5 kHz UHF channel.

After the demonstration, Paul opened the floor for questions of which there were many. Questions covered everything from amateur digital systems to HDTV.

The meeting concluded with several lucky attendees winning door prizes.

TECHNICAL COMMITTEE REPORT

By Bill – W6OAV

This report provides an overview of the items discussed during the March Technical Committee meeting.

Voter System
Goal: Design and build the voter site and a remote site for the 147.33 voter system.

- WW0LF has updated the system diagrams and notes. He hopes to have the remote station built by next April's meeting.

Voter System
Goal: Determine link frequencies and coordinate with CCARC as needed.

- KB0A is working on this issue.

Interference to 449.35
Goal: Determine the commercial source that mixes with the RMRL 449.45 repeater and produces a spur on the 449.35 input.

- KC0CZ and W6OAV have been performing the following test: When the 449.45 repeater is active, turn off the 449.35 PL. Scan UHF business bands (450.0 to 469.975 mHz) to attempt to locate the commercial frequency mixing with 449.45.

Temporary Salvation Army Location:
Goal: Determine feasibility for installing VHF/UHF systems and for installing a temporary NVIS station should the need arise for the latter.

- K0SSE inspected the facility. The "ham shack" room will accommodate the club's desk. Approximately 100' of coax will be required to reach the roof via the venerator.
- A work party will soon be scheduled to install the VHF/UHF systems.

TS-940 Failure at Station 4
Goal: Determine if re-soldering and cleaning connectors will fix radio.

- KB0A and KK0JD will get together to determine and schedule actions to be taken.

Remote HF Transceiver
Goal: Determine the feasibility of building an Internet accessible Remote HF transceiver for club member use.

- This project will be put on hold until the voter system comes on line.

(Continued on page 3)

(Continued from page 2)

147.33 - Hudson Audio and RF issues
Goal: Repair bad audio and replace bad RF connector:

- KB0A and N1ETV will perform tests to determine if multi-path is an issue with the audio.

Field Day
Goal: Start laying the ground work for the 2010 Field Day.

- K0SSE expanded the list of action items and presented them to the Tech Committee.

Station 4 Antennas Verses New Fire Station
Goal: Determine if the height and proximity of the new building to the tower is blocking antenna coverage.

- KB0A determined that there is no issue here.

Tech Committee Meeting Productivity
Goal: Investigate the possibility of increasing the Tech Committee meeting productivity by using tools like Skype audio conferencing.

- Tests proved that Skype conferencing is feasible. The committee agreed that all members should install Skype.

145.49/448.625 Controller Upgrade
Goal: Replace S Comm controller with a 7330 controller.

- KB0A is working this item.

Special Courtesy Tone/Announcement for Repeaters in Emergency Mode
Goal: Configure the controllers for: 1).Command- able special courtesy tone (such as a double beep) which will indicate to users that the repeater is in the emergency mode, 2). A command-able emergency mode broadcast message.

- This issue put in the "*On Hold Category*."

THE DRC HAS A NEW SALVATION ARMY LIAISON

By Bill – W6OAV

The DRC has a new Salvation Army Liaison. He is Bob Zimprich, WB0BZZ. Bob will basically coordinate the DRC activities with The Salvation Army (TSA) much like Mile Gelski performed in the past.

Bob retired from Hewlett-Packard 2 years ago as a Consultant I in the OpenVMS systems group. The group supported mission critical mid-range systems at financial institutions, the U.S. Government, and other critical sites. Bob told us "I got my Technician and General licenses and joined the DRC. I was struck by the DRC's commitment to TSA and soon became involved. I answered one of Oscar Hall's calls for volunteers for Windsor and in the process, met Mike Gelski and the rest is history. We all lost a true friend when he passed on".

Bob has already announced some of his plans… "There are several projects we need to get going on… Not the least of which is bringing up a station at the new TSA garage. We need to make sure that all the radios in the various vehicles and sites are in good working order as I want to have TSA drivers start actively using radio communications whenever they take equipment out. We also need to shake out the repeater and portable tower and make sure we have all the parts and knowledge to bring up the equipment associated with TSA Command Vehicles on short notice. Also noteworthy, TSA has made it a matter of policy that "communicators" will not be asked to assist with other Emergency Disaster Services (EDS) tasks. That doesn't preclude a communicator from offering and they won't be asked by TSA".

NO VHF SWR METER? NO PROBLEM.

By Dan Romanchik – KB6NU

Will a CB SWR meter work on a 2 meter ham radio??

"Yes and no. I use a CB SWR meter to check 2M antennas all the time. There is a trick to it however."

"If all you want to do is check SWR on your 2M antenna, you don't necessarily have to buy a dedicated VHF/UHF SWR meter. What I keep in my tool bag for that is a cheapie $5 hamfest special CB SWR meter. They really don't work well on 2M but there's a trick you can do that will net a reasonably accurate SWR reading on 2M with one of these meters.

What you do is connect up the meter as usual, key the rig with the switch in the forward power position, set the adjustment for full scale. Now, without touching anything, swap the coax connections so that the rig is connected to the ANT' side of the meter, and the antenna is connected to the 'XCVR' side. The reading you see on the meter will be very close to your real SWR. The closer to 1:1 your SWR is, the more accurate it will be. It would be more convenient to have a real SWR meter or antenna analyzer if you do a lot of testing, but for a quick antenna check after a mobile install or whatever, the $5 CB meters works OK."
"The theory is relatively simple."

"A basic SWR bridge is comprised of two couplers, each of which consists of a strip-line or a pickup loop, and a detector diode. One coupler is used to detect forward power, the other reflected."

"At 27 MHz, the precision of the components required isn't too stringent. Just about any diode will work, and minor imperfections in the strip-line or pickup coils won't impact the accuracy that much."

"But at 2M suddenly minor differences between the strip-lines, stray capacitance, and type of diode starts to matter. By using just one of the couplers for both the forward and reverse readings any error that exists in that coupler is the same for both readings and thus cancels out. It's unlikely it'll work at 440 however, it's just too much to ask to expect a true 50 ohm network and zero bias or hot carrier diode in a cheap CB meter."

"The absolute reading on 2M may still be somewhat inaccurate, especially at high SWR but odds are you don't care about that. All you're interested in is 1:1 or as close to it as you can get, and for that the $5 meters will be good enough."

THE W6RYX ANTENNA – PART 2

A GROUND-PLANE, PHASED, 90° CORNER REFLECTOR

By Norwood J. "Pat" Patterson – W6RYX

Antenna Design

After considering various directional antennas, we concluded that a 90° corner- reflector antenna would best meet the need. I designed the antenna and supervised its construction. My son performed the testing to determine its proper operation. The W6RYX corner reflector antenna consists of a ¼-wavelength, folded radiating element bisecting the vertex angle between two flat-plane reflecting sheets. Most corner-reflecting antennas use a balanced, half-wave dipole antenna as a radiating element. Review of the references, listed at the end of this article, indicated that a conventionally designed 220-MHz corner reflector would be of considerable size. Changing the radiating element to a ¾-wavelength with a ground plane would reduce the vertical size of the antenna by half, and at the same time reduce the feed-point impedance by half.

The references gave antenna resistance curves for the corner reflector with a half- wave, balanced dipole antenna, but no impedance curves for a ¼-wavelength, ground-plane corner-reflector antenna.

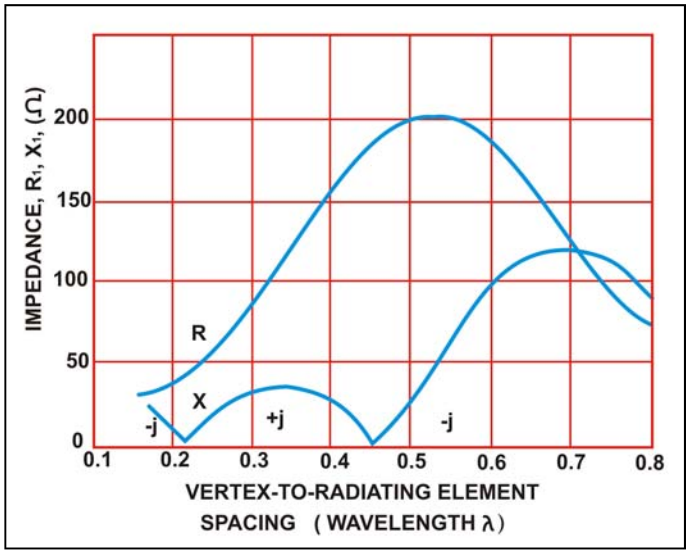


Figure 1–Base impedance compared to radiating element-to-vertex spacing for a 90° corner reflector antenna. The radiating element is a folded monopole.

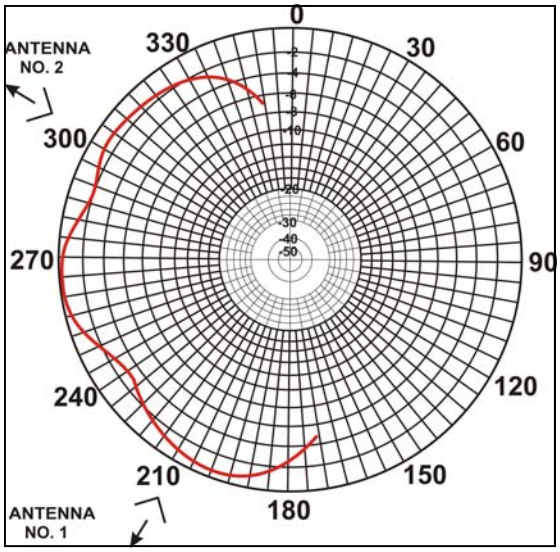


Figure 2–Calculated antenna radiation pattern for two 90° corner-reflector antennas mounted 286° apart and tad in phase.

Table 1

Conversion of "Voltage-Ratio Method" Decibel Difference Readings to SWR

dB	VSWR	dB	VSWR
1	17.41	17	1.33
1.2	14.50	18	1.29
1.4	12.43	19	1.24
1.6	10.90	20	1.22
1.8	9.66	21	1.194
2	8.73	22	1.170
2.2	7.94	23	1.153
2.4	7.29	24	1.136
2.6	6.73	25	1.120
2.8	6.26	26	1.105
3	5.85	27	1.093
3.5	5.03	28	1.083
4	4.42	29	1.074
4.5	3.95	30	1.066
5	3.57	31	1.058
5.5	3.26	32	1.051
6	3.01	33	1.046
6.5	2.80	34	1.041
7	2.62	35	1.036
7.5	2.46	36	1.032
8	2.32	37	1.029
8.5	2.20	38	1.027
9	2.10	39	1.023
9.5	2.01	40	1.020
10	1.92	42	1.016
11	1.79	44	1.013
12	1.67	46	1.010
13	1.58	48	1.008
14	1.50	50	1.006
15	1.43	55	1.004
16	1.37	60	1.002

(Continued on page 5)

(Continued from page 4)

To determine proper spacing and impedance, the base impedance was calculated using image antennas for the analysis. The results are plotted in Fig. 1. Figs. 4, 5 and 6 give gain of the antenna, pattern, and base impedance as a function of spacing. (Equations appear in the Appendix.) Refer to Fig. 1. The base impedance was calculated using a folded-monopole antenna with equal-diameter elements. A spacing between vertex and radiating element of 0.23 wavelength will give a 50-ohm base impedance with substantially zero reactance. The impedance set-up ratio (r) is 4:1. Conversely, if a single element radiating antenna were desired, the values showing (Fig. 1) would be divided by four (both resistance and reactance). For example, at approximately 0.23 wavelength the resistance of a single-element radiator would yield a resonant impedance of approximately 12.5 ohms (50/4). This very low impedance would contribute to antenna inefficiency. The folded-monopole radiating element was chosen for the 50ohm feed-point Impedance and because a grounded antenna would also reduce static noise in the receiver.

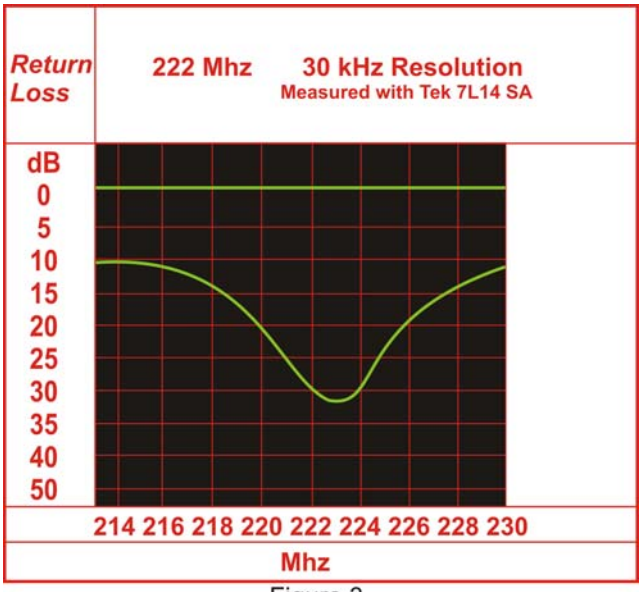


Figure 3

Figure 3–Antenna return-loss for two 90° ground-plane folded-monopole corner reflector. The center frequency was 222MHz. Vertical divisions are 10dB each; horizontal divisions are 2 MHz each.

To cover the required 160° with a 3-dB beamwidth, it was necessary to use two antennas fed in phase and separated 286 electrical degrees. The pattern was calculated in accordance with **Eq. 6,** and is plotted in Fig. 2. A ¼-wavelength matching section of 75-ohm coaxial cable was used to permit feeding each antenna with equal currents in phase. The input of each transmission line after the ¼-wavelength matching section showed a

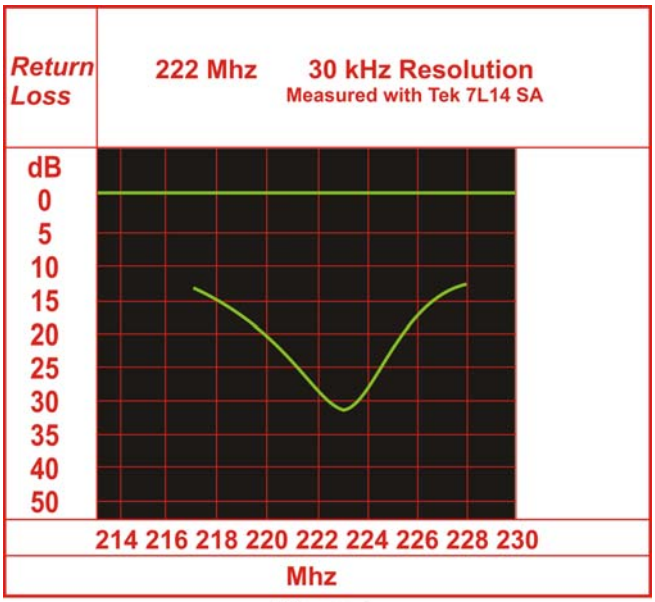


Figure 4

Figure 4–Antenna return-loss measurement for two 90° corner reflectors with folded monopole radiating elements, spaced 286° apart and fed in phase. The center frequency was 223MHz. Vertical divisions are 10dB each; horizontal divisions are 1MHz each.

resistance of 112 ohms, which, in parallel, gave a feed-point impedance of 36 ohms. Fig. 3 shows a measured return loss of 32dB, which equates to a very acceptable SWR of 1.052. During tests, the antennas demonstrated a considerable broadband characteristic effect. At the repeater frequencies of 222.44 and 224.04 MHz the return loss was 28 and 27dB, respectively, which calculates to SWRs of 1.083 and 1.094, respectively (Fig3, 4; Table 1). An SWR of 1.5 or less was measured over an 11MHz bandwidth.

For a corner reflector to have a good unidirectional pattern and reasonable gain, the length of the sides of the corner must be at least twice the spacing between the antenna and vertex **(see Eq. 1)**. To keep the antenna small, a spacing of approximately 0.23 wavelength was chosen. Had a folded monopole not been used, a spacing between the vertex and the radiating element of ½ wavelength could have been used. This spacing would require the sides to be at least 1 wavelength long. Using the folded monopole accomplished three things: It gave the proper operating impedance of 50 ohms with a spacing of 0.23 wavelength; it reduced the physical size of the antenna by one half; and it reduced static noise. This compromise resulted in a small sacrifice of gain and a wider lobe. Fig. 5 demonstrates a theoretical gain of 11.5 dBd and a measured gain of 11 dBd, a reasonable sacrifice for the convenience of a smaller antenna.

(Continued on page 6)

(Continued from page 5)

At higher frequencies, the physical size of the antenna would become smaller. A wider spacing between the vertex and the radiating element and use of a single radiating element, rather than the folded monopole, would give a good operating base impedance near 50 ohms with no reactance. The gain would increase approximately 2 dB over the W6RYX antenna (Figs. 1 and 5).

Figure 6 demonstrates the effect on the horizontal pattern of using smaller sides for the reflecting surface. The theoretical pattern identified "A" shows a narrower beam, nulls at 45° and theoretically no radiation to the rear. Pattern "B" is a commercial corner-reflector antenna. Pattern "C" is the measured pattern of the W6RYX corner-reflector antenna and demonstrates a practical antenna for 220 MHz with measured gain of 11dB over a half-wave dipole in free space, with a unidirectional pattern.

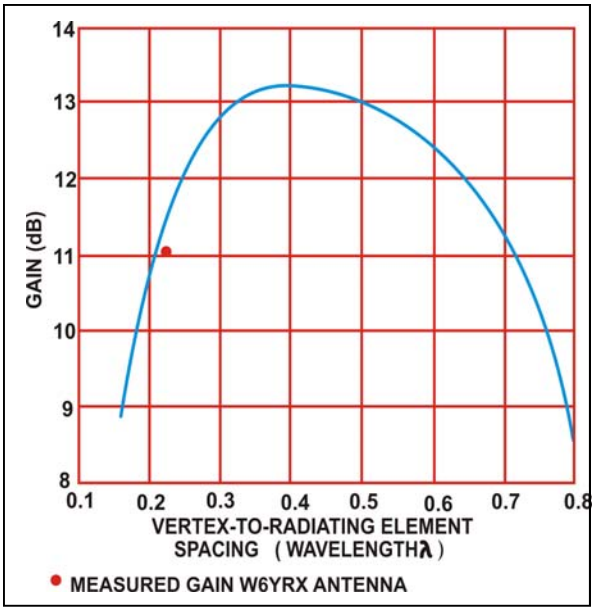


Figure 5–Calculated gain of a 90° corner reflector with folded monopole radiating element as a function of radiating

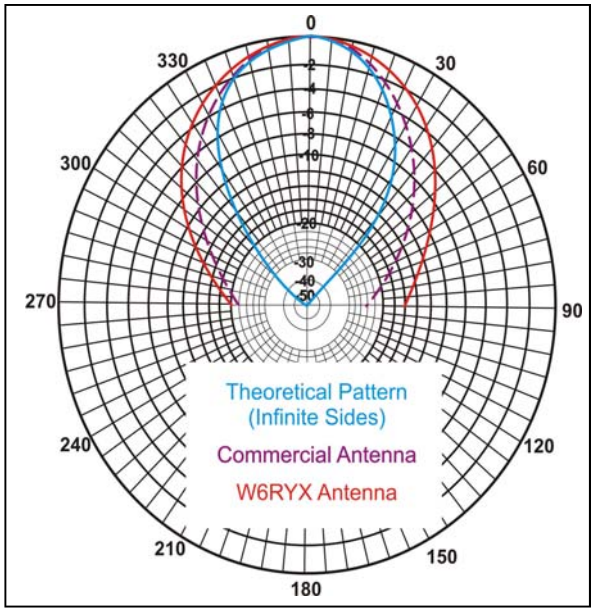


Figure 6–Measured radiation pattern of the W6RYX 90° corner reflector compared with a theoretical pattern (With Infinite sides) and a commercial antenna.

EQUATIONS

Eq.1
Antenna power gain estimate:

$$\cong \quad 4\left(\frac{300}{\alpha^\circ}\right)$$

$$\text{dB} \;=\; 10 \log \left\{4\,\frac{300}{\alpha^\circ}\right\}$$

Gain of antenna in L reflector over antenna with same power acting alone.

Eq. 2
$\lambda/4$ transmission line transformation:

$$Z_1 \;=\; \frac{(Z_0)^2}{Z_2}$$

Eq. 3
Folded dipole transformation ratio:

$$\gamma \;=\; \left\{1 + \frac{\log \frac{2S}{d_1}}{\log \frac{2S}{d_2}}\right\}^2$$

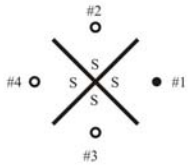
When $d_1 = d_2$, the last term becomes 1.

$$\therefore \quad (1+1)^2 = 4$$

γ = transformation ratio of Z_1 / Z_2

Eq. 4
Analysis of 90° corner reflector antenna with images:

$I_1 = 1\angle 0°$
$I_2 = 1\angle 180°$
$I_3 = 1\angle 180°$
$I_4 = 1\angle 0°$



where
#1 = real antenna
#, 3 and 4 = image antennas

Z_{12} = mutual impedance between antenna #1 and #2.

Z_1 = base impedance of antenna #1.

$$Z_1 = \frac{I_1}{I_1} Z_{11} + \frac{I_2}{I_1} Z_{12} + \frac{I_3}{I_1} Z_{13} + \frac{I_4}{I_1} Z_{14}$$

By substitution:
$Z_1 + Z_{11} - 2Z_{12} + Z_{14}$

Note:
I and Z are complex values.

$Z_1 = |Z| \angle \Psi \; R \pm jX$

Eq. 7
Reflection coefficient in decibels to SWR:

$$SWR = \frac{1 + |\Gamma|}{1 - |\Gamma|}$$

$$|\Gamma| = \left\{\frac{P_r}{P_f}\right\}^{1/2}$$

$|\Gamma|$ = reflection coefficient
P_r = power reflected
P_f = power forward

$$|\Gamma| \text{ (dB)} = 20 \log \left\{\frac{P_r}{P_f}\right\}^{1/2}$$

$$= 10 \log \left\{\frac{P_r}{P_f}\right\}$$

$$\frac{P_r}{P_f} = \text{antilog} \frac{\Gamma(\text{dB})}{10}$$

ie $= |\Gamma| = -15$dB

$$\frac{P_r}{P_f} = 0.0316$$

$$\Gamma = (0.0316)^{1/2} = 0.1778$$

$$SWR = \frac{1 + 0.1778}{1 - 0.1778} = 1.4326$$

Eq.5
Ground-plane antenna λ/4 gain and pattern over λ/2 dipole in free space (only lobe with real antenna):

$$\frac{F_1}{F} = \left\{\frac{R_{11} + R_{1L}}{R_{11} + R_{1L} + R_{14} - 2R_{12}}\right\}$$

$$2.83 \left\{\cos(S° \cos\phi°) - \cos(S° \sin\phi°)\right\}$$

where
I_1 = current antenna #1
I_2 = current antenna #2
I_3 = current antenna #3
I_4 = current antenna #4
R_{1L} = loss resistance of antenna #1 (1Ω assumed)
R_{11} = self resistance of antenna #1
R_{12} = mutual resistance of antenna #1 and 2
R_{13} = mutual resistance of antenna #1 and 3
R_{14} = mutual resistance of antenna #1 and 4
ϕ = azimuth angle from the plane bisecting corner angle
F_1 = field from corner antenna
F = field from dipole λ/2 antenna (free space)

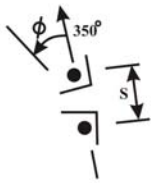
Note: Base impedance for grounded vertical antenna taken from self impedance curves computed by S. A. Schelkunoff.
Mutual impedance for identical antennas taken from mutual impedance curves of Chambers & Garrison.

Assumptions:
Infinite sides.
Infinite ground plane.

Eq. 6
Formula for antenna radiation pattern with the two antennas combined:

$E_\phi = E_{1\phi} \angle 0° + E_{2\phi} \angle S° \cos\phi°$

(H plane only)



S = spacing antenna #1 to #2 in degrees
ϕ = azimuth angle

Antenna pattern oriented:
#1 = 210° T
#2 = 300° T

S = 286°
ϕ = 350° T (antenna centerline)

Note: Because of the construction and orientation, no appreciable coupling between antennas was expected or observed.

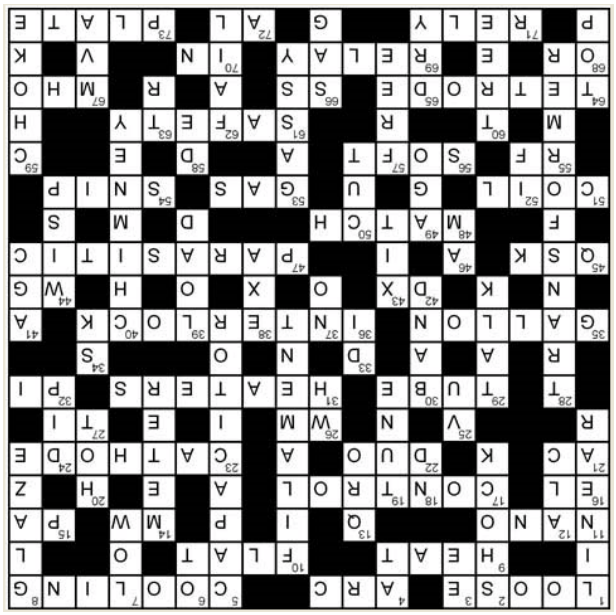
Reprinted In Part
Reprinted with permission, December 1985 QST; copyright ARRL.

In the May issue of the RT: Part 3 – "Construction and Installation" of the W6RYX antenna.

UP COMING EVENTS

HAMFEST LIST

April 3, 10 – Longmont ARC, **LARCFest**, Boulder County Fairgrounds
June 26-27, 10 – **DRC/ARRL Field Day**
July 17, 10 – **PPRAA Megafest**, Lewis-Palmer High School
August 22, 10 – **DRC Hamfest**, Jefferson County Fairgrounds. This is the BIG one, start planning to participate now.
Contact Bryan - KB0A for more information.

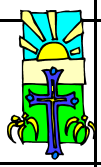
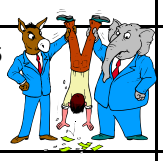
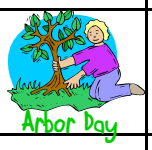


If you can't make the Field Day Event this is one you should seriously consider.

June 26-27,10 – Bike MS 2010
To volunteer contact Paul Garvey – K0BLM
Bike MS 2010 Communications Coordinator
303-520-5545 or k0blm@arrl.net

APRIL 2009

DRC Net Sunday 8:30pm Local

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1 	2	3 *LARCFest*
4 *Easter Sunday* 	5	6 Last Quarter	7 *Learning Net* 7pm	8	9	10
11	12	13	14 *Learning Net* 7pm New Moon	15 	16 	17
18	19	20	21 *DRC Meeting* Elmer 6:30pm General 7:30pm First Quarter	22 	23	24
25	26	27	28 *Learning Net* 7pm Full Moon	29	30	

Check www.ARRL.org for Contests and Rules!

DRC Board of Directors

President	W0GV	Gerry Villhaurer	303-467-0223	W0GV@hotmail.com
Vice-President	KB0A	Bryan Steinberg	303-987-9596	KB0A@arrl.net
Secretary	WA9TVH	Orlen Wolf	303-279-1328	owolf@mines.edu
Treasurer	K0TOR	Jim Beall	303-798-2351	K0TOR@arrl.net
Board Member	WG0N	Dave Baysinger	303-987-0246	WG0N@arrl.net
Board Member	K0HTX	Dave Gillespie	303-880-1938	K0HTX@comcast.net
Board Member	AC7SX	Joe Delwiche	303-233-6229	lakewoodjoe@aol.com
Board Member	K0RCW	Robert White	303-619-1048	rcwhitejr@mac.com

DRC Staff and Volunteers

Trustee	WA9TVH	Orlen Wolf	303-279-1328	owolf@mines.edu
Net Control	K0TOR	Jim Beall	303-798-2351	K0TOR@arrl.net
Emergency Coordinator	K0SSE	Oscar Hall	303-375-0627	oscarh1934@aol.com
Membership	KC0OUQ	Bob Proctor	303-986-0612	KC0OUQ@att.net
Club Librarian	WG0N	Dave Baysinger	303-987-0246	WG0N@arrl.net
VE Team	AC0T K0MEL	Wally Gamble Mel Minnick	303-202-0339 303-761-3456	wallygamble@comcast.net k0mel@msn.com
Swapfest Mgr	KB0A	Bryan Steinberg	303-987-9596	drcfest@comcast.net
Field Day	K0SSE	Oscar Hall	303-375-0627	oscarh1934@aol.com
Tech. Committee Chair	W6OAV	Bill Rinker	303-741-2537	W6OAV@arrl.net
APRS Chair	KB0MQQ	Lloyd Plush	303-277-0785	LloydPlush@aol.com
Benevolent		Carolyn Wolf	303-279-1328	
RT Editor	AG0S	George McCray	303-751-7246	AG0S@arrl.net
Education	K0RAR	Robert Rude	303-841-6443	K0RAR@comcast.net

DRC Repeaters

BAND	Freq / Shift / PL Tone	Additional Information
10m	29.620mHz (-100kHz) FM	Not In Service
6m	53.090mHz (-1mHz)	
Packet	145.05mHz<>14.105mHz	
2m	145.490mHz (-) 100Hz PL	**Linked to the 70cm - 448.625mHz machine.**
2m	147.330mHz (-) 100Hz PL	**Local Area, Members Auto-Patch Does Not TX a PL!**
2m	147.330mHz (-) 131.8Hz PL	**NE Area Remote Does Not TX a PL!**
1.25m	224.380mHz (-) 100Hz PL	
70cm	448.625mHz (-) 100Hz PL	**Linked to the 2m - 145.490mHz machine.**
70cm	449.350mHz (-) 100Hz PL	**Wide area coverage with Echolink Node # 4140.**

Editor's Note

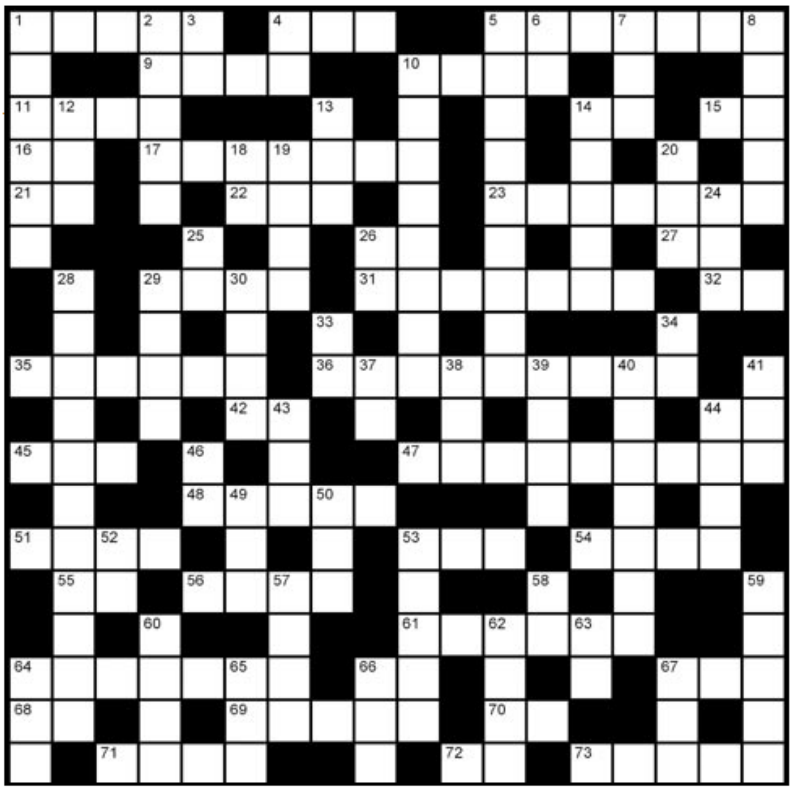
DRC members - this is your newsletter. If there is something which is club or amateur radio related that you'd like to see as a regular feature, email suggestions to the editor. Members are the heart and sole of The Denver Radio Club, if you have an expertise or an interest in a particular segment of ham radio that you'd like to write about, you may email your submissions to AG0S@comcast.net. Submission deadline is the 25th of the April. **Editor**

QRO: Under the Hood

Puzzle By H. Ward Silver, N0AX

At night, its glowing filaments light (and heat) the whole shack. In a pinch, an amplifier can make the difference between getting through and closing the log empty, whether it's in a DX pileup or in an emergency. This installment of the Crossword Puzzler celebrates the ham's equivalent of the V-8 engine and wide tires--the linear amplifier and its reliable workhorses, vacuum tubes.

Solution on page 8.



Across

1.Not tight
4. Current across a gap
5. Removing heat
9. Thermal energy
10. Low gain
11. One-billionth
14. Thousand kilowatts
15. Power Amp (abbr.)
16. Az-_ _
17. The means of adjusting
21. Varying voltage
22. A pair
23. Electron source
26. Wattmeter (abbr.)
27. Titanium (symbol)
29. Contains a vacuum
31. These raise the temperature
32. Output network
35. Legal maximum is a full ...
36. Safety mechanism
42. Distance (abbr.)
44. Waveguide (abbr.)
45. Full Break-In (signal)
47. Unwanted oscillation
48. Adjust to the same impedance
51. Inductor
53. Excessive power
54. Cut or trim
55. Radio Frequency (abbr.)
56. Old tubes get like this
61. What always comes first
64. Four element tube
66. Stainless Steel (abbr.)
67. Unit of conductance
68. Boolean complement to AND
69. Magnetically-controlled switch
70. Where the drive goes
71. Trust
72. Aluminum (abbr.)
73. Most positive electrode

Down

1. Replicates accurately
2. Electrical jolt
3. Engineer (abbr.)
4. Antenna Tuner (abbr.)
5. Stores electric energy
6. Old Timer (abbr.)
7. Not high
8. Smooth surface on ceramic
10. Lights up under power
12. Controls amp gain (abbr.)
13. High Power (signal)
14. Measuring instrument
18. Rarest Tenth District state (abbr.)
19. Adjust frequency
20. High temperature
24. Shows plate current resonance
25. Voice level units (abbr.)
26. Watt-hours (abbr.)
28. Changes AC voltages
29. Use your voice
30. Frequency range
33. Prefix for two
34. Touch the HV and you'll be one of these (abbr.)
37. Normally Open (abbr.)
38. Prefix for a billion-billion
39. Dummy
40. Glass air guide
41. Controls gain (abbr.)
43. Variable transmit tuning
44. First bit of smoke
46. Mode with a steady carrier
49. At a previous time
50. Stop the action!
52. Intermediate frequency (abbr.)
53. Contaminated vacuum
57. The best price
58. From (abbr.)
59. Keeps RF current out
60. Natural antenna support
62. To stop working
63. Switch between talk and listen (abbr.)
64. Not the bottom
65. Remove water
66. Hang down in the middle
67. One thousand kVA (abbr.)