Mt. AIRY V.H.F. RADIO CLUB, INC.

CHEESE BITS

W3CCX

CLUB MEMORIAL CALL

ARRL Affiliated Club

Volume XLIV **JUNE 2002** **Number 6**

PREZ SEZ

Sorry I missed the May meeting it sounds like it went very well. We all need to thank Paul WA3GFZ for all his tireless work and effort. Also thanks to the sponsors who contributed to make the awards program a success. The term CLUB means to me more than one person with common interest organizing to PARTICIPATE in activities as a group. I hope you keep this in mind this June. The contest effort needs operators even if you come up one morning and go back home that night you will be listed as participating. We want our contest effort to be competitive and fun, so what do you say? Come on up to the mountain…. that is all…. **73 N3EXA**

Thanks to our Donors and Congratulations to our Awardees

Donors:

Owen Wormser K6LEW $75

Bill Murphy W0RSJ $100	Brian Taylor N3EXA $100	Paul Sokoloff WA3GFZ $50	Joe Taylor K1JT $50
Bob Fischer W2SJ $100	Stan Smith K3IPM $100	Joe Keer W3KJ $25	Rick Rosen K1DS $25

The following were Award Recipients: Plaques were prepared and presented at the May 16th meeting.

1st Place Single Op High Power:	WA3NUF, PHIL MIGUELEZ SCORE 205,002 POINTS
2nd Place:	W3RJW, RON WHITSEL SCORE 119,600 POINTS
3rd Place:	N3EXA, BRIAN TAYLOR SCORE 116,928 POINTS
1st Place Single Op Low Power:	K1JT, JOE TAYLOR SCORE 130,914 POINTS
2nd Place:	WA3GFZ, PAUL SOKOLOFF SCORE: 86,095 POINTS
3rd Place:	W3KJ, JOE KEER SCORE: 69,915 POINTS
1st Place Multi-op:	N3NGE, LEN MARTIN WITH W2PED, WU3C SCORE 320,892 POINTS
2nd Place:	W0RSJ, BILL MURPHY WITH K2GE, W3DFM, W2IX, SCORE 165,760 POINTS
3rd Place:	K3EOD, AL BOBLITT WITH WR3P,W2SJ SCORE 42,160 POINTS

(continued on P9)

June Contest A Final Urgent Plea!

The final countdown to the June contest has begun! By the time you read this the June VHF QSO Party will be only a week or so away. Hopefully most of us have planned to set aside some time to help the club on the mountain or get on the air and work W3CCX. Although things are shaping up well for another successful effort, there is still an URGENT need for more help, especially on Friday. So to anyone who can find the time, please try to come up and help the club! Since my last report there have been some new developments. First I'd like to thank WA3NUF for again agreeing to do 2m one more final time. In a VHF contest multi op team the 2m guy is almost like the quarterback, so it's great to see one of our "top ops" over there. On 432, Bill, K3ESJ has offered some equipment and will try to come up for a while. Bryan N3EXA has agreed to help him and I will also help on that band. On the "bad news" front, Don, N3OZO has recently informed me that due to work conflicts he will not be able to make it this year. As most of us know, Don has, along with Doc (W3GAD) kept us well fed on the mountain for many years and I would like to thank him for all his help. Doc is still on, and I will pick up some of the work ,BUT WE COULD USE SOME HELP!! If you would like to help with the food, please contact W3GAD or myself. Following is a updated list of those I have signed up and the days they plan to be there. PLEASE CHECK FOR UR CALL IF YOU SIGNED UP, AND INFORM ME OF ANY CHANGES OR CORRECTIONS. ALSO I AM HOPING THAT THOSE I HAVE DOWN FOR FRI. CAN BE AT BOB'S FOR LOAD UP, THIS IS OUR WEAK SPOT NOW.

WA3RLT S Sun Mon	K1JT ? S Sun Mon	WA3GFZ F S Sun Mon
W3GAD F S Sun Mon	N3EVV S Sun Mon (**NEEDS RIDE UP SAT**)	NE3I ? Sun Mon
WA3DRC F S Sun Mon	K1DS F Rove (**NEEDS RIDE BACK FRI NITE**)	N3EXA F S Sun Mon
KB3XG F S Sun Mon	AA3GN F S Sun Mon	WA3YUE F S
W3IIT S Sun Mon	K3DMA F S Sun Mon	WA1YHO F S Sun Mon
WA3NUF F S Sun Mon	K3IUV S	N3ITT F S Sun Mon

TOTALS 12 Fri. 15 Sat. 15 Sun. 14 Mon. Is your name and call here?? Please make the effort. CONGRATS AND THANKS TO THE W3CCX CREW OF 2002! ALSO THANKS TO THOSE WHO CONTRIBUTED FINANCIALLY TO MAKE THIS POSSIBLE AND TO THOSE WHO PLAN TO WORK THE CLUB STATION IN THE CONTEST!! Well that's it, nothin left to do, but to DO IT!!! ENJOY THE CONTEST!!! 73, CU on the mountain or cu in the log! Al, N3ITT

PackRats **CHEESE BITS** is a monthly publication of the **Mt. AIRY VHF RADIO CLUB, INC.** -Southampton, PA.

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PACKRAT BEACONS - W3CCX/B
FM29jw Philadelphia, PA
50.080 144.284 222.065 432.295 903.071 1296.251 MHz
2304.037 3456.220 5763.190 10,368.140 MHz (as of 3/1/01)

MONDAY NIGHT NETS

TIME	FREQUENCY	NET CONTROL
7:30 PM	50.150 MHz	WA3EHD/K3EOD
8:00 PM	144.150 MHz	N3ITT
8:30 PM	222.125 MHz	W2SJ/N3EXA
8:30 PM	224.58R MHz	W3GXB
9:00 PM	432.110 MHz	W3RJW
9:30 PM	1296.100 MHz	WA3NUF
10:00 PM	903.100 MHz	N3AOG

THURSDAY NIGHT NETS (1st & 4th of the month)
9:30 PM 2304.100 MHz W3KJ, & go to 3.4G & up after

K2TXB Is pointing at the moon with a pair of long yagis on a polar mount, polarization steering and using JT44

Editor's Column

It's early May and I am wondering how much time I'll have for the VHF weekend already. Well, when your youngest daughter has her college graduation on Saturday afternoon, you know there will be some tension. Perhaps that night we'll do some local grids, then try the other long-haul stuff Sunday in the rover. At least I get to celebrate the last tuition payment done. The rover picture has continued to improve, both in numbers and station capabilities, as well as general activity on the real exotic bands, 24 and 47 GHz. Postings appearing regularly on new distance achievements, articles and photos on the reflectors and in the club newsletters, and a nice general rover article in the new CQ VHF publication. It was interesting to read the details of……………..12 volt connectors and fusing arrangements, something that needs more attention in my set-up.

I am happy to report that I am back on the low bands also, having installed the Spider antenna on the van and the G5RV in the attic. Despite sub-optimal layout, it seems to load and work out very nicely on 40-10m, with plenty of phone and cw DX activity. One of the advantages is being able to refresh some higher speed CW skills on the low ends of the bands. Having picked up a stack of aluminum from an old 6m beam at the last Mario Raffle, It is encouraging me also to have an attic VHF-UHF array—I'll be trying to piece some older smaller antennas together to be able to operate at least on 6 thru 432 from home without having to assemble the rover set-up.

The January results appear to be complete, and from the reports from the NEWS group and the Rochester gang, although we appear to have again had the best score in the Unlimited Club class, it is the Rochester club that had a score about 200K higher, with fewer entries in the Limited Club class.. They had some super results, with two of their multis amassing a combined total of 1 million points, and several of their rovers contributing another half million. Kudos to our *confreres* (how do you like that little word Tom?) in the snow-belt. The stories in their newsletter were a treat and a fine example of dedication to task. How will we respond in 2003? Who will be the super powers for next year, and where will Murphy strike?

All of the membership should be happy to see that we are continuing to grow our ranks slowly, with hams who have a desire to participate actively, and bring their skills and support to the club. The nominating committee will soon be seeking a slate of officers for the coming year, and this year's incumbents seem to be in a position to maintain their posts, having done such a fantastic job. As I get at least a dozen club newsletters, I am always surprised to see rosters of other clubs up over 100, with a list of committee chairpersons encompassing about half of the members. It is essential that all contribute to the operational needs of the club (officers, board, publication) and the activities (speaker, event chair, attendee, operator, cook, driver, key-holder, etc). During this past year we added the positions of Quartermaster and replaced the outgoing Awards Chairperson. Other important include those listed in the left-hand column of this page. Please, let's all show them our appreciation for the jobs they do, without reward, and to pass on your positive comments about their efforts and labors. Several active folks are looking for apprentices to manage contesting support needs for the future—you can help, if even for just a few hours as we need folks to help load, drive, unload, operate, log, cook, clean-up, pack-up and return. Don't let Al go begging—volunteer and commit some time for the club now.

We have reduced the mailed copies to 65/month and with each solicitation, we have more PDF subscribers. You can still do it—and get this in full color, and about a week before the mail copy arrives...send an email to rick1ds@hotmail.com

Please bring your cameras for all of the June activities so we have plenty of material for the next issues. Special mention to the photog who captures a Camelback bear on film. 73, Rick, K1DS

JUNE CONTEST FAQs

Q: I am not a contester, what can I contribute?
A: No matter what your background, capabilities or previous contest experience has been, the effort to run a contest on at least a dozen bands from the remote site atop Camelback needs help loading, unloading, setting up, operating, logging, cooking, cleaning, greeting visitors, breaking down and packing up. Not only are you welcome to help, but we implore you to be part of the team and spirit of the effort. For those who are new to the club, this is a great group bonding event. You will get exposed to lots of interesting gear and accessories, big VHF antennas, high powered VHF and UHF and microwave amps, computerized logging, plenty of eating and drinking, and enough memories to last a year (or more!)
Q: How do I get to the W3GXB QTH to load Fri AM?
A: see map on page 9, please be there at 8AM
Q: I can't get to Bob's, how do I get to the mountain? And what should I bring?
A: see map on page 9, plan to be there any time after 1PM Friday. Bring some personal tools that are marked with your name or color. Various socket and ratchet wrenches are the most useful. Bring clothing for both warm and cold weather, and some rain gear, as mountain-top conditions are variable. A sleeping bag, cushion and changes of clothing, plus your personal toiletries and toilet paper. Expect to sleep in your own car/van or plan to catch a space on the floor of a communications truck. Insect repellant and sunscreen would also be advisable. Cell phones can be used, but not to set up any QSOs while contesting. Contacts may be made between club members who participate in the event and the club station on frequencies at 2304 and above, so bring any gear that is portable on those freqs, especially your laser communicator.
Q: What about food and drinks?
A: The club supplies meals and drinks from Friday evening through Monday breakfast. Friday lunch is usually a hoagie from the shop at the base of the mountain, and you can also pick up some personal snacks there also.
Q: Due to other obligations, I can't devote the whole weekend to the event. What if I can only some for a limited time? Can I come at night?
A: All time contributed to the effort is appreciated, as there will be errands to run, relief needed for the ops, and assisting as a logger or in the chuckwagon. The road to the top of the mountain is chained for security purposes at night after 8PM, and opens again at 8AM. Plan accordingly, and if a special exception is needed, see Al, N3ITT.
Q: I just can't get to the mountain at all due to XX, YY and ZZ……..so how can I support the club effort?
A: By being active and making QSOs with the club station from your home or other QTH, you will contribute to the multi-op club score. If you can only make it to Bob's to help load or unload (Monday about 11 AM or so) that would also help.
Q: Can I get a ride or give a ride to anyone?
A: Yes, by all means! We are currently seeking a ride down the mountain on Fri. eve for K1DS, and a ride up for N3EVV on Sat AM. Post your available or needs on the club reflector, or call Al, N3ITT at 610-547-5490.
Please make time to support the club effort.

Radio Action June 2002

SUN	MON	TUE	WED	THU	FRI	SAT
						1 Microwave activity 7A-1PM
2	3 Mondays are Net Nights. See P2 for times and freqs and net	4	5	6	7 Load the vehicles at QTH of W3GXB (p9)	8 VHF contest starts at 1900Z
9 VHF Contest ends at 0300Z Sun nite	10 Take down and return 8AM	11	12	13	14	15
16	17 Mondays are Net Nights. See P2 for times and freqs and net	18	19	20 Club Election Meeting-8P	21	22 ARRL Field Day
23 ARRL Field Day	24 Mondays are Net Nights. See P2 for times and freqs and net	25	26	27	28	29
30						

DIRECTIONAL COUPLERS USED FOR VSWR AND POWER MEASUREMENT

by Dick Knadle, K2RIW, 4/25/02.

INTRODUCTION -- Over the years I have heard many engineers, and some smart amateurs, express opinions that reflect a considerable misunderstanding about the operation of Directional Couplers, and how to properly use them in the measurement of Voltage Standing Wave Ratio (VSWR), and power. This memo is intended to give some basic information that may help. At first, the average electronic technologist is mystified by at least two of the concepts of how RF behaves within transmission line structures:

(1) The concept of a Directional Coupler (DC); the idea that it favors a signal that flows in one direction, yet rejects (at least partially) a signal that flows in another direction seems (to them) to be in violation of some basic laws -- like the Law of Reciprocity.

(2) On top of this, many technologists have great difficulty believing that a normal transmission line, completely keeps separate, the signals that flow in the two directions on that line, even if those two signals originally came from the same source.

I believe that both of these principles must be absorbed (and understood), if meaningful DC measurements are to be properly executed, and believed. Here are my recommended procedures, with some partial explanations of what is taking place at each step.

A DIRECTIONAL COUPLER USED IN A VSWR OR POWER MEASUREMENT PROCEDURE

(I) DIRECTIONAL COUPLER CALIBRATION -- The first step in this procedure is to establish the quality of the Directional Coupler (DC) that you are about to use. I don't care if the label on the DC says it is a "Cadillac" or "Rolls Royce" brand, and the calibration sticker says it is traceable to "The Bureau of Standards" with and accuracy of 0.01 dB; you still have to confirm that it is good working order right NOW. It is possible that the DC was thrown onto a concrete floor yesterday, and the internal termination may have been shattered. If that had happened, it could loose almost all of it's directional characteristics -- it's "Directivity." The confirmation requirement is similar to the proper use of an Ohm Meter. Notice that a good technologist will always short the two leads together; and the Ohm meter had better read a small fraction of an ohm, before the technologist will proceed with the next measurement. Similarly, a prudent technologist will measure the Directivity of the DC he is about to use. It is also useful to know that sometimes the DC can be used far outside the frequency range it was designed for, as long as the principle of operation is somewhat understood, and a calibration at the present frequency is performed. Here is the Directivity Confirmation procedure.

DIRECTIVITY CONFIRMATION -- Unfortunately, the Directivity Confirmation procedure requires a known good termination (dummy load), and the procedure will have an accuracy that rarely is much better than the quality of that termination being used. First apply an RF signal to the DC "input" port, with a known good termination connected to the "output" port. Position the DC so that it favors the Forward flowing signal. Place a power-measuring device at the directional port. This can be a Power Meter, Spectrum Analyzer, calibrated Crystal Detector, Scalar Network Analyzer, etc. Measure (and record) the DC's response to the forward-flowing signal (in dBm units). If, for instance, you are using a known Directional Coupler (DC) with a -10 dB Coupling Coefficient, the measured power should be nearly 10 dB weaker that the power that's being applied from the signal generator. By the way, "dBm" means Decibels of signal strength with reference to a 1 milliwatt signal. Next, reverse the DC "input" and "output" ports, and repeat (and record) the previous measurement. The difference in the two readings indicates the Directivity. For instance; if a 0.0 dBm signal generator is applied to a 10 dB coupler, and it measured -10 dBm during the Forward Measurement, and -30 dBm during the Reverse measurement, that would indicate a Directivity of 20 dB (the difference in the readings). A DC of "Good" quality will show a directivity of 20 dB, that is, the apparent reflection from the termination will appear to be -20 db (an apparent VSWR of 1.22:1), even if the termination is a perfect 50 ohm resistance at the present frequency. An "Excellent" DC will show a Directivity of 30 dB (an apparent VSWR of 1.065:1), and there are Instrumentation-type DC's that can display a Directivity of over 50 dB (an apparent VSWR of 1.006:1). More on this later; there are ways of improving your DC's Directivity. Simplistically, you could say that a DC that displays a Directivity of 20 dB will not be able to easily resolve the Reflection Coefficient from an unknown load of better than about -20 dB, there are ways to get around this. Depending on how well your DC is internally balanced, the finite Directivity (-20 dB for instance) represents the degree of response it has to a signal that is flowing in the wrong direction -- this is really it's degree of imbalance. A modern Network Analyzer uses a complicated "12 point" calibration procedure to drastically improve the accuracy of a Reflection measurement it makes with it's "only Good quality" Directional Couplers.

ALTERNATE CALIBRATION PROCEDURE -- There is an alternate Calibration Procedure that does not require the inconvenience of reversing the DC to measure it's Directivity. This is to recognize that a good Short (or Open) circuit has a Reflection Coefficient of nearly -0.0 dB. In this method, first measure (and record) the apparent reflected power from a Short (or Open) termination, then place the Known Good Termination on the "output" port of the DC and repeat the measurement. The difference (in dB) between the two measurements represents the DC's Directivity. When using SMA or type N connectors at 10 GHz (and below), an "Open Circuit" will have Reflection Coefficient of nearly -0.0 dB, and is a good calibration "short/open termination." However, if you're using a Wave Guide (WG) type DC, an open circuited WG flange makes a pretty good transmitting antenna, with a VSWR of about 1.5:1 (reflection coefficient of about -12.9 dB). Therefore, don't use this as a high reflection termination. Instead, place a sheet of metal (tightly) across the WG flange as the high reflection termination.

SIGNAL GENERATOR VSWR -- There is an additional danger to the alternate calibration procedure. It is vulnerable to the VSWR of the signal generator. I would only use this procedure if there was a 10 dB (or greater) pad between the signal generator and the DC. Without that pad, the reflected signal could re-reflect from the signal generator and cause a confusing reading. The signal-generator-reflected voltage can add to the incident voltage and create an apparent signal source that would appear as much as 6 dB greater (or more) in magnitude -- but only during the short/open portion of the test. Also, if the DUT happens to have a rather high VSWR (reflection of greater than say -20 dB), I again would recommend the use of a 10 dB pad at the signal generator.

(II) THE UNKNOWN MEASUREMENT -- Once you have confirmed that your DC is performing properly, it is time to place the Unknown Circuit (the Device Under Test [DUT]) on your DC to measure, and tune, it's Reflection Coefficient. The DUT-reflected signal can then be translated into VSWR by using a look-up table or by performing a two step calculation. Step (1): Convert the reflection coefficient (in dB) into a reflection Voltage, which is usually represented by the Greek letter Rho. Step (2): Convert the Rho magnitude into VSWR.

(1) Rho = ALOG(-dB/20)

(2) VSWR = (1 + Rho) / (1 - Rho)

Where: ALOG = Anti-LOG, or 10^(-dB/20)

Rho = |Absolute Value| of the Reflection Coefficient (as a Voltage).

The final dB of Reflection Coefficient in the numerator must be a negative number that's then divided by 20 and raised to the power of ten in formula (1). At first, some technologists will understand that the dB value is negative dB's, they place it into the formula that has another negative sign in it, that converts it to a positive value (+), and they come up with answers that are crazy.

CHEAP AND BROAD -- The beauty of using a Directional Coupler (DC) in VSWR measurement is that, generally, they are rather inexpensive, and they are rather broadband, therefore a swept frequency measurement is possible if your power detector is a fast acting one, such as a calibrated Crystal Detector (and oscilloscope), a Spectrum Analyzer, or a Scalar Network Analyzer (SNA). As you tune your DUT, it is nice to know that you are tuning for a broadband match, as apposed to an impedance match that is only effective across a narrow frequency range.

(III) DC ALTERNATES -- There are a large number of devices that can serve as the Directional Coupler (DC). They have such names as Quadrature Hybrid, 90 Degree Hybrid, Branch Hybrid, Branch Coupler, Magic T, Ring Hybrid, Zero-180 Degree Hybrid, Wave Guide Broad Wall Coupler, Wave Guide Narrow Wall Coupler, Wave Guide Beth Hole Coupler, etc. The one kind of hybrid that can't be used this way is a Wilkinson Half Hybrid, or Zero Degree Hybrid.

(IV) DC EXTENDED FREQUENCY RANGE -- Few technologists know that a well constructed Directional Coupler (DC) has an operational frequency range that extends many octaves in the lower-frequency direction. For instance, if you plotted the Forward Response of a DC that's rated for operation from 1 to 2 GHz, you would find that it has useful operation all the way down to 10 MHz (and probably below). The only thing that changes is it's frequency flatness, and the Coupling Coefficient decreases -- but that can ba a considerable advantage. Here is what's happening:

(A) A TEM-type (non Wave Guide type) Directional Coupler has it's greatest coupling at the frequency where the internal coupling section is 1/4 wave long. Above (and below) that frequency the response falls off in a very predictable manner -- it's a SINE wave of amplitude. In other words, if I was sweeping that DC that's rated for 1 to 2 GHz, and I plotted the Foreword absolute Voltage response versus frequency at the Coupled Port, the resultant plot would look like a rectified SINE wave, with the horizontal axis being frequency (instead of time). There would be a zero response a zero MHz, a broad peak near 1.5 GHz, a second zero near 3 GHz, a second broad peak near 4.5 GHz, etc. Unfortunately, a DC only has Directivity at the 1/4 wavelength frequency region, and at lower frequencies -- but that still leaves many octaves of useful operation.

(B) That predictable response outside of the rated frequency range has turned into an advantage for me on many occasions, here are some examples:

For my first published article, "A Stripline Amplifier/Tripler for 144 and 432 MHz", Ham Radio, February, 1970, I needed to test the power output, and harmonic content, of the 144 MHz section and the 432 MHz tripler section of that 4CX250B amplifier. I needed a 300 watt frequency-indicating power meter, that I didn't have. A Spectrum Analyzer (SA) can do the job, but it can't tolerate the 300 watts. If I had a -30 dB DC, the coupled power would be 0.3 watts and the SA could easily make the measurements. But, my company's Instrumentation Department said they didn't have a -30 dB DC at that frequency range, and non of their DC's could tolerate 300 watts.

I studied what they had and found a solution. They had a Narda -10 dB type-N Directional Coupler rated for 8 to 12 GHz and 1 watt maximum. I reasoned that the coupling section was 1/4 wave long (90 degrees in phase length) at 10 GHz, the center of it's frequency range. I then divided 144 MHz by 10 GHz, multiplied by 90 degrees, and reasoned that the coupling section was only 1.296 degrees long at 144 MHz. The SIN of 1.296 degrees is 0.02262. Since this is a voltage response I took 20*LOG(0.02262) = -32.9 dB. That means that the coupled response at 144 MHz would be -32.9 dB (weaker) than at 10 GHz, where it was a -10 dB coupler. Therefore it is a -42.9 dB coupler at 144 MHz. I calibrated it at 144 MHz and found it to be a -43.1 dB coupler -- close enough. And, since the internal coupled line is isolated from the main line by -43.1 dB, that means that the internal 50 ohm termination would never see more than 0.015 watts when I applied 300 watts of 144 MHz signal to the coupler. I similarly calibrated it at the harmonic frequencies, applied the 300 watts to it, it worked like a charm, I made all the measurements this way, and they appeared in the article.

2) In the low frequency area of a coupler's response (near 0 degrees of a SIN function) the response is almost a straight-line response that falls off at -6 dB per octave (-20 dB per decade) as you go down in frequency. Therefor the "-43.1 dB coupler" I used at 144 MHz would be a -63.1 dB coupler at 14.4 MHz. As you are about to see, Directional Watt Meters use this principle.

(V) BIRD-TYPE WATT METERS -- It is interesting to note that the slug of a Bird Watt Meter is also a less than 1/4 wave section of a Directional Coupler. The Bird slug achieves frequency flatness across it's rated frequency range by using a rectifier circuit that has a low-pass filter action that rises at 6 dB per octave as you go down in frequency. Each slug also has a finite Directivity, depending on how well it was balanced and calibrated at your favorite frequency. Therefore, be careful about falling into the trap of using a high power slug to measure the forward power of your 1 kw XMTR, and then switching to a low power slug to measure a very low VSWR. Your antenna may be perfect, and have no reflected power (voltage), but the slugs approximate 20 dB of Directivity would show an apparent antenna reflection of -20 dB (10 watts). That would lead you into believing that the antenna VSWR was 1.22:1.

(VI) COUPLER IMPROVEMENT TECHNIQUES -- AS the above material shows, a DC that has less than ideal Directivity is really displaying a slight imbalance that causes it to slightly respond to the signal that is flowing in the wrong direction on the main line of the coupler. There are many ways of improving the DC's balance.

(1) Internally, you could re-adjust the accuracy of it's termination, or you could add a small gimmick capacitor in the correct location to improve the Directivity balance.

(2) But, an even better way is to use a Double Slug Tuner, or a Wave Guide E-H Tuner. If you have a known good termination, you can assume that it has perfect absorbtion and essentially no reflection. You then place the tuner between the DC and the good termination, and adjust it until the DC shows no reflected power from the termination. You then leave the tuner connected to the same port of the DC, while you proceed with the VSWR or power measurements. When you were adjusting the tuner for a null in the DC's Reflection response, you were really creating a second small reflected signal that was equal in amplitude and 180 degrees out of phase at the DC coupled port. That created the improved balance and made the DC nearly ideal, at that frequency. The bandwidth of this DC correction technique is dependent on the amount of correction that was required. When in doubt, recheck the balance at the next frequency.

(VII) TRANSMISSION LINE DIRECTIONALITY -- When I tell a technologist that a transmission line will keep the two signals completely separate, that flow in opposite directions on a transmission line, they often don't believe it -- particularly if the two signals came from the same source. There are many RF tests that could be performed to prove this, but I have discovered that a

well-informed sceptical person can always come up with an alternate explanation that supports their point of view. I have found that the best way is to use visual experiments. (1) A pool of water is really a radial transmission medium. If I drop a pebble at the North end of the pool, waves will travel to the South. Similarly, a pebble dropped into the South end will create waves that travel to the North. If I drop pebbles at both ends of the pool, the waves will meet at the middle, and pass right through each other with no interference, as long as the waves are kept small enough (use the linear region of wave amplitude -- no white caps).
(2) I can tap the 1/4 inch guy wire on my 200 foot Rohn-55 tower and watch the wave travel up the guy wire, strike the tower, reverse in polarity, and propagate back down to me (it hit a "short circuit"). I can wait until the wave has struck the tower, and started back to me, then I can strike the wire again (with any polarity) to start a second wave going up the guy wire. As the two waves meet in the center, they pass right through each other with no interference, as long as the waves are small enough that I don't get into non-linear stretch (deflection) of the steel. (3) I say that most linear transmission mediums obey this property -- even RF in free space. Those waves that meet in free space pass through each other with no real interference. When you move your Handy Talky Radio around a room that is reflective, you will find what you think are signal nulls. This is because you are using an antenna that has no Directivity, and it is responding to at least two waves that are out of phase. Similarly, the probe that is used on a Slotted Line VSWR setup has no directivity, and it displays the Standing Wave Ratio that is caused by the signals that flow in both directions through the Slotted Line. This measurement technique has become the classic way of specifying the Reflection Coefficient of an RF device -- it's VSWR.

(VIII) LETS DO AWAY WITH VSWR -- If you took the directional probe from the slug of a Bird Watt Meter and operated it on that Slotted Line, you would discover that the Standing Wave has disappeared, and you could now independently measure the amount of power (or voltage) that is flowing in each direction (by reversing the slug) -- that's really what you wanted to know in the first place.

In the past, that Slotted Line measurement was the only way you could conveniently measure the reflected voltage -- by using an interferometry technique to indirectly measure it as VSWR. It really is time that we abandon "VSWR measurements" because we don't do it that way any more. We should only discuss the Reflection Coefficient -- in watts ratio, volts ratio or dB ratio (choose your favorite units), because we now directly measure the reflected signal. We RF mavens seem to spend half our life converting back and forth between VSWR, Voltage Reflection Coefficient (S11, S22) or Power Reflection Coefficient, just so that we can communicate with a technologist (or the data sheet) that uses the other system of units. "VSWR" is now a "coded message," it's really time that we "Break the Code" or stop using that code when we're training the new RF recruits. I'll admit that we will have to keep mentioning it, for historic reasons.

(IX) TROMBONE IMPROVEMENT -- I'll warn you that these last three paragraph will only be appreciated by a person with a rather exacting-type of personality.

Once you accept the fact that RF power can independently flow in two directions on a transmission line, you then realize that changing the length of a lossless transmission line does not change the Reflection Coefficient; thus it doesn't change the true VSWR of your antenna. However, if the Directional Coupler (DC) device your using (coupler or a Bird) has less than ideal Directivity, than the Reflection Coefficient, and VSWR, will appear to change. This is because there is a small amount of Forward-flowing signal (I'll call it the Leakage Signal) that's mistakenly being picked up by your coupling device, that beats against the real Reflected Signal that your coupler is now measuring (from your antenna, for instance). As you change the length of the transmission line (with a Trombone Line), the two signals go in and out of phase with each other. This will show up as a cyclicity of the apparent Reflected Signal Power, as the Trombone is operated. This assumes that your trombone can move about one wavelength at your frequency -- you not going to do this at 80 meters, Hi. Although, there you could insert fixed lengths of low loss cable to get the same effect.
Knowing the operation of the system, and its shortcomings can allow you to gain a higher accuracy in the Reflection Coefficient measurement. A perfect DC or Bird would show no change in reading as the Trombone (on the antenna side) is operated. The magnitude of the "ripple" is an interferometry effect that is telling you exactly how strong is the Leakage Signal into your coupling device. Once you know the strength of the Leakage, you can subtract it out of your measurement. This is exactly the accuracy improvement procedure that is done in the microprocessor of a modern Network Analyzer. You can convert the Ripple into a Leakage Magnitude by using the following formulae:

$$\text{Leakage Voltage} = (a - 1) / (a + 1).$$
$$(1)\ \text{Leakage Voltage(dB)} = 20*\text{LOG}[(a - 1) / (a + 1)].$$
$$a = \text{ALOG}[\text{Ripple} / 20].$$

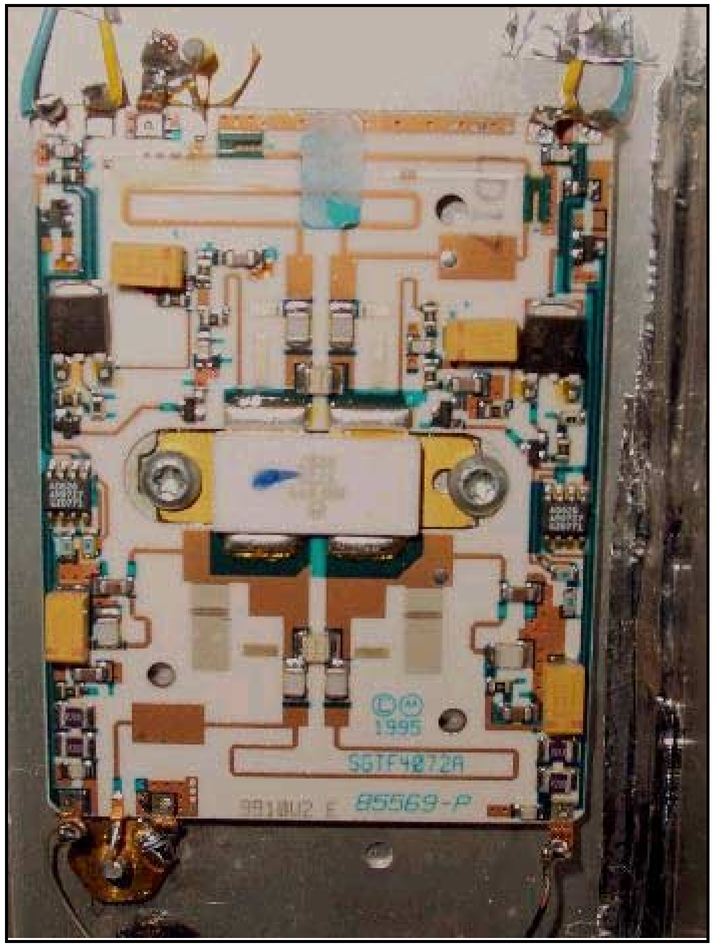
Where: Ripple is expressed in Peak-to-Peak dB's, a positive number. LOG is calculated in base 10. ALOG is the Anti-Log, or 10^(Ripple / 20). "a" must be a positive number, greater than 1. Here is a measurement example. Assume I'm measuring the Reflection Coefficient of my UHF antenna system and my DC says that the Reflection is around -19.5 dB. As I operate the Trombone after the Coupler, I see a Peak reading of -19 dB, and a valley reading of -21 dB. That's a Peak-to-Peak reading of 2 dB. The formula tells me that my Leakage Signal is 0.1146, or -18.81 dB (weaker) than the Peak and Valley measurements I have made. That relative Leakage voltage was in-phase at the -19 dB reading, and out-of-phase at the -21 db reading. I can choose to subtract the voltage from the -19 dB, or add it to the -21 dB reading. This relative voltage will thus be 1.1146, or 0.9954 (as a voltage), and I can take 20*LOG of these voltages. Thus, I can either add 0.94 dB (in absolute terms) to the -19 reading, or subtract 1.06 dB (in absolute terms) from the -21 dB reading. In either case the corrected reading will be an antenna Reflection Coefficient of -19.94 dB.
I hope this information is useful to those who could read this far. Feel free to correct the mistakes.

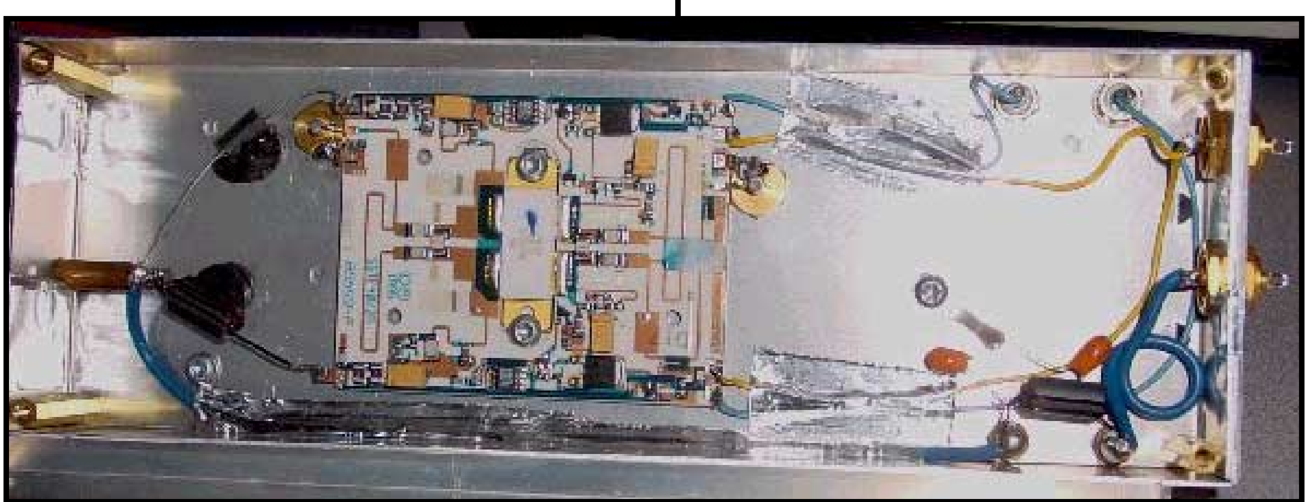
73 es Good VHF/UHF/SHF DX,
Dick K2RIW. Grid FN30HT84DC27

903 MHZ 150 watt amplifiers

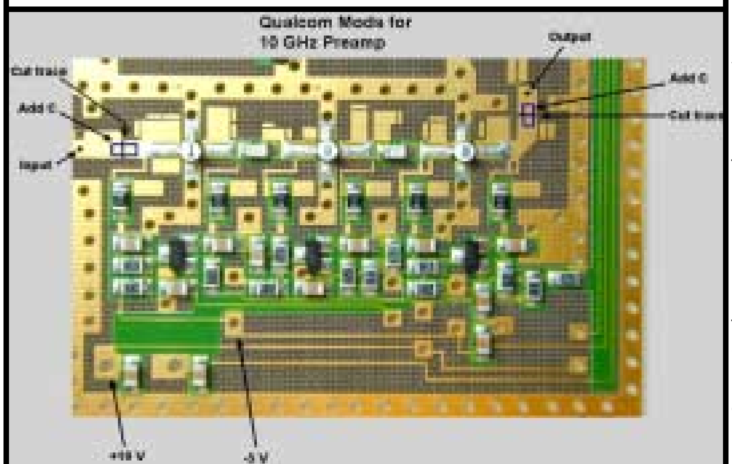
Using those 903 MHZ 150 watt amplifiers I finally got around to packaging a 150 watt 903 amp. When I started my objective was to go to the junk box and find the needed parts avoiding spending more money. That goal was met without difficulty. Most of the members can accomplish the same thing. Dave, W3KM suggested making an PC board interface to the amps since they are on a fragile alumina substrate. This was a great idea; one that I supported. But I got looking around and thinking about making a board and decided that would take too much time. I then looked for an easier (faster) way to get this project done. What I did was use 2 female chassis mount SMA connectors with a short piece of .100" Teflon coax that I had acquired and mount them very close to the RF in and out tabs on the board. (See Cheesebits 2-02 or my written description for pin layout) I cut most of the Teflon coax off leaving only about 12 mm of cable. I then cut off the shield and Teflon insulation and bent the center conductor over to mate with the tabs and soldered them in place. Next I soldered the ground tabs of the boards directly to the SMA connectors. Use lots of heat here; once the solder flows onto the SMA connector push the ground tab over with the iron and solder it in place. DO NOT keep the heat on the ground tabs while waiting for solder to flow on the connector body, they may break! Next I brought out the bias tabs to a 1000 pf feedthrough. Following that I brought out the extra tabs that do not seem to be required for our purposes, just in case I ever wanted to do anything with them. I am not clear on how Motorola used these terminals. Finally I brought both 26 VDC tabs to a common point through RF chokes. Use a VK-200 here using wire sufficient to handle about 5 amperes. Since I was soldering directly onto the tabs of the board I then used a large glob of silicon adhesive to hold the RF chokes in place avoiding stress on the tabs themselves. From there I ran a #14 wire to a terminal with a .47 UF tantalum capacitor to ground and then used a third choke to another terminal with an additional .47 uf tantalum. Finally a #14 to a 1000 pf feedthrough. Looking at the pictures you will get an idea how I laid this project out. I had to do some creative cutting of the heatsink around the SMA connectors. Notice that I used metal tape over the wires running next to the board. I did this for two reasons; to hold them in place avoiding stress on the tabs, and for RF shielding as they pass the board. The box I used is a little large but I had it on hand. A possible modification would be to include the voltage regulator within the amplifier box for the 15.5 VDC bias voltage. This must be a well regulated voltage to maintain the linearity of the amplifier. Of course a much smaller box would also work. Make sure you use enough heatsink. BNC or N connectors would be alternatives though they would require long leads to and from the amplifier RF tabs potentially causing problems.

Good luck, Randy Bynum, NR6CA





Rick got my mind off LNB's and thought I would mention the Gold Board we have here also. Is normally a 12 Ghz multistage Rf pre amp part of a much bigger board. We cut with scissors the Receiving Rf pre amp out and band saw the housing the contained the entire larger board into a small chunk about 3 by 3 inches sq. and 3/4 inch high. Without retuning we get 1-2 nf and 27 Db gain at 10 Ghz. Same principal as before add chip cap to input output and supply +10 volts and -5 volts bias for amp. Have assemblies containing Gold board and larger aluminum housings to cut amp metal required in conversion. When complete have SMA input output conversion pre amp. Will attach picture of RF amp without required housing. If you can band saw aluminum housing cost essentially same as LNB with hosing and postage for entire unit. Parts required 2 1-2 Pf chip caps and 2 SMA connectors long shank for mounting on bottom of housing. **Best 73 Chuck WB6IGP**



Dayton Hamvention News

ARRL DONOR RECEPTION FEATURES NOBEL LAUREATE JOE TAYLOR, K1JT

From The ARRL Letter Vol. 21, No. 21 May 24, 2002

A highlight of ARRL's Dayton Hamvention-related activities was the inaugural ARRL Major Donor Reception, hosted by Chief Development Officer Mary Hobart, K1MMH. Nobel Prize laureate and QST author Joe Taylor, K1JT, was the guest of honor as the League recognized donors who have generously supported ARRL fund-raising campaigns. Now the dean of faculty at Princeton University, Taylor was first licensed at an early age, and he regaled the audience with tales of his formative years as a young amateur building gear with parts from cast-off TV sets. Inactive for several years as his professional endeavors burgeoned, Taylor got back into the hobby in 1999 and started applying his professional knowledge to Amateur Radio, making use of the same techniques successful in digging extremely weak signals from the stars. Taylor and Russell Hulse, ex-WB2LAV, won the 1993 Nobel Prize in Physics for the discovery of the first orbiting pulsar. Taylor is most recently known in the amateur community for his development of the WSJT software for meteor-scatter and other weak-signal communication work. (See "WSJT: New Software for VHF Meteor-Scatter Communication," by Joe Taylor, K1JT, QST, Dec 2001.) A historical sidelight: The event was held in the rooms where the Dayton Peace Accord was signed. ARRL Chief Executive Officer David Sumner, K1ZZ, and President Haynie included presentations of Education & Technology Fund gifts to Kay and Carter Craigie, WT3P and N3AO, and to David Brandenberg, K5RQ, to recognize their extraordinary generosity to the ARRL Education and Technology Program--"The Big Project."

MOST IMPROVED SCORE WA3EHD, JIM ANTONACCI 859% INCREASE SCORE 35,904 POINTS

2002 HOME BREW AWARDS

BEST CONSTRUCTION: STEVEN KERNS N3FTI

MOST UNIQUE: RICK ROSEN K1DS

BEST DESIGN: PAUL SOKOLOFF WA3GFZ

BEST PRESENTATION: BOB GRIFFITHS NE3I

MOST INGENIOUS: LEN MARTIN N3NGE

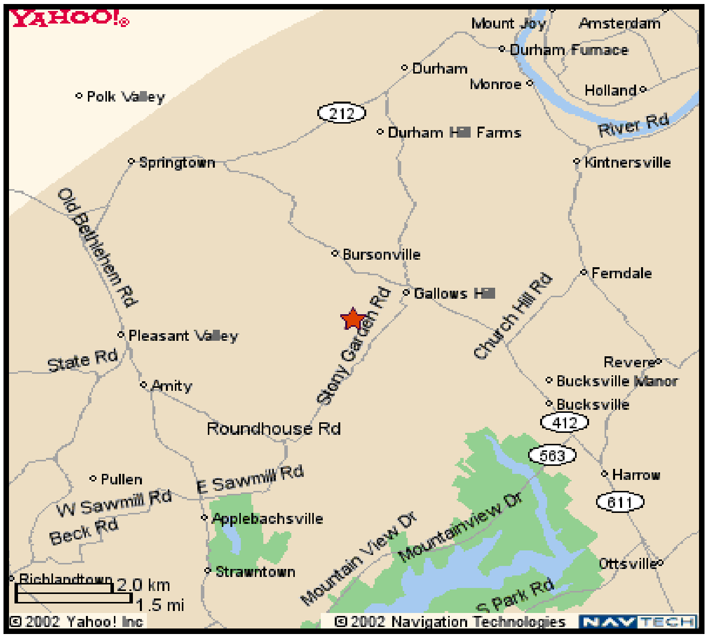
MOST ECONOMICAL: CHRIS GETMAN N3PLM

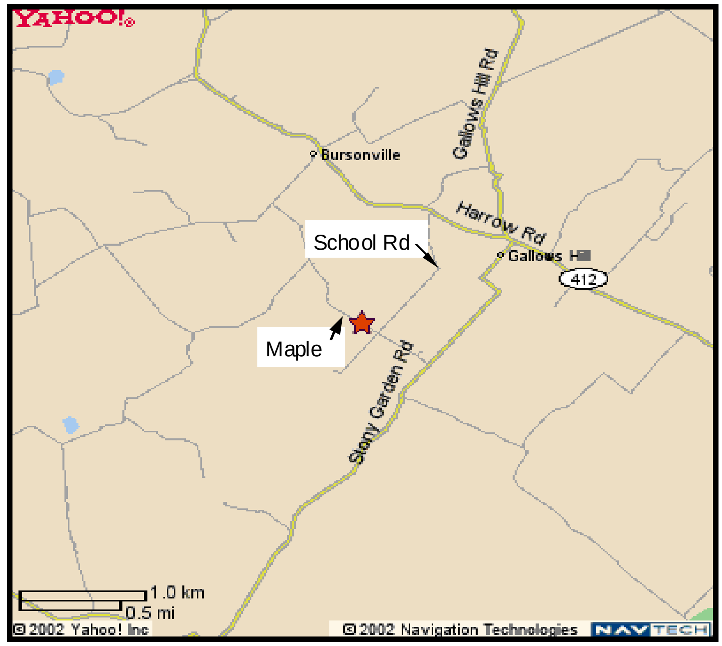
DOC CUTLER (K3GAS) MEMORIAL AWARD: DOC WHITTICAR W3GAD

Packrat of the Year: Rick Rosen K1DS (*thanks for all of your support! Editor*)

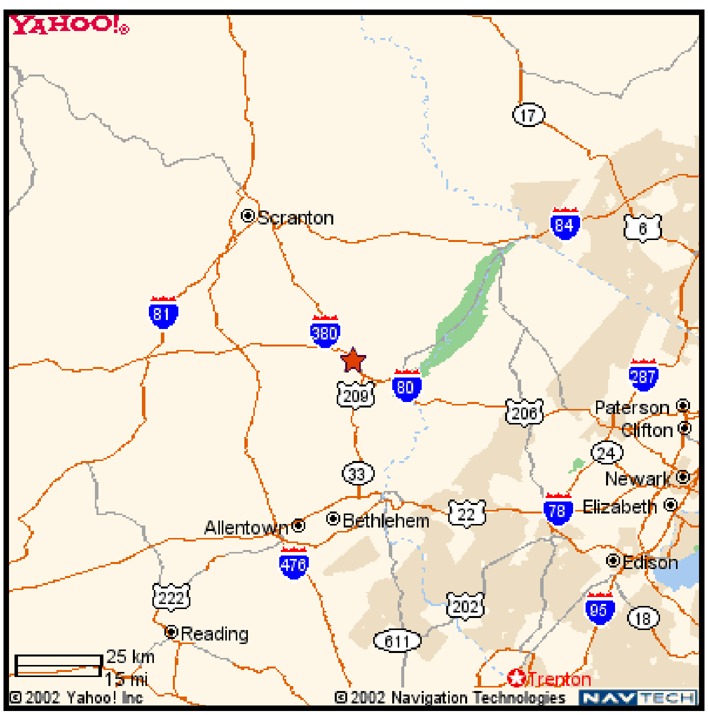
Directions to Bob, W3GXB for Friday, Jun 7th: Take 611 North out of Doylestown, bear Left onto 412 at Harrow, Make a left onto School Road and a right onto Maple—third Mailbox on left, driveway on right.

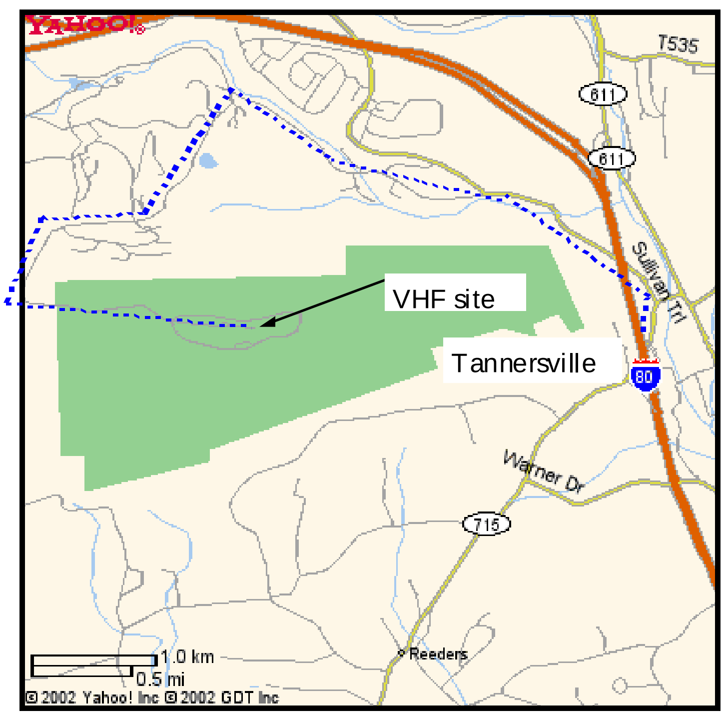
ROBERT G FOX 1449 MAPLE RD KINTNERSVILLE PA 18930 8:15 AM



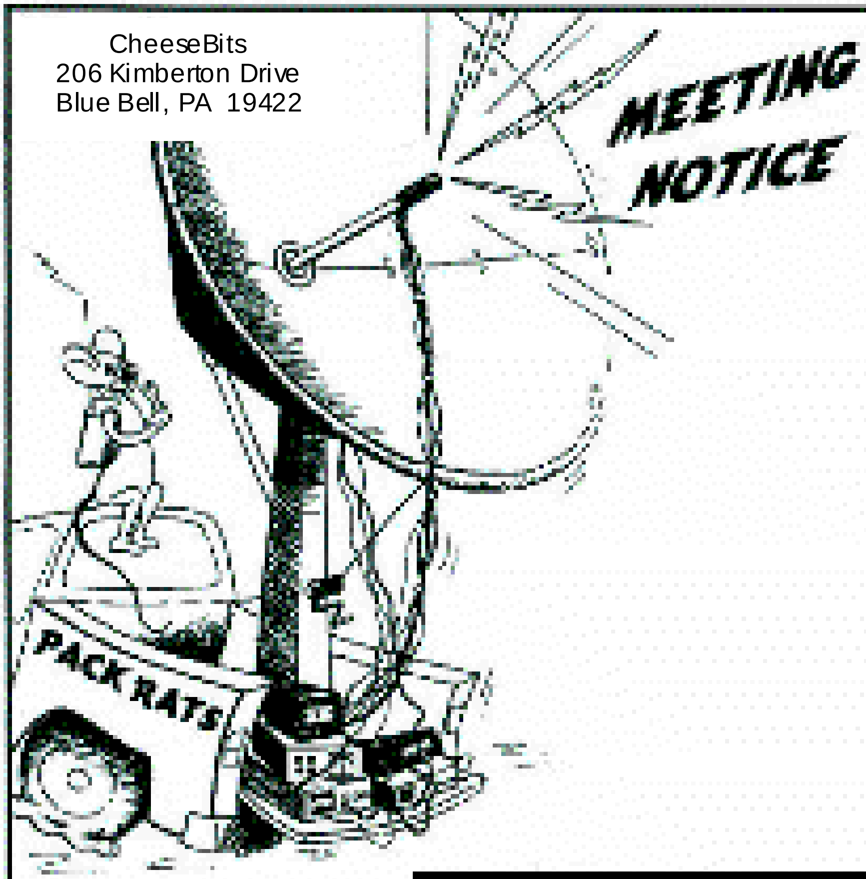


How to get to the June VHF Contest site: Take the NE Extension to Rte 80, head east and exit at Tannersville. As an alternate, take 611 north to Tannersville. Follow signs to the ski area at Camelback, making a sharp left uphill to enter the mountain area, follow to the summit parking lot. Please come—for whatever time you can commit.





CheeseBits
206 Kimberton Drive
Blue Bell, PA 19422



Your club and your fellow members need your help to make this a successful and memorable VHF QSO Party outing on Camelback. Read inside and join the team and the action!

Be a contributor to one of the biggest and best club activities of the year

FIRST CLASS

MT. AIRY VHF RADIO CLUB, INC.