SAN BERNARDINO MICROWAVE SOCIETY, Incorporated

FOUNDED IN 1955

A NON-PROFIT AMATEUR TECHNICAL ORGANIZATION DEDICATED TO THE ADVANCEMENT OF COMMUNICATIONS ABOVE 1000 MC.

W6IFE Newsletter

April 2010 Edition

President John Oppen KJ6HZ 4705 Ninth St Riverside, CA 92501951-288-1207 john.d.open@boeing.com.
Vice President Doug Millar, K6JEY 2791 Cedar Ave Long Beach, CA 90806 562-424-3737 dmillar@moonlink.net
Recording Sec Larry Johnston K6HLH 16611 E Valeport Lancaster CA 93535 661-264-3126 k6hlh@sbcglobal.net
Corresponding Sec Jeff Fort Kn6VR 10245 White Road Phelan CA 92371 909-994-2232 jnjfort@Verizon.net
Treasurer Dick Kolbly, K6HIJ 26335 Community Barstow, CA 92311 760-253-2477 dick@eventhorizons.com
Editor Bill Burns, WA6QYR 247 Rebel Rd Ridgecrest, CA 93555 760-375-8566 bburns@ridgecrest.ca.us
Webmaster Dave Glawson, WA6CGR 1644 N. Wilmington Blvd Wilmington, CA 90744 310-977-0916 wa6cgr@ham-radio.com
ARRL Interface Frank Kelly, WB6CWN PO Box 1246, Thousand Oaks, CA 91358 805 558-6199
fm.kelly@verizon.net
W6IFE License Trustee Ed Munn, W6OYJ 6255 Radcliffe Dr. San Diego, CA 92122 858-453-4563
w6oyj@amsat.org.

At the **1 April 2010** SBMS meeting the "Tech Talk" will be Ed, WX6DX will talk about his trip to Cape Kennedy to have a satellite launched. The SBMS meets at the American Legion Hall 1024 Main Street (south of the 91 freeway) in Corona, CA at 1900 hours local time on the first Thursday of each month. Check out the SBMS web site at http://www.ham-radio.com/sbms/.

Election of new SBMS officers will take place at the 1 April meeting!!!!

REMINDER- NO PARKING IN THE CHURCH LOT

Last meeting.. Tony, KC6QHPgave a super talk about a wide range of activities to support the construction of a 47 GHz radio. Including; EDM machining, making waveguide switches, embedded microcontroller for TR switching, building a suitable tripod head, acquisition of hard to get parts (caps, wire bonding wire, substrates, chips, epoxies, etc.) putting together circuits with MMICs, interfacing to and from bare die MMICs, etc. Talk about having difficulty assembling SMD parts--this is under a large microscope with tiny gold leads. WOW. An Email from Tony indicated:

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Last week I gave a talk on my 47 GHz radio project at the March meeting.
Here are some links if you are interested in more details.

Dicing Saw Project (4 part article):
http://mightyohm.com/blog/2009/07/tonys-diamond-chop-saw-part-1/

Hot Plate Project:
http://www.instructables.com/id/Heated_Stage_for_Thermosonic_Wedge_Bonding/
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Pictures of my progress on the radio:
http://www.flickr.com/photos/kc6qhp/sets/72157620658417282/.
Tony KC6QHP

Larry, K6HLH DM14 talked about his 144 MHz EME contact with Ed, KL7UM in Alaska using the WJST 65 mode. Steve WA7LKP was our visitor from Sun City. There was discussion of tours for MUD of JPL Labs for maybe 2.5 hours along with a talk, but security and 40 people max were concerns. Kat Hutton is to be the banquet speaker. There will be the annual antenna tune up party at Fairview Park in Brea the last Saturday of July (31 July) prior to the August 10 GHz and Up contest. 29 people present.

Activity reported at the March SBMS meeting: Pat, N6RMJ had 1296 EME contacts using 4 55 element antennas and 55w at the antenna; Larry, K6HLH has a new DB6NT rig but had LO feed through on transmit so had to filter it; Bill, N6MN cleaned the garage; Peter, K6PTL did MUD work; Mel, WA6MBL did some 10 GHz LO work; Steve, WA7LKP did some Gunn Oscillator work; Rein, W6SZ did some 10 GHz and digital SDR work; Brian, AF6NA did some mechanical lay out for his 10 GHz rig; Tom WB6UZZ worked on test equipment; Walt had another one of his famous demos for us in the use of diode modulation of RF; Dennis, W6DQ worked on his 1296 MHZ gear; Ed, W6OYJ reported the San Miguel beacons back on 10,368.380 MHz and 5760.00 MHz and did some End wave 24 GHz work; Bill, WA6QYR built a cage at the feed point of his 8 ft dish to hold the new feed for 1296 MHz EME; Chuck, WA6EXV is rebuilding his Qualcomm 10 GHz rig; Dick, WB6DNX built an az-el mount for his 3 ft dish; John, KJ6HZ did house construction; Michelle, W5NYV did some broadband data over microwave and open source software work; Paul, KB5MU worked at the Palomar site; Don, KE6BXT indicated having newly licensed amateurs out of his Mission Viejo class and that there was some microwave surplus equipment available at KE6BXT.CON/pictures/microwave..

Threads

The North American Microwave Activity column for DUBUS is due shortly. If you know of any interesting 1 GHz + activities, QSO's, Projects, etc. Please contact me directly. wa5vjb@flash.net

Phase Noise
WA1ZMS/4's entire Phase noise presentation is now available at:
http://www.wa5vjb.com/references.html
Note, this is a BIG file About 12 Meg. Kent WA5VJB

An alternate choice for a LO (local oscillator) frequency may be 1,139.000 MHz for an IF of: 5,840.0 - 5(1,139.0) = 145.0 MHz (RF-LO = IF),
synthesizer LO freq is multiplied 5 times to get to the final LO freq.
Why? This frequency in a A32 synthesized LO module will have a lower phase noise than 1,139.2 MHz.
Lower phase noise is good, or at least better than higher phase noise.
If you have a choice, avoid non integer (fractional) frequencies from a synthesizer
With the RF specified at 5,840.00 MHz, any drift down due to the harsh space environment may put the frequency below the 2M band starting at 144.00 MHz, Even though RX only, some RX may not tune to be able to handle freqs < 144.00 MHz. (avoid band edges) With an IF of 145.0 MHz, I should be able to tune lower within the 2M band. More room to play.
The doppler frequency shift would also be lower for the spacecraft going away from the observer.

With the very low data rates and significant path losses, I would need the best S/N with a very low RF noise figure, low as possible LO phase noise, and the best frequency stability possible for the significant, potential, processing gains of DSP.
My trade off is having the frequency accuracy/stability with an externally referenced LO synthesizer, vs, the increased phase noise, compared to a xtal oscillator.
After the orbital phase, I would expect the doppler freq shifting to be more constant.

With Paul's transverter design with pipe cap filters, the % freq change is small.
5760 > 5840 ~1.4% change, the filters may be capable of being tuned to both freqs or at least can be retuned to the satellite freq.
Another thought with the A32 synthesizer is to be able to have 3 different LO frequencies, switch selectable, in a single transverter, W1GHZ, DEMI, etc.

#1 freq = 1,139.0 for the RF of 5840.0 MHz, IF of 145.0 MHz, satellite RX only, #2 freq = 1,123.0 MHz for the RF of 5760.0 and an IF of 145 MHz, terrestrial RX and TX #3A freq = 1,104.8 MHz for the RF of 5,668.0 and an IF of 144.0, TX only satellite modes.
(I am less concerned about phase noise on TX.) #3B freq avoiding the band edge issues, may be more critical with amateur 2M transceivers on TX.
freq = 1,104.6 MHz for the RF of 5,668 MHz and a IF of 145.0 MHz

There is noting magic about a 2M, 70cm, 222 MHz, or 1296 MHz IF.
Plan for the equipment you have on hand.
A 2M IF transceiver is very popular for the microwave bands.

For planning purposes only, no 5,840 MHz downlink nor 5,668 MHz uplink satellites are available today.

Stan, W1LE Cape Cod

Zack Widup wrote:
> This would be SO easy to do with the W1GHZ 5760 transverter. Just re-tune the pipe cap filters. I'm sure the frequency is close enough to 5760 that the ratrace mixers wouldn't require tuning.
>
> In this case, for a 144 MHz IF, the LO would be 1139.200.
> 73, Zack W9SZ

Thanks Jerry. That answers a lot of my questions. I myself am mainly interested in the typical weak-signal transverter with CW in the 15 to 25 WPM range and the IF rig having a bandwidth of 400 Hz or narrower.

Interesting that you found the KD6OZH circuit among the best in your paper. That is the circuit I have employed in my transverters on 10 GHz and below. Phase noise hasn't been a problem there with that circuit.
I'm just looking ahead to when I will probably have things put together for 47 and 78 GHz. I've gathered that phase noise is more of a concern there.
Garry K3SIW/9 uses a DFS circuit for 47 GHz similar to the one WA1ZMS uses in his mm-wave equipment. I know WA1ZMS spent a lot of money on the custom low phase noise OCXO's used to make his record-breaking QSO's.
I guess I have some reading to do.
73, Zack W9SZ

On Wed, Jan 27, 2010 at 2:22 PM, Dr. Gerald N. Johnson <geraldj@weather.net> wrote:
On Wed, 2010-01-27 at 11:47 -0600, Zack Widup wrote:
> I have become increasingly interested in this subject. I have a lot
> of questions about it. Maybe someone more knowledgeable than me can
> do a presentation on this some day. I think Brian WA1ZMS and Jerry
> K0CQ know quite a bit about it.

I did a paper presentation at MUD 2008 on a survey of some of the available oscillators. My version of the presentation with what I think I said and some cases what I wish I'd said is at http://www.geraldj.networkiowa.com/papers/K0CQ2008MUD.pdf Its much longer than what was printed.
What I wonder, mainly, is how the various sources of signals for LO's rank for phase noise. For instance, how good can a phase-locked crystal LO be made in regards to phase noise? What about the reference oscillator? Is a free running OCXO better than a GPS disciplined OCXO when considering phase noise? Are these better or worse than a rubidium standard? What about a direct-frequency synthesis source derived from an OCXO instead of a phase-locked crystal oscillator?

Phase locking a crystal can degrade the phase noise from the digital and reference noise of the phase locked loop. It probably won't improve the phase noise ever because the good crystal oscillator is really good. And it won't be better than the reference oscillator multiplied to the output frequency. A fundamental of PLL that I learned by experiment in the 70s is that the phase noise of the result is set by the phase noise of the VCO. A PLL may reduce the phase noise within the loop bandwidth, but not outside of the loop bandwidth. Figure it this way, the VCO voltage is corrected only at each cycle of comparison at the phase detector then that's low pass filtered to keep out the noise of the digital process, so for time intervals longer than the phase detector period the VCO gets to random walk. If its good its noise is small, if its bad it runs like a wild dog just unleashed.

A disciplined OCXO is a different animal because the loop is frequency control and the loop bandwidth is very narrow. Hz or fraction of Hz, not 10s or 100s of KHz. A disciplined OCXO can be practically as good on phase noise as a free running OCXO. And the family of OCXO can have a lot of variation, depending on the quality of the oscillator and the rock. The smaller the crystal the poorer the phase noise I think. The better the polish and parallelism of the crystal the better the phase noise and stability. Cheap rocks can be noisy.

The best crystal oscillators use a Butler or Driscoll oscillator circuit, at least those that admit the circuit. Driscoll claims to be better than Butler. Most ham gear today uses some form of a Butler circuit. The two transistor Butler I think is better. These circuits separate gain from gain limiting and minimize the resistance in series with the crystal that would lower its loaded Q. Wenzel makes superb oscillators and doesn't show the oscillator circuit. The major contributions to crystal oscillator phase noise come from active device flicker or 1/f noise and circuit degradation of the resonator Q from loading. For that a low noise bipolar transistor tends to give better phase noise than a JFET or MOSFET because the 1/f noise spectrum is stronger and wider in the FETs. I just saw an article by Ulrich Rohde, October or November 2009 Microwave Journal (should be findable on line on the Microwave Journal web page) where he liked SiGe transistors for coupled cavity oscillators in the 2 to 6 GHz range. And showed some really good phase noise numbers. SiGe transistors haven't seen much ham use being overshadowed by microwave GaAs FETs for long noise RF stages, but the FET low frequency noise is not the best for oscillators. But for RF stages FETs tend to have lower noise and a much better dynamic range than any bipolar transistors.

Since the rubidium line is not a simple multiple of 10 MHz there is a synthesizer in the rubidium standard that contributes phase noise. Essentially it uses a 10 MHz crystal disciplined by the synthesizer and the rubidium line. The quality depends greatly on that 10 MHz oscillator but is affected by the rest of the box.

I think the direct frequency synthesis oscillator will produce lower phase noise than a PLL on a crystal oscillator. You still get the 20 log N (where N is the multiplication factor or division factor) increases and decreases in phase noise in the DFS and then some because multipliers, dividers, and mixers add some of their own phase noise. Little things like a wandering threshold trigger level in a digital divider chain. Some spurs show up because dividing by an odd number means the drive for the next mixer can't start with a symmetrical sine wave. I'd advocate that all divisions in the DFS should end with a divide by 2 stage to make a symmetrical square wave. I think the DFS that ends with a crystal filter should have the best phase noise because of the filtering effect of the narrow crystal filter that's also cleaning up spurs while it can be narrowing the phase noise spectrum within the limits of the phase noise of the crystals themselves. That's an area that needs more work.

In the PLL, you have the phase noise from the VCXO, the phase noise from the dividers, the lack of control between phase detector cycles (and then some due to the required low pass filter), and you still have the 20 log N multiplication factor from the reference. They all add.

Are some chips better to use for phase locking than others? For instance, I've been told that the MC145158 and MC145170 series of PLL chips are pretty good but the MB1501's are poor.

A lot has to depend on the phase noise introduced by the dividers and the phase detector and how low a frequency you have to divide to for the phase detector. And then chip layout and ground bounce on the chip has to hurt and be dependent on the fundamental chip design. I especially dislike a PLL with the VCO in the digital package. First the VCO tends to not have a high Q resonator (in the old days it was RC and especially noisy), then there's the close stray couplings from ground bounce and being very close to rapid rises of digital circuitry. To make things worse that VCO often has a wide tuning range so that microvolts on the tuning line mean KHz of frequency change. So noise on the tuning line adds phase noise. The shot noise in a high value resistor was responsible for much of the phase noise of the IC-211 which historically has been documented as the ham rig for 2m with the greatest phase noise.
Changing that series resistor to a RF choke gives the same RF isolation (or better) and takes out most of the resistor shot noise. (sometimes called Johnson noise).

I'm sure this is a rather complicated subject but I'd guess that generally certain types of LO references are better than others.

The best LO today start with a 10 MHz range oscillator for stability. Its just a fundamental phenomena that rocks in that range with a good oscillator circuit have the best medium and long term frequency stability. Overtone 5 MHz crystals the size of a 6146 were the best oscillators 40 or 50 years ago. The cut of the crystal has a big effect, the best is SC cut like in the HP 10811 OCXO. But when

multiplied to 100 MHz the phase noise is greater than that of a 100 MHz crystal oscillator. So the best microwave sources use the 10 MHz standard to discipline the 100 MHz oscillator in a way (narrow loop bandwidth) to not increase the phase noise of the 100 MHz oscillator. Or to look at in another way, the 100 MHz oscillator uses the crystal selectivity and regeneration to filter phase noise multiplied up from the 10 MHz reference. Then a dielectric puck oscillator at 10 GHz (or 2 or whatever microwave frequency is wanted) does the same thing. That's what the best commercial oscillator modules do today. I remember Kent using a DRO at 5760 long ago for SSB transverter. Because its long term stability was poor he had to tune constantly but the received signal didn't seem to be degraded by phase noise. With disciplining it can work well.
73, Zack W9SZ

The fundamental question on how much phase noise is too much is still unanswered. When there are strong adjacent spectrum signals reciprocal mixing predominates the receiver effects (to say nothing of the phase noise spectra of those signals). In the pristine very rural hill top environment (maybe only seen in the shielded room!) phase noise also sets the MDS from essentially reciprocal mixing of the RF stage and antenna broad band noise. W1GHZ has found the PLL 10 GHz transverter is a couple dB poorer at MDS in the field than the vintage crystal oscillator based transverter. That PLL has a broad phase noise spectrum trying to clean up a noisy VCO with the loop giving a flat spectrum MHz wide where the crystal oscillator (though less convenient for frequency agility) has the typical 1/f spectrum. The PLL spectrum has much more noise power for mixing unwanted or antenna noise to the IF frequency.

I plan to make experiments on the bench with adjustable phase noise sources and very low noise RF stages. I've built all the pieces but not put them together. Now I'm in the midst of moving and that's going slow from laziness, work, and winter weather. Someday perhaps I'll get the experiments calibrated, accomplished and reported.
73, Jerry, K0CQ

The correction to the waveguide slot antenna spreadsheet mentioned in the latest Scatterpoint is now available: <http://www.w1ghz.org/antbook/slotantenna.xls>http://www.w1ghz.org/antbook/slotantenna.xls
(Dan, W6DFW reported an error in the dimensions produced by W1GHZ equation for slots for 10 GHz vertical antenna.)
The difference is pretty small, so you'd probably only notice the error if you have CNC machinery. 73 Paul

Scheduling.
16, 17, 18 April Echoes of Apollo will again take place with even more stations on the air (moon) and with Arecibo on 432 MHz. See CQ VHF for Winter 2010.
6 May Frank, WB6CWN on 24 GHz hardware.
1, 2 May SBMS 2 GHZ and Up Club Contest
May 23-28 week IEEE conference in Anaheim Conference Center- Demos by Pat, Dennis, Brian and Walt.

SBMS sponsored MUD 2010 October 21 to 24 Cerritos Sheraton Hotel. Website is microwaveupdate.org. Preregistration on line $35. Hotel info on the web site. Thursday Tours. Friday talks and swap meet. Saturday talks, noise figure measurements, banquet and speaker. Sunday antenna measurements. Papers due 1 September for proceedings.

ARRL 2010 Contest Calendar
June 12-14 VHF QSO Party
June 26 Field Day
August 7-8 UHF Contest
August 21-22 10 GHz and UP contest 1st weekend
September 11-13 September VHF QSO Party
September 18-19 10 GHZ and UP second half

European EME Contest Calendar 2010
April 17/18 2.3 GHz
April 24/25 432 MHz, 5760 MHz
May 22/23 1.2 GHz

Wants and Gots for sale.
For Sale- Gonset 20mtr 5 elm beam $10; 220MHz heavy duty 7 el beam $15; Bill WA6QYR 760-375-8566 bburns@ridgenet.net.
For Sale: 10 ft prime focus dish mesh/fiberglass $100 Brian AF6NAbytcorona@yahoo.com 909-226-2015
For Sale 30w 1296 MHz kit $50 + $5 for shipping Chris Shoaff cshoff@yahoo.com

San Bernardino Microwave Society 2GHz and Up Club Contest for 2010

In the spirit of stimulating activity in the microwave bands, the San Bernardino Microwave Society (SBMS) is sponsoring a **2 GHz and Up Club Contest**.

For this year, the 2010 contest period runs from 6 a.m. Saturday May 1 to 8 p.m. Sunday May 2 local time.

This is a club competition in which members tally up their scores and add them with other members score to make up a club score.

1. Object
Worldwide groups of amateurs (Clubs) work as many amateur stations in as many different locations as possible in the world on bands from 2GHz through Light.

2. Date and Contest Period
First weekend in May. The weekend begins at 6 a.m. local Saturday though 8 p.m. Sunday.

3. Exchange
Six-character Maidenhead Locator; example DM04ww (see April 1994 QST, p. 86 or www.arrl/org/locate/gridinfo.html). Signal report is optional.

4. Miscellaneous
Scheduling contacts is both permissible and encouraged.
Stations are encouraged to operate from more than a single location. A station may be worked again on each band for additional credit after a change of location.
For purposes of the contest, a change of location is defined as a move of at least 16 km (10 miles).
A transmitter used to contact one or more stations may not be used subsequently under any other call during the contest period with the exception for multiple licenses in the same family sharing the same equipment (family rule). The intent of this rule is to prohibit "manufactured" contacts.

5. Scoring
Distance points: The distance in km between stations for each successfully completed QSO. One point per kilometer (eg. 10km is 10 points).
In making the distance calculations, a string (or ruler) and map may be used. However, calculations by computer program are preferred. Several such programs are available, including a BASIC program listing in The ARRL World Grid Locator Atlas. For purposes of making calculations, stations are defined as being located in the center of the 6-character locator sub-square (most computer programs make this assumption).

6. Multipliers

2GHz =2 times
3 GHz to 10GHz times 1
24GHz = 2 times

47GHz = 4 times
76GHz and up = 8 times

7. Bonus points

100 points for each unique call sign worked per band

8. Awards

1st place plaque and all club entries will receive a certificate, suitable for framing.

Send entries no later than 60 days after the contest to be considered.

Submit logs via regular mail only.

William Burns, WA6QYR
247 Rebel Road
Ridgecrest, CA 93555

For more information, rules and past scores see the SBMS web page at http://www.ham-radio.com/sbms

The feed cage on Bill, WA6QYR's 8 ft dish

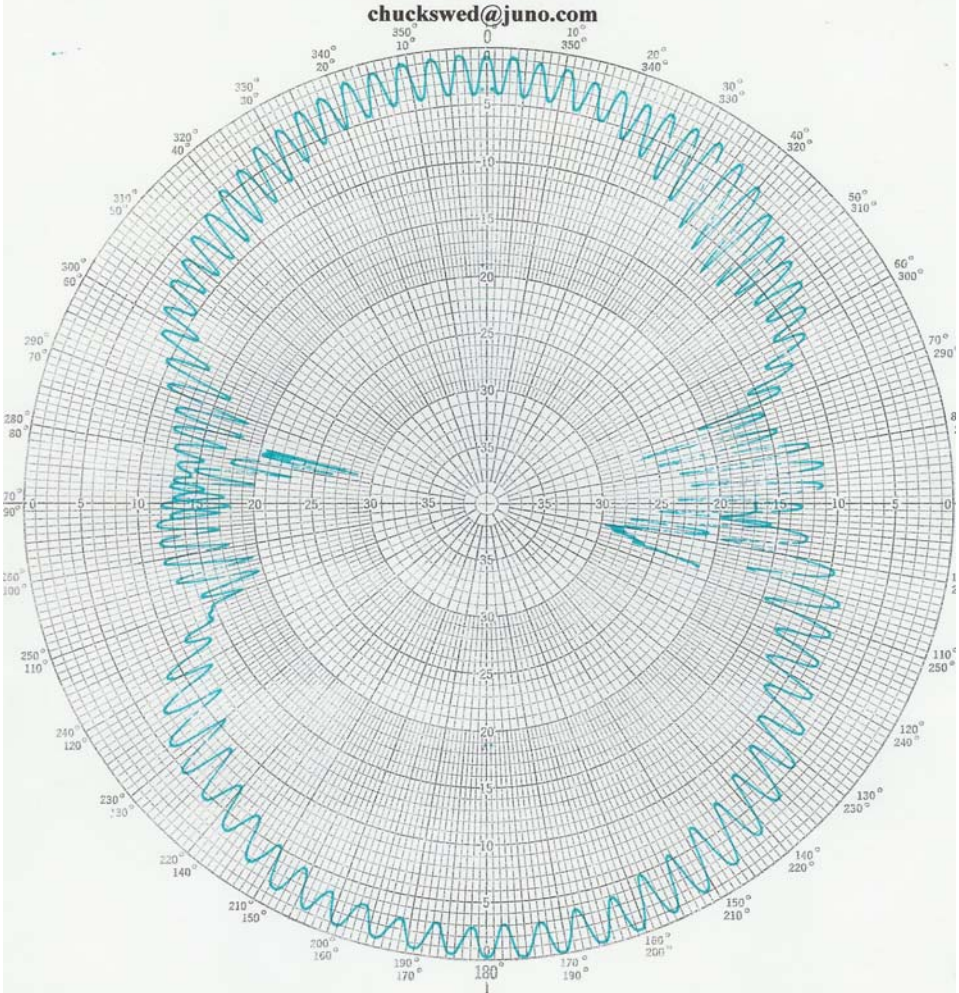
Bill, WA6QYR's mobile 8.5 ft dish with a piece of 7 inch aluminum pipe standing in for the 1296 MHz circular polarized feed.

WA6EXV ANTENNA RANGE

P.O. BOX 605

RIDGECREST, CA 93556-0605

chuckswed@juno.com



NOTES

1. Signal Generator: Gigatronix 6062A
2. Soruce Antenna: Rotating Dipole
3. Range: 47 Feet.
4. Port 1: Top Port 2: Bottom
5.

PROJECT: 1296MHz CP Feed WA6QYR

FREQUENCY: 1296.1 MHz

POLARIZATION: Circular

REFERENCE ANT: None

DATE: 02-07-10

Gary, W6KVC's ATV control station at the March SBMS meeting. The San Bernardino Microwave Society is a technical amateur radio club affiliated with the ARRL having a membership of over 90 amateurs from Hawaii and Alaska to the east coast and beyond. Dues are $15 per year, which includes a badge and monthly newsletter. Your mail label indicates your call followed by when your dues are due. Dues can be sent to the treasurer as listed under the banner on the front page. If you have material you would like in the newsletter please send it to Bill WA6QYR at 247 Rebel Road Ridgecrest, CA 93555, bburns@ridgecrest.ca.us, or phone 760-375-8566. The newsletter is generated about the 15th of the month and put into the mail at least the week prior to the meeting. This is your newsletter. SBMS Newsletter material can be copied as long as SBMS is identified as source.

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