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

August 2007 Edition

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At the**2 August SBMS** meeting will be planning for the August portion of the ARRL 10 GHZ and up contest. Bring your extra stuff for another Square Deal Doug auction. 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/.

REMINDER- NO PARKING IN THE CHURCH LOT UNTIL CLAIRIFICATION IS MADE.

Last meeting-. Mel WA6JBD presented at great talk on the NEC synthesizers out of up and down converters from digital microwave point to point radios in the 1.8 to 1.9 GHz range. (Bill wa6qyr has forwarded the text and pictures to the SBMS web site. Text and a few pictures are included in this newsletter.) Thanks Mel. The link on the 445 repeaters has been completed so we can have additional coverage in the southland. Doug indicated that the OVRO outreach programs have been going great. Frank, WB6CWN will have some more of the endwave 24 GHz radio parts coming in. Dishes are still available from the Northern California surplus dealer. Everyone operating in the "2 GHZ and Up contest" needs to get their logs in to Pat, N6RMJ now! Mike, W6YLZ is looking for members who would like to be on the Mexico 10 GHz contest trip. 26 members present.

If you have moved, changed email address, or some how altered how you wish to receive this newsletter, you need to let Bill, WA6QYR know your preferences. bburns@ridgenet.net.

Scheduling
July 28 Picnic/ Tune-up party
August 2 SBMS meeting
August 4-5 ARRL UHF Party

August 18-19 ARRL 10 GHz and Up contest
Sept 8-10 ARRL VHF QSO
Sept 15-16 10 GHz and Up second half
October 18-19-20 **MICROWAVE UPDATE (MUD) 2007** Historic Valley Forge Philadelphia**,**

"Wants and Gots for sale.
For Sale- 1.2 GHz amplifier single 7289 air or water cool with power supply Doug K6JEY 562-810-3989
For Sale- Programming sub-board for the Verticom and Stellex synthesizer. Assembled PCB, chip programmed for 11.880 GHz available from Chris N9RIN at: cshoaff@yahoo.com. SBMS member cost $6.00 not counting shipping.
For Sale-This is labeled as a 200-400 MHz amplifier, it really operates between 143 MHz and 453 MHz. It requires 1 - 2 Watts drive and puts out a solid 200-Watts key down for hours. It is RF sensed, but it is a linear amplifier so adding a wire for direct key is desirable. It's also easy to do! It operates at 28 Volts @ 19 Amps and Full T/R switching is built-in. It is made by Kalmus and is in like new condition, tested and guaranteed. The picture is located at: http://www.usmw.com/auction/UHFAMP.jpg
$400.00 Plus shipping. I take PayPal and money orders. Dave - WA6CGR 1-310-977-0916
Want- 432 MHz to 28 MHz down converter for use in my noise figure measuring setup. Bill WA6QYR bburns@ridgenet.net 760-375-8566
Want- another SBMS member to operate in XE august/ September 07 Mike W6YLZ
For SAle FT897D 100w hf-6-144-430 $575 Howard WA6YGB 626-789-0451
Activity reported at the **July SBMS** meeting- Dick, WB6DNX had his endwave 24 GHz rig for show and tell, has been working with the Scientific Atlanta 9660 video receivers on ATV and had a Power Werks auto-shutoff box to save batteries; Steve, AD6HT has been tweaking stuff; Bill, WA6QYR has been working on a local repeater link; Mike, KG6FWH has been collecting stuff; Doug, K6JEY updated his web site to include 47 GHz rig; Dennis, W6DQ has sold his house and is moving to Inyokern, Mel, WA6JBD prepared for the tech talk; Jeff, KN6VR did some power amplifier work; Tom WB6UZZ is working on a GPS frequency lock and IF radios; Maurice, K6YNH is visiting; Chris, N9RIN did some 10 GHz work and has available boards for the micro-controllers of the Verticom synthesizers and DC-DC converters and found that some of the YIG oscillators would not reach 10,224 GHz but worked fine at lower frequencies; Don, KF6QWC is working on a digital receiver; Kurt, K6RRA did some 10 GHz work and is collecting parts for a 24 GHz radio; Dave, K6OW stopped by for a visit after a long absence; Frank, WB6CWN finished the Mexico radios with GPS locked crystals; Pat, N6RMJ has his house rebuilt so he can now play with the radios; Wayne, KH6WZ had a couple of nice articles in QST and CQ magazines, Has 3 10 GHz radio in work, and is working on the 24 GHz endwave radio; Larry, KG6EG is collecting parts for a 24 GHz radio; Mike, W6YLZ has a shed for storing stuff; Dick, K6HIJ has been doing more 24 GHz waveguide switch work and is building a test set to measure the switches at more than 70 dB dynamic rage; Phil, K6COY is back after a long absence; Larry, K6HLH found the waveguide switch at the top of his tower to stick, is playing with a DDS-60 digital radio, and has an America QRP Club 0-80 MHz digital signal scores; Gary, W6KVC is doing Forest Service Work; Dan, W6DWF worked on a Cactus radio; John, KJ6HZ indicated that the QST ARRL standing need to be updated every two years so send info on Call, states worked, DXCC, grids, DX km to Steve Ford.

NEC Synthesizer conversion Mel Swanberg – WA6JBD

- **What are they?**

1.865-1.995 GHz up and down converters for point to point digital microwave radios.
70 MHz IF. Up converter has 0 DBM RF output. Down converter is around 4 dB NF.
A and B version designates high or low side injection.
The heart of the NEC synthesizer is the NEC uPD67020 PLL chip. This chip is used in both the up and down converters
By lifting various pins from ground, step size can be changed.
Known step size can be 5 MHz, 4 MHz, 4.4444 MHz, 1.250 MHz, 3.33333 MHz, 3.636363 MHz.
Based on difficulty on converting these to 2304, it was decided to attempt to use them as a signal source only.

- **The synthesizer**

1850-2000 MHz, depending on version. Most will go somewhat beyond that with no modification.
I've been successful in modifying these to operate from 1650-2350.
Features: 5 MHz step size, 10 MHz reference, 5 PPM. Very clean and stable. +8 and -15 VDC power requirements. Switch selectable frequencies.

- **Goals**

1. Expand frequency range
2. Smaller step size - 1 MHz?
3. External reference.
4. What else can they do? RX section can be made SMALL! TX section can put out +15 DBM!

This document will describe 3 separate procedures:

- **Up Converter**

Remove top and bottom covers.
Remove cover to VCO module.
Optional: remove and discard external interface board with 96-pin connector.
Remove metallic tape on end, near where the circulator was. This uncovers predrilled holes.
Remove 2 GHz circulator from the main chassis. Salvage the SMA connector, and the long gold pin and Teflon insulator.
Unsolder tuning stubs and connecting strap between output of TR1 and the mixer stage.
Insert the Teflon insulator in the predrilled hole, and using a razor blade, trim flush. Use the salvaged gold pin to extend the center pin of the SMA connector, and connect to the board at the output side of TR1.
Wire a jumper between the two-8vdc input feed throughs.

- **Modifying the synthesizer for different step size**

In their native state, the two on board hexadecimal switches allow for 5 MHz steps. One switch does 5 MHz steps; the other goes in 80 MHz steps. If this is acceptable, this step can be skipped.
By lifting one or more pins from ground, various step sizes can be achieved.

- Pin 14 = 4 MHz steps
- Pin 15 = 4.444 MHz steps
- Pin 10, 51, and 52 = 1 MHz steps from 1792 to 2047 MHz

In addition, opening or grounding other pins will raise or lower the range of the dividers:

- Grounding Pin 49 lowers the frequency range to below 1790 MHz
- Opening Pin 41 increases the range to 2063 MHz
- Opening Pin 42 increases the range to 2079 MHz
- Opening Pins 41 AND 42 increases the range to 2095 MHz
- Opening Pin 43 increases the range to 2111 MHz

Pins are removed from ground by heating with a soldering iron, and pealing back with a dental pick.
An example would be setting for 2276 MHz for use as an LO for a 2304 transverter with 28 MHz IF.
Set S3=2, S1=6
Open Pins 14, 41, and 51.
Ground pin 49.
PLL will now lock at 2276 MHz, provided the VCO will go there.

Up Converter Factory Switch Settings

CH No.	TX Freq	LO Freq	S201	S202	Type
1	1855	1925	1	8	
2	1865	1935	3	8	
3	1875	1945	5	8	C5883A
4	1885	1955	7	8	
5	1895	1965	9	8	

6	1905	1975	B	8	
7	1915	1985	D	8	
8	1925	1855	3	7	
9	1935	1865	5	7	
10	1945	1875	7	7	
11	1955	1885	9	7	C5883B
12	1965	1895	B	7	
13	1975	1905	D	7	
14	1985	1915	F	7	

Down Converter Factory Switch Settings

CH No.	TX Freq	LO Freq	S1	S3	Type
1	1855	1925	1	8	
2	1865	1935	3	8	
3	1875	1945	5	8	C5885A
4	1885	1955	7	8	
5	1895	1965	9	8	
6	1905	1975	B	8	
7	1915	1985	D	8	
8	1925	1855	3	7	
9	1935	1865	5	7	
10	1945	1875	7	7	
11	1955	1885	9	7	C5885B
12	1965	1895	B	7	
13	1975	1905	D	7	
14	1985	1915	F	7	

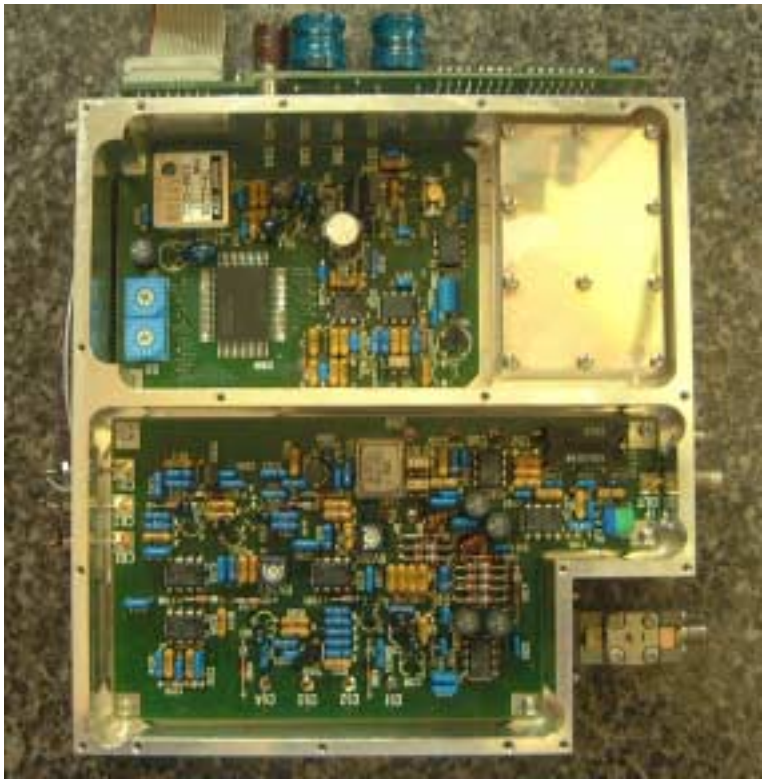
- **VCO mods**

In it's unaltered form, the VCO is designed to operate in the range approximately 1800 to 2000 MHz. There is a high side and low side injection version, but this makes itself apparent primarily in the VCO control voltage that the PLL settles on when locked. Target voltage is in the 6-volt range, but these are stable down to about 2 volts, and up around 12.
Modifying the VCO is simply a matter of moving the varactor diode around on the microstrip stub. Further out lowers the frequency, closer in raises it.
Modify the VCO first to operate close to the desired frequency with JX removed, and then modify the PLL chip pin out to set the exact frequency desired.

- **Down Converter**

Remove top and bottom covers.
Remove 5 screws that hold VCO module.
Carefully unsolder the VCO and set it aside.
Unsolder the pins from the feed through capacitors to the synthesizer board.
Remove the synthesizer board from the chassis (3 screws).
Re-install VCO onto the synthesizer board using 5/16” spacers.
There are 3 available by removing the external alarm interface board.
Remove the cover to the VCO module.
Unsolder and remove “probe” extending from the VCO.
This is the RF output.
Using a nibbling tool, notch out the VCO cover above where the RF output probe was soldered to the board inside.

Remove the SMA connector from the down converter box, and reinstall
On the VCO where the “probe” was removed. A small piece of the probe can be used to extend the center pin of the SMA.
Drill and tap the cover to hold the SMA connector. An alternative, a gold SMA can be used, and soldered to the cover.
Apply +8v at pad marked C65, and –15v at pad marked C64.
The down converter synthesizer is tuned exactly like the up converter.


The NEC down converter module.


The NEC up converter module.

Mel, WA6JBD giving his tech talk on NEC synthesizers at the July meeting.

Trip To Raton NM (DM76 and DM86)

By Phil Lee, W6HCC SBMS member in northern Colorado

On 6-25-07 I traveled to Raton NM. For a microwave shot from Capulin Volcano (DM86) and Raton pass (DM76) to Louisville CO. (DM79) on 10.368 GHz and 2.304 GHz. I planned to communicate with Bill, K0RZ and Don, N0YE. The distance from Lousiville to Capulin Volcano is 231 miles. It is 210 miles to Raton Pass.

I left home at 0800 hrs. and traveled south on I25. I stopped for some food in Pueblo CO., then continued south and reached Trinidad CO. about noon. I started up Raton pass only to find the road had been closed due to a serious accident further up the pass. I spent about an hour waiting for the road to open. I had planned to arrive in Raton at about 1300, after checking out a site at Raton pass on the way. I would get lodging for the night and then go over and try a shot from Capulin volcano. It is about 30 miles from Raton to Capulin.

All this went on hold and I arrived at Capulin mid afternoon. The weather was getting steadily worse. There was a large T storm to the south and it was raining in the little town of Capulin, about 3 miles south of the volcano. When I got to the visitor's center at the base of the mountain, I found that the road would be closed at 1830 and not open until 0730 the next morning. So much for an early shot!!

My golden age passport spared me the $5.00 admission fee to the national monument. I mentioned that I wanted to make a microwave shot back to the Denver area. I was told that the only place to stop was a small turnout on the north east side of the mountain and the parking lot at the top.

Armed with this information, I headed for the top. The road is paved and is a good, but narrow, mountain highway. It is an easy grade, but be sure to stay on your side of the road in some of the sharp turns.

I arrived at the top to find a large parking lot with a good view from SSW to North. My boresight was about 25 degrees west of north. By parking along the west side of the lot (perpendicular to the marked parking spaces), I was able to line up the dish in the clear.

By this time, the weather had worsened. The rain which was in the town of Capulin had moved to the mountain. There was also some thunder. I decided not to erect the 433.1 MHz com antenna. That was too much like a lightning rod!! I set up the 4-foot dish for 10ghz. I called Bill on the cell phone (at a very few places in the lot I was able to get cell service from some unknown analog site) and told him I was ready to go.

Bill runs 15 watts to a 30-inch dish on his tower. My system is 3 watts to a 4-foot dish in my ford excursion.

Bill sent a cw carrier and I immediately found his signal. It was about S6 and had the 'watery' signature of a rain scattered signal. We made an easy exchange of calls and grids in CW.

We next went to 2304. On this band Bill runs 15 watts to a loop yagi and I run 1.5 watts to the 4-foot dish. Signals again were very 'watery' and only S2. We made the exchange of calls and grids in CW.

By this time the rain was coming down in earnest. I quickly took down the dish and secured. After about 15 minutes, the rain quit and I called Bill on the cell phone. He said that Don was ready on 10ghz. Don runs 3 watts to a 3-foot dish in the back of his Land Cruiser.

I set up the system again and this time Bill and I used narrow band FM. Signals were better and we had good voice communication with signal levels from S8 to S9+20db. Don's signal was much weaker, about S1-S2. I asked Don to go to NBFM. I was able to copy calls and grid with a few repeats.

We decided to experiment with SSB. We found that the signals were very distorted, like someone with a sever cold. However, they were intelligible and 100% copy was possible. (Usually SSB is too distorted for copy at all on rain scatter.) Even on Don's signal, SSB would have been an easier copy than NBFM, even though the voice was much more distorted.

The rain was returning again, so we decided to secure. I planned to go to Raton Pass and we would try that path at 1800. On the way back to Raton, I came through a very heavy rain/sleet storm. I was slowed to 30 mph and even then it was difficult to see the road. When I got back to Raton, the rain had stopped.

I went up to the pass. It is 8 miles from Raton. When I got there, guess what was waiting for me?? Another thunder storm!! I waited for about 30 minutes and then gave up and returned to Raton for the night.

Next day we planned an 0600 shot from the pass. I arrived there at about 0530. I set up 10ghz and erected the long yagi with mast mounted preamp, for 433.1 MHz. I run 50 watts using a Yaesu 847. Comm on 433.1 SSB was good. Signals were S2 to S6.

Signals on 10ghz were not too good. This time, no scatter signature, just weak and clear. Signal levels were S1 to S2. The path is obscured in he middle. It passes nearly over Pikes Pk. We made the exchange in CW. Don was on the air, but I could not hear him, nor could he hear me. We decided to switch to 2304.

If signals on 10ghz were weak, signals on 2304 were horrible!! Nothing heard at times, then just a few short bursts of aircraft scatter. I sent to Bill and he got both calls and a partial grid. He sent to me and I got a good burst in which I copied my call. This went on for about an hour, during which we pieced and patched in high speed CW to get full calls and grids. We finally made it!! Without good liaison on 433.1 we could not have done it.

I left the pass at about 0800 and arrived in Louisville at about 1130. The roads were good and I made good time. My excursion averaged 21 miles/gal of diesel fuel. Good for a 6000-pound truck! My travel distance for the trip was 724 miles. Bill, Don and I had lunch together and recounted the days adventure. Two new grids and a new state on 2 bands. Not bad for 2 days work!!

LOG TIMES: Time (UTC) Contact elapse Time (MDT)

6-26-07 DM86AS:

K0RZ 10 CW 2142-2152 1543-

10 NBFM/SSB 2222-2252

2.3 CW 2155-2200
N0YE 10 NBFM/SSB 2202-2255 1655

6-27-07 DM76SX:
K0RZ 433.1 SSB 1159-1327 0559-
10 CW 1201-1210
2.3 CW 1226-1355 0755

Square Deal Doug auctioning off equipment at the July SBMS meeting.

Dick, WB6DNX's 24 GHz Endwave SDH/ Verticom rig shown at the July SBMS meeting.

Email threads

Pipe cap filters

Some interesting points skirted around. Basically the pipe cap filters are quarter wave resonators. In the pipe cap proportions the housing is so large as to be a cavity that has a much more complicated set of concerns than a quarter wave resonator. While pipe caps allow some real sloppy probes to be inserted and mounted on a printed circuit board it leaves one open to a minor nightmare to analyze. Experimentation covers
up most of what one might learn otherwise.

It is prudent to use 1/4 or 3/8 pipe caps at 10 GHz. Realize that mechanical tolerances get difficult quickly.

At lower frequencies the cross section can approach that of a 50 ohm coax and a tube within a tube with an internal screw protruding from the end of the internal tube so as to adjust the electrical length becomes quite real. This can be done from 5 GHz downward and gets away from the thread problems.

The picture gets a lot more complex than this for optimized filters and I am not an expert in the modeling. I have made many filters from 112 MHz up and 10 GHz down using 1/4 in at the top to 1.5 in at the bottom and they work. They work better when you can find suitable test equipment to test and align them.

Have Fun. Burt N2YYU

I have found the following out from building some of these. Standard 1-inch pipe caps have a natural resonance around 6.5 GHz. 3/4 inch is around 9 GHz. 1/2 inch is around 11.5GHz.

There are some caps out there that are slightly longer than others. 3/4-inch pipe caps may be either 3/4 in long or 7/8in long. 1/2 inch caps maybe either 1/2 in long or 5/8 in long. In general, from my findings, the longer ones give lower loss. If I wanted a 8.4GHz filter I would use a 1/2 inch cap and try to find the longer ones.

The 10GHz 1/2 inch pipe cap filter from the "ARRL UHF/ Microwave Project's Manual" will tune to 8.4GHz easily. To optimize it at that frequency I would probably change the spacing between the probes to 3/8 inch instead of 5/16 inch. The probe length determines the Q and the loss. Higher Q (narrower bandwidth) is higher loss.

These filters are so easy and cheap to make, as well as forgiving, just go play a little!

We use 2-inch pipe cap filters in our lab for both GPS and XM/Sirius Satellite radio use. They easily cover 1.575GHz to 2.35GHz. Just turn the screw! I also have made some with

1 1/2 inch pipe caps. They work better for 2.3GHz having less loss.

Have fun.

Gary Reed WE9Y

RF Engineer

Laird Technologies

Holly, MI

According to Reference Data for Radio Engineers, the natural resonant wavelength of a cylindrical cavity is wavelength = 2.61 X radius of cylinder. The height does not affect the wavelength but it does affect the Q. Of course, this is a ballpark figure because the pipe caps I've seen aren't perfect cylinders from top to bottom. I used a 1.5-inch pipe cap for 2304 with good results. I forget what the probe lengths were that I used because they're all soldered up and I didn't note it down anywhere, but I just used protruding ends of UT-141 with no shield for the probes. I used a spacing of 0.8 inches.

I would think that the 1/2 inch pipe caps would do fine for 8 GHz. The actual inside diameter is about 0.6 inches so the natural resonant frequency would be about 15 GHz. You should be able to move it down to better than half this frequency with the tuning screw. I've used that size at 12 GHz, BTW.

I'm wondering if anyone ever made a clamp type arrangement to test pipe cap filters for useful range without soldering the caps to a board? 73, Zack W9SZ

Like using any other filter for a diode multiplier, it’s been found that there is an optimum distance between the source and the diode and between the diode and the filter to enhance the harmonics. That concept has also been applied to the output of an overdriven MMIC. Those lengths are best chosen to enhance match from the drive to the diode while absorbing the least harmonic on the input side and on matching the diode to the filter at the harmonic frequency while minimizing the absorption or the mismatch of the fundamental signal applied to the circuit. They interact. And I suspect there could be fancier circuits used than just varying the length of the two lines which is all that I've seen. I'm sure those optimizations also depend on the off frequency impedances of the output filter.

Basically a band splitter duplexer should work with the diode on the common, so the drive gets to the diode through a low pass filter and the harmonics depart through a high pass filter with the two filters made so the opposite band filter doesn't load the other. So you don't want the low pass filter to have a series resonant trap to ground at its output nor the input L and C of the high pass to have a spurious resonance at the input put frequency. Which means you can't quite design the high pass and the low pass for a duplexer independently, but that's the thing needed and then probably the line lengths from the drive and to the filter probably aren't critical. Just that by adjusting those two line lengths a rudimentary duplexer is being developed. I don't know whether a fancier duplexer will give increased output over a simple series inductor at the input and a small coupling capacitor for the output or not, but with transistor multipliers I've found careful selection of the none resonant shunt drive L and C components has significantly improved the output while its decreased the pass through of the drive frequency. 73, Jerry, K0CQ,

Dick, K6HIJ presenting his tech talk on microwave couplers at the May SBMS meeting. Dick did an excellent job of explaining couplers and how to use them along with a demo.

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.

San Bernardino Microwave Society newsletter
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