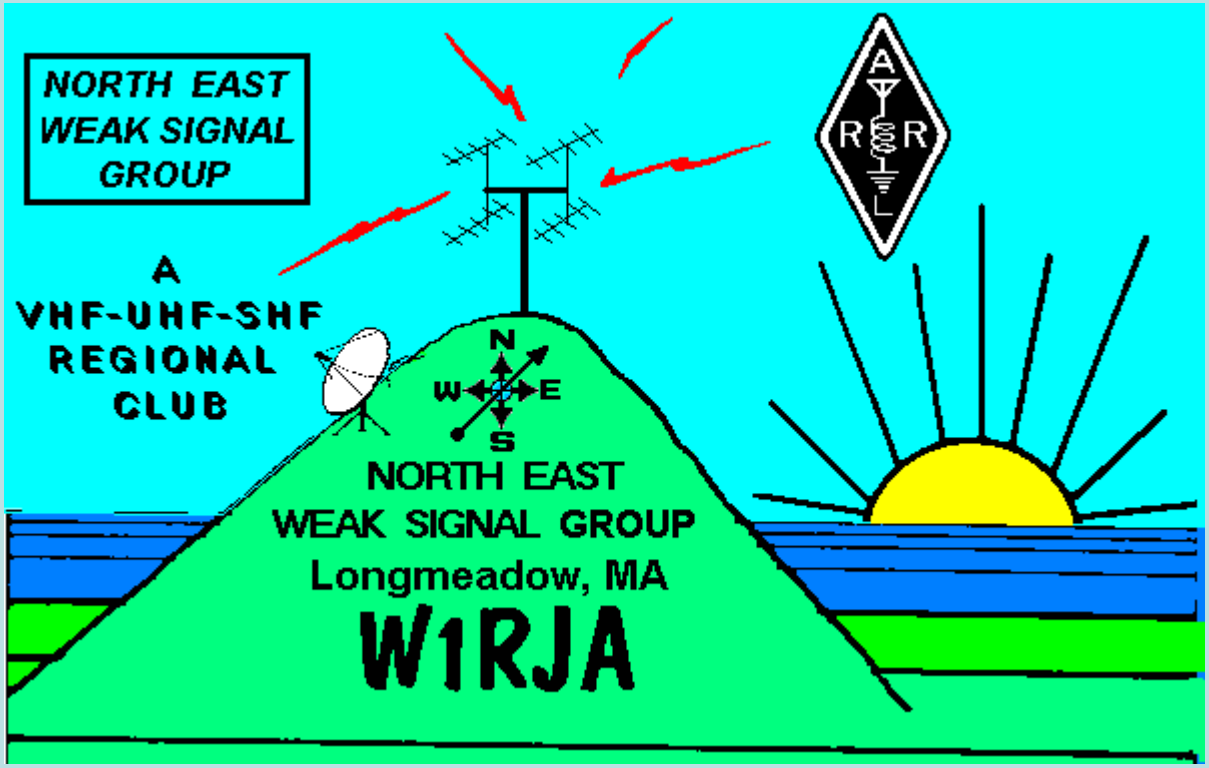
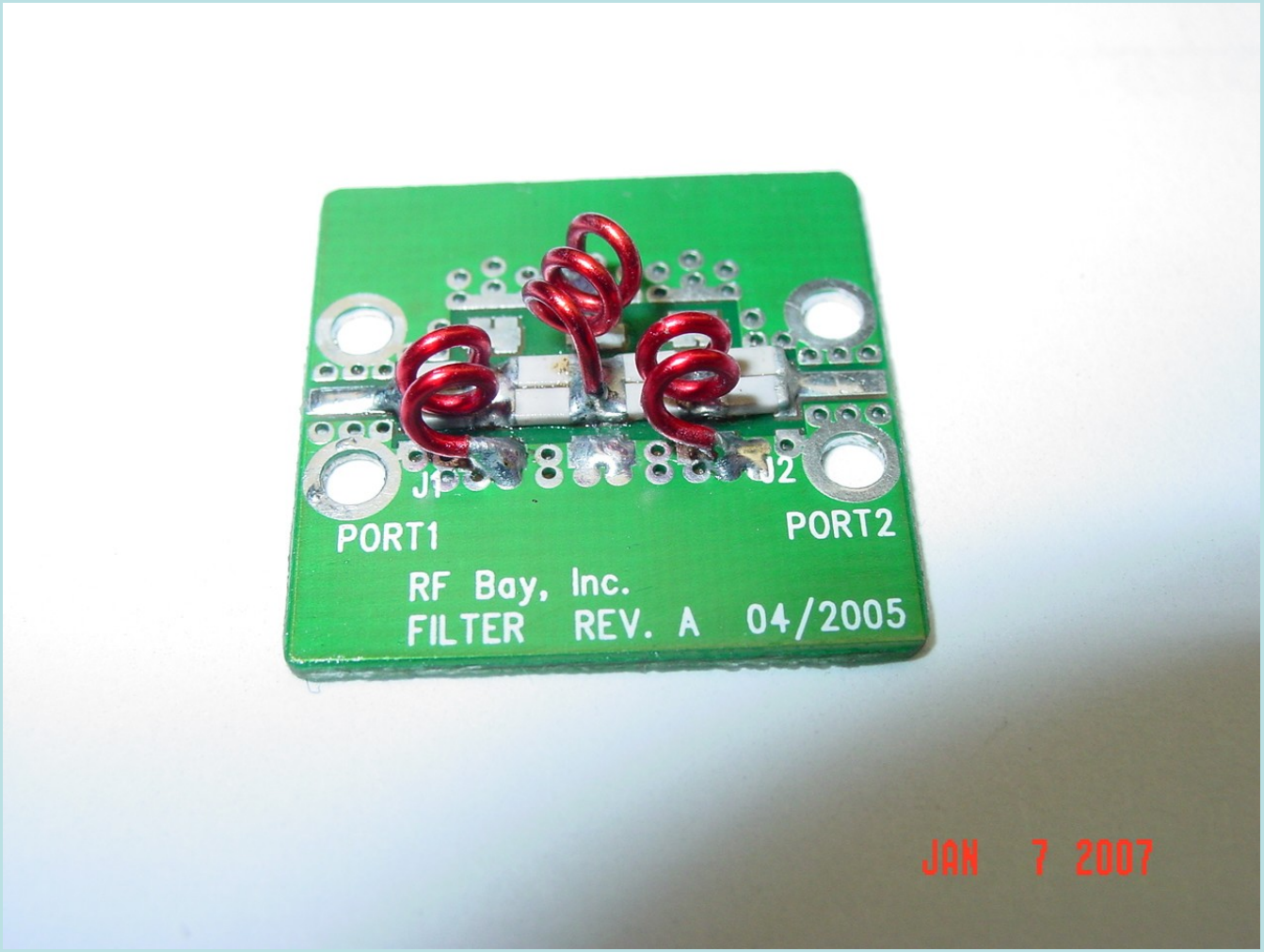
Tower Mounted Switched Preamp Design for 903 & 1296 MHz

Including a 900 MHz Hi Pass Filter & LNA-1400 Preamp

N.E.W.S. September 29, 2007

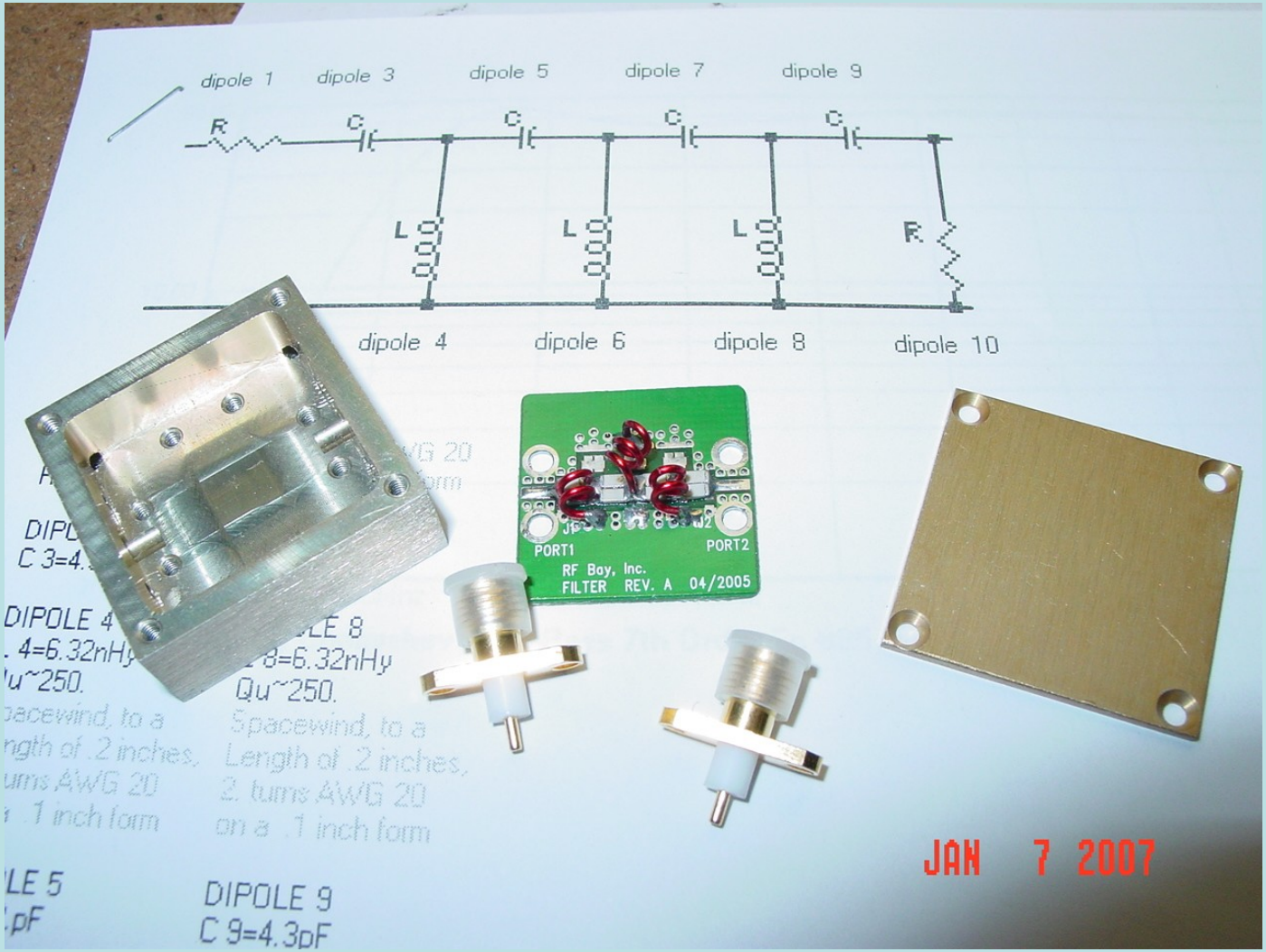
WA2VNV, George Sintchak, P.E.



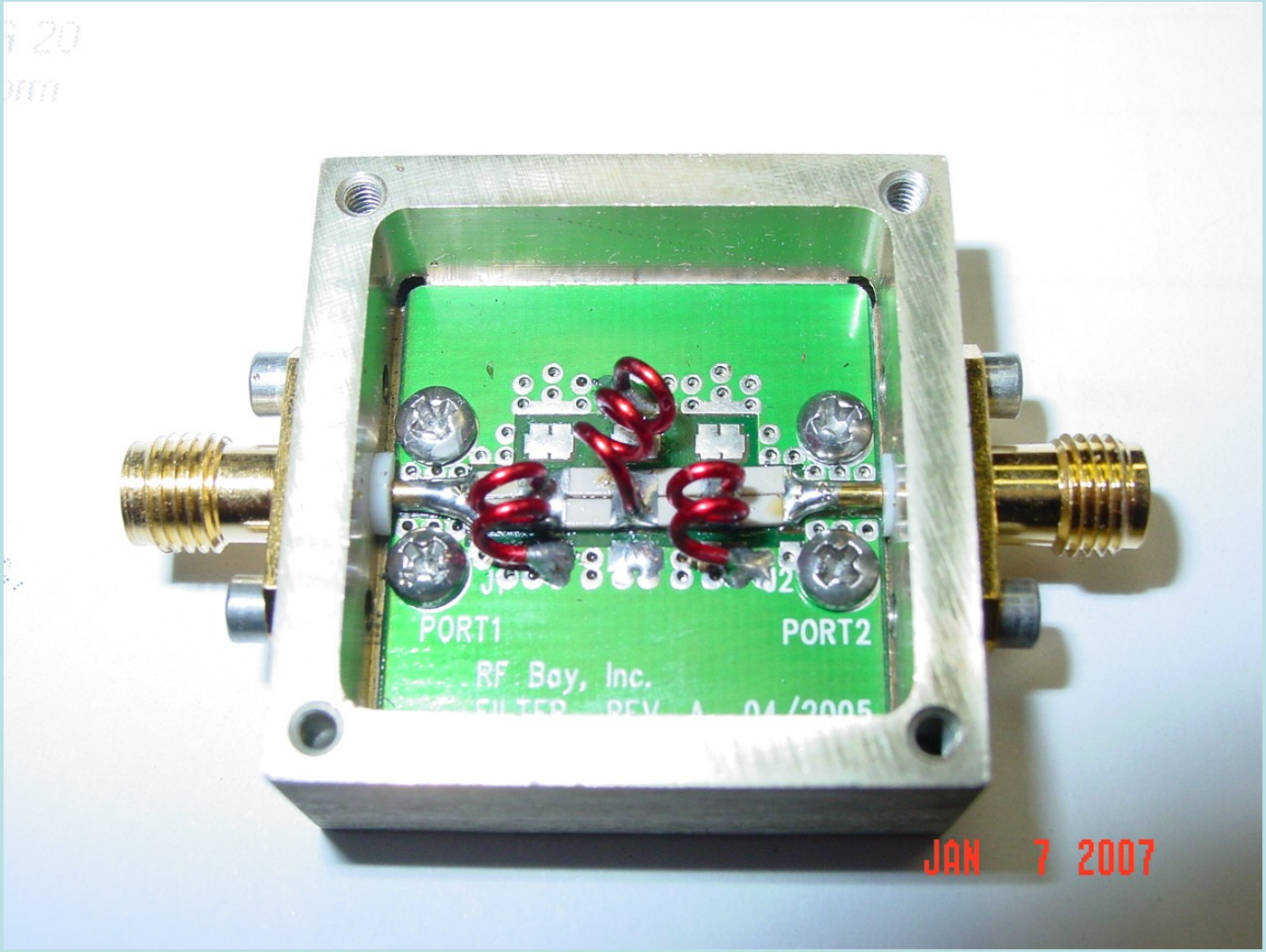


This High Pass filter is to be used ahead of a broadband LNA (0.8 dB NF, ~20 dB Gain, ~100 to 1400 MHz) as a switched mast mounted preamp for 903 & 1296 MHz using a single run of 140 ft of LDF5 7/8 inch coax to feed relay switched antennas. Preamp is auto switched out on transmit.

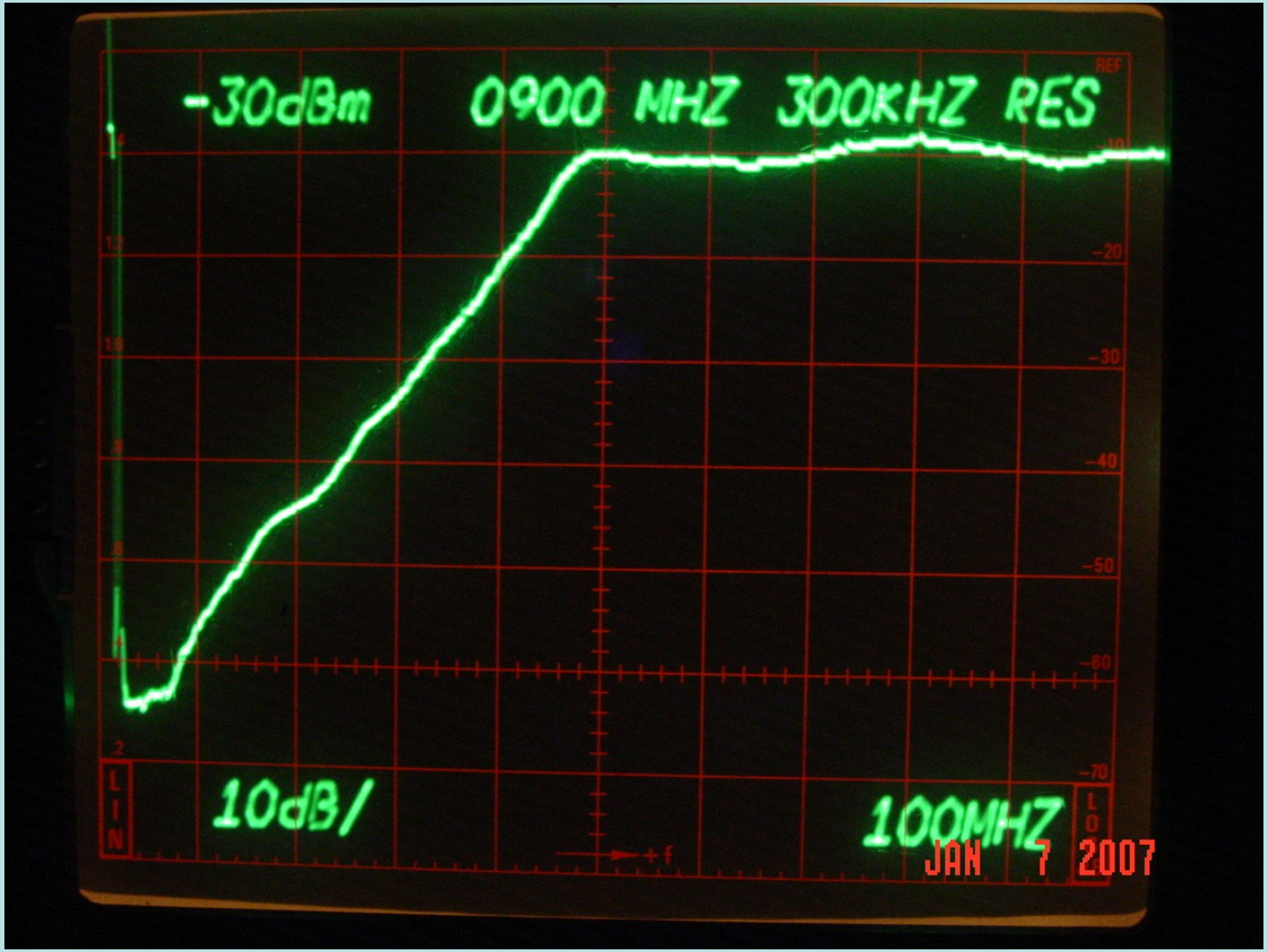
Filter design is 7th order Chebyshev Hi Pass, Fc, cutoff @ 897 Mhz @ 1.0 dB max ripple in passband. 50 Ohm in/out Z. 900 MHz Hi Pass Filter PC Board with coils & caps installed ready to put in enclosure box. Using a generic PC board. You design & add components. Caps are 1 & 3.3 pF combinations, to make 2 & 4.3 pF. Coils are 20 Ga wire. Board is approx 1 x 1 inches, setup for SMA connectors.



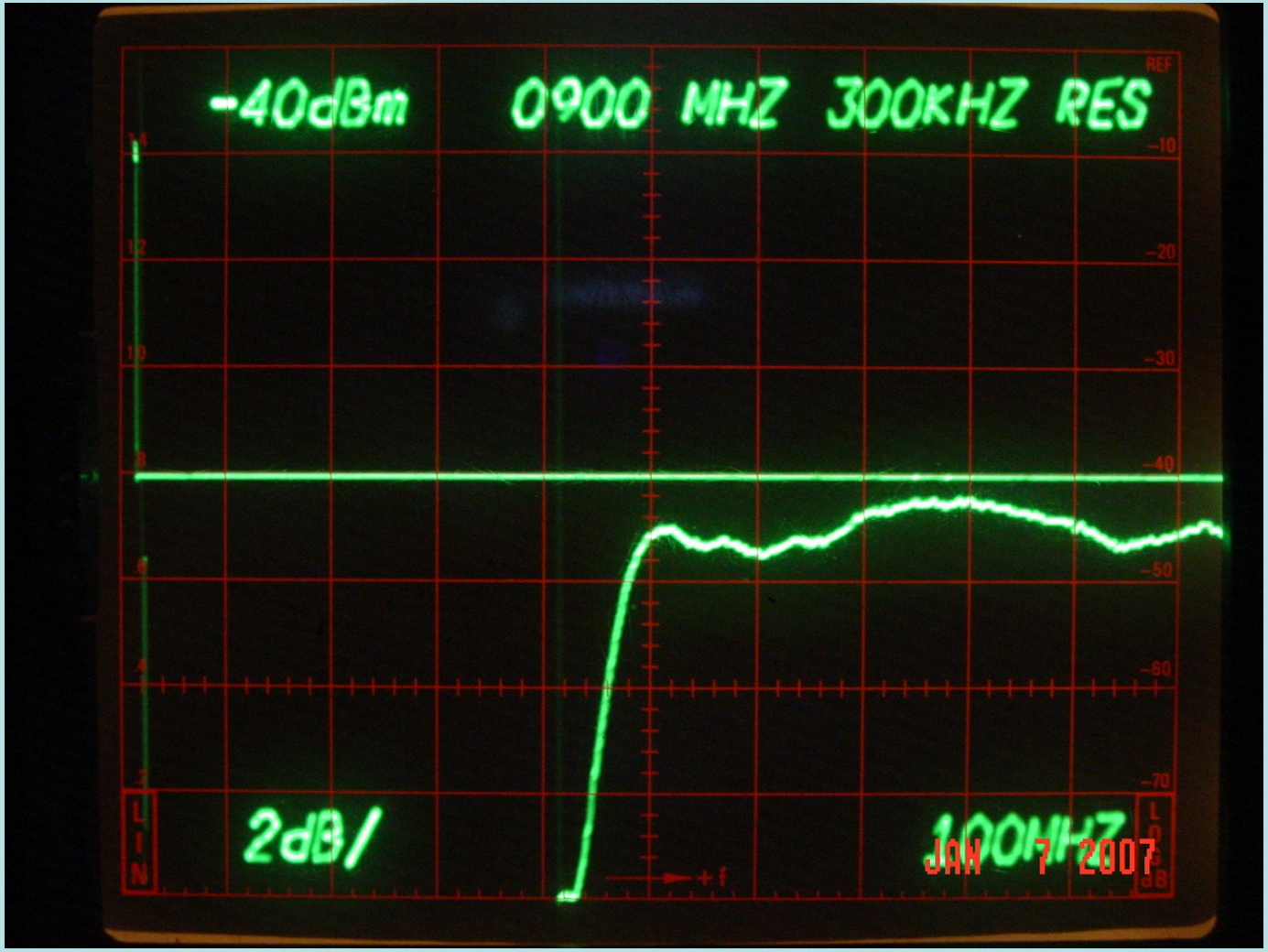
Enclosure & parts to make up the input filter
AADE Filter Design, V 4.2.1. Free download at www.aade.com
Computer generated filter element parameters. Very complete program.
I suspect the inductor design info is not correct for these UHF frequencies.



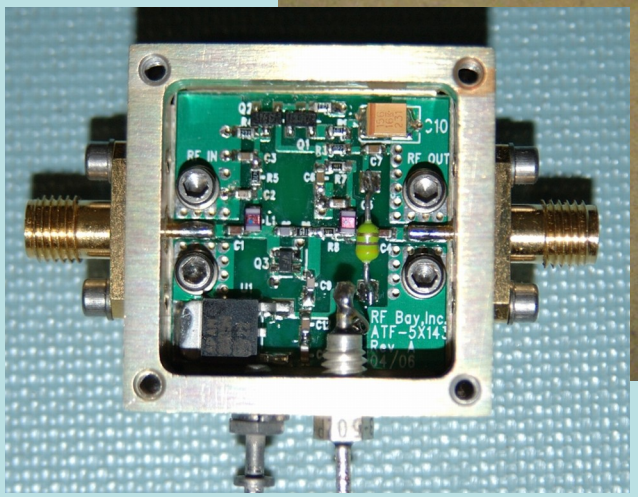
Filter in Box Ready for Testing
Initial testing, Fc was about 750 MHz. (I thought the coils looked too big.)
The final design used different coils, sort of small hairpin loops you can bend over to tune somewhat.

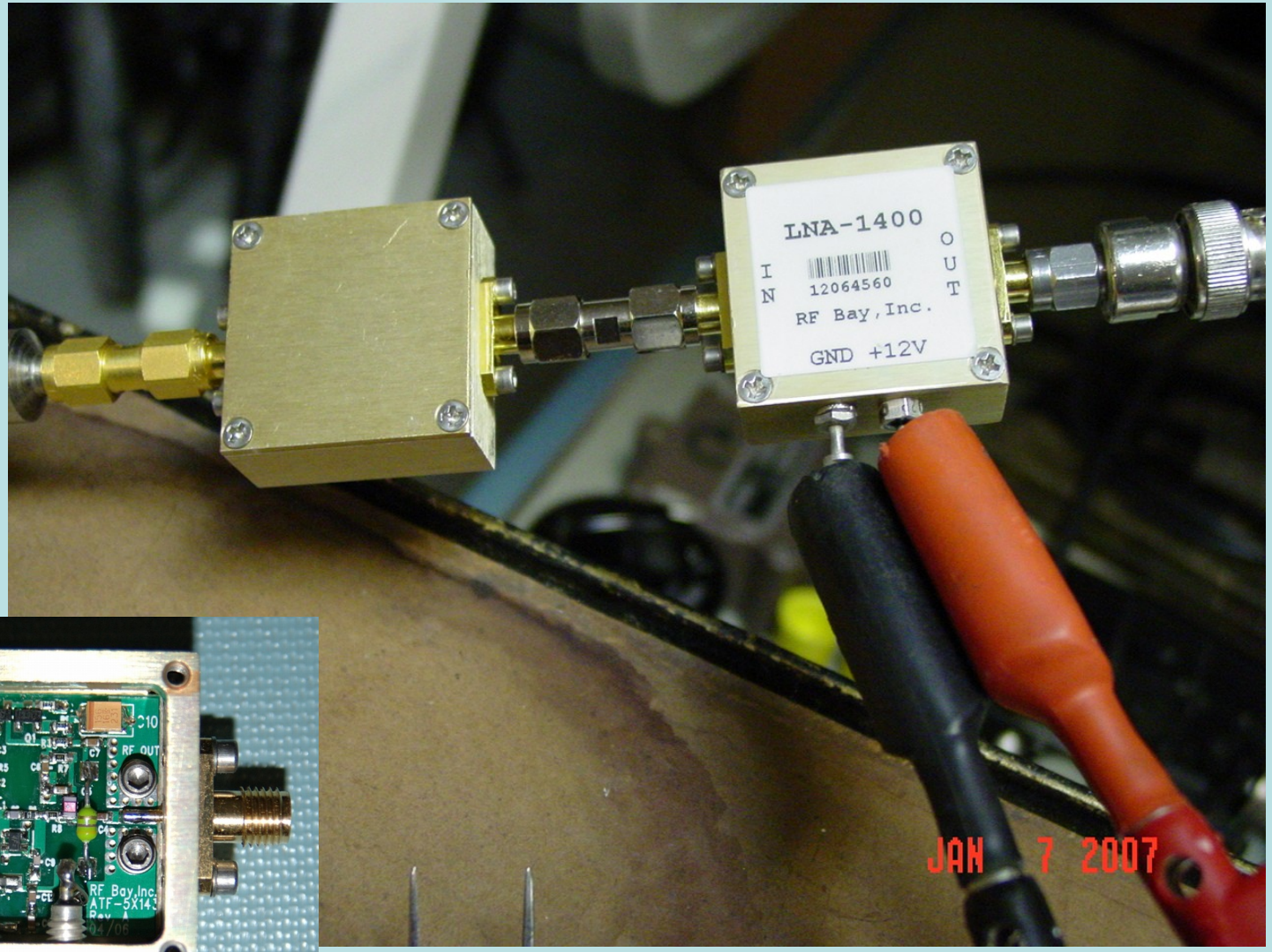


Final Design Filter Response Plot
Vert is @10dB/div, scope center freq is at 900 MHz, 100 MHz/div.
Using a Tektronix 7L14 Spectrum Analyzer & TR502A Tracking Generator.
There are 6dB pads at the ends of cables for isolation & matching.
Fc and attenuation slope is pretty close to -60 dB/decade as was desired.



Vert is now @2 dB/div with center line as 0 dB gain.
Generator & cable(etc) anomalies subtracted out.
Insertion loss is -1 dB at 903 & 1296 MHz, Passband ripple is ~ 1 dB.
Fc (-1dB) @ 885 MHz, -3 dB @ 857 Mhz.
It was tweaked to minimize loss & filter shape at 903 MHz.
As expected, you have to check response with cover in place. It shifts everything ~ 30 MHz.





Filter together with LNA ready for testing. LNA uses an Agilent ATF-54143 low noise enhancement mode pHEMT device.

RF BAY, Inc.

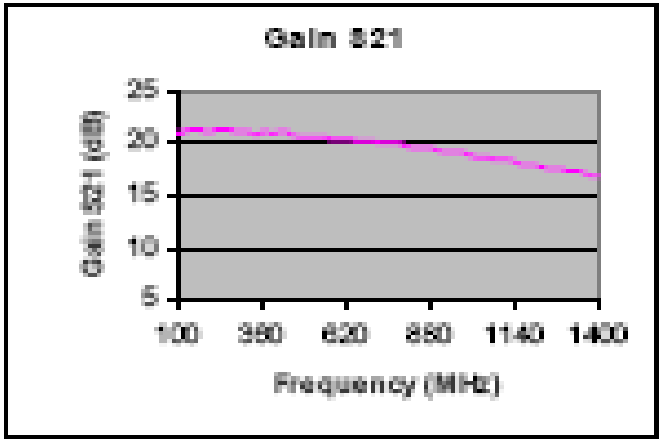
www.rfbayinc.com

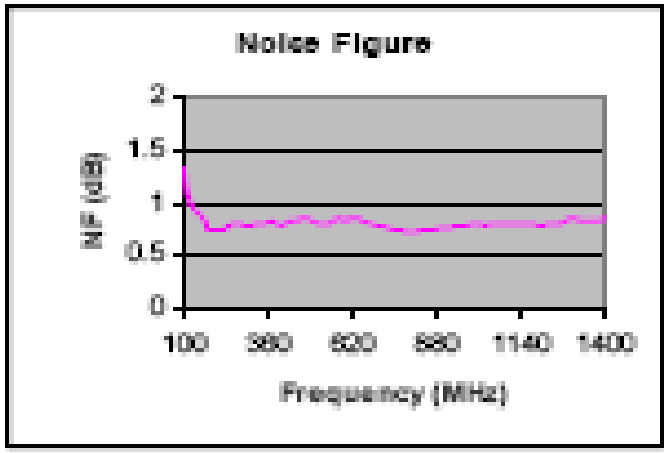
LNA-1400

LNA Series

100 – 1400MHz Low Noise Amplifier

Typical Performance @ +25 °C





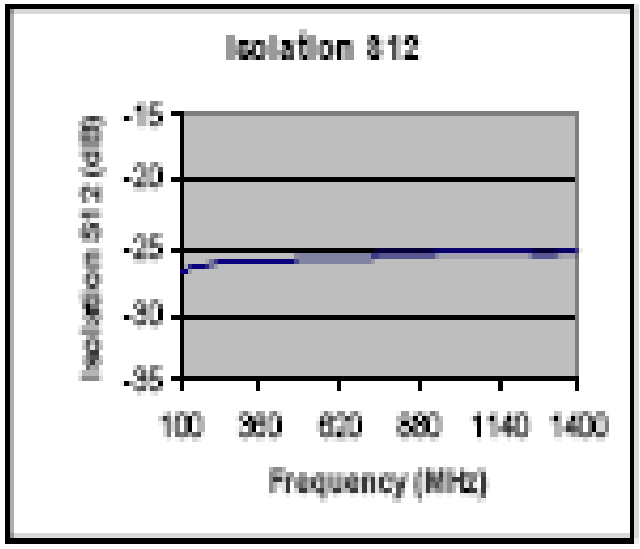
RF BAY, Inc.

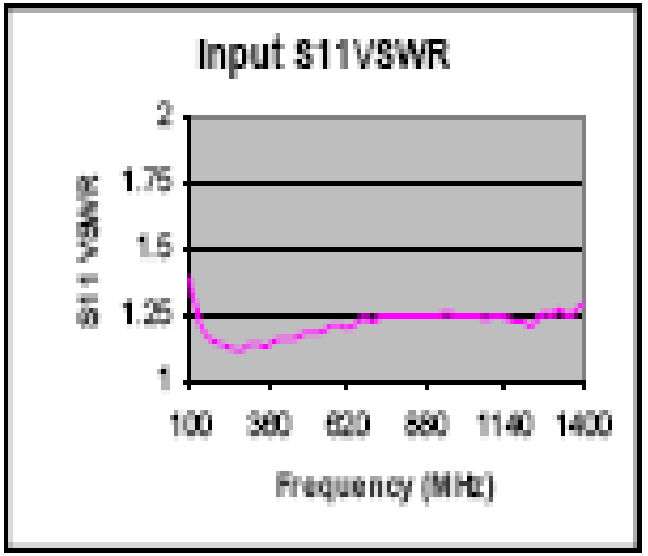
www.rfbayinc.com

LNA-1400

LNA Series

100 – 1400MHz Low Noise Amplifier





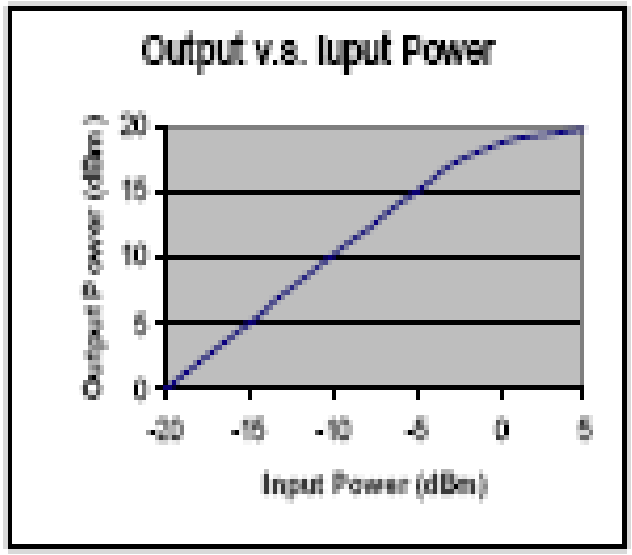
RF BAY, Inc.

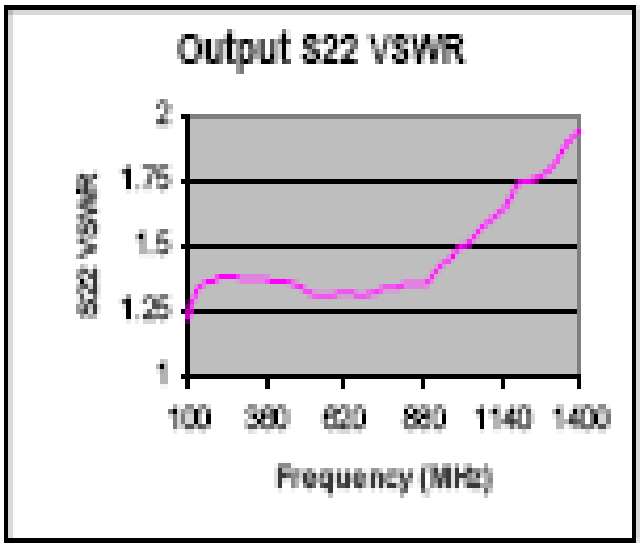
www.rfbayinc.com

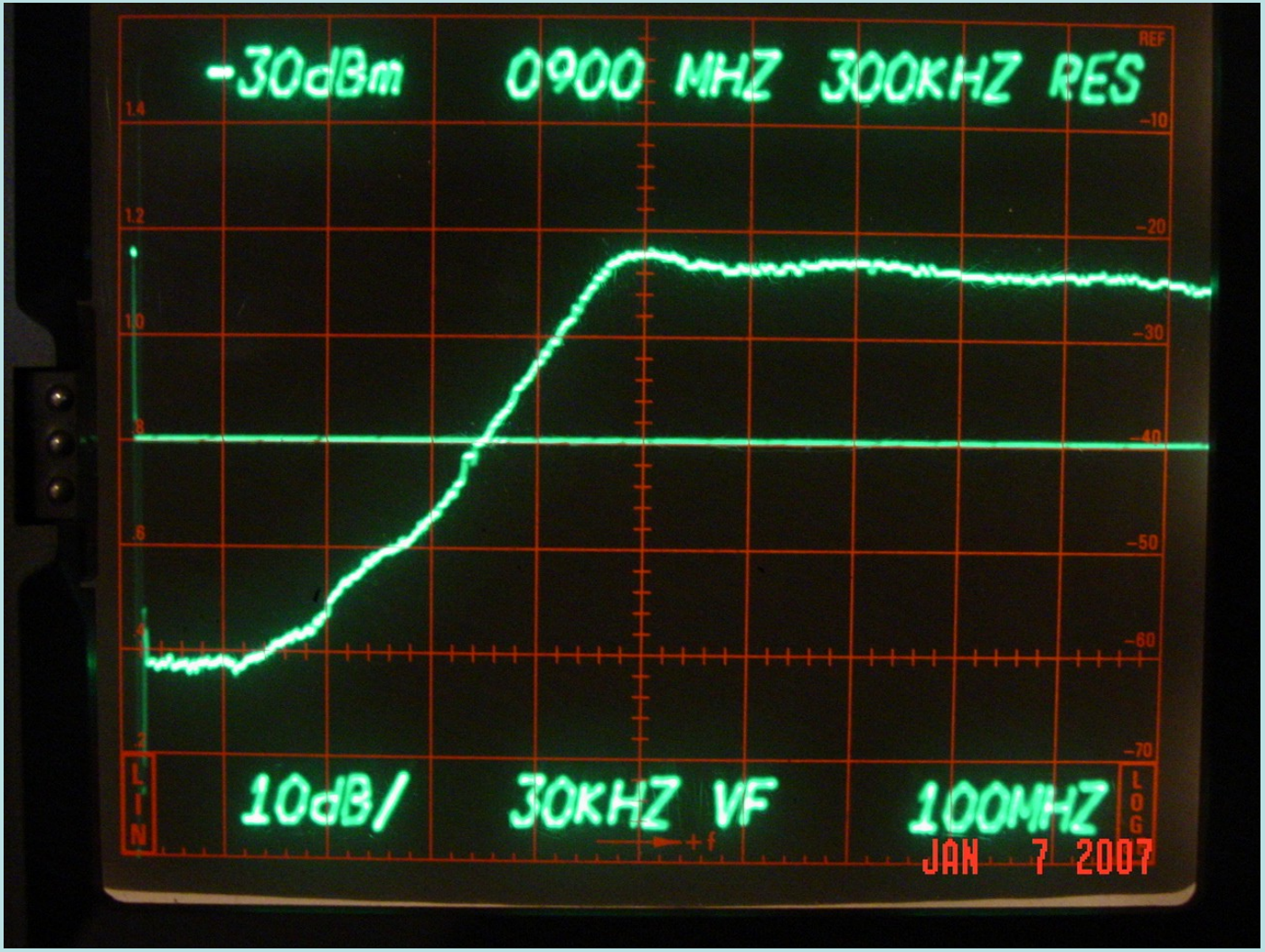
LNA-1400

LNA Series

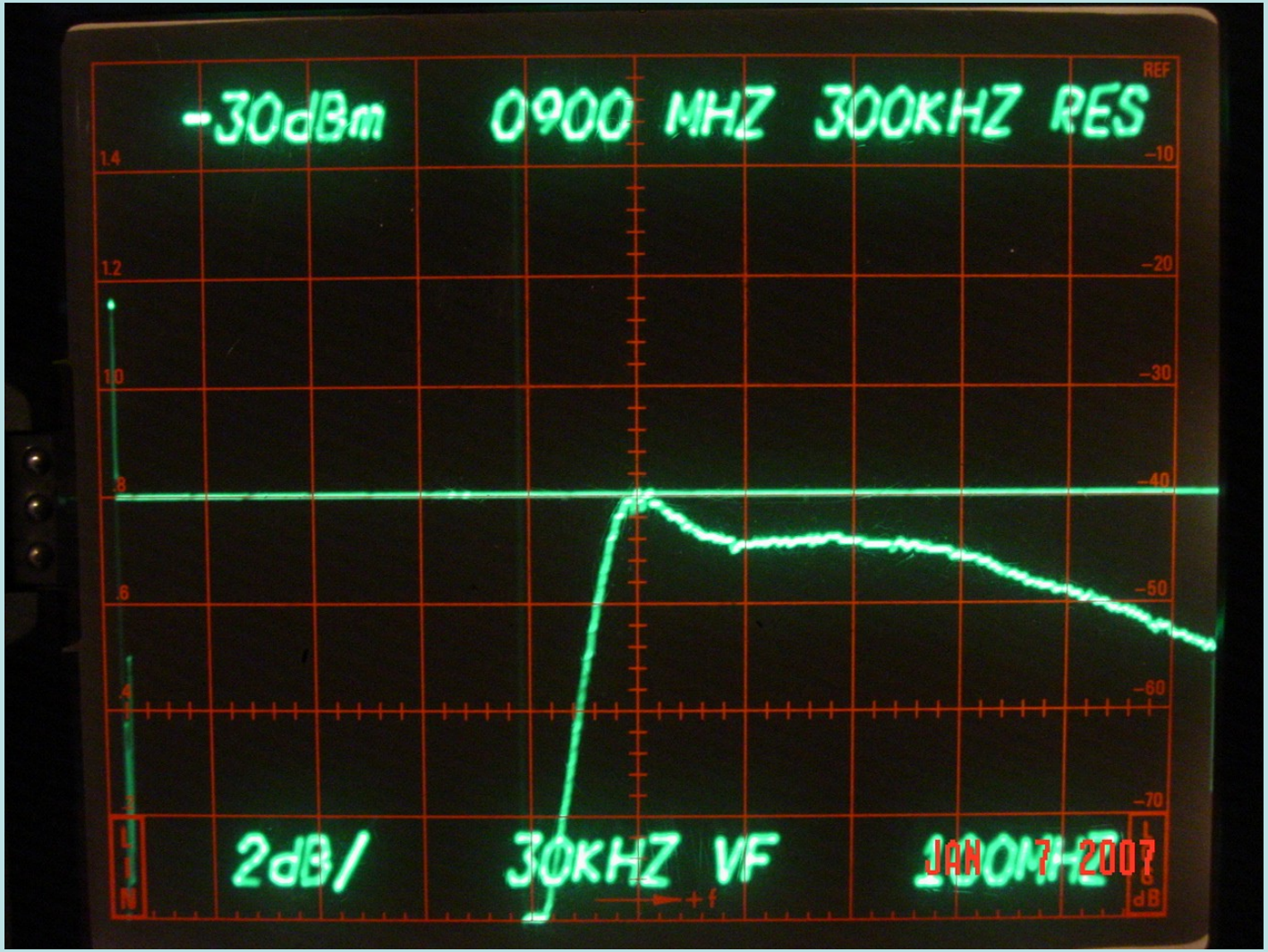
100 – 1400MHz Low Noise Amplifier







Filter + Preamp Response Plot.
Vert is now @10 dB/div with center line as 0 dB gain. Generator & cable(etc) anomalies subtracted out.
Total insertion gain +18 dB @ 902 MHz. Slopes down a little with increasing frequency from preamp roll off as expected.
Generator output decreased to keep amplifier output well below IP1 compression level of +17 dBm.



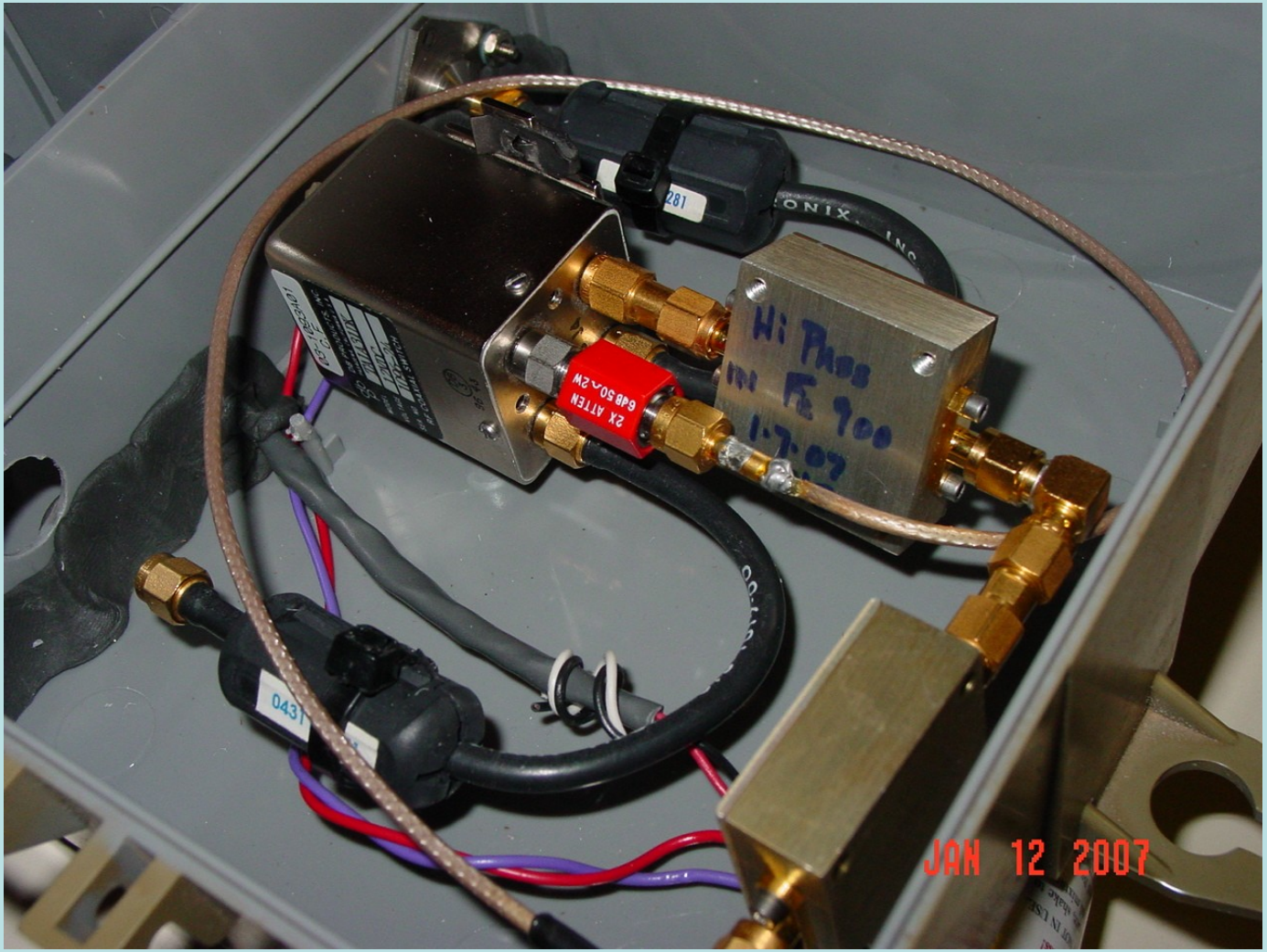
Vert is now @2 dB/div with center line normalized at 18 dB gain to show approx -2 dB rolloff at 1296 MHz. Generator & cable(etc) anomalies subtracted out. Total insertion gain is +16 dB at 1296 MHz.



Tower Weatherproof Enclosure

Now I just have to put everything into the weatherproof enclosure with the transfer relay,etc., before the contest in 2 weeks. Ferrite clamp around blocks (Fairite 61 mix) added around coax & power cables to minimize stray RF pickup from other sources. Relay is DB Electronics TA1A31, 12 VDC transfer relay, good to 26 GHz, 80 dB isolation up to 4 GHz. It can cold switch ~150 Watts at 1.3 GHz with SMA connectors.

7/8 connector with N to SMA adapter on lower right compartment where hard line will enter. (and support the box)



Final Configuration Ready for Tower Install.
Added a Tektronix 6 dB pad (DC to 4 GHz) on the output of the preamp to provide a broadband load and keep the input of the SSB LT 23/33 transverters happy. They have a tendency for the front end to go into oscillation if the input sees any out of band reactance.
I didn't want to be climbing the tower in a snow storm to add it later.
The resultant net gain into the transverter(s) receive input (including –3 dB coax loss) is +9 dB on 903 and +7 dB on 1296 MHz, so no front end overload. ~2 dB system noise figure.



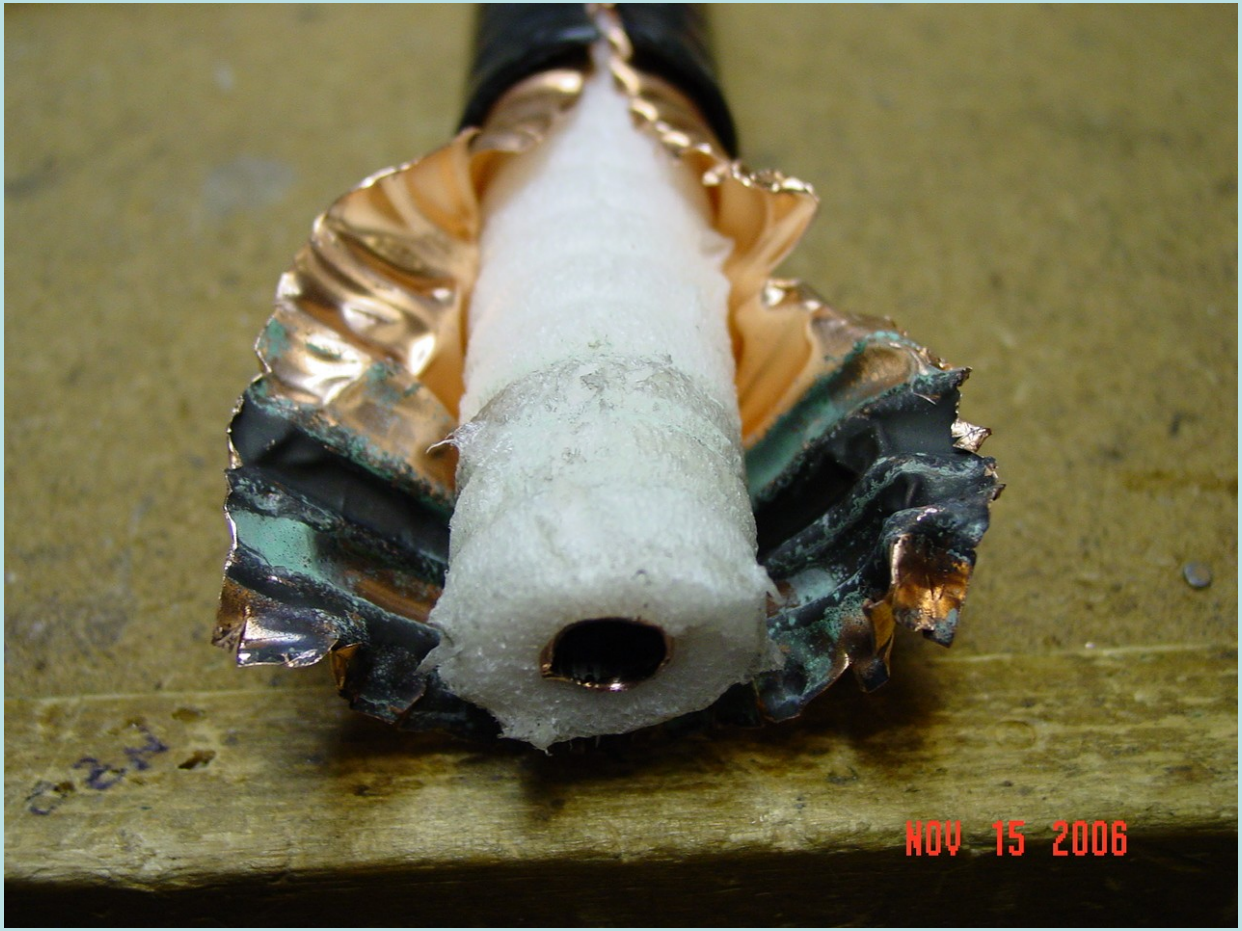
Final installation completed on the tower on Jan 12th, one week before the contest weekend
Do you think I can add some more antennas on the mast?



Antenna Relay & Preamp Control Box
Green push on, push off, controls the preamp relay.
Auto switched off for transmit when either transverter is keyed.
Red button switches antenna feed coax to 903 antenna & LT33 transverter.
Off mode defaults to 1296. Both transverter outputs have terminated output circulators to prevent final(s) destruction if the wrong mic is keyed. (*I'd never do that!*)
Led's show that relay current is flowing and presumed switched OK.



The Shack – 50 thru 1296 - Ready For The Contest
(DEMI 222 not shown)



P.S. Thanks to Bruce, N2LIV, who got me started on this project with his donation of some old Andrew LDF5 7/8 hardline. That's another story….
(I'm not sure if I should thank him or curse him.... ha, ha)