WHITE BOXES

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Using the RX converter on the 24.048Mhz ham band.

Many of us can now buy at low cost, the 23Ghz microwave links called « boite blanche » (white box).
I have been checking the RX converter.
Several types are available , all very similar :
-GBX124 : 23Ghz RX converter with LSB mixer (LO frequency lower than RX frequency).
-GBX125 : 23GHz RX converter with USB mixer (LO frequency higher than RX frequency).
-GBY111 like 125.

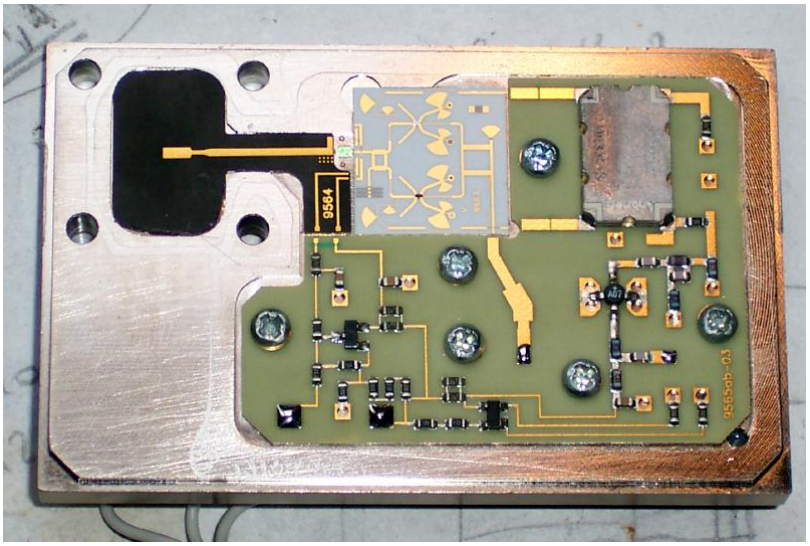


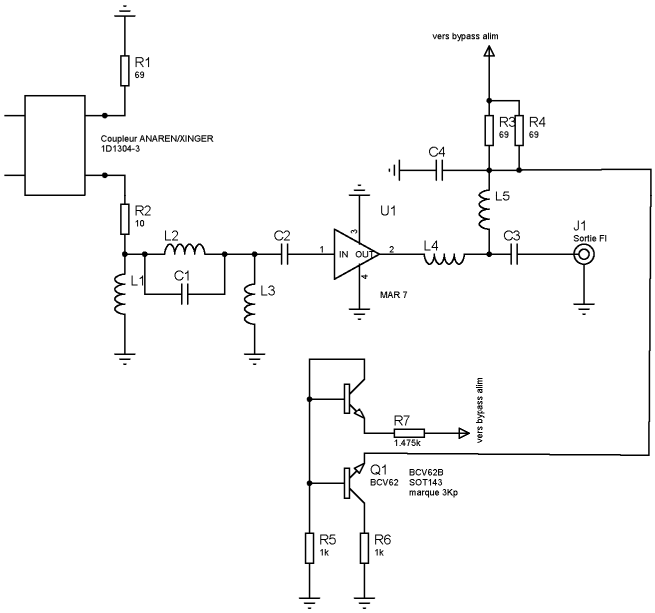
Much information (pictures , schematics) can be found on http://f1chf.free.fr/boite%20blanche/forum.htm).
If your converter is an LSB type : no problem , you can use it without modification. (there is generally an INF sticker on the synthesizer box) .
Mine was a GBY111 (SUP sticker) , so without mod the LO had to be on 12240 Mhz (harmonic mixer and 432 IF) , otherwise , if I had used the LSB LO (23616Mhz) , the 24048 would be rejected (image reject mixer) !

1) RX converter modification to use the LSB LO on an original USB converter :

The mixer used in the white box converter is an image reject type. On the output 3db coupler ,we find two mixing products. On one of the outputs , there is the LSB product , on the other the USB product. So all we have to do is to use the other output.

-To open the converter box , you only need to insert a small screwdriver tip between the two covers , both covers are only silver pasted.

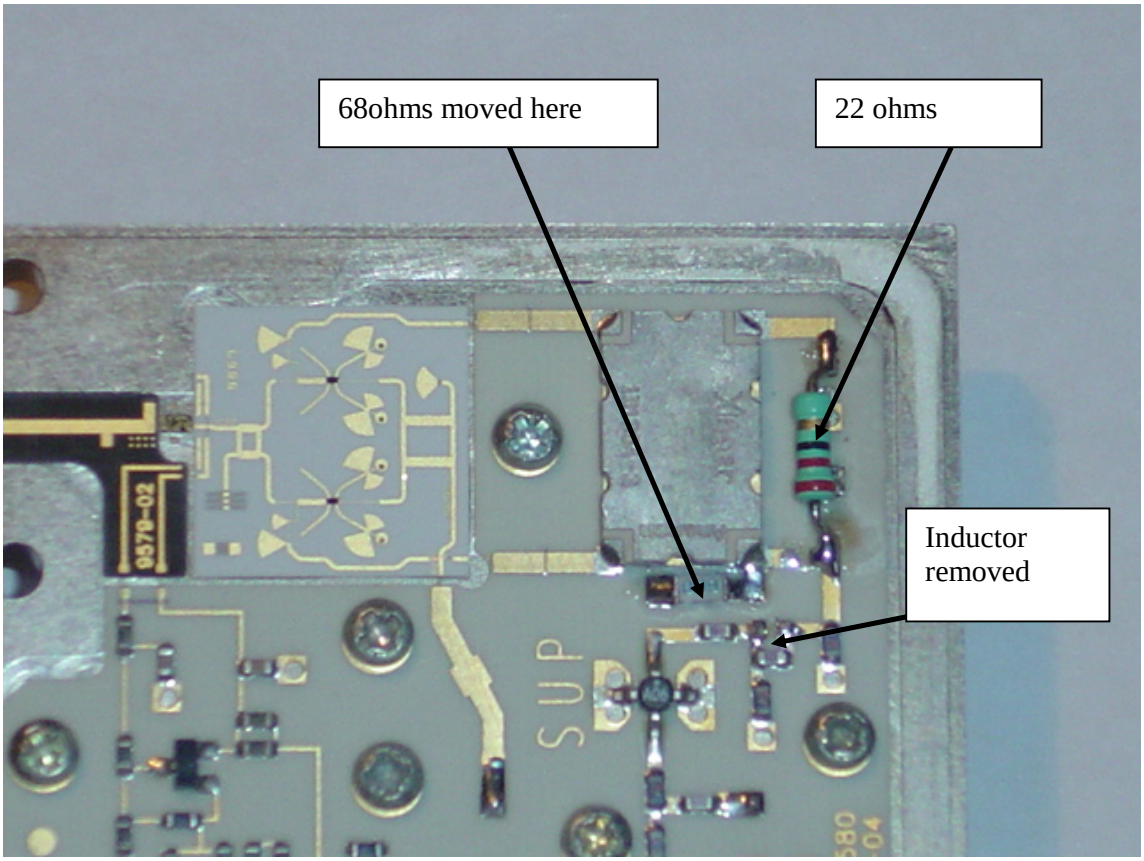




IF part is where we are going to work.

Nice electronics can be seen once the box is open :
On the left side , the WR42 access and its microstrip adapter , the hybrid module is the 23Ghz low noise preamplifier.
On the preamp output , there is a 3db coupler driving two harmonic mixers (so the LO is 12Ghz) , both mixers are summed in the 3db output quadrature coupler. One of the two outputs is loaded by R1 , The other output is connected to the IF amplifier via R2 (in my case it was a 22 ohms , and not 18 ohms like shown on the schematic). All the rest is polarisation and LO access components
What we need to do now (if our converter is not the right one) , is to reverse the two Anaren coupler outputs. The output originaly connected on the IF amplifier , will go to the ground via 68 ohms (SMD resistor in my case) and the other one will go to the IF amp via 22 ohms.

-So : unsolder carefully the two resistors , then solder an SMD 68 ohms between the 3db coupler output and the closest via to the ground , and solder the 22 ohms on the other side to the IF amplifier input , and all is done…..



3 db coupler modifications

2) IF passband :

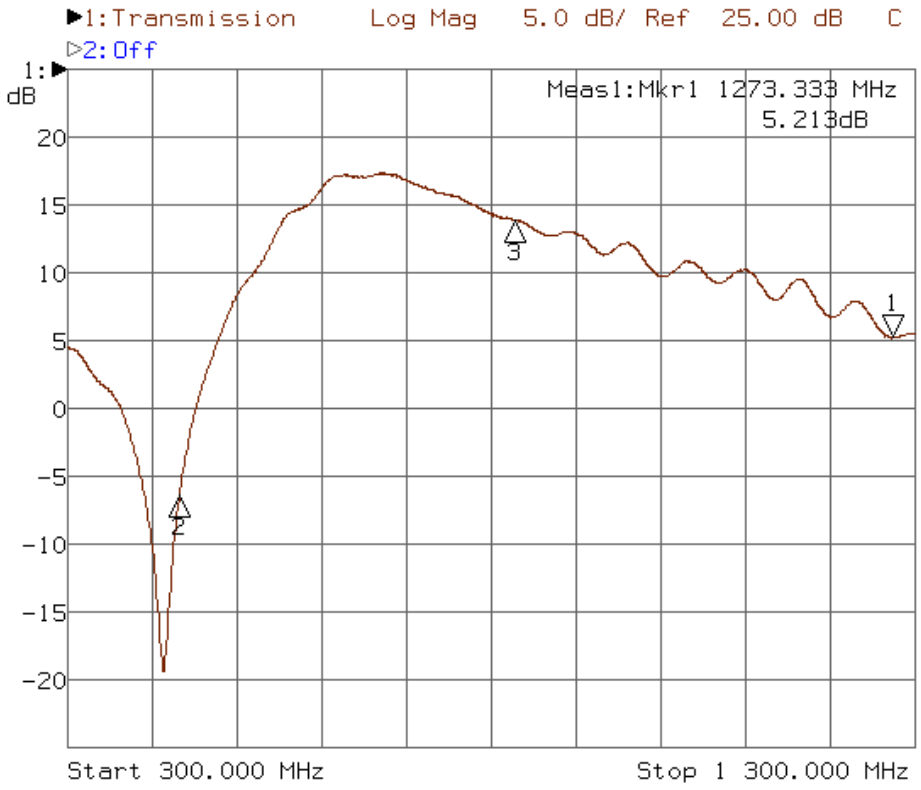
Originally the white box IF was around 600/800 Mhz.. In my case , I wanted to use 432Mhz for an IF. The question was : was this possible??

Two possible problems :

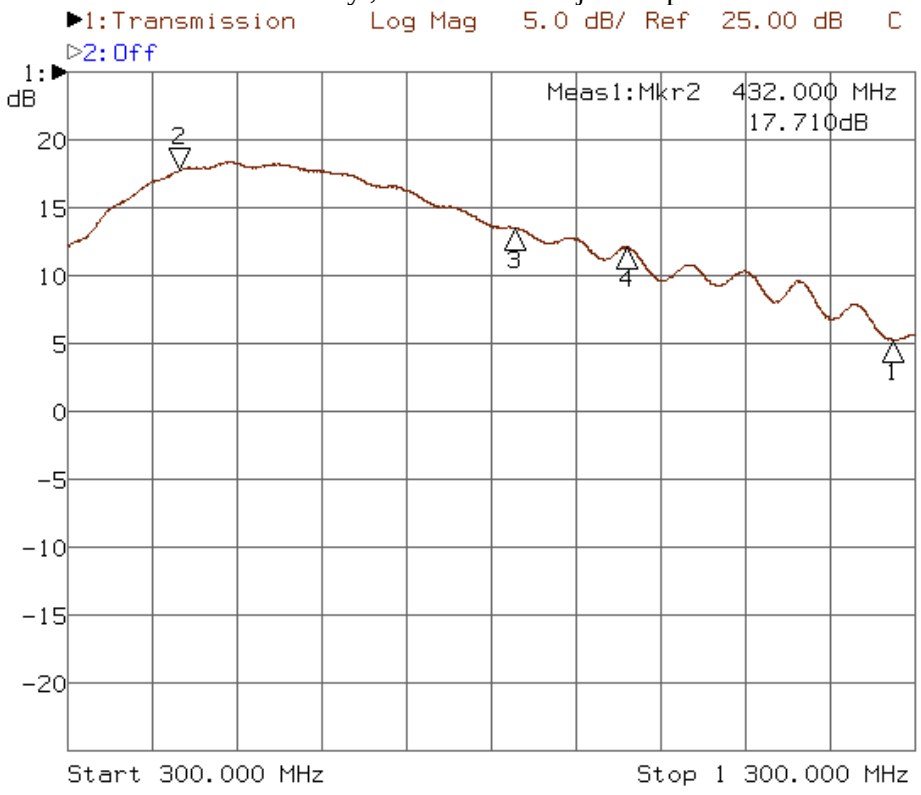
- The 3db Anaren coupler is not designed to be used at 432Mhz , what will be the image rejection if the same coupler is kept , but with a 432 IF ?

-Is the IF amp possible to use at 432Mhz?

First of all , I ran a network analyser measurement of the IF amplifier:



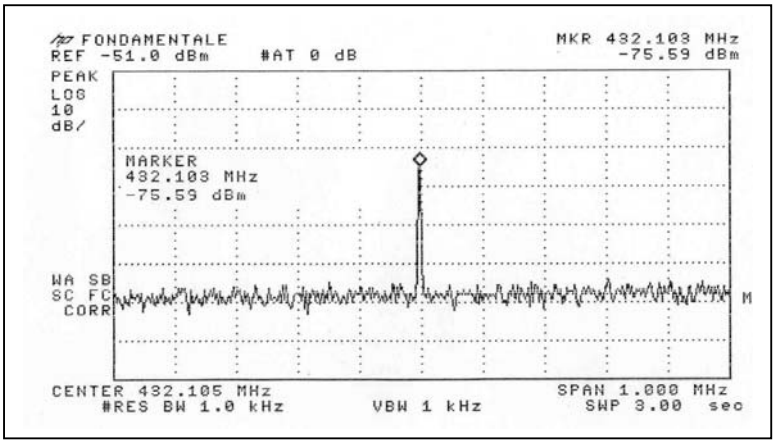
We can see than the IF amp gain is not OK at 432Mhz , where the gain is –7db !
I decided to take the L2 inductor away , as it creates a rejection pole with C1.



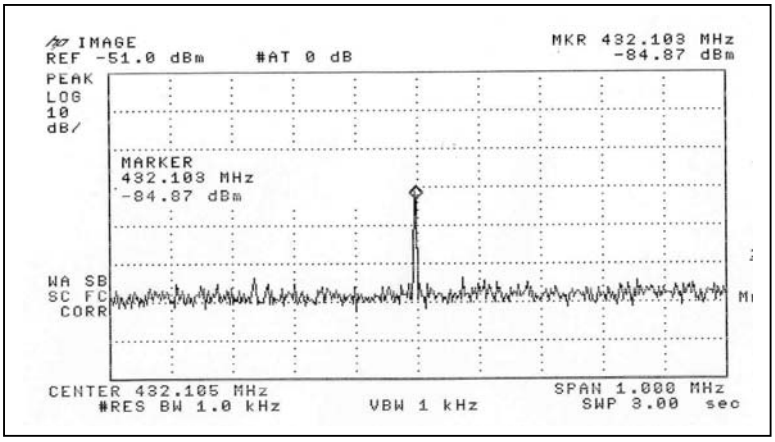
17db gain at 432 : better :0)

3) Image rejection

A good idea would be to replace the 800Mhz Anaren with the same model but designed at 432Mhz. Unfortunately I had only one converter available . Taking the original coupler away is a risky operation , as I had no spare converter , so I decided not to try it. A question remained : how much image rejection?



With 24048Mhz at the input the 432 output is –75.6dbm



With the image frequency at the input (same level) , the 432Mhz IF level is –84dbm

So we can state that the image rejection is 9db , not extraordinary , but acceptable.

4)Noise figure :

I ran some cold sky/ground measurements to do some NF evaluations.I did an average of several measurements .The converter noise temperature found is about 270°K. But there is some image noise contribution to take in account. What we measure here is the DSB noise figure. What we need is the SSB noise figure , so we have to correct our measurement . Usually we don't need to do this , as the image rejection on the systems we run CS/GND have enough image rejection to neglect it. If we do the correction , the SSB noise temperature is about 300°K , so about 3db NF.

The end :

So the white box converter gives a good performance. For a top notch 24Ghz RX (1.5db NF) , a preamp will be used , with enough gain to be able to add an OE9PMJ filter between the converter and the preamp , so that , the image frequency will be well down.

Notes :

Principe de la mesure du facteur Y et calcul du NF par F5CAU.
Image reject mixers by Aksel Kiis in Applied Microwave winter 91/92

Aknowledgments *:*
F1VL,F1BOH,F1CHF,F6BVA,F9HX and G4ALY.