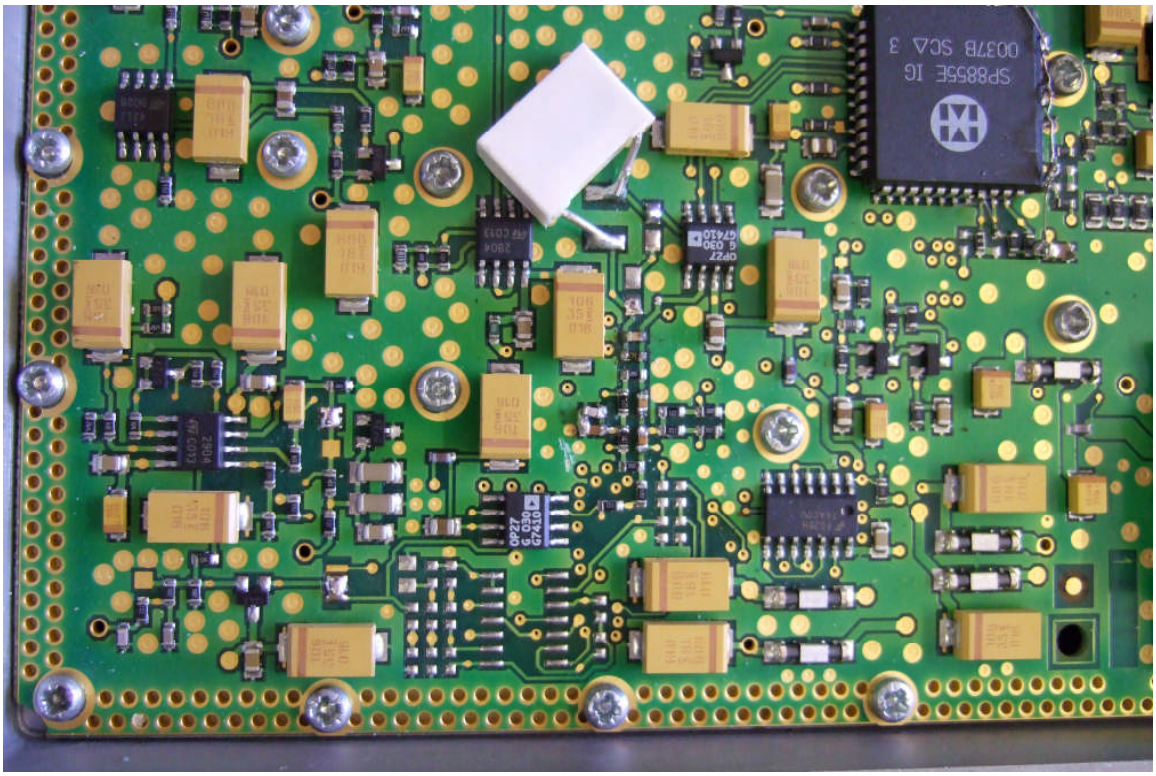
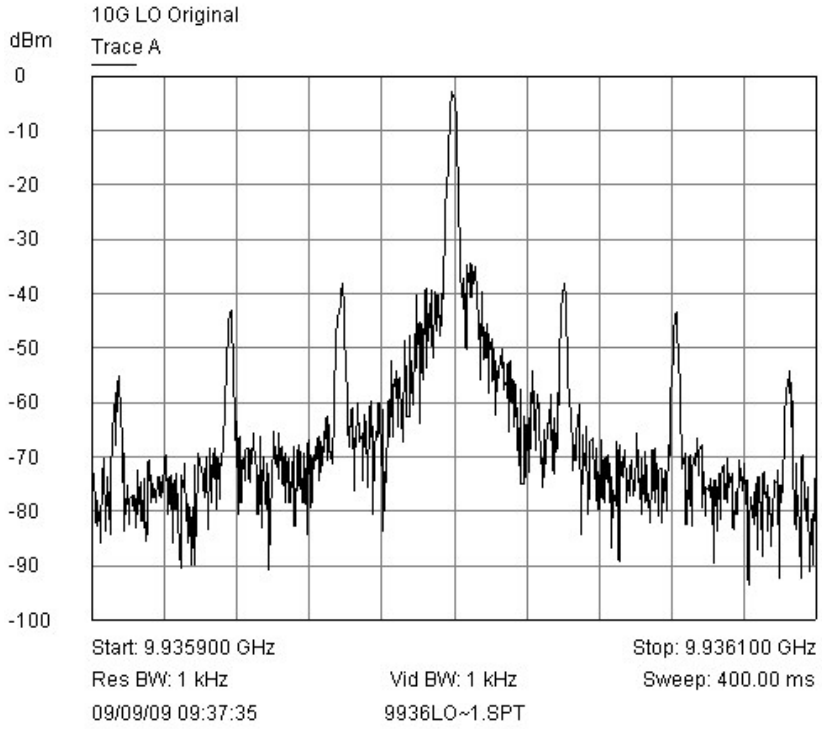


Improving the Alcatel 10GHz synthesiser

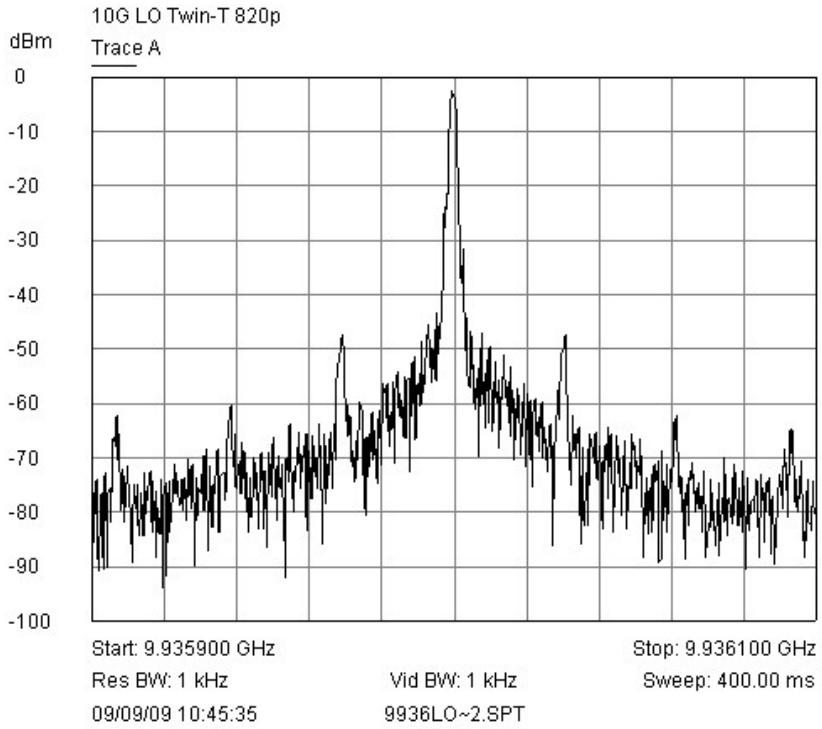
by Roger Ray G8CUB

Having now used the Alcatel synthesisers for 5.7/10GHz, 24GHz and 47GHz. The one thing that still bugged me was the close in spurii on the Zarlink 10GHz (9936MHz) synthesiser.
It was hoped that by changing the twin-T filter following the loop filter, that the spurious sidebands, could be notched out.
Looking at the output of the synthesiser at 4968MHz the sidebands were 31kHz away.
With help from Francois F1CHF, the original component values were identified, showing the notch was on 200kHz. The question was, could the filter be moved to 31kHz, without upsetting the loop stability.
Using one of the twin-T design utilities on the web http://sim.okawa-denshi.jp/en/TwinTCRkeisan.htm to compute the values for 31kHz. It was decided to keep the resistor values the same (12k21), and just change four capacitors. The capacitors C320,C321,C322,C323 were changed from 68pF to 420pF. They can be seen in the centre of the picture, the twin-T components forming a sort of cross.
The improvement was useful, as the plots show. But, it was thought further improvement could be obtained. All capacitors were then changed to 820pF, the loop went unstable! One of the parallel capacitors was removed. The plot shown was obtained, giving around 10db improvement on the 31kHz spurs.
It is important to use SM capacitors (0603), as leaded components can inject more noise into the loop.

There was some effect on the initial lock-up time of the loop. A ‘hick-up’ occurring after about 20-30 seconds, after that it was fine. This should not in practice cause any problem.

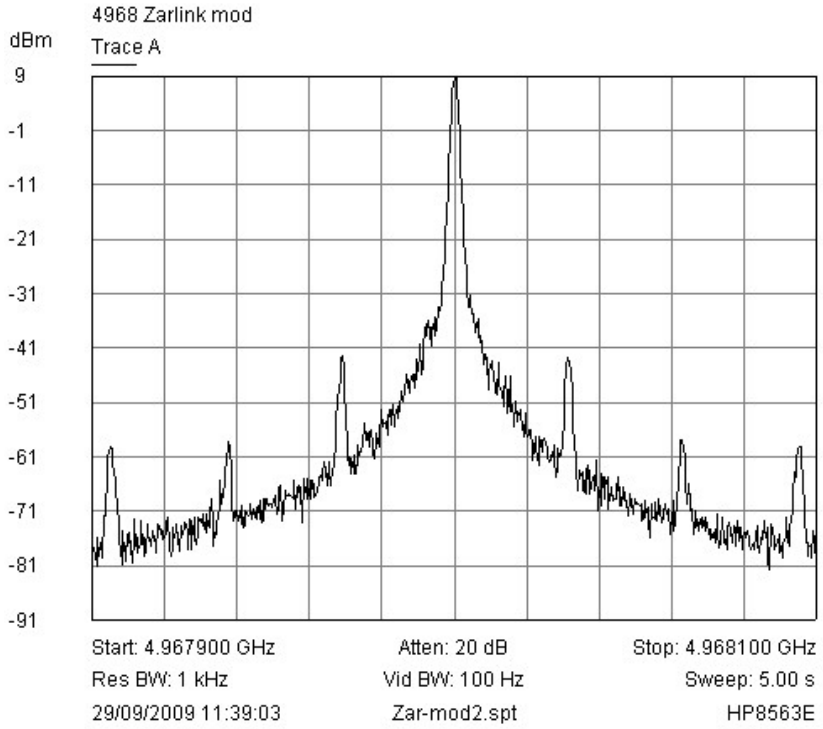


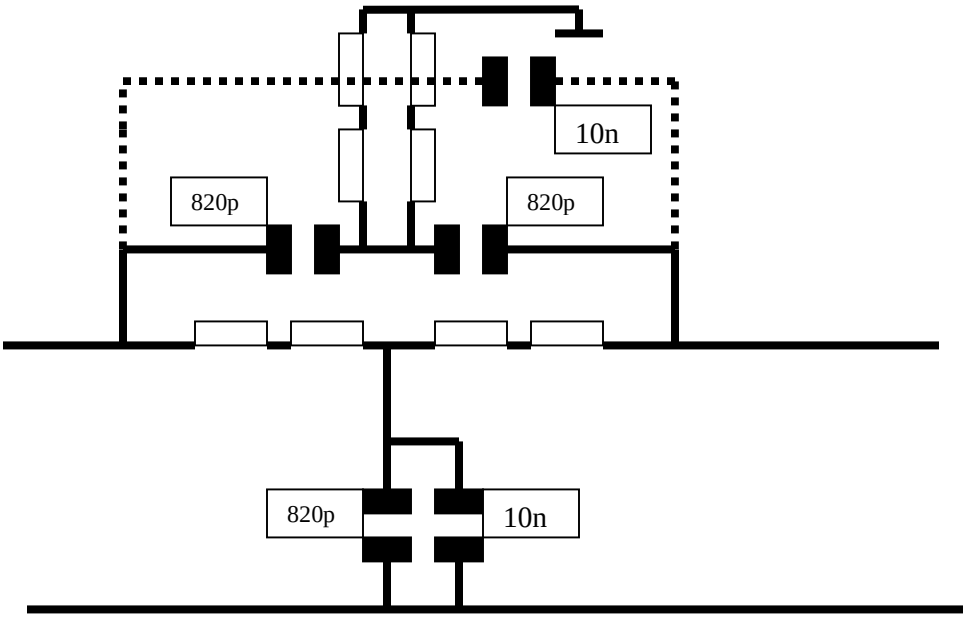
Unmodified unit



Twin-T filter capacitors changed to 820pF (just one to ground)

When the loop was unstable, the two capacitors were bridged with 10n to make the loop stable. This improved the spurii and when a 10n to ground was added, the close in noise improved as well. See the circuit and plots below (note these are at synth o/p freq. 4968MHz). I don't know why this works, but it does, and I have decided that I have played enough for now!

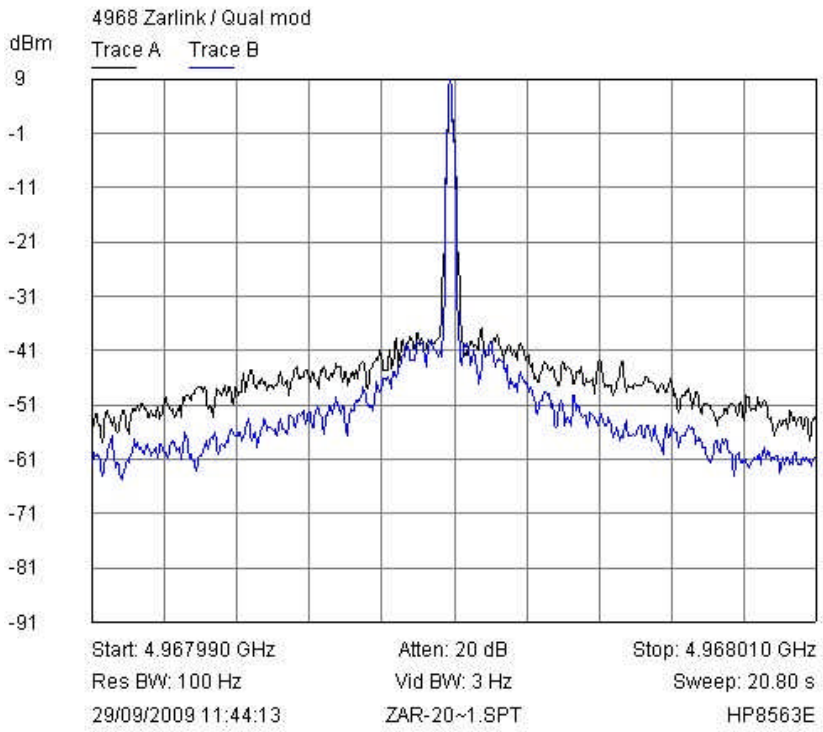




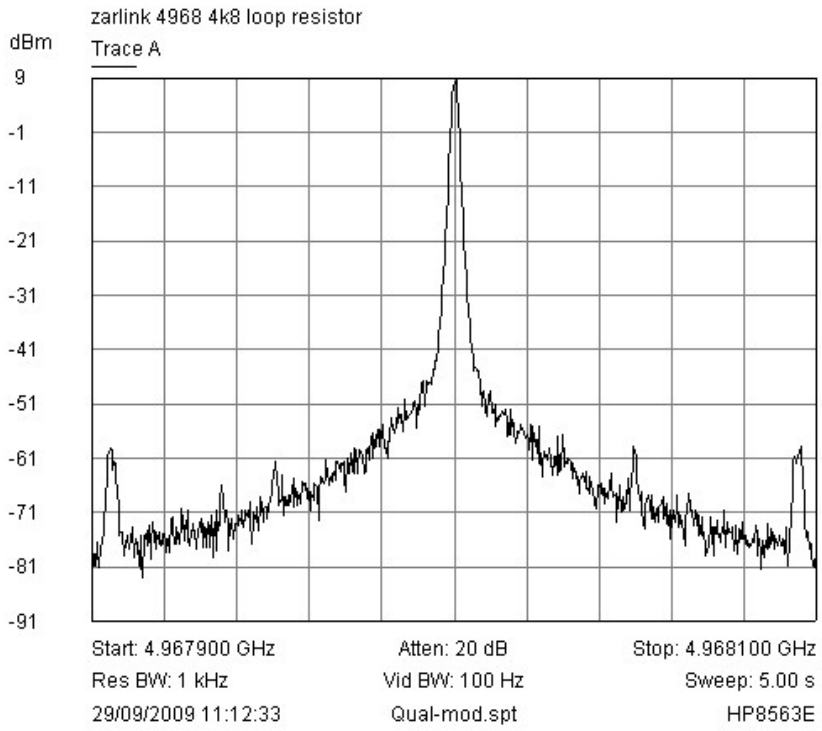
Twin-T filter showing added 10n (dotted lines), and changed values

I later found, that I had another synthesiser bought from Martlesham last year, which covered the same frequency range, but contained the Qualcomm synthesiser. I tried this and the 31kHz spurii were much better than even the modified Zarlink. Close in noise was worse, but that was without changing the loop filter. In this case changing the twin-T filter appeared to make things worse, so I left it alone.
It then occurred to me that improved noise performance would be obtained with a lower division ratio. If 6MHz was chosen as the loop frequency then the numbers still worked for 9936MHz (10G) and 5328MHz (5.7G). giving divisions of 207 and 222.
To obtain a 6MHz loop reference, the 10MHz source was externally multiplied by 3 to 30MHz. The internal R register was left at divide by 5.

The result was much improved noise +/- 20kHz as the plot shows.



The close in noise is much improved, on the modified Zarlink synth (top trace), but even better on the Qualcomm with 30MHz reference, and 4k8 damping resistor (lower blue trace).



The Qualcomm synthesiser with 30MHz reference, still has spurii, but they are 94kHz away, and nearly 70dB down.

On the Qualcomm synth the loop filter resistor consists of 2 resistors in series. I changed the 1k resistor to 2k7 making 4k8 total, to increase the damping. This improved the noise up to 2kHz away from the carrier by a couple of dB, but is really just the icing on the cake. Also there is a mirror of the loop filter from pin 3 of the filter Op amp to ground. Any changes should be made to both filters. In my synth the main filter caps were blue 68n so could be easily identified.
The 10 to 30MHz multiplier used, was based on the WA1ZMS design using two 1N5711 diodes, a 2 stage filter, and output amplifier.
The spurii on the Zarlink synth is likely to be similarly improved, by using a 30MHz reference, although I think the Qualcomm versions will always have the edge.