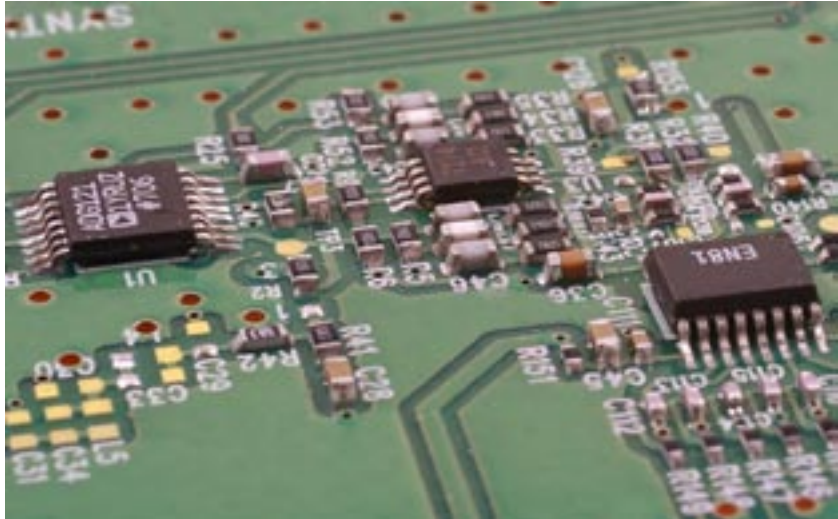


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Case Study

A Broadband Low Noise Fast Switching Synthesised Microwave Frequency Source



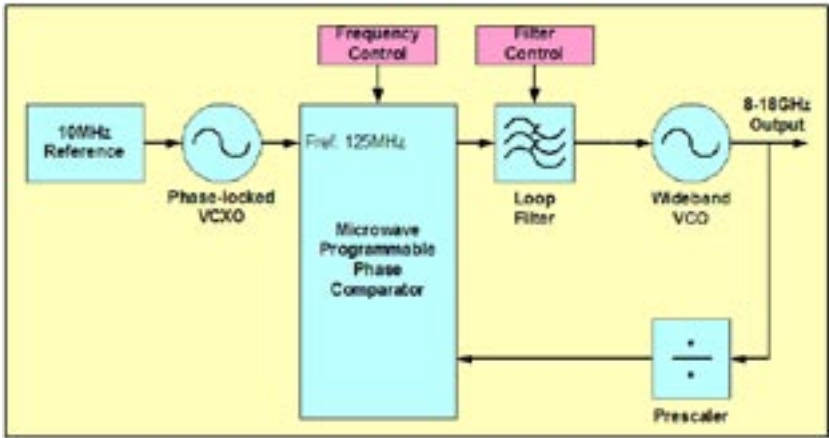
Microwave radios and military radar systems require frequency sources which:

- Can cover large frequency ranges
- Can settle rapidly after a frequency change
- Have extremely low phase noise
- Have low spurious output
- Are compact

Plextek has extensive experience in the design and supply of such frequency sources. This case study describes a microwave synthesiser designed and supplied by Plextek. The performance requirements of the synthesiser are presented in the table below.

Frequency Coverage	8 to 18GHz in 1GHz steps
Settling time	be on frequency in less than 10usec
Phase noise	$< -107\text{dBc/Hz}$ at an offset of 100kHz
Spurious output	$< -60\text{dBc}$

Required performance of the microwave synthesiser



Programmable frequency synthesiser

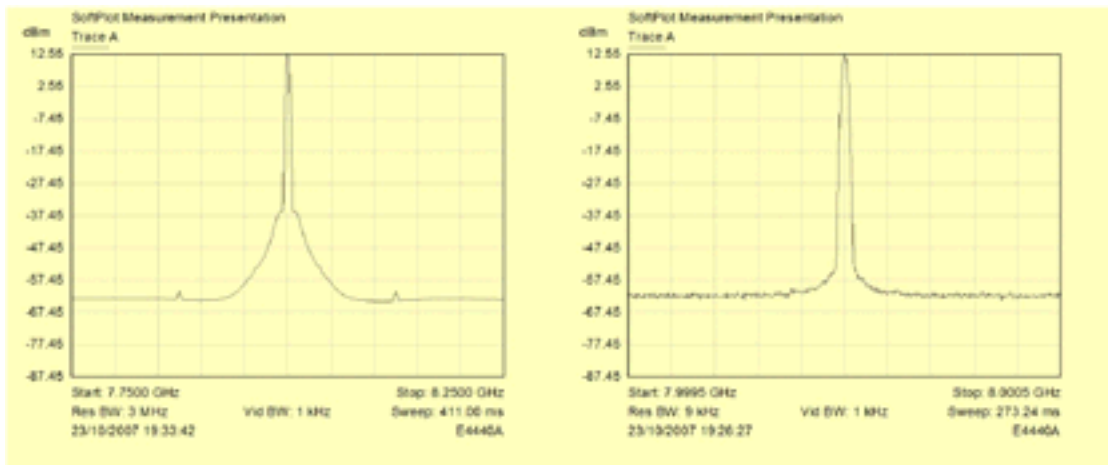
The selected architecture is based on a low noise frequency synthesiser as depicted in the block diagram to the left. A high stability external 10MHz reference, such as a Rubidium frequency standard, is used to lock an intermediate VCXO that provides an extremely low phase noise VHF reference source for the microwave programmable phase comparator. A high spectral purity wideband final frequency VCO is locked to this source.



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The large frequency coverage required the adoption of special control techniques to:

- Maintain loop stability,
- Reduce reference frequency products on the output
- Define the phase noise and settling characteristics for each output frequency



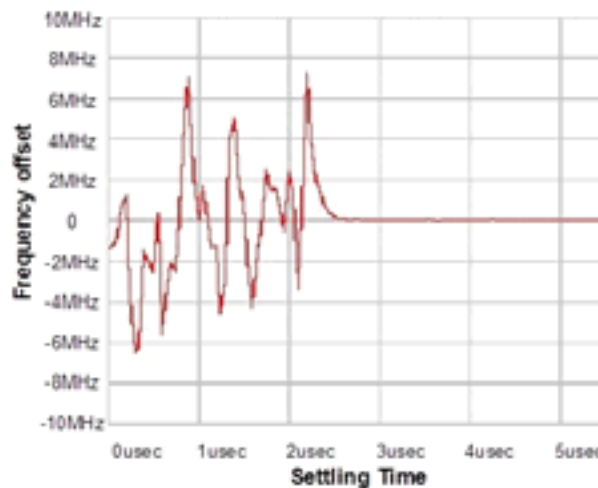
Measured output spectrum at 8GHz

An example of the measured phase noise performance of Plextek’s design is shown above for operation at 8GHz. The left hand plot highlights the spectral purity of the output across a ± 250 MHz frequency span. Reference frequency breakthrough is just visible at a level of -74 dBc at ± 125 MHz frequency offset.

The settling time performance of Plextek’s design is presented below. This measurement records the settling of the source to a 1GHz step change in frequency, going from 9 to 8GHz. The source has settled to within 100kHz after approximately 2.5usec.

The final challenging aspect of the design was strictly limited PCB area. The Plextek design met the clients requirements and is capable of fitting on to a 7cm x 11cm PCB – about one eighth the area of this sheet of A4!

The plot also shows the familiar shelf characteristic of a synthesised source with the loop filter rolling off at around ± 10 MHz offset. The right hand plot shows the phase noise performance close-in to carrier (± 500 kHz). This frequency range is within the loop bandwidth and the phase noise is flat at offsets of between ± 100 kHz and ± 500 kHz and is of the order of -112 dBc/Hz.



Measured settling time of the frequency source