

Re: Idea for a Vector Network Analyzer

Source: <http://sci.tech-archive.net/Archive/sci.electronics.design/2005-12/msg00584.html>

- *From:* Chris Jones <luginut808@xxxxxxxxxxxxxxxxxxxx>
 - *Date:* Sat, 03 Dec 2005 23:20:56 +0000
-

Adam S wrote:

> Chris Jones wrote:

>> Adam S wrote:

>>

>>

>>>I had the following idea for a home built vector network analyzer

>>>project. The block diagram is shown below. Essentially channels A and B

>>>are mixed down to separate 1kHz IF and sampled with a stereo 24bit DACE

>>>for the PC. Phase and magnitude of the resulting 1kHz signals are then

>>>calculated with DSP methods.

>>>f1-f0 = 1kHz as f0 sweeps from 0 to 20MHz.

>>>I know there will be problems as f0 gets close to 1kHz and again at near

>>>0Hz, due to SA602 not being an ideal mixer.

>>>

>>>Anyone think concept won't work ?

>>>

>>>

>>> To PC

>>> *

>>> |

>>> -----

>>> ----- |FT245BM|

>>>ch A ----- |||

>>>o-----|SA602|----| 2kHz |-----'. |USB I/O|

>>> |mixer| | LPF | | -----

>>> ----- | |

>>> | LO | |

>>> | -----

>>> o-----'. |24bit | | AVR |

>>> ||| ADC |---| |

>>> || |stereo| | uC |

>>> | | -----

>>> | | ----- | |

>>>ch B ----- |||

>>>o-----|SA602|-----| 2kHz |-----' |

>>> |mixer| | | LPF | |

>>> ----- | ----- |

>>> | |

Re: Idea for a Vector Network Analyzer

```
>>> ||
>>> |-----|
>>> f1|||AD9834|
>>> '--| 20MHz|---| DDS |-----o
>>> | LPF |||
>>> -----|
>>> |
>>> /|-----|
>>>SIG / | f0| |AD9834|
>>>OUT_/ |-----| 20MHz|-----| DDS |-----'
>>>f0 \ || LPF |||
>>> \ |-----|
>>> \|
>>> BUFFER
>>>
>>>[view in monospaced characters]
>>
>>
>>
>> Are you already aware of the N2PK network analyser? (Try google). I
>> think your idea of using an IF frequency rather than mixing down to DC
>> might be
>> preferable but there probably isn't much difference. Using a non-DC IF,
>> you might be able to make the receiver digitally filter out responses due
>> to the third (and other) harmonics of the source frequency, which could
>> make the signal source purity less difficult. The third and fifth
>> harmonics will unavoidably be present in the receive LO (since the mixer
>> only works well with hard driven LO port, creating odd harmonics), but
>> since the source and LO frequencies are different by  $1 * f_{IF}$  in your
>> system, the harmonics of the source will be received and downconverted to
>> frequencies  $3f_{IF}$  and  $5f_{IF}$  etc. which are not the same as the desired IF
>> signal so you can filter them out.
>>
>> I would also like to make a VNA, but to be interesting to me I would
>> really want it to cover the 2.4GHz WLAN frequencies so I could test
>> filters,
>> antennas etc. The receiver part looks feasible to me using AD8343
>> mixers, or maybe diode samplers, but the signal source and the
>> s-parameter test set
>> seem like the challenging parts to me. Rather than a 10kHz to 3GHz
>> signal generator, I wonder is it easier to generate a very wideband
>> pseudo-random bit sequence using ECL type comparators or latches, and to
>> use that as the stimulus, recording the response of the network in the
>> time domain using a second shifted PRBS generator driving a correlator,
>> and computing the
>> frequency response. I fear that this would take too long for a very wide
>> sweep however.
>>
>> Chris
>
>
```

Re: Idea for a Vector Network Analyzer

- > That last part paragraph flew over my head. I've heard of PRBS
- > generators used as a stimulus for audio speaker frequency analysis.
- > Maybe there is some way of correlating two of these generators and use
- > digital sampling (ones and zeros) at super high speeds to somehow
- > compute the frequency response. Could just be my imagination.
- >
- > I have seen the renowned N2PK network analyzer published on the web. I
- > would of though dynamic range could be seriously improved by using AC,
- > as DC would have drift problems.

I think that the N2PK design would not have bad DC offset problems because I think he flips the phase of the LO and then subtracts the two readings, thus getting rid of any offsets in the mixer and LO leakage into the receiver input. In some ways this is equivalent to having a very low frequency offset between the LO and source, the frequency offset being equal to one half cycle as often as the PC feels like it. It's probably not quite as good as a proper offset between the two frequencies though.

- > Once the 1kHz is inside the PC then
- > there are no noise/drift sources to speak of. There is also the other
- > advance as you mentioned, about harmonics of the source signal being
- > blocked by the 1kHz since they will not be 1kHz relative to harmonics of
- > the LO. But the catch is the DDS generates a bunch of non-harmonic
- > related spurs that shift all over the place as you sweep the frequency.
- > At some frequencies multiple harmonics will get mixed down to 1kHz and
- > cause error on the output. The DC mixing method of the N2PK will have
- > every spur joining together from each DDS and mixing down. Some will
- > subtract some will add. Needs more thinking..
- >
- > Adam

With regard to the DDS spurs, I think that the ultimate answer is to have a different kind of synth which I want anyway because I want coverage up to 2.5GHz at least. If that is too much work, then a big improvement could be had by moving from the AD9851 to the AD9951, which I think has more DAC resolution and much better spurs (and is more than twice as fast too).

Chris

• *References:*

- ◆ ***Idea for a Vector Network Analyzer***
◇ *From: Adam S*
- ◆ ***Re: Idea for a Vector Network Analyzer***
◇ *From: Chris Jones*
- ◆ ***Re: Idea for a Vector Network Analyzer***
◇ *From: Adam S*

- Prev by Date: ***Re: Remote Turn-On***
- Next by Date: ***Re: Pull-up circuit for altitude encoder tester needed.***

Re: Idea for a Vector Network Analyzer

- Previous by thread: *Re: Idea for a Vector Network Analyzer*
- Next by thread: *900MHz RSSI Level Meter*
- Index(es):
 - ◆ *Date*
 - ◆ *Thread*