Re: parametric detector

Source: http://sci.tech−archive.net/Archive/sci.electronics.design/2005−07/msg01576.html

- *From*: "colin" <no.spam.for.me@xxxxxxxxxxxx>
- *Date*: Wed, 13 Jul 2005 03:31:56 GMT

"doug dwyer" <dd@xxxxxxxxxxxxxxxxxx> wrote in message
news:qhU6G7E21v0CFwFV@xxxxxxxxxxxxxxxxxxxx
> In message <xzmAe.8581$Dq.7318@xxxxxxxxxxxxxxxxxxxx>, colin
> <no.spam.for.me@xxxxxxxxxxxx> writes
> >"doug dwyer" <dd@xxxxxxxxxxxxxxxxxx> wrote in message
> >news:98vvxpAYmT0CFwn1@xxxxxxxxxxxxxxxxxxxx
> >> In message <Z6Qze.7334$Dq.3916@xxxxxxxxxxxxxxxxxxxx>, colin
> >> <no.spam.for.me@xxxxxxxxxxxx> writes
> >> >Hi,
> >> > Im looking at using a parametric method for a phase detector,
> >> >The source (~4mhz) is already very strong but the sideband, @ 1−10hz,
is
> >> >extremely low, I am considering using a quartz crystal as the most
> >sensitive
> >> >slope detector but to get a significant signal to noise ratio I would
> >need a
> >> >crystal with a Q of over a million. I dont expect acheiving such a
high Q
> >is
> >> >practical, unless cooling it drasticaly would help ?
> >> >
> >> >The main noise problem is 1/f noise especialy as a high Q circuit
would
> >need
> >> >a high impedance amplifier and a mosfet would have too high 1/f noise
at
> >> ><10hz.
> >> >
> >> >However I cant see a way of using a paramatric method for a detector,
at
> >> >least not with any gain, I havnt realy looked at them much before,
> >although
> >> >I know the basic principles of operation of using as using variable
> >> >reactance in a ac voltage dividor or charge/voltage pump.
> >> >
> >> >I came accros an old parametric amplifier by AD the 310/311 but I
doubt
> >they
> >> >make this any more, at least something like this might be usefull

after a
> >> >diode detector, although I am not sure about how much the diode noise
> >> >particularly 1/f noise would be.
> >> >
> >> >Colin =^.^=
> >> >
> >> >
> >> I understand that you intend to apply a 4MHz signal with low sidebands
> >> to a high Q crystal offset slightly so that pahse modulation will
appear
> >> as amplitude modulation
> >
> >Hi, thanks, yes thats right :)
> >
> >> and then perhaps employ a low frequency
> >> spectrum analyser to look at the phase noise. Is this the idea?
> >
> >well it is actualy a modulation signal im trying to detect rather than
just
> >noise but it is very similar problem, of course the phase noise of the
> >reference oscillator is a big issue but I intend to try and null most of
> >that out I hope.
> >
> >> If so:
> >> A good quality 4MHZ crystal wcan have a Q approaching 1000000.
> >> All depends on the diameter/contour surface polish and the quality of
> >> quartz used.
> >
> >I'l go looking for some nice shiny quartz rocks... I chose 4mhz as it
seemed
> >they had the lowest series resistance for the frequency coresponding to
> >highest Q although manafacturers dont list Q on a per frequency basis,
its
> >generally 20k for off the shelf types, im not sure if its advantagous to
use
> >an overtone or not. Im not sure if i can get any better ones, but the
ones i
> >bought seem to demonstrate a higher Q than anticipated from the
simulation.
> Intrinsic acoustic loss is per cycle so ltimate q reduces from about
> 10000000 at 1 MHz to 100000 at 100MHz.
> Modern crystals use grown quartz which can be much lower Q however the
> best grown approaches the ultimate.
> A 5 MHz 5th overtone will have a q of 1 to 2oooooo but cannot be driven
> hard.
>
> >
> >> The crystal could be operated at its series resonance and terminated in
> >> 50 ohms so that a <1nVroot Hz amplifier could be used.
> >> The technique is not unknown
> >

> >aha, I have looked at using it in parrellel mode trying to use the
> >considerably high voltage generated from resonance to improve snr before
> >detection, although I was woried about destroying the crystal I can
easily
> >see 50v pk−pk.
> >I will experiment with the series mode in ltspice, the problem with most
> >1nv/hz^−2 amplifiers is 1/f noise is stil quite high as much as 1uv total
> >below 10hz, not that many manafacturers seem to specify noise below 10hz,
> >but certainly it has meant i have had to rethink things, I was hoping a
> >parametric amp would avoid the 1/f problem unless i am mistaken here ?
> >I have managed to get significant gain using the reactance of a varactor
in
> >a tuned circuit, but there still the problem of the preceeding detector
> >diode.
> >
> >
> >> Marconi manufactured a tuneable cavity in
> >> the 400MHz range for the purpose.
> >
> >so could a 400mhz cavity have a higher Q ?
> >
> >> The orthadox approach would be to mix a high q crystal reference
> >> frequency with the "unknown" and explore the LF result with an
analyser.
> >> I did well with this approach employing the steep side of an ssb
crystal
> >> filter to attenuate the resultant mixed carrier whilst looking at the 0
> >> to 3kHz ssb noise.
> >
> >Ive seen test aplication where the same type of oscillator is used as the
> >reference if it is a VCXO of course.
> >Ive tried using a PLL with a OCXO but this proved disapointing, of course
> >one never fuly knows if its the topology used or just unlucky
construction
> >with such low snr, from what I can gather I think 1/f noise can be
degraded
> >with handling/soldering etc.
> >
> >> With careful use of low noise gain blocks stepped attenuator to
overcome
> >> the dynamic range limitations of the 141T I could see down to −145db
> >> from the carrier.
> >
> >Thats quite impressive.
> >
> >> For another approach see error multipliers , these circuits are seldom
> >> seen now but you may be able to buy an old Tracor ? for the purpose.
> >
> >I will look into this with interest.
> >
> >> Finally a counter with low noise reference, high clock frequency and

> >> multiperiod capability can be programmed to convert jitter to ssb noise.
> >> See "AllensTime"
> >
> >thnks
> >
> >Colin =^.^=
> >
> >

Hi again,

I looked at using series resoance with a 50ohm resistor but the much lower voltage means a much smaler signal even tho the slope is higher, I did consider a curent transformer aproach but think it wpould be pushing things a bit to actualy get more SNR.

I looked at auto zero amplifiers and found they auto cancel the 1/f noise along with the dc offest, the AD8552 looks superb, very low voltage noise 1−10hz and very low input curent/noise too, so i can use a highly tuned high impedance/high voltage section to give maximum signal, so i got one of these now, (I already had one in my parts box !) and boarding it up now.

I couldnt find much on error multipliers, maybe il look some more ...

Colin =^.^=

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- ***Follow−Ups***:
  - ♦ ***Re: parametric detector***
    - ◊ *From:* doug dwyer

- ***References***:
  - ♦ ***parametric detector***
    - ◊ *From:* colin
  - ♦ ***Re: parametric detector***
    - ◊ *From:* doug dwyer
  - ♦ ***Re: parametric detector***
    - ◊ *From:* colin
  - ♦ ***Re: parametric detector***
    - ◊ *From:* doug dwyer

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