RUNNING TDA18219HN FROM EXTERNAL CLOCK

I'm finishing up the new design for VESNA's UHF receiver and one feature that sunk the most time was the ability to run two receivers synchronously from the same clock source.

Some of the silicon tuners from NXP, like the TDA18271HD, have a dual-tuner feature. The tuner runs a 16 MHz crystal oscillator that is used in a PLL to generate the local oscillator signal. If the chip is programmed as a master, it outputs a buffered differential sine signal on two XTOUT pins. Another tuner can be programmed as a slave and attached to that clock in place of the crystal resonator:

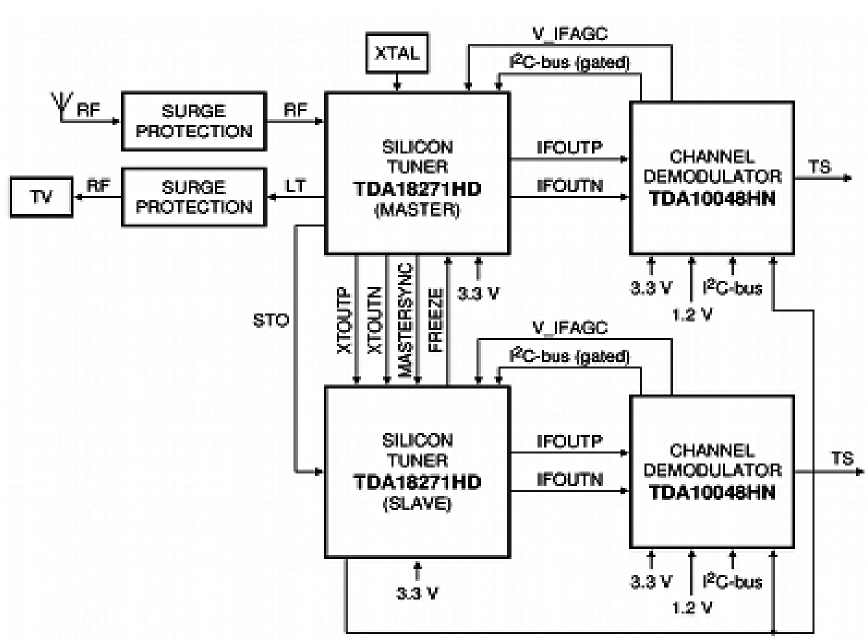


IMAGE BY NXP

Unfortunately the TDA18219HN that I'm using doesn't have that feature. You cannot disable the oscillator and set the pins XTALP and XTALN as passive clock buffer inputs. On the other hand, it still has the clock output, because that is useful to run the demodulator. This made me think it should still be possible to run two tuners synchronously, albeit with some additional circuitry.

Datasheet reveals very little about what is behind the XTAL pins:

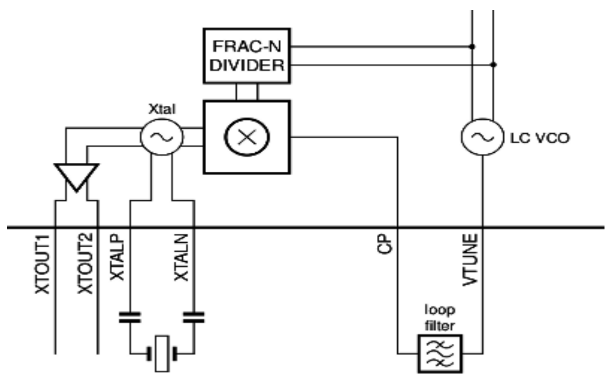
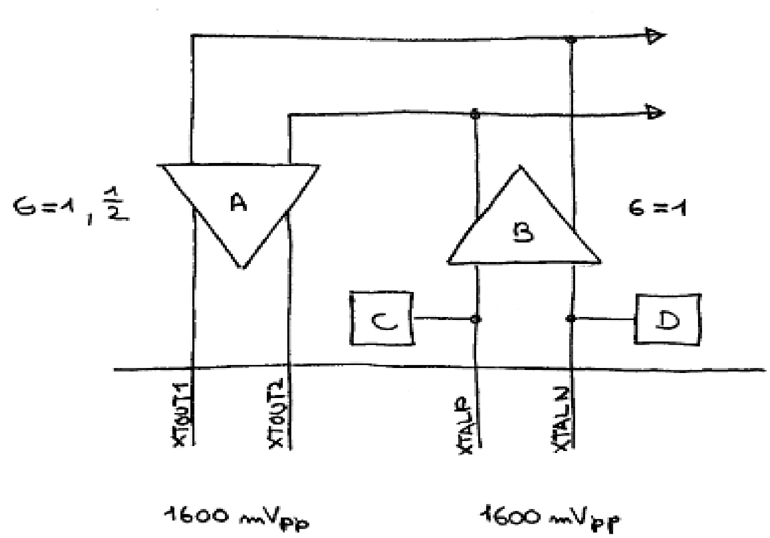


IMAGE BY NXP

Note that the capacitors are wired in series with the quartz and not to ground. So one thing is immediately obvious: this chip does not use the common Pierce oscillator topology. That makes sense, since the chip mostly uses balanced signals. The single-ended digital clock signal generated by the common oscillator variant would be of little use. It also means that running this chip from an external clock is not a simple matter of finding which crystal pin is the input to the integrated CMOS inverter.

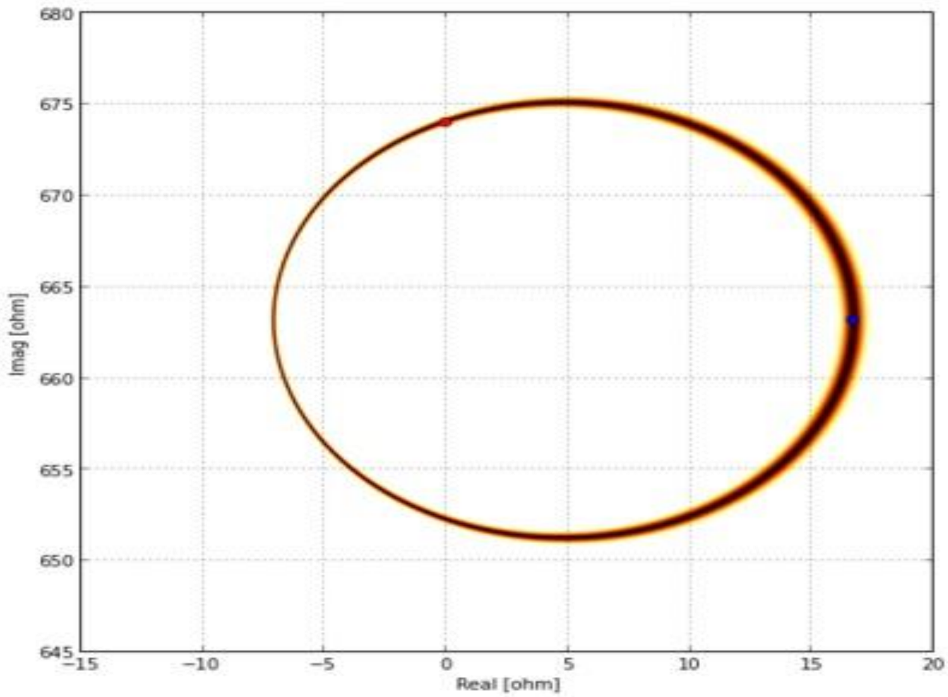
After some browsing of the literature I didn't find any quartz oscillator topologies that would require capacitors wired like that. In a number of experiments with a signal generator, oscilloscope and a pile of test circuits I came up with the following model:



XTAL pins are inputs to a differential buffer B. You can produce the correct differential clock even by driving just one pin, although analog performance is reduced because twice the required input level causes saturation.

Pins are also connected to circuits C and D that provide power to a ringing quartz crystal. Circuits on both pins are independent: driving one pin does not cause any change on the other one. The circuit is very prone to oscillations even without a quartz attached and I wasn't able to measure its input impedance directly.

From some indirect measurements and calculations it seems that it must lay on this circular path in the complex plane:



Since the circuit compensates for the losses in the oscillator, the real part of the impedance must be negative. The imaginary part is positive, so it exhibits an inductive reactance (at 16 MHz it's equivalent to around 6.6 μH). This is a bit weird, since quartz resonators typically also behave like inductors in a circuit and the inputs should compensate for that.

The final verdict is that it should be possible to drive XTAL inputs from respective XTOUT outputs, provided there's an AC-coupled voltage follower between them.

The follower must be powerful enough to drive the relative low impedance of the XTAL inputs. The power required is non-negligible - my worst case estimate from the impedance plot is 10 mW, which seems a bit high considering this is far above the microwatt levels quartz crystals typically endure.

In the end, I can't really test this until I have a prototype circuit on my desk because any stray capacitance from cables ruins the result. I also don't know how much of a problem phase shift between the receivers will be. If it turns out that it won't work at all, scraping this feature won't be too big a loss anyway.

Source:

https://www.tablix.org/~avian/blog/archives/2014/03/running_tda18219hn_from_external_clock/