

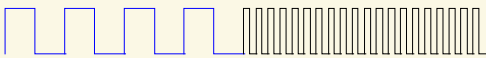
Novel Phase-Coherent Programmable Clock

Enabling Higher Precision Arbitrary Waveform Generator

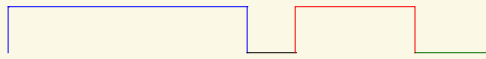
Normal DDS frequency transition can happen at any point in the waveform



Our DDS frequency transition can only happen at the end of the waveform

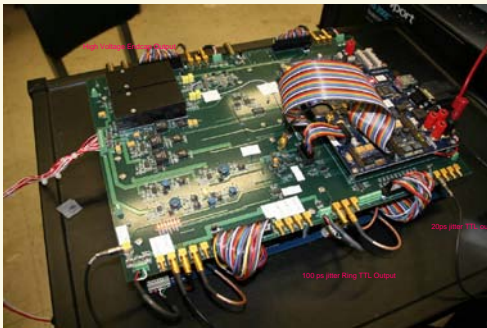


With a DAC and our DDS clock, we can create arbitrary waveforms with 48-bit precision. Each color in the depicted waveform represents a different frequency and number of clock cycles



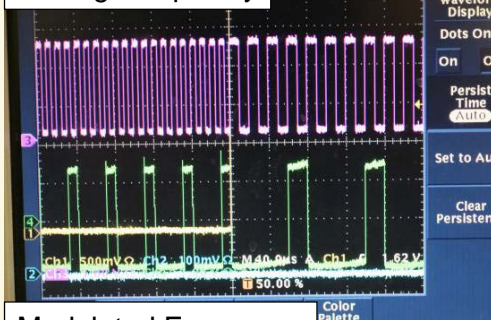
This technology can be used to create a mass spectrometer with mass stepping resolution greater than 1×10^3 or a delay generator with sub-picosecond resolution.

Prototype Arbitrary Waveform Generator



Arbitrary Waveform Generator Output

Driving Frequency



Modulated Frequency

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Summary

Direct digital synthesis (DDS) technology permits the generation of high frequency-resolved waveforms that can be changed on the nanosecond time scale (4 ns minimum). However when the DDS switches frequency, it occurs at any point in the phase accumulation consequently the output waveform during frequency stepping may be quite different. This randomness of frequency transition is called "DDS frequency transition jitter".

Scientists at ORNL have developed a method for phase-coherent DDS frequency stepping i.e. clock waveforms begin and end at the same phase regardless of the frequency or transition. This method enables rapid switching of DDS frequency at exactly the end of the output clock cycle allowing exact timing of multiple transitions to produce precise and temporally complex waveforms. Thus the DDS-generated clock frequency can be precisely changed as the arbitrary waveform is written. Changing the frequency only at the end of the output clock in a phase coherent process permits precise timing between each point in the arbitrary waveform. This method enables arbitrary waveforms to be produced with greater temporal complexity, precision and reproducibility than previously possible. This technology permits scanning or jumping of frequency while maintaining high resolution and jitterless transitions anywhere in the available frequency spectrum. It essentially adds time as a second variable in producing arbitrary waveforms.

Advantages

- Phase-coherent frequency switching enables production of precise temporally complex arbitrary waveforms
- Costs significantly less to produce compared to similar technologies in the market
- Software interface is flexible and easy to use.
- Very good scanning capability
- Transitions in the output waveform do not have to be spaced by the period of a single clock frequency.
- This technology opens the door for applications of arbitrary waveform generator for digital ion trap mass spectrometry as it enables higher mass resolution.

Patents

- (UTB – ID 1887) Patent Pending



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