Annotated Transcript (Editor Notes are in Bold Italic Text)

Demo of 409B Phase Continuous and Phase Synchronous Frequency Generation.

Hello, and welcome to a Novatech Instruments presentation of their model 409B DDS signal generator. In this video, we will demonstrate some of the key features of DDS technology, which stands for direct digital synthesizer technology, and how it can benefit the scientist and engineer when generating sine wave signals for system development.

First, let's get acquainted with the device. On the front panel, there's an indicator light and four, independently programmable, BNC outputs channels 0 through 3. On the rear panel, there's a power jack for the included 5 volt power supply and a DB9 serial port that accepts commands from the windows-based computer running the included SOF8_409 software. There are also two SMA connectors and one BNC connector that support features not discussed in this video.

One advantage of DDS technology is the ability to change frequencies, in a phase continuous manner, with no phase discontinuities. We will do this switching from 10MHz to 5MHz on the oscilloscope. This oscilloscope image is a capture of the 409B changing from 10MHz to 5MHz in a phase continuous manner, while in phase continuous mode. It can be seen clearly that, as it changes frequencies, there are no phase discontinuities.

(*Phase continuous operation requires that automatic clearing of the phase register is off. This is the default. See the 409B manual paragraphs 4.14 to 4.16*.)

Another advantage of DDS technology is the ability to generate multiple outputs that are phase synchronous and that can be made to be phase aligned. The 409B accomplishes this due to sharing one master clock for all output channels. This oscilloscope image shows two, 10 MHz sine wave signals, coming from two separate devices, running two separate master oscillators. The blue wave form is from the model 2975AR (***Rubidium***) Signal Generator, the yellow waveform is from the Novatech Instruments model 409B Signal Generator. There is inherent drift between the two signals due to the fact that they are running on two separate master oscillators, which is an example of non phase synchronous operation. We will do our best to try to synchronize these two waveforms.

(We try to synchronize the waveforms by adjusting the 409B to be as close to 10MHz as possible.)

For the following demonstration, the precision of our frequency counter, is within one part in 10 to the 11th for a 10 MHz signal. Let it be noted that the 2975AR blue wave form is indeed accurate to within one part in 10 to the 11th. Our best attempt at dialing in the 409B to within one part in ten of the 11th came to within 49 Parts in 10 to the 11th as a 10MHz waveform. Now, as we witness, there is still drift between the two waveforms due to the fact that two master oscillators are almost impossible to synchronize to the point of having two outputs at the exact same frequency. Therefore they will remain in non phase synchronous operation.

(The 2975AR master oscillator is a Rubidium Oscillator that is disciplined by GPS. The 409B master oscillator is a Temperature Controlled Crystal Oscillator)

We will now switch to ***(viewing)*** two output channels of the 409B. Please observe how they are phase aligned and share the exact same frequency. This is an example of phase synchronous operation. Also, the blue waveform has the same output amplitude as the yellow waveform, but has been scaled down for observation sake. Changing the phase of one channel, so that the outputs are 180 degrees out of phase with one another, we see that the model 409B retains phase synchronous operation. Now, if we rescale that one channel, we see that we have two identical 10MHz waveforms exactly 180 degrees out of phase with one another. This is during phase synchronous operation. Now, we can also change the frequency and we see that the intersection points are exactly where they should be. Changing back, from 5MHz to 10MHz, we see that the phase relationship is retained.

In phase synchronous operation, changing one frequency to simulate quadrature operation is very easy to do.

(Phase synchronous operation requires that automatic clearing of the phase register is on. This is not the default. See the 409B manual paragraphs 4.14 to 4.16.)

The Novatech Instruments Model 409B can also stimulate three phase power. The three outputs are connected at 60 Hertz, separated by 120 degrees. This is in phase synchronous operation.

Thank you for watching this Novatech Instruments video. Please feel free to contact us with any questions and visit our website, www,novatechsales.com **,** for full product information and documentation.

The presenter is Andy Syltebo, a senior in electrical engineering at Western Washington University. Andy produced this video when he worked for Novatech Instruments as a summer intern in 2017. He set up and operated all the instrumentation, operated the video camera and edited the video.