Moku:Go's Spectrum Analyzer

Lab study of Amplitude Modulated signal with Moku:Go

Moku:Go combines 10+ lab instruments in one high performance device. This application note discusses Moku:Go's Spectrum Analyzer and Waveform Generator and the advantages of a hybrid, swept signal spectrum analyzer.

Moku:Go

Moku:Go combines 10+ lab instruments in one high performance device complete with integrated power supplies. In this application note we discuss the benefits of a high performance swept spectrum analyzer and its use in an educational lab to investigate Amplitude Modulated (A.M.) signals.

Spectrum Analyzers

Spectrum analyzers are essential test & measurement instruments in any electrical engineering lab. They are used to display and analyze signals in the frequency domain. Compared to the Fast Fourier Transform (FFT) function available in some oscilloscopes, frequency swept spectrum analyzers typically provide better spectral resolution while maintaining a large frequency span. However, conventional spectrum analyzers can be much slower than the FFT based approach especially at a finer resolution. Moku:Go's Spectrum Analyzer instrument uses a hybrid technique, which delivers the advantages of both approaches and balances the speed and frequency resolution. In this guide, we will use Moku:Go's Spectrum Analyzer to investigate an A.M. signal and take advantage of the available frequency range and resolution bandwidth to examine the sidebands.

Generating A.M. signal

An amplitude modulated signal consists of the carrier plus a modulating signal. In this application note we have chosen a carrier of 15 MHz, modulated by a signal of 4 kHz. These figures are a reasonable example of a A.M. radio carrier carrying a signal in the audio bandwidth.

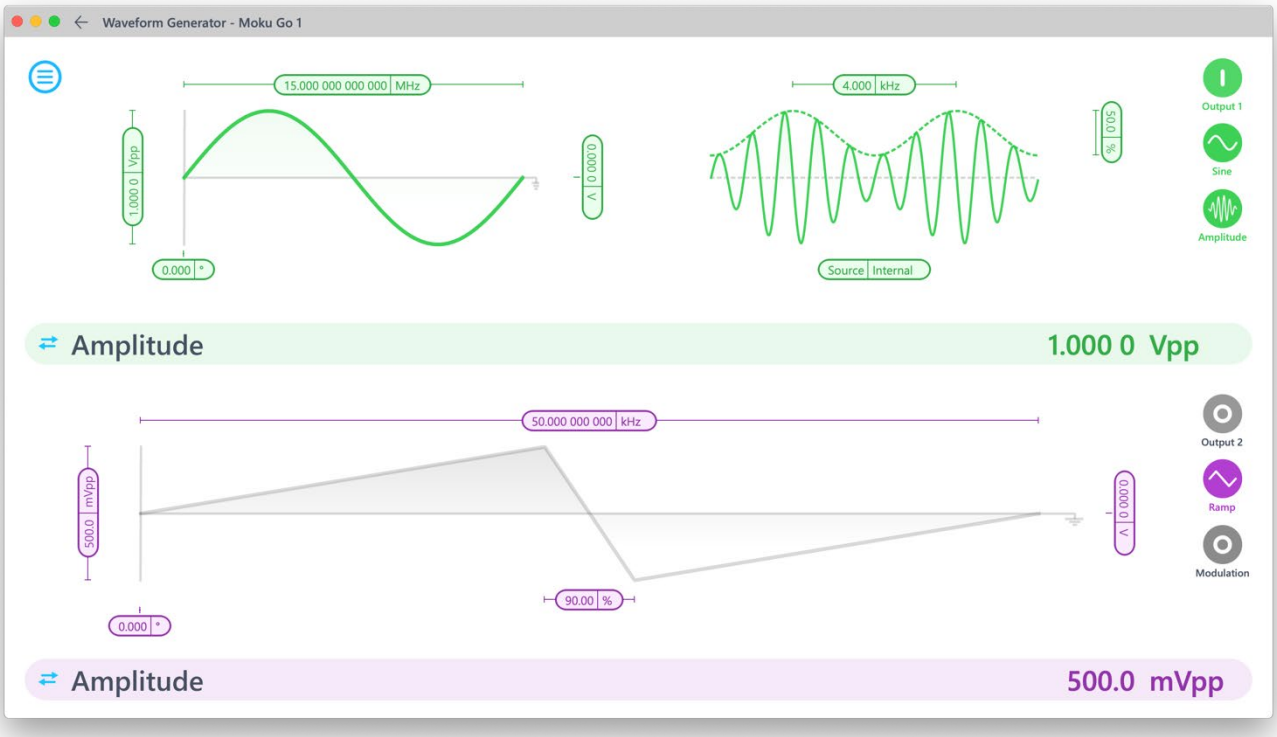

Figure 1: Moku:Go's Waveform generator, 15 MHz carrier with 4 kHz modulation

An A.M. signal will have a large carrier component together with sidebands; the bandwidth of the sidebands will correspond to the bandwidth of the modulating signal, so in our example we expect to see a carrier at 15 MHz and sidebands at 14.996 MHz and 15.004 MHz. An FFT-based spectrum analyzer, while fast, would likely not be able to resolve these fine 4 kHz details at the carrier frequency. Thus, it would not be possible to hold a meaningful lab investigating amplitude modulation.

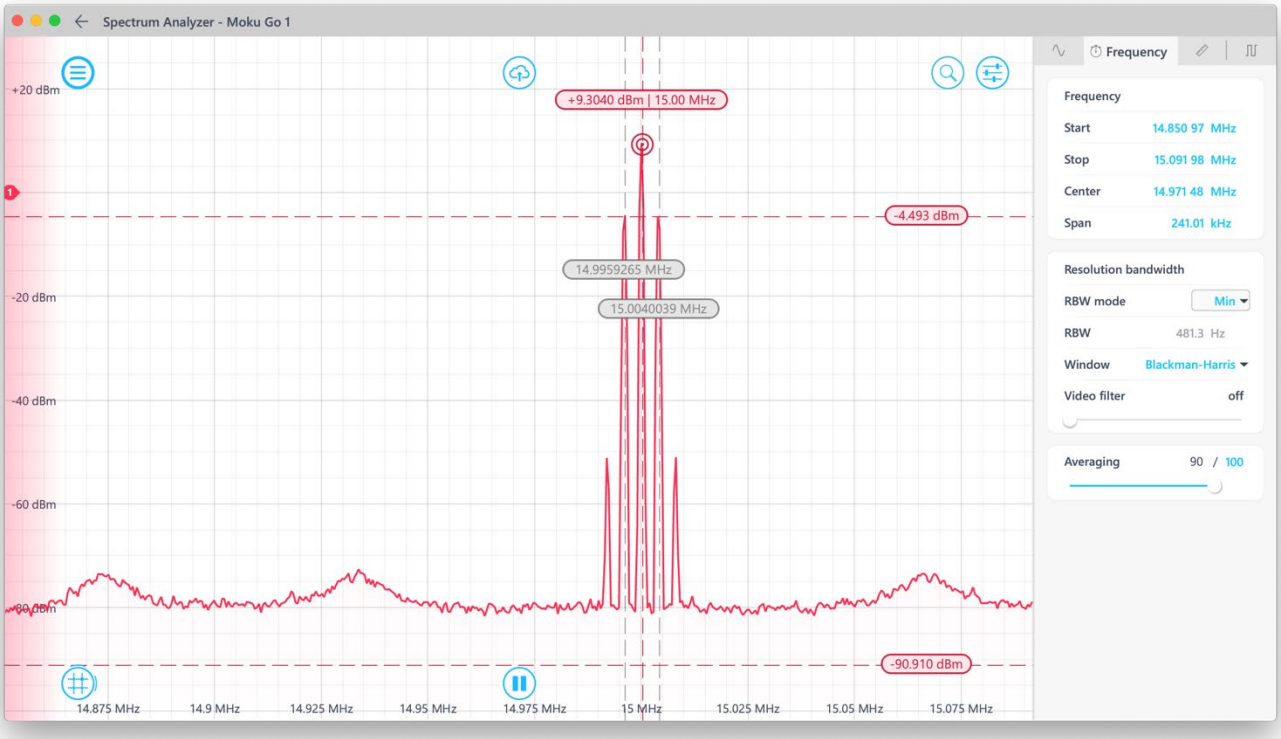

Figure 2: Moku:Go's Spectrum Analyzer revealing fine details of sidebands

Figure 2 shows Moku:Go's hybrid Spectrum Analyzer in operation. Because it implements a frequency mixer on Moku:Go's high performance FPGA, combined with an FFT we are able to clearly observed the sidebands, offset by 4 kHz. The minimum resolution bandwidth ("RBW") indicated is 481.3 Hz.

In a lab environment, we can then direct students to modify the modulating signal, observe the position of the sideband, and relate this back to their theory lectures. Further, Moku:Go's Waveform Generator can modulate the carrier by a signal on one of its analog inputs. Thus, we could supply a music or voice recording into a second Moku:Go's Waveform Generator and observe the bandwidth of the sidebands that result.

Benefits of Moku:Go

For the educator & lab assistants

Efficient use of lab space and time

Ease of consistent instrument configuration

Focus on the electronics not the instrument setup

Maximize lab teaching assistant time

Individual labs, individual learning

Simplified evaluation and grading via screenshots

For the student

Individual labs at their own pace enhance the understanding and retention

Portable, choose pace, place and time for lab work be it home, on campus lab or even collaborate remotely

Familiar Windows or macOS laptop environment, yet with professional grade instruments

Moku:Go Demo mode

You can download the Moku:Go app for macOS and Windows at the Liquid Instruments website. The demo mode operates without need for any hardware and provides a great overview of using Moku:Go.

Questions or comments?

Please contact us at support@liquidinstruments.com