How the Digital Down-Conversion (DDC) Functionality Benefits Your RF Measurement

Submitted by Keysight Technologies

RF Measurement Challenges

For RF signal analysis, it's common to frequency-shift the RF signal to an "Intermediate Frequency (IF)" so that you can use a high-resolution digitizer for a high dynamic range signal acquisition. This then gets sent to a PC for data analysis. However, the complexity of this analysis increases with today's wireless communication systems, such as 5G technologies, 802.11ax standard and so on. Measuring these systems can include complex modulation schemes (e.g. Orthogonal frequency-division multiplexing, OFDM), carrier aggregation, or MIMO (Multi-input Multi-output) /Beamforming signals.

These complications require significant signal processing, which in turn slows the measurement speed. This is a challenge as measurement throughput is critical in most applications, especially in high volume production testing.

In most vector signal analyzers, a digitizer is an indispensable component. For wider bandwidth analysis, you need a high-speed digitizer to capture signals. At the heart of a high-speed digitizer is a powerful FPGA or ASIC which processes data in real-time. This allows data reduction and storage to be carried out at the digital level, minimizing data transfer volumes and speeding-up analysis.

A key feature often available on PXI digitizers is real-time digital down-conversion (DDC). In frequency domain applications, DDC allows engineers to focus on a specific part of the signal using a higher resolution, and transfer only the data of interest to the controller/PC. It works directly on ADC data providing frequency translation and decimation sometimes called "tune" and "zoom".

How Digital Down Conversion (DDC) works

The frequency translation (tune) stage of the DDC generates complex samples by multiplying the digitized stream of samples from the ADC with a digitized cosine (in-phase channel) and a digitized sine (quadrature channel).

The in-phase and quadrature signals can then be filtered to remove unwanted frequency components. Then, you can zoom in on the signal of interest and reduce the sampling rate (decimation). Finally, the on-board processor send only the data you care about (I/Q data) to the on-board memory for further analysis. Most of Keysight's PXI digitizers and PXI vector signal analyzers (VSA) have implemented DDC to accelerate measurement speed and for demodulation acceleration. DDC accelerates measurement speed and increases processing gain to improve performance.

If you'd like to learn more about wideband signal acquisitions, you can refer to the following white paper Understanding the Differences Between Oscilloscopes and Digitizers for Wideband Signal Acquisitions to understand what you should be using for your application.