



RF vector signal generator employs quadrature digital upconversion

By Ashok Bindra

National Instruments' PXIe-5672 is a compact, three-slot 3U vector signal generator module that uses superheterodyne or IF upconversion to RF signals. To achieve that, it combines two existing modules into one PXI Express instrument: a PXIe-5442 arbitrary waveform generator and a PXI-5610 upconverter. Released recently at NIWeek, the PXIe-5442 is a 100 Msps arbitrary waveform generator with onboard signal processing (OSP). OSP functions include pulse shaping and interpolation filters, gain and offset control, a numerically controlled oscillator (NCO), and IQ mixing for quadrature digital upconversion. With 16-bit resolution and -91 dBc close-in spurious-free dynamic range (SFDR), the PXIe-5442 is designed for baseband I/Q and IF generation. Plus, it is also capable of generating general-purpose test signals at a maximum output range of 2 V_{pk-pk} into a 50 Ω load. For onboard signal processing (OSP), it implements a field-programmable gate array (FPGA). While PXI-5610 is a 2.7 GHz upconverter featuring wide real-time bandwidth and a highly stable time base accurate to within ±50 ppb.

Combining the two, PXIe-5672 generates RF signals from 250 kHz to 2.7 GHz with a 20 MHz bandwidth and signal levels from -145 dBm to +10 dBm. It can provide digital upconversion of baseband signals up to 40 Msps. And when configured with a redundant array of inexpensive disks (RAID) hard disk and PXI-5661 vector signal analyzer, the PXIe-5672 can stream RF signals for five or more hours.

With onboard high-speed PCI Express bus interface and OSP capability, stream-to-disk applications are now feasible. Because the PXIe-5672 is capable of digital upconversion for baseband signals up to 40 Msps, it can stream data from disk at the full bandwidth of the analog front-end. While digital upconversion is absolutely essential for streaming applications, it has other benefits as well. For example, it enables better memory utilization and allows the instrument to store longer waveforms. Also, it improves the frequency resolution. Because the IF carrier is derived from a numerically controlled oscillator (NCO) using direct digital synthesis (DDS), the instrument can generate RF carriers down to 355 μHz of frequency resolution.

PXIe-5672 comes with the NI-RFSG instrument driver and the modulation toolkit for LabVIEW. NI-RFSG is a fully functional instrument driver that is compatible with a variety of application software environments including LabVIEW, LabWindows/CVI, and C. It features easy-to-use functions for configuring the timing and synchronization, CW tone, and arbitrary waveform generation capabilities of the PXIe-5672. Additionally, it contains Express VIs for CW and arbitrary waveform generation, as well as interactive instructional examples and interactive online help to jump-start application test development.

Applications that can exploit this capability include broadcast video test, record and playback, and extended bit error rate (BER) testing. While PXIe-5672 with 32 Mbytes of memory costs \$17,499, the version with 512 Mbytes costs \$22,999.

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PXIe-5672 is a compact vector signal generator that uses a superheterodyne upconversion approach to minimize quadrature signal errors. It performs digital upconversion of baseband I/Q waveforms to an IF digitally in hardware on the FPGA.

