Overview

The NI 5421 is a 100 MS/s arbitrary waveform generator (AWG) featuring 16-bit resolution and up to 256 MB of onboard memory in a compact, 1 slot 3U PXI module or PCI board. With this combination of high resolution and deep memory, you can generate long, precise aperiodic waveforms, ideal for a range of applications in communications, consumer electronics, scientific research, automotive, and military/aerospace. Because the NI 5421 uses the PCI bus, waveforms can be downloaded up to 280 times faster than with GPIB-based AWGs. With the NI Synchronization and Memory Core (SMC) architecture of the NI 5421, you can create stimulus/response systems with digitizers and digital waveform generator/analyzers or synchronize multiple arbitrary waveform generators to form a phase-coherent multichannel system.

Analog Output Performance

Because of its 100 MS/s, 16-bit digital-to-analog converter (DAC) and clean back-end analog design, the NI 5421 has a close-in spurious-free dynamic range (SFDR) of 91 dBc and an average noise density of -148 dBm/Hz. These features make it ideal for even the most stringent frequency-domain applications common in communications. Depending on your signal and application needs, you can select from 2x, 4x, or 8x interpolation for an effective sampling rate up to 400 MS/s. For demanding time-domain applications, the NI 5421 has <5% pulse aberration and <1.0 psrms jitter at the analog output.

The analog output path features a 43 MHz 7-pole elliptical analog filter to suppress undesired high-frequency signal images. You can also choose from 50 or 75 Ω output impedance and vary the output attenuation with three digits of accuracy. In addition, you can bypass the output gain and attenuation by using the direct path. The direct path excels at intermediate frequency (IF) applications with passband flatness of ±0.25 dB from 0 to 40 MHz.

Shared Waveform and Instruction Memory

Because the NI 5421 is built on the SMC architecture, it uses the same physical memory for both waveform data and sequencing instructions. Traditionally, the instruction memory of AWGs is physically separate from the waveform data memory and is typically only a few kB. The limited instruction memory of traditional AWGs severely limits the maximum number of waveforms that can be sequenced as well as the overall flexibility of the AWG. The NI 5421 onboard memory of 8, 32, or 256 MB stores data and instructions together, giving you the flexibility to use as much space as you need for sequencing instructions. With shared memory, you can use the memory space for very long sequences with small waveforms, short sequences with very large waveforms, or a balance in between.
100 MS/s, 16-Bit Arbitrary Waveform Generator

**Triggering and Sequencing**
The NI 5421 has four triggering modes for controlling the starting and stopping of waveform generation – single, continuous, stepped, and burst. With these triggering modes combined with the linking and looping flexibility of the NI 5421, you can create sophisticated waveforms. With the 256 MB memory configuration, more than 1 million waveforms can be stored in memory and linked in any order. Each waveform segment can be looped up to 16,777,216 times or looped indefinitely. Triggers can be received from software as well as the front panel connectors, PXI trigger lines, PXI star trigger, or RTSI bus.

**LVDS Digital Pattern Output**
In addition to generating analog signals, the 32 and 256 MB configurations of the NI 5421 can generate low-voltage differential signal (LVDS) digital patterns. LVDS is increasingly used for digital signaling because of its reduced power consumption, lower electromagnetic interference, and immunity to noise. The digital patterns generated on the digital data and control (DDC) front panel connector correspond to the analog waveform being generated and make use of all of the linking, looping, triggering, and timing features. The sample clock is also available on the DDC I/O connector to latch the digital patterns. Alternatively, you can externally clock the NI 5421 via the DDC front panel connector. The NI Digital Waveform Editor is available as an add-on software package to provide you with further functionality in creating LVDS digital patterns.

**Timing and Synchronization**
The NI 5421 sample clock has three modes – Divide-by-N, High-Resolution, and External. Using the Divide-by-N sample clock, the jitter of the analog output is <1.0 ps rms and the phase noise is -137 dBc/Hz (10 MHz carrier, 10 kHz offset). The direct digital synthesis (DDS) based high-resolution sample clock has a sample rate resolution of 1.06 µHz, which offers you exceptional stability and sampling rate flexibility. The NI 5421 can also import its sample clock from the CLK IN and DDC connectors, PXI star trigger, and PXI trigger bus or RTSI bus. In addition, you can phase lock the NI 5421 oscillator to an external reference or the PXI 10 MHz reference clock.

With synchronization, you can create mixed-signal test systems by combining the NI 5421 with other modular instruments such as the NI 5122 digitizer and/or the NI 655x digital waveform generator/analyzer. You can also synchronize two or more NI 5421 modules to build a multichannel phase coherent AWG, important for applications such as I and Q signal generation or antilock brake system simulation.

To trigger other instruments such as oscilloscopes, the NI 5421 can generate marker event outputs. A marker event can be placed in a different location in each waveform segment.

**Calibration**
Every NI 5421 is factory calibrated using NIST-traceable standards. The NI 5421 has an onboard calibration reference that corrects for environmental effects on DC gain, offset, and timing errors. If you want to calibrate your device externally, return your NI 5421 to National Instruments or ship it to a qualified metrology lab for recalibration.

**Software**
Every National Instruments signal generator comes with the IVI-compliant NI-FGEN driver, which is fully compatible with NI LabVIEW, LabWindows/CVI, and Measurement Studio, as well as Microsoft Visual C++ and Visual Basic. NI-FGEN also includes the interactive FGEN Soft Front Panel, with which you can quickly generate standard signals such as sine, square, and ramp, as well as user-defined waveforms. Simulation mode is available in both the FGEN Soft Front Panel and the NI-FGEN instrument driver, so you can develop your application without having the hardware in your system. In this mode, several developers can write applications for the same hardware and share resources.

With the Analog Waveform Editor you can rapidly create or edit analog test signals for use with the NI 5421. To view or edit existing waveforms, you can open files saved in binary, ASCII, or the LabVIEW Express Jvm file format. Alternatively, you can create your waveform from scratch by selecting from a list of over 20 waveform primitives, such as sine and Gaussian noise, or enter a mathematical expression. The Analog Waveform Editor is included with the 32 and 256 MB models of the NI 5421, and is a separate add-on for use with the 8 MB model.

**Ordering Information**

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>NI PXI-5421</td>
<td>8 MB</td>
<td>778697-01</td>
</tr>
<tr>
<td></td>
<td>32 MB, LVDS output</td>
<td>778697-02</td>
</tr>
<tr>
<td></td>
<td>256 MB, LVDS output</td>
<td>778697-03</td>
</tr>
<tr>
<td>NI PCI-5421</td>
<td>8 MB</td>
<td>778692-01</td>
</tr>
<tr>
<td></td>
<td>32 MB, LVDS output</td>
<td>778692-02</td>
</tr>
<tr>
<td></td>
<td>256 MB, LVDS output</td>
<td>778692-03</td>
</tr>
</tbody>
</table>

Includes NI 5421 module, SMB112 cable, NI-FGEN, and FGEN Soft Front Panel.
The 32 and 256 MB models also include the Analog Waveform Editor.

**Software**
NI Analog Waveform Editor ........................................778848-01

**LVDS Cable**
SHC68-68-D3.....................................................188143-01

**Accessories**
Recommended PXI switch
NI PXI-2593 .....................................................778793-01

**Related Products**
NI 5122 High-Speed Digitizer
NI 655x Digital Waveform Generator/Analyzers
NI SCXI-1193 Multiplexer Switch

**BUY ONLINE!**
Visit ni.com/products and enter pxi5421 or pci5421.
100 MS/s, 16-Bit Arbitrary Waveform Generator

Specifications

Specifications are valid for 0 to 55 °C, unless otherwise noted.

General
- Number of channels: 1
- DAC resolution: 16 bits
- Maximum sampling rate: 100 MS/s
- Maximum effective sampling rate with Interpolation: 400 MS/s
- Bandwidth: 43 MHz
- Output paths: 1. Main Output Path setting with driver selected Low Gain Amplifier or the High Gain Amplifier
  2. Direct Path optimized for RF applications

Analog Output
- Amplitude range (full scale)
  - Main output path: 12 Vp-p to 5.64 mVp-p (50 Ω load)
  - Direct path: 1 Vp-p to 0.707 Vp-p (50 Ω load)
- Offset range: ±25% of Amplitude Range
- Output impedance: 50 or 75 Ω, software selectable
- DC Accuracy
  - ±0.2% of amplitude, ±0.05% of offset ±500 mV
  - Maximum within ±10 ˚C of self-calibration temperature
- AC amplitude accuracy: ±1.0% of Amplitude ±1 mV at 50 kHz
- Offset range: ±25% of Amplitude Range
- Frequency resolution
  - Normalized Passband Flatness, Direct Path
    - 12 Vp-p to 5.64 mVp-p (50 Ω load)
- Glitching
  - ±0.01 A

A/D Conversion
- Resolution: 16 bits
- Accuracy: ±25 ppm

Digital Data and Control, DDC (optional front panel connector)
- Data output signals: 16 UCS data lines (ANSI/IEEE-844 compliant)

Start Trigger
- Sources
  - PCI, PXI, RTSI
- Modes
  - Single, Continuous, Pulled, Burst

Markers
- Destinations
  - PCI, PXI, RTSI

Waveform and Instruction Memory Utilization
- Onboard Memory Size
  - 8 MB Standard: 8,388,600 bytes
  - 32 MB Option: 32,054,452 bytes
  - 256 MB Option: 268,435,456 bytes
- Memory limits
  - Arbitrary waveform: 4,194,120 Samples
  - Arbitrary sequence: 4,194,304

Power
- ±3.3 VDC
- ±5 VDC
- ±12 VDC
- ±12 VDC

Certifications and Compliances
- CE Mark compliance

Note
- Unless otherwise noted, the following conditions were used for each specification:
  - Analog filter enabled
  - Interpolation set to maximum allowed factor for a given sample rate
  - Signals terminated with 50Ω
  - Direct path set to 1 Vpp-pk, Low Gain Amplifier Path Set to 2 Vpp-pk
  - High Gain Amplifier Path set to 12 Vpp-pk
  - Sample clock set to 100 MS/s

For detailed specifications on power, environmental, safety, and physical dimensions, please visit

ni.com/products and enter express code: pxi5421 or pxi5421
Global Services and Support

NI has the services and support to meet your needs around the globe and through the application life cycle – from planning and development through deployment and ongoing maintenance – and tailored for customer requirements in research, design, validation, and manufacturing. We have direct operations in more than 37 countries and distributors in another 12 locations. Our local sales and support representatives are degreed engineers, ready to partner with you to find solutions that best fit your needs.

Local Sales and Technical Support
In offices around the globe, our staff is local to the country so that you have access to field engineers who speak your language and are available to consult on your unique needs. We also have a worldwide support organization staffed with Applications Engineers trained to quickly provide superior technical assistance. Use our online Request Support interface at ni.com/support to define your question, then speak to or e-mail an Applications Engineer, or access more than 14,000 worldwide measurement and automation professionals within NI Developer Exchange Discussion Forums. ni.com/support also provides immediate answers to your questions through self-help troubleshooting, product reference, and application development resources. For advanced technical support and software maintenance services, sign up for Premier Support, a program that provides expanded hours of support availability and expedited phone/e-mail response time (typically four business hours).

Training and Certification
NI recognizes that both initial instruction and ongoing education contribute to your success. NI provides a variety of training alternatives, from self-paced tutorials and interactive CDs, to worldwide hands-on courses taught by experienced instructors – all designed so that you can choose how to learn about our products. Further, NI offers certifications acknowledging individual expertise in working with NI products and technologies. Visit ni.com/training for more information.

Professional Services
Our Professional Services team consists of National Instruments Applications Engineers, NI Consulting Services, and a worldwide Alliance Program (a network of 600 independent consultants and integrators). Our Professional Services team can offer services ranging from basic start-up assistance and collaborative development with your engineers, to turnkey system integration and maintenance of your system. In addition to our NI Alliance Partners, we have developed global relationships with many industry partners that range from computer software and hardware companies, such as Microsoft, Dell, Siemens, and Tektronix. By collaborating with these companies, you receive a complete spectrum of solutions – from components to turnkey systems. Find the Alliance Program member directory at ni.com/alliance

Product Services
NI GPIB products are warranted against defects in workmanship and material for one year from the date of shipment. To help you meet project lifecycle requirements, NI offers extended warranties for an additional charge. NI provides complete repair services for our products. Express repair and advanced replacement services are also available. Or, order your software and hardware installed in PXI and PXI/SCXI™ systems with NI Factory Installation Services.

Ordering Made Easy
Visit ni.com/products to browse product specifications, make comparisons, or access technical representatives via online chat or telephone. Worldwide customers can use a purchase order or credit card to buy in local currency and receive direct shipments from local NI offices. Our North American Customer Service Representatives are available Monday through Friday between 7 a.m. and 7 p.m. Central Time. Outside North America, please contact the NI office in your country.

Order Status and Service Requests
National Instruments brings you real-time status on current orders at ni.com/status. Similarly, find out the status of open technical support incidents or hardware repair requests at ni.com/support/servicereq