

PathWave FPGA Programming Environment

Insert your logic into Keysight instruments

If you are an engineer for which a standard AWG, Digitizer, or Transceiver does almost all you want, but not everything, this may be the tool for you. Keysight opened its PXI and AXI instruments allowing custom user data or processes to be inserted into the instrument FPGA.

PathWave FPGA™ enables engineers of all FPGA skill levels to add logic, control, and combinatorial routines to a wide range of Keysight instruments. PathWave FPGA ships with a rich set of built-in library elements that can be dropped into your schematic.

Rapidly prototype your mode of operation or new control structures on a Keysight AWG, Digitizer and more.

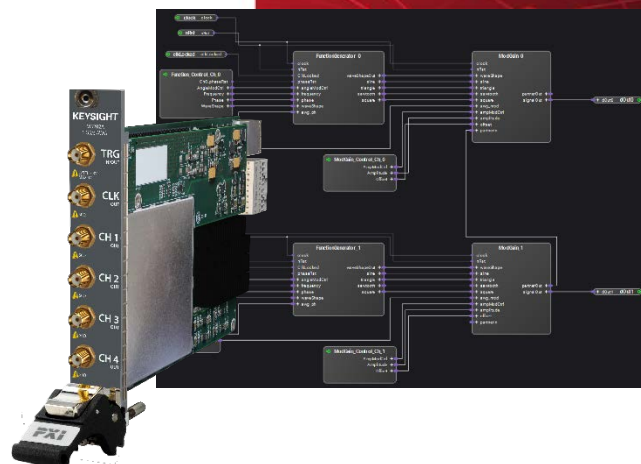
- Insert your own logic into an instrument FPGA to add custom protocols, streaming processes, DSP applications and more
- Compile your mode of operation or control structure to hardware with one-click and no external cables or devices
- Create hardware-in-the-loop tests that accelerate key measurements
- Change the FPGA image without rebooting the instrument

Reduce learning and development time with the user-friendly, graphical FPGA programming environment

- Quickly visualize application flows and insert custom logic
- Compile easily to FPGA hardware, even if you are not an FPGA expert
- Begin with all the functionality of the standard instrument, and customize from there

Streamline your design process with full native FPGA-code compatibility

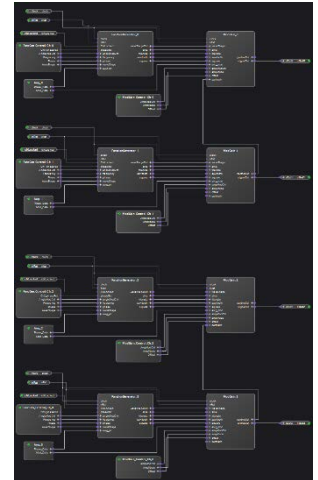
- Minimize the need for FPGA-code development from scratch, with the ready-to-use block library
- Import and easily integrate VHDL, Verilog or Xilinx® VIVADO projects and Xilinx CORE Generator IP Cores



PathWave FPGA is compatible across a range of Keysight instruments. If you begin your design with a modular PXIE instrument and run out of bandwidth, it can be easily migrated to a higher power AXIE instrument. This also helps avoid design re-entry from prototype to production.

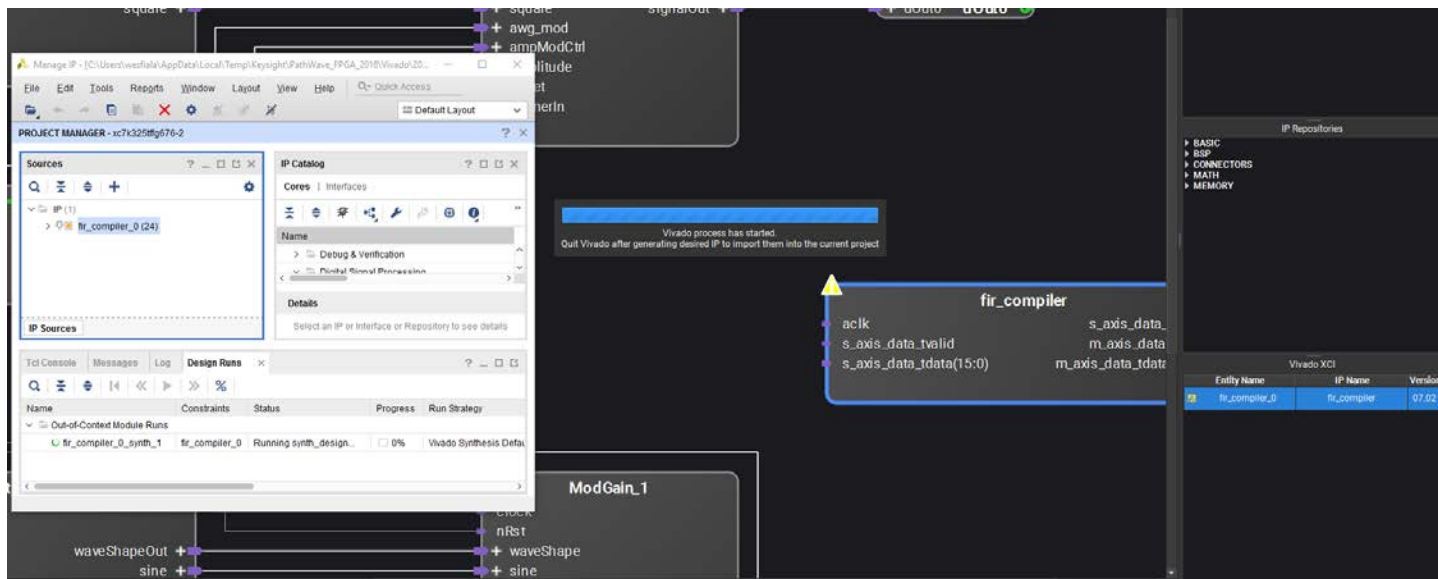
6 steps to start your AWG experiment at a higher level

1. Begin your project from a preloaded schematic. Includes all the basic instrument capability. 4-channel PXIe AWG pictured at right with access to Clocks, Mod Gain, Control Channels, Function Generators and more
2. Add your own custom functions to the instrument FPGA.
3. Pair channels if needed for complex functions.
4. Insert pre-configured functions, DSP blocks, and instrument commands from the provided library, or import from the Vivado library.
5. Connect to host, and debug instruction sets running on CPU.
6. Upgrade your design to an AXIe based AWG if more capability is needed.



Easily insert Vivado Library Elements

Additionally, you can open Vivado (the white box on the left in the figure below) and integrate Xilinx IP into the Keysight instrument flow. Xilinx IP instantiates as a graphic element, in this example a fir_compiler box. The fir_compiler library element is then added to the local library for easy archiving. It's that easy. No complex programming. We guide you through the process.



Rapidly prototype or accelerate a specific function, or create virtual instrument configurations

For engineers who need more control over their instruments, this capability, often called hardware-in-the-loop (HIL), enables them to do three basic things.

1. **Rapidly import and connect multiple elements in an end-to-end solution** to quickly prototype and test out concepts.
 - a. In software defined radio this might create an insertion point to experiment with multiple ECPRI protocol elements.
 - b. In radar this makes it possible to create adjustment points for doppler and delay.
 - c. In Quantum this can entail synchronizing hard real-time execution of ps/fs time determinism across dozens or hundreds of ports of AWGs and Digitizers.
2. **Accelerate a specific, computationally-bound or I/O-bound function** that is repeated frequently in test. In production, time is money and some transforms, tests or complex sequences require the modular instrument to communicate across the backplane to the PC controller to complete. Deploying in HIL

optimizes for just that function, and inserts it in-line. The result is referred to as deterministic, given that code running in instrument hardware will always complete in minimized and defined latency.

3. **Configure Virtual instruments or pair channels to run math on multiple signals** or other functions that can be achieved within the PathWave FPGA's virtual instrument control capability. Keysight offers further hardware instrument virtualization and synchronization in the compatible M3602A software to scale the test from one to dozens or hundreds of instruments.

Accelerate prototype development with a rich, expanding library

Blocks in PathWave FPGA represent instrument elements such as control channels and input data, clocks, function generators, modulation gain, etc. The most rapid way to prototype is to add and connect known good elements from the standard library or import elements from Vivado. VHDL or Verilog modules are easily added. And blocks can be differentiated, to identify blocks that can be temporarily removed to create more FPGA space. Because FPGAs load like memory, multiple FPGA configurations can be stored and loaded without power cycling the machine. On an engineer's workbench this accelerates prototyping. On a production floor this accelerates change-over for alternate DUTs.

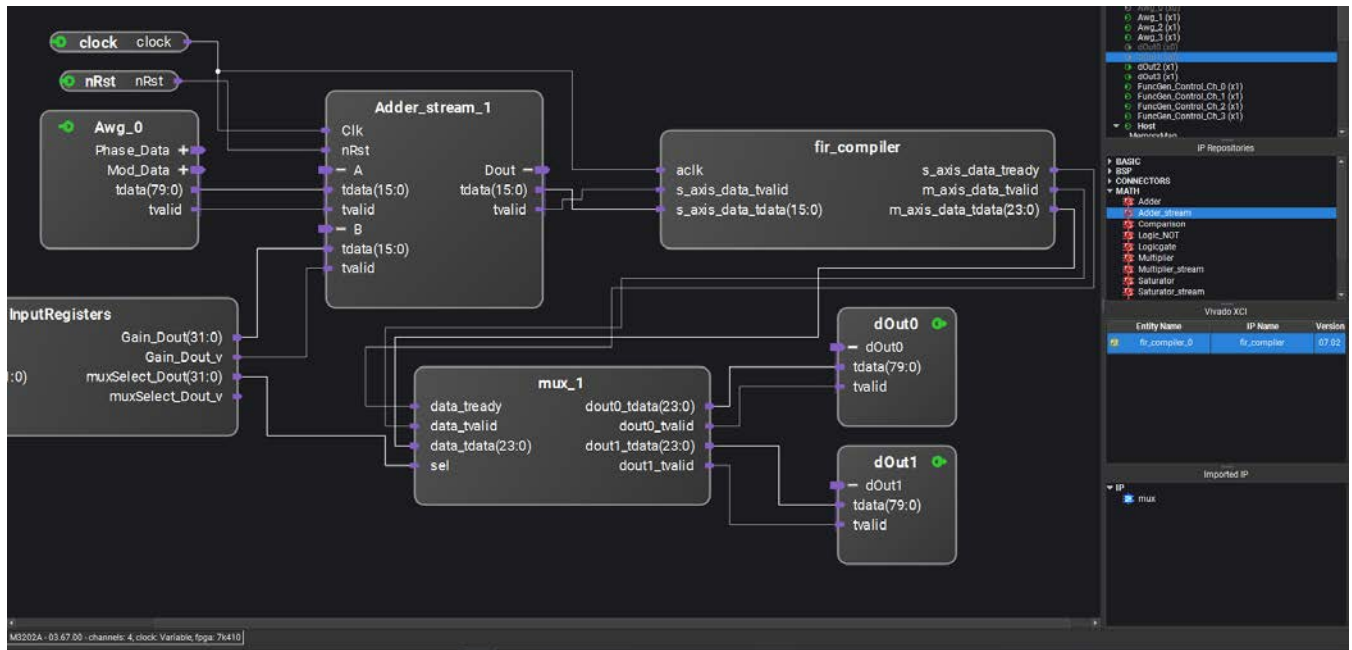


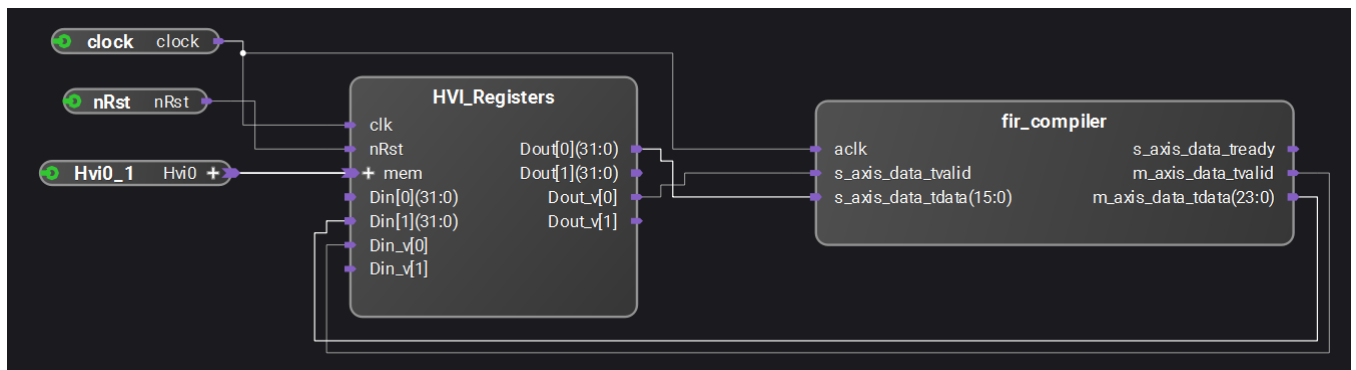
Figure - Schematic format enables each function to be quickly added and to be worked on independently.

Hardware Virtual Instrumentation Enables Scaling to Multiple Instruments

Built into PathWave FPGA and Keysight Instruments is the ability to use HVI to synchronize multiple instruments. The M3601A Hardware Virtual Instrument (HVI) design environment provides ultra-fast, real-time execution of signal generation, acquisition, and decision making for M3XXX series Keysight PXIe AWGs and digitizers.

The user-friendly flowchart style design interface enables inter-module synchronization and data exchange in minutes, with no complicated external triggering. Execution is performed by hardware, without operating system, and independent of the user PC.

Additionally, HVIs can interact with user-defined FPGA functions, such as the fir_compiler pictured below, enabling many options for custom applications.



Solutions, Services and Training Accelerate your Project Timeline

Keysight also offers optional Reference Designs and FPGA Design Services to provide a quicker start or an end-to-end solution framework. Beginning a project with a working prototype provides a head start. Team members can more easily experiment with single components. Solutions from Keysight provide rich frameworks that become the basis for your experimentation. Sandboxes are custom or semi-custom.

Conclusion

PathWave FPGA opens up Keysight instruments to enable you to insert custom logic into the instrument FPGA. Or to accelerate a specific function as hardware-in-the-loop on the instruments FPGA. Please contact your local AE to see if PathWave FPGA is right for your project.

Learn more at: www.keysight.com

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at: www.keysight.com/find/contactus

