The Quartz Family: Xilinx Zynq UltraScale+ RFSoC

The Pentek Quartz™ family is based on the Xilinx Zynq® UltraScale™ RFSoC FPGA. Quartz brings the performance and high density integration of the RFSoC to a wide range of different application spaces with a uniquely flexible design path. Quartz is available in standard form factors like 3U VPX, or with the QuartzXM™ Carrier Design Package, it can be deployed on application specific custom carriers. Designed to work with Pentek’s Navigator® Design Suite tools, the combination of Quartz and Navigator offers users a streamlined path to IP development and deployment.

RFSoC Advantages

The Xilinx Zynq UltraScale+ RFSoC Processor integrates eight RF-class 4 GHz 12-bit A/Ds & eight 6.4 GHz 14-bit D/As into the Zynq FPGA fabric and quad ARM Cortex-A53 and dual ARM Cortex-R5 processors, creating a multichannel data conversion and processing solution on a single chip.

Quartz 3U VPX RFSoC Board Architecture

Complementing the RFSoC’s on-chip resources, the Quartz Model 5950 board adds:
- Dual 100 GigE optical interfaces for high-bandwidth data streaming
- 16 GB of DDR4 SDRAM
- High-signal integrity connectors for RF inputs and outputs
- Sophisticated clocking for multi-channel and multi-board synchronization
- x8 PCIe Gen 3 VPX backplane system interface
- QuartzXM eXpress Module design for flexible development and deployment
- Factory-installed IP for waveform generation, real-time data acquisition and more
- Air-cooled and conduction cooled versions

QuartzXM eXpress Module Speeds Integration for Custom Form Factors

The Model 6001 QuartzXM eXpress Module speeds custom deployment of RFSoC in SWaP critical environments. Measuring only 2.5 by 4 inches, the eight-channel 4 GHz 12-bit A/Ds & 6.4 GHz 14-bit D/As QuartzXM module includes all of the circuitry needed to maximize the performance of the RFSoC. As the central core of the Model 5950 3U VPX board above, the Model 6001 module migrates easily to other carriers with standard or custom form factors.

QuartzXM Carrier Design Package

The Model 4801 QuartzXM Design Package supports customers interested in building their own carrier for the Model 6001 by sharing Pentek’s RFSoC design expertise. QuartzXM module documentation includes thermal profiles, 3D mechanical models, pin definitions, and electrical specifications of all signals. Model 5950 3U VPX carrier documentation includes reference design schematics, PCB design guidelines, routing rules, and much more. A design review by Pentek engineers is included to help speed successful development.

Ready-to-Use Quartz Development Platform

The Model 8257 is a low cost 3U VPX chassis ideal for developing applications on Pentek’s Model 5950 Quartz RFSoC board. Providing power and cooling to match the 5950 in a small desktop footprint, the chassis allows access to all required interfaces on the front panel and the Model 5901 rear transition module. The 8257 can be configured with optional real-panel dual MPO optical connectors to support the 5950’s dual 100 GigE interfaces and VITA 66.4.
Extendable IP Design

For applications that require specialized functions, users can install their own custom IP for data processing. The Pentek Navigator FPGA Design Kits (FDK) include the board’s entire FPGA design as a block diagram that can be edited in Xilinx’s Vivado IP Integrator. In addition to the IP Integrator block diagrams, all source code and complete IP core documentation is included. Developers can integrate their own IP along with the Pentek factory-installed functions or use the Navigator kit to completely replace the Pentek IP with their own.

The Navigator Board Support Package (BSP), the companion product to the Navigator FDK, provides a complete C-callable library for control of the 5950’s hardware and IP. The Navigator FDK and BSP libraries mirror each other where each IP function is controlled by a matching software function, simplifying the job of keeping IP and software development synchronized.

The Navigator BSP includes support for Xilinx’s PetaLinux running on the ARM Cortex-A53 processors. When running under PetaLinux, the Navigator BSP libraries enable complete control of the 5950 either from applications running locally on the ARMs, or using the Navigator API, control and command from remote system computers.

Example Application 1 - High Bandwidth Data Streaming

The RFSoC’s eight 4 GSPS A/Ds are capable of producing an aggregate data rate of 64 GBytes/sec when all channels are enabled. While capturing this much raw data is not feasible, the A/Ds built-in digital down converters can reduce this data throughput in many applications to a rate reasonable for the data streaming and storage components downstream in the system.

In some applications capturing the raw, full bandwidth data is crucial. The 5950’s dual 100 GigE UDP engine provides a high bandwidth path for moving data off of the board. Along with the built-in data acquisition IP, the 5950 can stream two full bandwidth A/D data streams over optical cable to a downstream storage or processing subsystem.

Example Application 2 - Waveform and Radar Chirp Generator

The 5950’s IP includes a flexible waveform generator engine. Multiple waveforms can be loaded into the 5950’s DDR4 SDRAM through the PCIe interface. These waveforms can then be output through the D/As based on user programmed sequences and triggers. In an alternate mode, waveforms can be streamed directly to the D/As via the 100 GigE interface.

The 5950 also includes a chirp generator ideal for radar applications. Chirp parameters like length, frequencies and sweep can be programmed and triggered by the front panel trigger input or through a software command.