# The Pentek Pipeline

*A quarterly publication for engineering system design and applications.*

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- **Feature:** The feature article explores the new and improved technologies that have boosted wideband signal and data recorder performance.

*"Wideband recorders draw upon diverse disciplines of new technology to keep pace with growing demands of burgeoning information traffic, both in the number of channels and in signal bandwidth. Fortunately, many of these technologies are driven by large worldwide market forces, which feed off our planet's insatiable need for connectivity and storage."*

*Rodger Hosking, Pentek Vice President and Co-founder*

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# How New Technologies Improve Wideband Signal and Data Recorder Performance

*by Rodger Hosking, Vice President, Pentek*

Virtually all military ground, sea and airborne platforms rely on wideband signal and data recorders for surveillance, interception, and monitoring of signals from sensors. Communication, radar, and telemetry systems often require recording functions for storing signals of interest or logging traffic during operational missions. Designers of these systems are always looking for critical recorder components that exploit new technologies to boost performance. These include solid state drives, higher resolution data converters, faster serial interfaces, and advanced RAID controllers. Integration of these components to maximize overall performance requires not only careful hardware and software design, but also qualification and testing to guarantee loss-free recordings under worst-case operating conditions.

## Critical Roles for Wideband Recorders

Each day, the already overwhelming glut of signals vital to government and military operations grows to challenge the never-ending race for information dominance in SIGINT, ELINT and warfighting. Gaining this advantage can significantly improve the outcome of any conflict, ranging from a theater of war operation to a homeland security initiative. Often, the amount of information and the number different signal channels overwhelms the real-time analysis and decision-making capacity of the acquisition platform, regardless of whether it's a small unmanned vehicle, a fighter jet, or even a battleship. Recording this information allows it to be reviewed and forwarded to an analysis facility as required. ➤

*Pentek's Talon® RTX 2766*

However, when the opponent develops new encryption and anti-detection techniques, existing equipment cannot extract information from the signals and new receivers must be designed. Wideband recorders can capture these new RF signals so they can be analyzed, and then used iteratively in testing during the development of new or enhanced software radio equipment. Fortunately, wideband recorders can be equipped to handle both chores: routine collection of information streams and raw recordings of unknown signals.

To operate successfully in these applications, wideband recorders must satisfy tough requirements. Because shock and vibration are notorious challenges for a rotating media hard drive, an increasingly popular alternative is the solid state drive (SSD). Other environmental factors such as temperature, humidity, and altitude, dictate specific design strategies for operational compliance.

Some recorders must capture signals based on a hardware gate or trigger, such as a radar system recorder which may need to capture repetitive radar pulses and skip the intervals between them. Several recorders at different locations may need to start capturing data at the same sample clock to calculate the position of a satellite through triangulation using the relative phase the received signals. This often requires a GPS receiver in each recorder, fully integrated with the recording software and hardware.

An increasing number of applications require precise time stamping of each recording, often resolved to a specific sample clock.

High bandwidth analog and digital inputs push recording rates far beyond the capability of a single drive, forcing the use of RAID controllers to aggregate the speed of multiple drives. Often, recorded signals represent highly sensitive information, so the data must be physically removed from the vehicle or craft after the mission for transport to a secure facility. In some cases, recorded data must be encrypted in the event the drives fall into enemy hands through a vehicle mishap or a security breach.

Perhaps the most fundamental requirement for these recorders is the bot-tom line: they must capture data continuously at the required rate for a specified duration under all conditions with absolutely zero loss of data.

## Solid State Drives

Offering size, weight and power factors much lower than rotating media drives and inspired by enormous market opportunities, SSDs continue to benefit from new technology rapidly evolving over the last several years. At the same time, costs and performance levels are steadily improving.

For MIL-AERO systems, a primary benefit of SSDs is their immunity to shock and vibration. In older systems, extreme measures of protection were required to isolate these effects from rotating drives to maintain head-to-platter alignment for reliable, sustained operation. This factor made systems bulky and expensive to maintain, so SSDs naturally presented an immediately attractive alternative.

The latest generation of SSDs offer data read/write speeds far exceeding those of rotating drives, which also suffer from track seek times and rotational latency delays. This means fewer SSDs are required in a RAID array to meet a guaranteed recording rate.

However, in spite of their many benefits, each SSD memory cell suffers from a finite number of write cycles before it can no longer retain data reliably, referred to as "endurance." To mitigate this problem, SSDs include micro controllers that keep track of how many times each cell is written to, and allocate new write operations to cells with low write counts. Other algorithms move data from high write-count cells to those with lower counts as a background housekeeping task. These measures and others are collectively referred to as "wear leveling". ➤

| Feature | 3.5-inch Rotating | 2.5-inch Solid State |
|---|---|---|
| Capacity (high end) | 8 TB | 1.92 TB |
| Read Rate | 120 MB/sec | 500 MB/sec |
| Write Rate | 120 MB/sec | 300 MB/sec |
| Weight | 750 gm | 75 gm |
| Size | 376 mm$^3$ | 89 mm$^3$ |
| Power | 10.7 W | 0.28 W |
| Operational Shock | 30 G | 1500 G |
| Operational Temp. | 5 to 55 °C | 0 to 65 °C |
| Cost | $400 | $1,100 |
| Cost / GB | $0.05 | $0.58 |
| Lifetime Write Cycles | ∞ | 10,000 |
| Wear Leveling | No | Yes |

**Table 1.** *This table compares typical features of rotating media drives and SSDs by highlighting the winning advantages of each. Unlike rotating drives, SSD costs are dropping quickly and technology is advancing rapidly to help narrow the price gap.*

Since each SSD vendor uses unique and proprietary wear leveling technology, the "down time" to perform these operations can be significantly different, making some SSDs completely unsuitable for sustained, real-time recording. Performance levels from a single vendor can not only vary widely from model to model, but also between revision levels of the same model. For this reason, recorder system vendors must thoroughly qualify each production batch of SSDs to ensure proper operational margins.

To characterize endurance considerations, SSDs were originally rated for a maximum number of write cycles per memory cell, shown in Table 1 along with other comparisons to rotating drives. An increasingly popular specification for endurance is the number of bytes written into each drive during its useful lifetime, commonly expressed as a TBW (terabytes written). Yet another method specifies either the warranty period in months or years along with the maximum number of drive writes per day, or DWPD.

In spite of endurance issues, because they have no moving mechanical parts, SSDs are generally considered more reliable than rotating drives. Nevertheless, one class of applications not recommended for SSDs is continuous looped recording, such as a video security camera system which simply overwrites the oldest data. Because data is being written continuously, the TBW limit of an SSD are likely to be exceeded before any mechanical failure of a rotating drive.

Finally, prices of SSDs are dropping rapidly due to market forces and healthy competition.

## Self–Encrypting Drives

In order to protect data recorded during sensitive missions, a new class of drives called SEDs (self encrypting drives) has emerged. They use a unique AES-256 key to encrypt data as it is written to the drive without impacting read/write speeds. The encryption key is stored within the drive in a write-only memory. Each time the system is powered up, the encryption key



**Figure 1.** *Models 7070-320 PCIe and 5973-320 3U VPX. Two wideband analog I/O modules featuring dual 3 GHz 12-bit A/Ds, dual 2.8 GHz 16-bit D/As, Virtex-7 FPGAs, and DMA engines supporting PCIe Gen 3 x8 PCIe data links to system memory.*

must be re-entered to restore access to the drive.

If an SED drive is removed from the system because the encryption key cannot be retrieved, all data on the drive is completely inaccessible. However, if the drive is installed on another system, and the original encryption key is entered, data is once again available. This elegant approach satisfies security requirements for virtually all secure applications.

Another major benefit of SEDs is the instant erase feature which destroys the current encryption key and automatically generates a new one. The drive can now be installed in a new system, and initialized with a newly generated key, just as if it were a new, empty drive. This eliminates the drastic data scrubbing measures often required of drives that must be retired from service or moved to non-secure locations.

## Analog I/O

The electromagnetic spectrum suitable for signal propagation and reception presents a virtually unlimited number of targets for intercepting and recording critical information. Exploitation of each precious frequency band for maximum information bandwidth, reliable performance, and

adequate security mandates complex digital signal processing techniques at both ends of the signal path. Spread spectrum techniques and the insatiable demand for data at every level of the economy can only be met with wideband modulation schemes. This drives need for fast data converters to capture and generate these wideband signals to keep pace with vast markets of communications, radar, and wireless networks.

Monolithic ADCs (analog-to-digital converters) operating at sampling rates of 3 GHz and above can directly digitize signal bandwidths of 2 GHz. Dealing with this torrent of digital samples in real time is often a task for a local ASIC or FPGA to extract the required information (typically digital down conversion, demodulation, decoding, etc.) which usually results in a lower data rate for subsequent downstream processing or recording.

However, some wideband recorder customers want to capture all digitized information at the full bandwidth, so that the extraction of information from unknown signal types can be attempted later on in the lab. In this case, the recorder must be capable of continuously recording gigabytes of data each second, perhaps for hours or days. ➢

**Figure 2.** *Pentek RTX 2766 ruggedized airborne recorder features four removable, hot swap QuickPac® drive packs, each containing eight SSDs in RAID arrays for easy transport of up to 60 TB of recordings to a secure facility.*

Recorders take advantage of ADC and DAC board-level products, which provide the interfaces between the data converters and the CPU. FPGAs offer a popular solution for this task because of their configurable I/O ports using high-speed parallel LVDS and gigabit serial links to match the specific requirements of each data converter. They also are equipped with standard PCIe interfaces capable of supporting PCIe Gen 2 and Gen 3, with 4, 8, or 16 lanes.

FPGAs can also implement the critical timing, triggering, gating, synchronization and time stamping of the recorded signals.

## Digital I/O

In addition to analog signals, many recorders must store high-speed digital streams arriving in a wide range different formats and protocols, but Ethernet dominates due to widespread adoption and low-cost hardware infrastructure, including optical and copper interfaces, cables, routers, host adapters, and switches. Virtually every computer system now sports one or more 1GbE ports, but higher-performance systems are migrating to 10, 40, and 100 GbE ports.

Recording systems take advantage of commercially available Ethernet adapters that handle dozens of different interfaces including several types of copper cables with different numbers of pairs, data rates, shielding, connectors, and coding protocols. Optical adapters accommodate single- and multi-mode fiber with different wavelengths, data rates, cable types, and optical connectors. Fortunately, most of these adapters use PCIe interfaces suitable for connection to virtually any CPU chip set and come with drivers for all popular operating systems.

Unlike Ethernet adapters, which are usually ASIC-based, other types of digital I/O adapters often exploit FPGAs, for the same reasons they are used for data converters. Configurable I/O transceivers and state machine engines implemented with configurable logic support SerialFPDP, SerialIO, Infiniband, and parallel LVDS interfaces and protocols, and they deliver data to the system across PCIe.

## System Components

Today's recording systems benefit from a wealth of new technology developed for the data server market, including RAID controllers and server-class computers. RAID controllers join multiple disk drives, typically using SATA or SAS ports, to the system over a PCIe interface. They perform two functions vital for wideband recorders.

First, by striping reads and writes across each of the connected drives, RAID controllers aggregate the individual access speeds of each drive. With new SSDs rated for transfer rates of 500 MB/sec, a 16-port RAID controller using a PCIe Gen 3 x8 interface that can sustain guaranteed read/write rates of 4.8 GB/sec for the array.

Secondly, RAID controllers also aggregate the capacity of the drives for longer recording times. In the example above, using 1.92 TB drives, the combined capacity is more than 30 TB, providing a recording time of over 1.75 hours at a recording rate of 4.8 GB/sec.

Fast RAID controllers and fast data acquisition boards are useless without a powerful PCIe system environment. Server class PCs feature chip sets that join the CPU and fast SDRAM system memory to a number of PCIe slots and peripherals. The latest chip sets support DDR4 SDRAM with 2400 MHz transfer rates, and multiple PCIe Gen 3 ports with up to 16 lanes. In operation, system memory is used as a staging area for data buffers. Data acquisition boards use internal DMA (direct memory access) controllers to move data across PCIe into buffers in system memory. Once initialized, these hardware engines take care of completing the transfers with no CPU overhead. Likewise, the RAID controllers fetch data from system memory across PCIe using their own DMA controllers, and then stripe the data writes across the array of disks.

As shown in , this basic scheme of moving data with hardware engines across a well-defined PCIe fabric, ➢

and without CPU intervention, ensures real time performance for wideband recording applications.

## Software and User Interfaces

Although the CPU never "touches" the data in the scheme outlined above, the system CPU must orchestrate the transfers by setting up the number and size of data buffers in system memory before the recording starts, and then monitor the progress of each DMA operation during the recording. While simple in concept, choosing the appropriate transfer parameters is critical to achieving guaranteed real-time operation, primarily because of system latencies. Such latencies occur because of the burst transfer nature of DMA packets and often conflicting priority levels for myriad system processes. Each recording system requires an optimized configuration based on the number of channels, guaranteed recording rates, characteristics of the RAID array, and the architecture and chipset of the system PC.

To accomplish all of these requirements, Pentek offers its SystemFlow recording software for the Talon family of recorders running under Windows operat-

ing system. SystemFlow also includes a GUI for ease of use, and a Signal Viewer utility to monitor acquired signals in time and frequency domains before, during, and after the recording. An API (application programming interface) library allows Talon recorders to be controlled from a remote facility or a larger system, where the recorder acts as a front-end or back-end peripheral.

**Watch the Video!**

In this short video, Chris Tojeira describes Pentek's QuickPac® drive packs, which provide the ability to quickly remove and replace storage drives in the field. These canisters hold eight SSDs, providing up to 30 TB of storage.

To view the video, click **here** or click the picture.

## Summary

Wideband recorders draw upon diverse disciplines of new technology to keep pace with growing demands of burgeoning information traffic, both in the number of channels and in signal bandwidth. Fortunately, many of these technologies are driven by large worldwide market forces, which feed off our planet's insatiable need for connectivity and storage. ❏
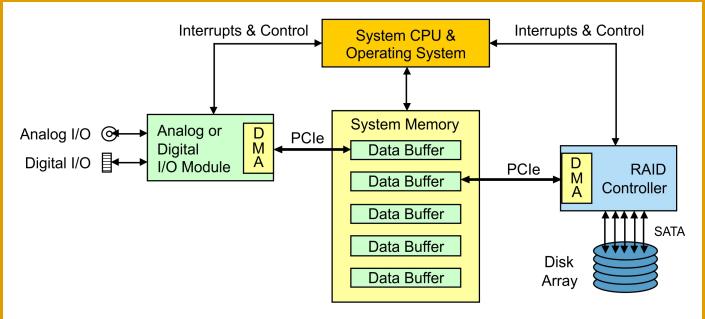


**Figure 3.** *Hardware DMA engines in analog or digital interface modules and RAID controllers take advantage of fast PCIe data links to and from buffers in system memory provided by new chip sets in server-class PCs. The CPU supervises these transfers, but never actually touches the data so real-time performance is maintained.*

# Pentek Boosts Bandwidth for Record and Playback of Talon Rugged Series Recorders

**Product Focus**

## Talon RTR 2745

A new addition to the Talon® Series of recorders, the Talon RTR 2745 rugged rackmount recorder is optimized for rugged operating environments. This versatile recorder increases the bandwidth for record and playback of the Talon Rackmount Series with the capability to capture and reproduce signal bandwidths up to 560 MHz.

The RTR 2745 is a turnkey, wideband recording and playback system that provides real-time capture of RF and IF signals. With two 3 GHz 14-bit A/D converters and built-in digital downconverters (DDCs), the system is ideal for capturing the IF outputs of RF downconverters with bandwidths as high as 600 MHz. Selectable DDC tuning frequencies allow the RTR 2745 to accommodate a broad range of IF outputs.

*"The RTR 2745 was designed to complement the wideband IF outputs of the latest RF downconverters," stated Chris Tojeira, product director of Recording Systems. "With high-speed, high dynamic range A/Ds and D/As, this system is our first to provide extremely wide bandwidth recording with matching playback," he continued.*

The DDCs provide a fixed decimation of 4 with selectable tuning frequencies to fs/2. This provides excellent flexibility when trying to match the IF of a selected wideband RF downconverter.

Two output channels with 2.8 GHz 16-bit D/As and matching digital upconverters (DUCs) provide a fixed interpolation of 4 to allow for precise signal reproduction of recorded signals.
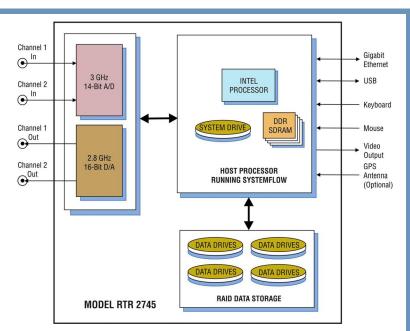
The 3 GHz A/Ds can operate without the digital downconverters to provide an extremely wide baseband capture. The system offers flexible sample rates ranging from 1.5 GHz to 3.0 GHz.

The RTR 2745 offers a storage capacity up to 61 TB, utilizing up to 32 hot-swappable solid-state drives (SSDs) that can be easily removed or exchanged during a mission to retrieve recorded data.



MODEL RTR 2745

## Features

- Multi-channel real-time recording of RF Signals up to 3 GHz

- Captures and reproduces IF bandwidths up to 560 MHz

- Up to 61 TB of hot swappable SSD storage capacity

- Real-time sustained recording rates up to 6.4 GB/sec

- Designed to operate under conditions of shock and vibration

## Ease of Operation

All Talon recorders are built on a Windows 7 Professional workstation and include Pentek's SystemFlow software, featuring a GUI (graphical user interface), signal viewer, and API (Application Programming Interface). The GUI provides intuitive controls for out-of-the-box turn-key operation using point-and-click configuration management. Configurations are easily stored and recalled for single-click setup. User settings to configure data format for the signal viewer provide a virtual oscilloscope and spectrum analyzer to monitor signals before, during and after data collection. The C-callable API allows users to integrate the recorder control into larger application systems. Enhancements to the GUI allow more efficient configuration of the recording channels.

The data format used for storage follows the NTFS standard, allowing users to remove drives from the instrument and read the data using standard Windows-based systems, eliminating the need for file format conversion.

## Free Demo

Pentek's SystemFlow Simulator software package simulates the SystemFlow® recording software, which is installed on all Talon® recording systems. You can download and install the free SystemFlow® Simulator to your desktop or laptop PC. Click here to download the demo. ❑

# Pentek Announces 6.4 GHz A/D and D/A Jade XMC Module for Wideband Defense, Radar and Communication Applications

**Product Focus**

## Jade Model 71141

The newly announced Model 71141 is a 6.4 GHz dual channel analog-to-digital and digital-to-analog converter with programmable DDCs and DUCs. It is the newest member of the Jade" family of high-performance data converter XMC modules based on the Xilinx® Kintex™ Ultrascale FPGA.
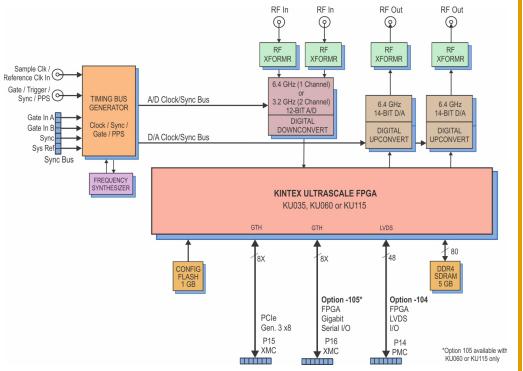
Model 71141 is suitable for connection to IF or RF signals for very wideband communications or radar system applications, including:

- Satellite communications (SATCOM)

- Phased array radar, SIGINT, and ELINT

- Synthetic aperture radar (SAR)

- Time-of-flight and LIDAR distance measurement

- RF sampling software defined radio (SDR)

For applications that require unique functions, users can install custom IP for specialized data processing tasks. Pentek's Navigator" FPGA Design Kit includes source code for all factory-installed IP modules. Developers can integrate their own IP with the Pentek functions or use the Navigator kit to completely replace the Pentek IP with their own.

*"The new Jade product family of high-performance processing boards utilize TI's LMX2594, ADC12DJ3200 and DAC38RF82 RF sampling data converters to boost wideband solution performance to a new level - two times faster than previous generations of Pentek products," said VC Kumar, high-speed data converter manager at Texas Instruments. He added, "Designers can leverage this performance to move closer to the antenna, capture the wider bandwidths, and process more information in real time."*

*"With direct radio frequency (RF) sampling of signals up to 8.1 GHz, the Model 71141 not only covers L-band, S-band, and C-band, but also extends into X-band. Now RF designers can digitize large frequency spans with a single board solution," said Bob Sgandurra, director of Product Development at Pentek.*

## Features

- Utilizes new state-of-the-art high-speed A/D and D/A chip design

- 2X faster A/D and D/A sampling rate

- Matching 6.4 GHz A/D and D/A sampling allows for more efficient data transfers

- XMC (VITA 42) with PCIe Gen 3 interface

- Jade architecture with Xilinx Kintex UltraScale FPGA

- Navigator Design Suite supports Xilinx's graphical Vivado® IP Integrator



## Design Saves Costs and Development Time

The Pentek Navigator tools reduce the development time and cost associated with complex designs. Users can also select the size of the FPGA they would like installed so they are getting exactly what they need performance-wise without paying for a ➤

larger FPGA they may not need. Unlike others in the industry, Pentek still provides support to customers at no cost.

### A/D Stage and DDC

The Model 71141 is the first of the Pentek Jade products to use the Texas Instruments ADC12DJ3200 12-bit A/D. The front end accepts analog RF inputs on a pair of front panel SSMC connectors. The converter operates in single-channel interleaved mode with a sampling rate of 6.4 GHz and an input bandwidth of 7.9 GHz; or, in dual-channel mode with a sampling rate of 3.2 GHz and input bandwidth of 8.1 GHz.

The A/D built-in digital down converters support 2x decimation in real output mode and 4x, 8x, or 16x decimation in complex output mode. The A/D digital outputs are delivered into the FPGA for signal processing, data capture, or for routing to other module resources.

### Digital Upconverter and D/A Stage

A Texas Instruments DAC38RF82 D/A with DUC accepts a baseband real or complex data stream from the FPGA and provides that input to the upconversion, interpolation, and dual D/A stages. When operating as a DUC, it interpolates and translates real or complex baseband input signals. It delivers real or quadrature (I+Q) analog outputs to the dual 14-bit D/A converter. The two 6.4 GHz 14-bit D/As pair well with the dual input channels while delivering more than twice the output performance of previous generations of Pentek products.

### Performance IP Cores

The 71141 factory-installed functions include two A/D acquisition and two D/A waveform generation IP modules. In addition, IP modules for DDR4 SDRAM memories, a controller for all data clocking and synchronization functions, a test signal generator, and a PCIe Gen.3 interface complete the factory-installed functions. System integrators get to market with less time and risk because the 71141 delivers a complete turnkey solution without the need to develop any FPGA IP.

### The Jade Architecture

The Pentek Jade Architecture is based on the Xilinx Kintex UltraScale FPGA, which raises the digital signal processing (DSP) performance by over 50% with equally impressive reductions in cost, power dissipation, and weight. As the central feature of the Jade Architecture, the FPGA has access to all data and control paths, enabling factory-installed functions including data multiplexing, channel selection, data packing, gating, triggering, and memory control. A 5 GB bank of DDR4 SDRAM is available to the FPGA for custom applications. The x8 PCIe Gen 3 link can sustain 6.4 GHz data transfers to system memory. Eight additional gigabit serial lanes and LVDS general purpose I/O lines are available for custom solutions.

### Navigator® Design Suite for Streamlined IP Development

Pentek's Navigator Design Suite was developed to work with Pentek's Jade architecture and Xilinx's Vivado® Design Suite, providing a plug-and-play solution to the complex task of IP and control software creation and compatibility. The Navigator Design Suite consists of two components: Navigator FDK (FPGA Design Kit) for integrating custom IP into Pentek-sourced designs and Navigator BSP (Board Support Package) for creating host applications. Users can work efficiently at the API level for software development and with an intuitive graphical interface for IP design. The Navigator BSP is available for Windows and Linux. ❑



### Watch the Video!

In this informative video, Rodger Hosking discusses:

- New challenges for embedded software radio
- Evolving Xilinx FPGA technology
- Gigabit serial interfaces
- Optical backplanes
- AXI4 interconnect standard
- Navigator design tools
- Software radio protocols

To view the video, click **here** or click the picture.

# Pentek Announces 4-channel 200 MHz A/D with 32 DDCs Jade XMC Module for Communication and Radar Systems

**Product Focus**

## Jade Model 71862

The newest member of the Jade" family of high-performance data converter XMC modules is based on the Xilinx Kintex UltraScale FPGA. The Model 71862 includes four 200 MHz, 16-bit A/D channels and a unique combination of 32 programmable multiband DDCs for both wideband and narrowband frequency monitoring.

## Performance IP Cores

The 71862 factory-installed functions include four A/D acquisition IP modules, each containing nine DDCs. In each module, the wideband DDC supports decimations from 2 to 32 for capturing signal bandwidths up to 80 MHz. The eight narrowband DDCs allow decimations up to 1024 for signal bandwidths down to 16 kHz. These two types of DDCs operating in parallel are ideal for applications that need to monitor a wide spectrum but quickly tune to identified frequency bands of interest for further analysis.

*"The combination of wideband and narrowband DDCs is a common request from our customers," said Bob Sgandurra, director of Product Development at Pentek. "The added resources of the Kintex UltraScale FPGAs allow us to include these powerful*

*functions in our Jade products at a very competitive price. Model 71862 makes an ideal turnkey platform for FPGA-processing IP solutions in communication and radar systems."*

## Pre–Configured SPARK System Ready to Use

With a Pentek 8266 SPARK® PC, 8264 SPARK 6U VPX, or 8267 SPARK 3U VPX development system, work can begin immediately on applications. A SPARK system saves engineers the time and expense associated with building and testing a development system and ensures optimum performance of Pentek boards. SPARK development systems are ready for immediate operation with software and hardware installed. In many applications, the SPARK development system can become the final deployed application platform.
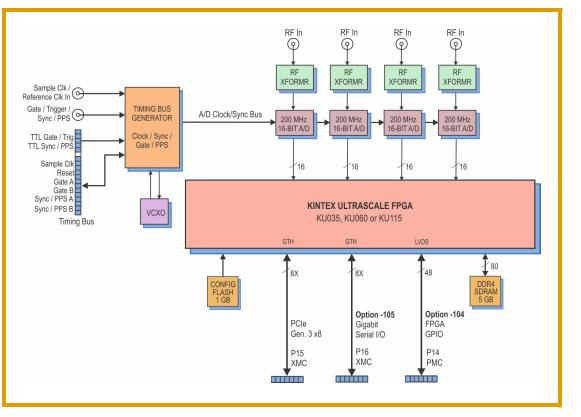
## Form Factors

The Model 71862 XMC module is designed to operate with a wide range of carrier boards in PCIe, 3U & 6U VPX, AMC, and 3U & 6U Compact PCI form factors, with versions for both commercial and rugged environments.

## Features

- Four 200 MHz, 16-bit A/Ds

- Four wideband FPGA-based Digital Down Converters (DDCs)

- 32 narrowband FPGA-based DDCs

- XMC with PCIe Gen 3 interface

- Jade Architecture with Xilinx Kintex UltraScale FPGA

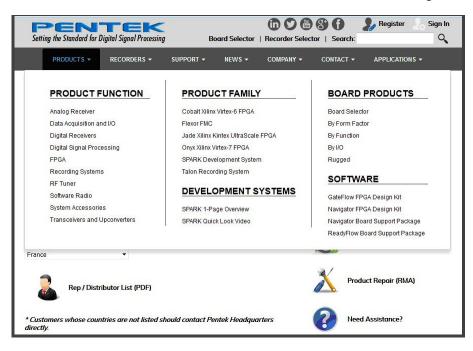- Navigator Design Suite for Streamlined IP Development

# 4 Reasons Why You Should Visit the New Pentek Website Today

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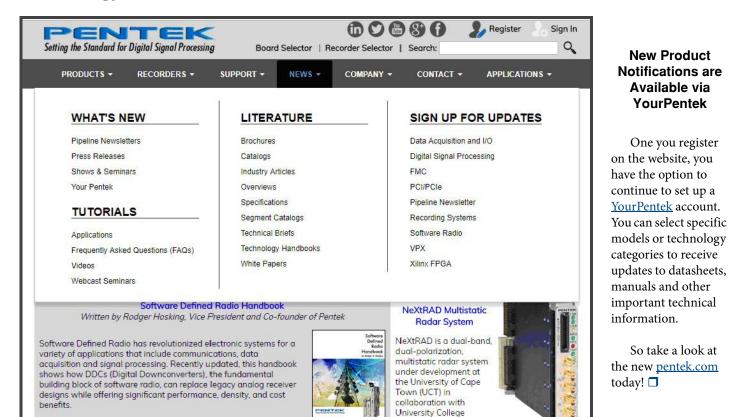
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