VPX for Rugged, Conduction-Cooled Software Radio Virtex-7 Applications

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PENTEK

25 YEARS

System Essentials: Rugged Software Radio

Industry Standard Open Architectures
Wider Product Selection and Compatibility

Faster System Interfaces
Eliminate real-time data flow bottlenecks

Wider RF Signal Bandwidths
New radar & communications signals

Wideband Digital Downconversion
Required for Baseband DSP Algorithms

Improved Dynamic Range
Detection, Identification and Interception

Easy Runtime Reconfiguration
Field Upgradability and Adaptive Operation

Backplane Optical and RF Analog I/O
Improved reliability and maintainability

OpenVPX: Foundation for Rugged SDR

- VITA-65 OpenVPX: leading industry standard for rugged systems
- Defines form factor, topology, power, control & I/O
- Standard profiles for backplanes, slots, and modules
- Fast gigabit serial links replace slower parallel bus backplanes
- Forced-air, air flow through, liquid and conduction cooling
- Improved multi-vendor compatibility and interoperability
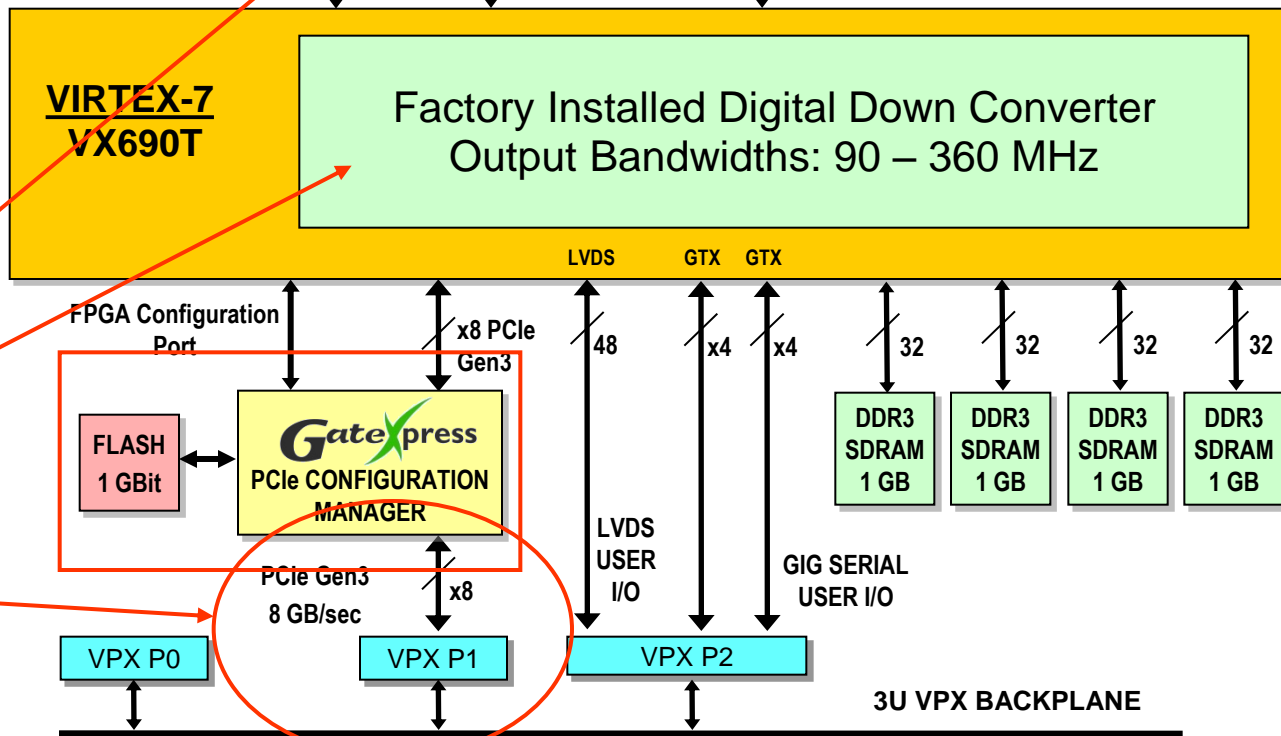- RF and Optical backplane I/O

Onyx Model 53741 3.6 GHz A/D + DDC

3U VPX - CC
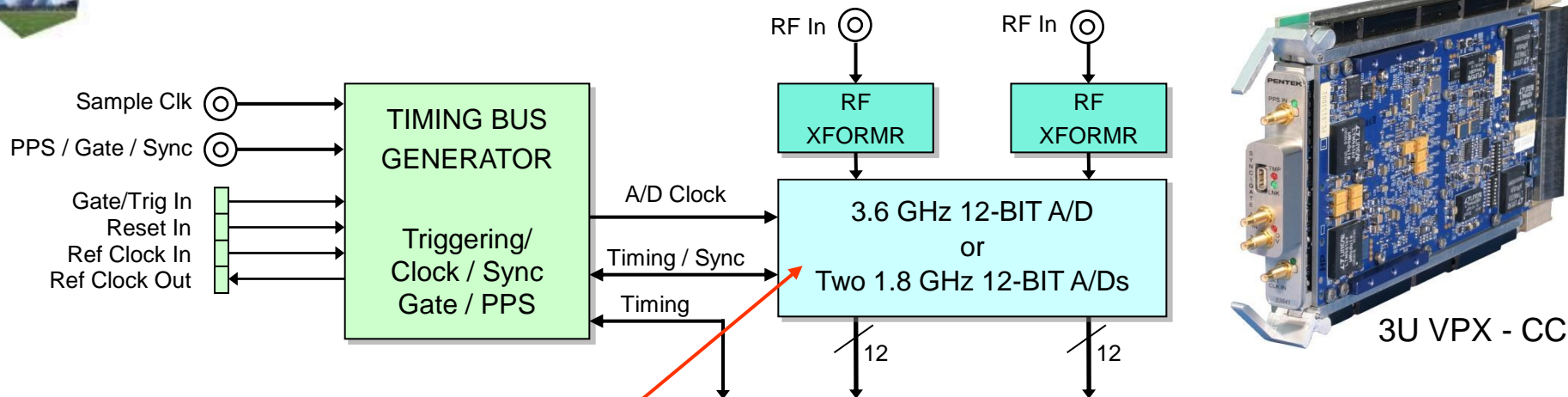
- 3U VPX Module
- Conduction-cooled
- Virtex-7 DSP Engine
- Digitize Bandwidths up to 1500 MHz
- Wideband Digital Down Converter
- 1600 MHz DDR3 SDRAM
- PCIe Gen 3 System Interface

Sample Clk
PPS / Gate / Sync
Gate/Trig In
Reset In
Ref Clock In
Ref Clock Out

TIMING BUS GENERATOR

Triggering/ Clock / Sync Gate / PPS

RF In
RF In

RF XFORMR
RF XFORMR

A/D Clock

Timing / Sync

Timing

3.6 GHz 12-BIT A/D or Two 1.8 GHz 12-BIT A/Ds

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VIRTEX-7 VX690T

Factory Installed Digital Down Converter Output Bandwidths: 90 – 360 MHz

LVDS **GTX** **GTX**

48   x4   x4   32   32   32   32

FPGA Configuration Port

x8 PCIe Gen3

FLASH 1 GBit

GateXpress PCIe CONFIGURATION MANAGER

DDR3 SDRAM 1 GB
DDR3 SDRAM 1 GB
DDR3 SDRAM 1 GB
DDR3 SDRAM 1 GB

LVDS USER I/O

GIG SERIAL USER I/O

PCIe Gen3 8 GB/sec

x8

VPX P0
VPX P1
VPX P2

3U VPX BACKPLANE

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GateXpress PCIe Configuration Manager

- Allows host software utility to completely reconfigure the entire FPGA
- All loading done through the host PCIe interface
- Supports live, run-time FPGA reconfiguration without reboot
- Supports over-the-air reconfiguration of FPGA in a UAV
- No non-volatile storage of sensitive FPGA code in case of capture

Pentek's New flexor FMC Family

- **Based On Pentek Onyx Virtex-7 FPGA XMC Technology**

  - Dozens of software radio and digital I/O functions

  - Industry-leading analog I/O performance: speed and signal integrity

  - ReadyFlow Board Support Libraries

  - GateFlow FPGA Design Tools

  - GateXpress FPGA Configuration Manager

- **Pentek's First FMC (FPGA Mezzanine Card) Products**

  - FMC Carrier: 3U OpenVPX with Virtex-7 FPGA

  - FMC Module: 4 Ch 250 MHz 16-bit A/D & 2 Ch 800 MHz 16-bit D/A

  - Compliant with ANSI/VITA 57.1 FMC Standard

  - Rugged, conduction-cooled versions

- **Industry's First VITA 66.4 VPX Optical Backplane Offering**

Flexor 5973 3U OpenVPX FMC Carrier

- Powerful Virtex-7 FPGA
- High Pin Count FMC Site
  - 160 LVDS & 10X GTX Serial
- x8 PCIe Gen 3 delivers 8 GB/sec
- GateXpress FPGA Configuration Manager
- 4 GB 1600 MHz DDR3 SDRAM

- 16-pairs LVDS User I/O on P2
- 4x Gigabit Serial User I/O on P1
- VITA-46, VITA-48, VITA-65, VITA-57.1, and VITA-66.4
- VITA 66.4 Optical Backplane
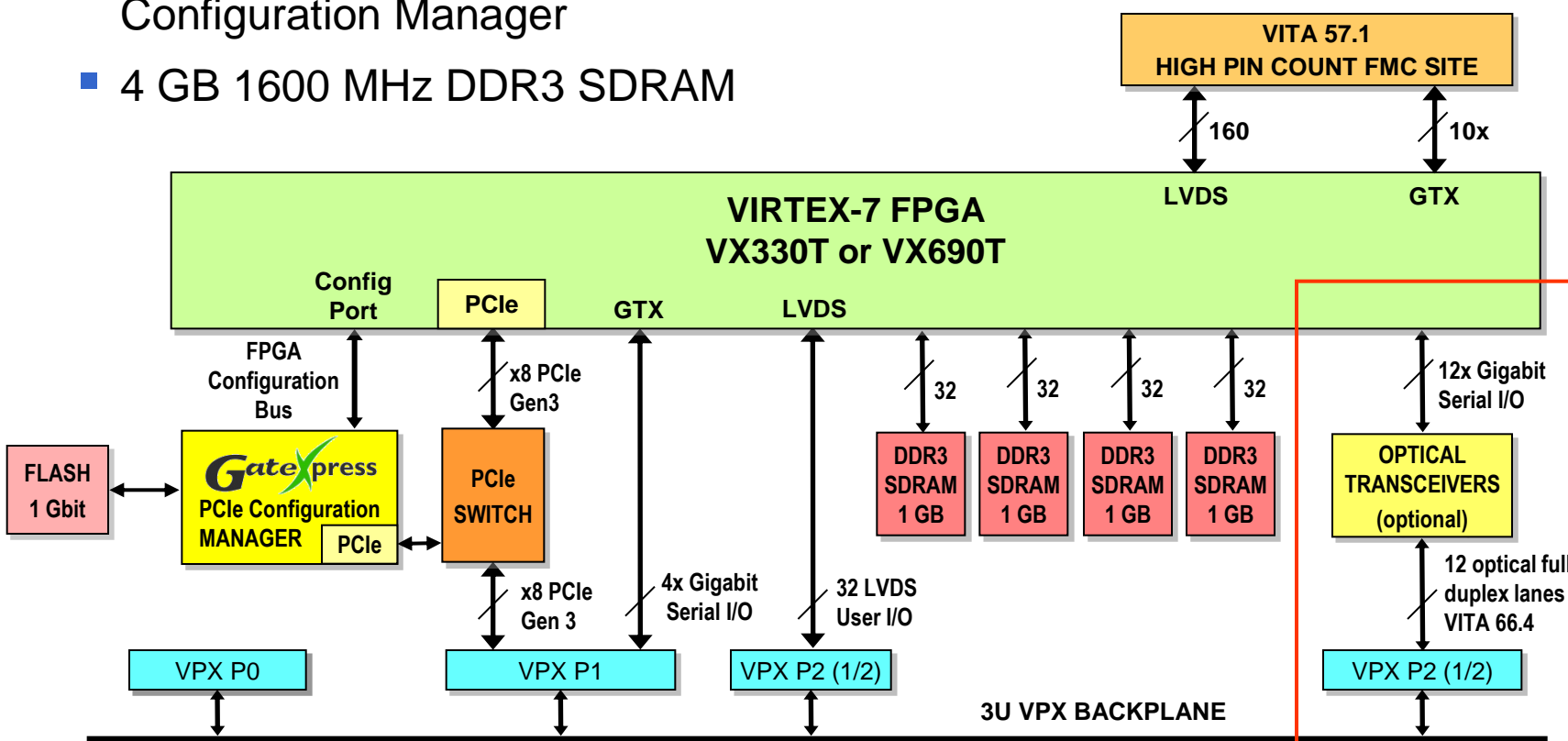
VITA 66.4 Optical Backplane I/O

- Uses Molex Ruggedized Optical MT Backplane Interconnect System
- 12 full-duplex optical links
- Data rates to 6 Gb/sec
- Floating, blind mate connectors
- Supports single-mode and multi-mode fibre optic interfaces
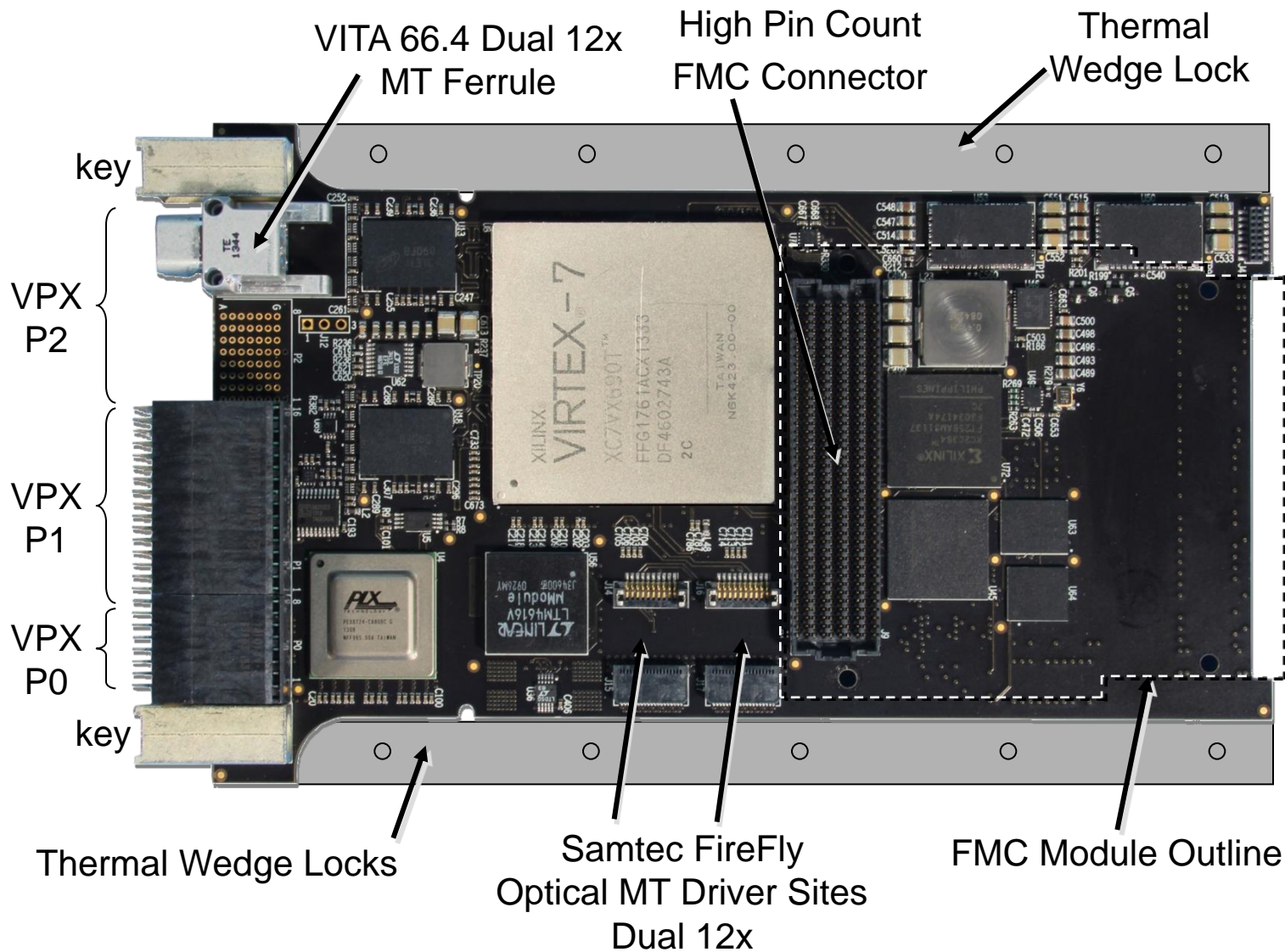- Samtec Firefly™ Optical MT Transceiver modules
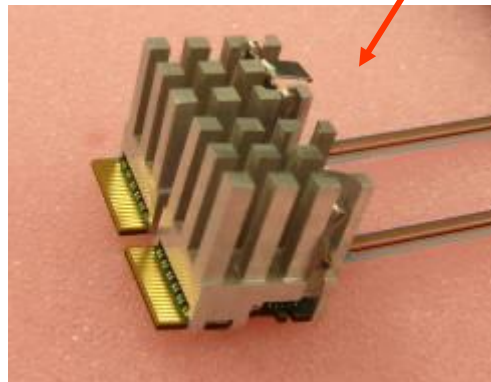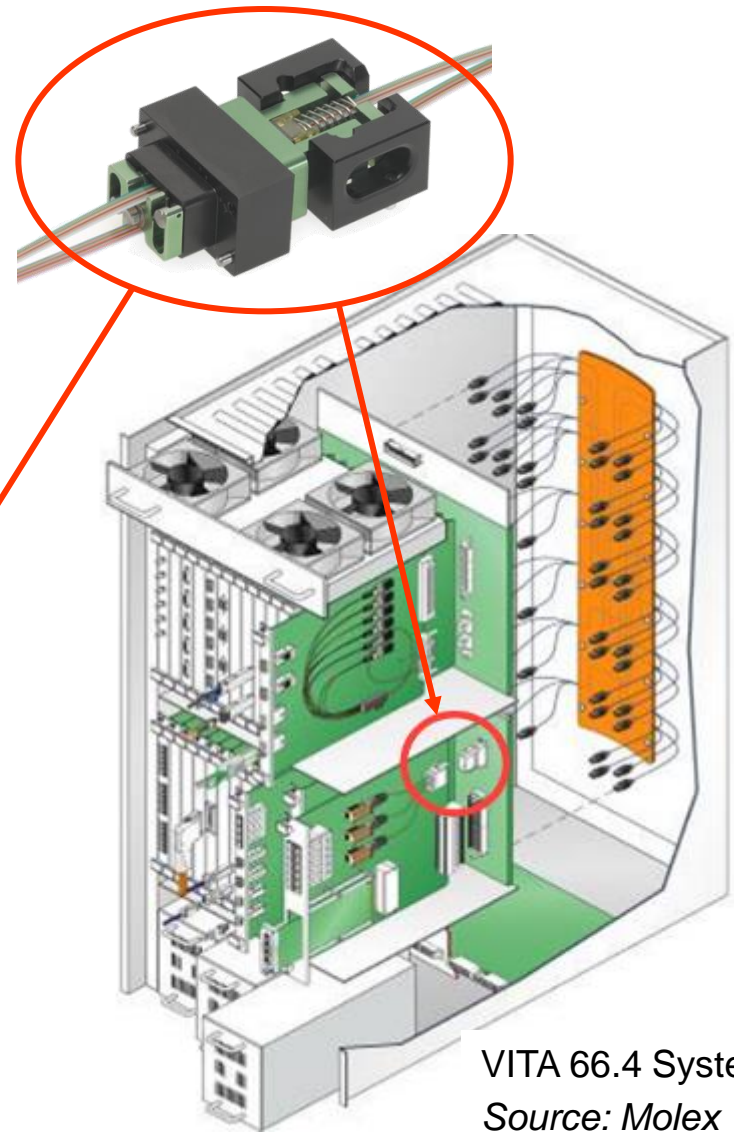
SamTec
FireFly Optical
MT Interface

VITA 66.4 System
Source: Molex

Flexor 5973 3U OpenVPX FMC Carrier

VITA 66.4 Dual 12x MT Ferrule

High Pin Count FMC Connector

Thermal Wedge Lock

key

VPX P2

VPX P1

VPX P0

key

Thermal Wedge Locks

Samtec FireFly Optical MT Driver Sites Dual 12x

FMC Module Outline

Flexor 3312 4-Ch A/D & 2-Ch D/A FMC

- Four 250 MS/sec 16-bit A/Ds
  - Four 100 MHz BW inputs
- Two 800 MS/sec 16-bit D/As
  - Two 100 MHz BW outputs
- Complex Digital Upconverter
  - One 200 MHz BW IF output
- On-board sample clock synthesizer
  - Full-function gating, triggering and synchronization

- High Pin Count FMC Connector
- Compatible with 5973 VPX Carrier
  - Fully-Optimized FPGA Code
  - GateFlow FPGA IP Design Tools
  - Windows/Linux Drivers & BSP
- Powerful transceiver/transponder for communications and radar
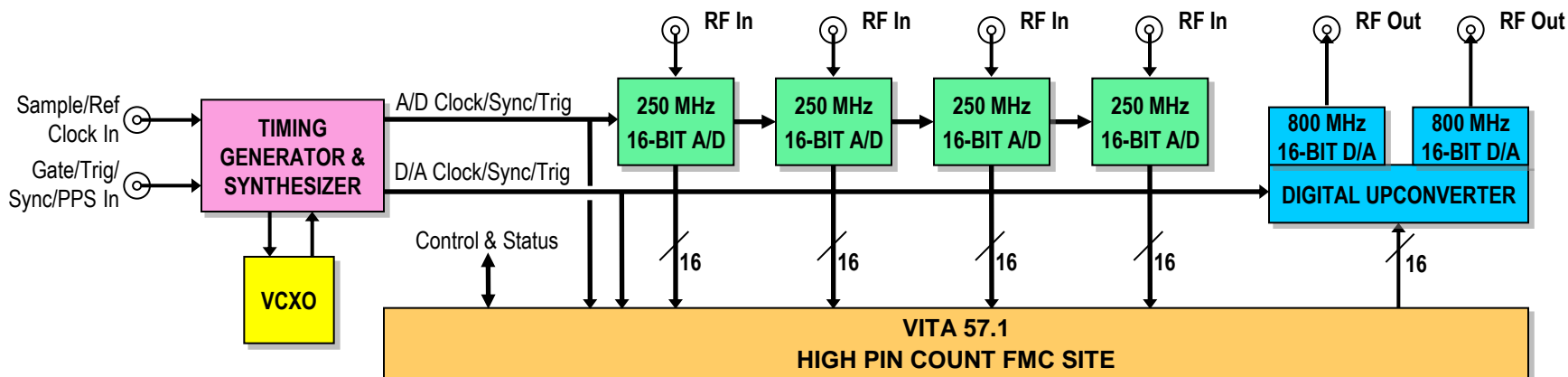
flexor 3312 4-Ch A/D & 2-Ch D/A FMC

- Version with no front panel connectors available

- Rugged, conduction-cooled or air-cooled versions available

- Thermal plate spreads heat to wedgelocks or cooling fins

- Excellent shielding, regulation and layout to maintain very high dynamic range > 85 dB

Clock, Trigger, Sync, Analog I/O

High Pin Count FMC Connector

- Eliminates front panel coaxial RF connections for VPX
- Replaces segment of backplane MG RT copper connector
- Spring loaded blind mating
- Simplifies maintenance
- Improves reliability
- VITA 67.1
  - 3U VPX – 4 RF connectors
- VITA 67.2
  - 6U VPX – 8 RF connectors
- Available on Pentek 53xxx conduction-cooled 3U VPX series products by option
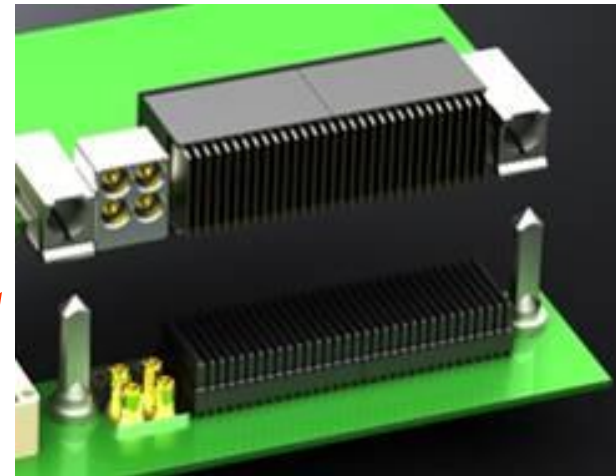

VITA 67.1 - 3U: 4 RF connectors

VITA 67.2 - 6U: 8 RF connectors
Source: TE Connectivity

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SystemFlow® Recording Software

- **VPX Backplane Handles Real-time Recording System Transfers**
  - Analog I/O (VITA 67) and Digital I/O (VITA 66)
  - PCIe for data and control
  - SATA for disk I/O
- **Hardware DMA controllers handle all critical, real-time data transfers**
  - VPX Backplane PCIe Links eliminate data flow bottlenecks
- **System CPU & Operating System**
  - Does not "touch" the real-time data
  - Initializes the I/O modules, RAID controller, and DMA engines
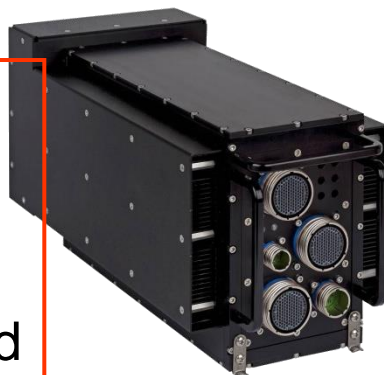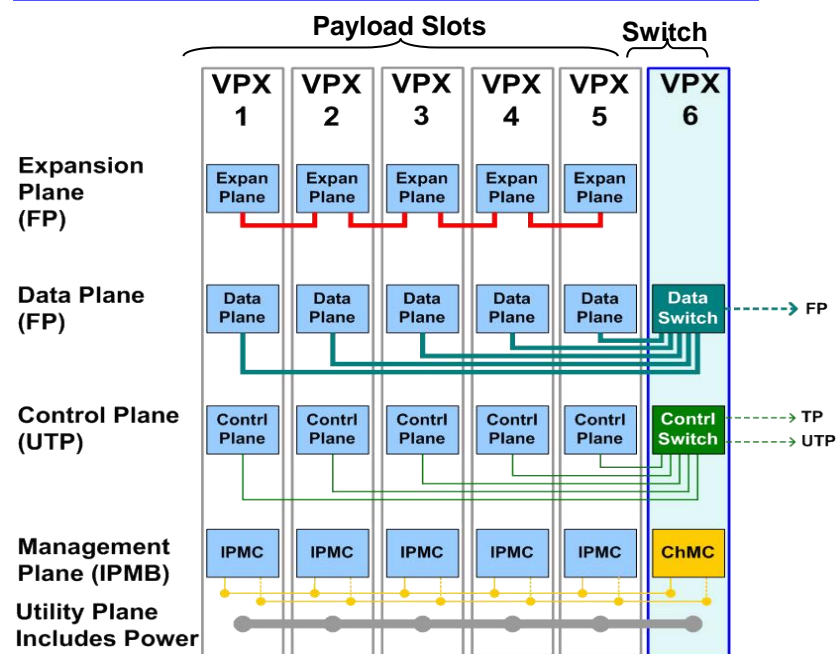 - Manages performance through interrupts
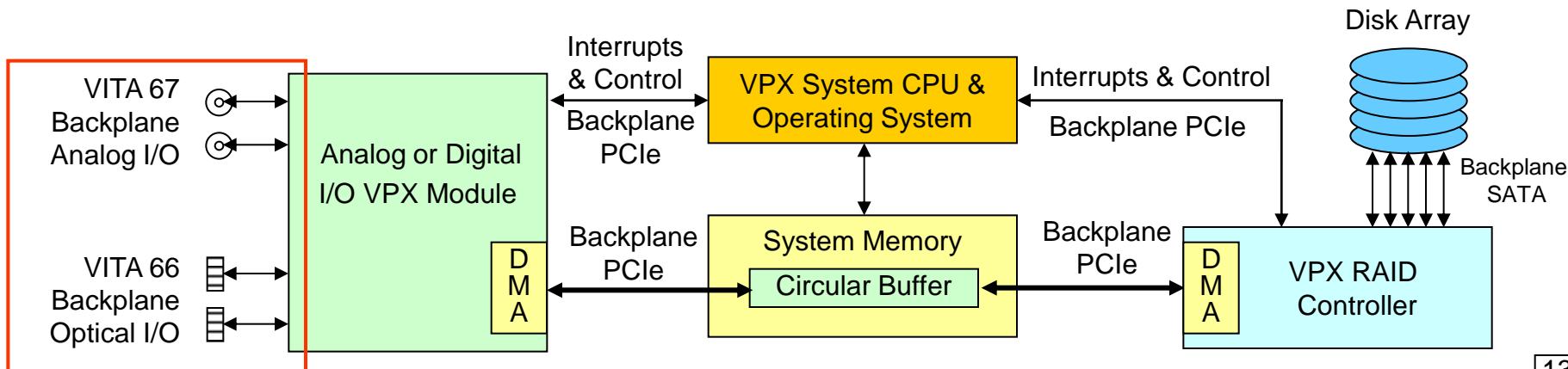
UAV VPX IF Recorder

- Recording of two analog IF channels
- 10 kHz to 40 MHz signal bandwidth
- 2 TB real time storage, RAID 5 disks
- UAV computer controls operation through API via Ethernet
- Key Features
  - 85 dB SFDR
  - Vibration tolerant
  - ½ ATR chassis
  - Flight safety certified

Backplane Profile: BKP3-CEN06-15.2.2-1

Module & Function	Slot Profiles	Module Profiles
CPU, SDR, Digital Receivers, RAID controllers, SSDs	SLT3-PAY-1F2F2U-25.2.2	MOD3-PAY-1F2F2U-27.2.2-1
Data Switch	SLT3-SWH-8F-25.4.2	MOD3-SWH-8F-27.4.2-2

Rugged SDR Strategies with OpenVPX

- Wealth of product offerings cover a wide range of system functions – 35 vendors, 350 products

- Fast, multi-protocol gigabit serial backplanes

- Diverse thermal management strategies

- Proven interoperability between vendors

- Standard profiles enhance product compatibility

- Military customers see widespread, sustained life-cycle commitment to OpenVPX

- New I/O technologies including backplane RF and optical links

- FPGA reconfigurability for mission flexibility and safeguards for secure applications

- More Information: www.pentek.com