



Innovative Integration

a subsidiary of ISI

... real time solutions!

Product Guide | Volume 22



DSP
Data Acquisition
Embedded Control



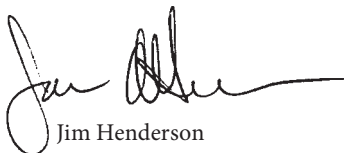
Innovative DSP, Data Acquisition & FPGA Products

Since 1988, Innovative Integration has grown to become one of the world's leading providers of DSP, Data Acquisition, and FPGA solutions. Innovative offers a product portfolio unrivalled in its depth, ease of deployment and performance/price value.

Whether your application is real-time data acquisition, embedded DSP on PC or stand-alone systems or ultra-high speed FPGA - assisted signal processing, Innovative has the solution. To accelerate your development, our hardware products are enhanced by complete kits of sophisticated software tools, including device-drivers, software libraries, useful applets and detailed on-line documentation that will help you meet your design goals, on schedule.

At Innovative Integration, we strive to serve leading-edge fields with proven, real-time platforms that best utilize the latest advances in DSP and FPGA chip technologies. Our products give our customers the competitive edge that is so critical in today's global markets. We provide a hardware, firmware and software framework that will allow you to incorporate the most advanced board architecture in your application without the risk associated with advanced product development. Your efforts are channeled into the area you know best: your application.

Made in the USA, competitive pricing is made possible by our parent company Interconnect Systems, Inc. ISI – www.isipkg.com.


Jim Henderson


Dan McLane

Solutions for Advanced Data Acquisition, Signal Processing and Embedded Systems - off the shelf!

Since 1988, Innovative Integration has been delivering a rich mix of Data Acquisition, DSP (Digital Signal Processor) and FPGA (Field Programmable Gate Array) boards with productive support tools, providing off-the-shelf solutions to developers of high-end signal capture and co-processing software.



Largest State of the Art FPGAs for End-user Code

Xilinx Spartan 2/3, Virtex II & Virtex II-Pro, Virtex-5, Virtex-6 (LX and SX)



Analog I/O & High Speed Digital Interfaces

Fully integrated on-board, with burst interfaces, up to 3 GHz digitizing speed or >3 GHz and >120 dB dynamic range SNR



Rapid Application Development

Matlab & C++ support, drivers, libraries, code examples operating peripherals at full speed

4 PCI Express XMC Modules

Intelligent, Customizable I/O, High Performance IO and FPGA Core

13 eInstruments

A rugged enclosure containing an ultra-miniature PC running Windows/Linux for user-customizable, turnkey embedded instrumentation.

17 VPX Products

Rugged, high-bandwidth products in 3U OpenVPX form-factor.

19 PCI Express Boards

Intelligent, Customizable I/O High Performance I/O and FPGA Core

20 PMC Modules

Ultra-fast Reconfigurable I/O PMC/XMC Cards Advanced Software Radio Modules

22 Carrier/Adapter Boards

Adapt PMC/XMC/FMC Modules to Desktop, Notebook, Compact PCI, PXI and OpenVPX Systems

23 Data Logger Products

Turnkey, high-speed data acquisition and waveform playback at 2 GB/s from a 48 TB hard disk array.

24 FMC Products

Wide range of dense, high-performance I/O solutions in VITA57 form-factor

25 Software, FrameWork Logic, IP Cores

Development support toolsets for high performance embedded DSP & computing. Logic IP cores for FPGAs for wireless, interface and control applications.

33 Wireless IP Cores

High performance FPGA cores for channelization, downconversion, and demodulation

With strong partnerships with Texas Instruments, Xilinx and The MathWorks, Innovative Integration delivers superior architectures and development tools that allow customers to be first to market in their respective field of expertise.



PCI Express XMC Modules

Intelligent, Customizable I/O

High Performance IO and FPGA Core



Datasheets and online pricing available @ innovative-dsp.com

High Performance

The X3, X5 and X6 module families feature high performance analog and digital IO on a standard XMC module format with a flexible PCI Express host interface bus. Each has a powerful user-programmable FPGA computing core that is used for data acquisition and connects the I/O to the PCI Express host interface.

Three Product Groups

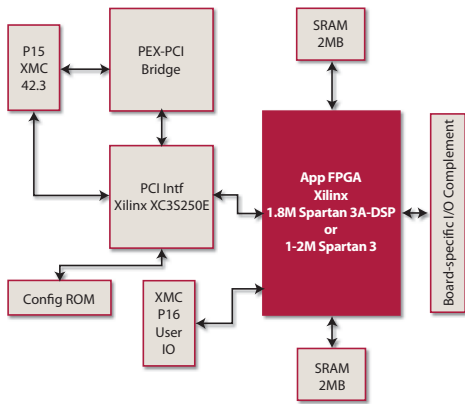
The X6 group provides a state-of-the-art combination of the newest generation, high-density, user-reprogrammable Virtex-6 FPGA logic meticulously integrated with ultra-high-speed analog or digital I/O to address the most demanding radar, wireless RF and communications applications.

The X3 group provides an extremely cost-effective combination of analog or digital I/O plus a Xilinx Spartan 3 or 3A DSP user-reprogrammable FPGA which provides a plug-and-play, yet customizable solution for common data acquisition, waveform generation and servo/control applications.

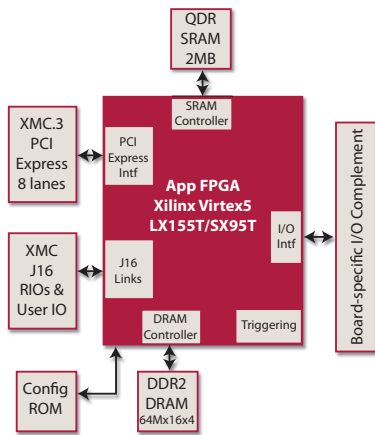
The X5 group provides a high-density, user-reprogrammable Virtex-5 FPGA with a PCI Express Gen 1 interface.

All 3 product groups are usable in a wide variety of hardware platforms. These extremely versatile modules are easily adapted for use in virtually any type of system, Desktop PC, Industrial Chassis, PXI & PXIe Chassis and single board computer based systems. Innovative Integration adapters include CompactPCI, VPX, Desktop PCI & cabled PCI Express systems.

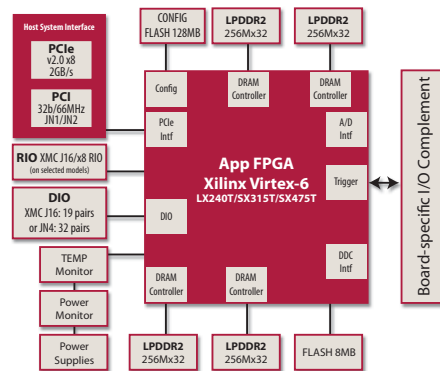
Module	FPGA	Xfer Rate	A/D	Memory	A/D Rate	A/D Res	D/A	D/A Rate	Sample Clock	D/A Res	Digital I/O	Rocket I/O	Special Feature
X6-RX	Virtex-6 SX315T / SX475T or LX240T	2.6 GB/s	4	4 GB (4 banks X 1GB)	160 MSPS	16-bit	0		PLL or external		64	8	GC6016 DDC 24 Channel
X6-400M	Virtex-6 SX315T / SX475T or LX240T	2.6 GB/s	2	4 GB (4 banks X 1GB)	400 MSPS or 500 MSPS	14-bit 12-bit	2 1	2 X 500MSPS 1 x 1GSPS	PLL or external	16-bit	64	8	DDC cores for up to 1024 channels available OFDM receiver and transmit IP cores
X6-GSPS	Virtex-6 SX315T / SX475T or LX240T	2.6 GB/s	2	4 GB (4 banks X 1GB)	2ch.@1.8GSPS 1ch.@3.6GSPS	12-bit	0		PLL or external		64	8	Programmable DDC cores available for wideband channels
X6-1000M	Virtex-6 SX315T / SX475T or LX240T	2.6 GB/s	2	4 GB (4 banks X 1GB)	1 GSPS	12-bit	2	4 X 500MSPS 2 x 1GSPS	PLL or external	16-bit	64	8	DDC cores for up to 1024 channels available
X6-250M	Virtex-6 SX315T / SX475T or LX240T	2.6 GB/s	8	4 GB (4 banks X 1GB)	310 MSPS	14-bit	0		PLL or external		64	8	Very high input channel count
X5-400M	Virtex 5 SX95T	1.3 GB/s	2	512MB DRAM 8 MB SRAM	400 MSPS	14-bit	2 or 1	2 X 500MSPS 1 x 1GSPS	400 MHz or external	16-bit	38	8	DDC cores for up to 1024 channels available
X5-210M	Virtex 5 SX95T	1.3 GB/s	4	512MB DRAM 8 MB SRAM	250 MSPS	14-bit	0		250 MHz or external		16	8	Multi-channel SDR receiver with PSK demodulator available
X5-TX	Virtex 5 SX95T	1.3 GB/s	0	512MB DRAM 8 MB SRAM			2 or 4		PLL or external	16-bit	16	8	Memory controller supports arbitrary and complex pattern playback at full 1 GHz rates
X5-GSPS	Virtex 5 SX95T	1.3 GB/s	2	512MB DRAM 8 MB SRAM	3 or 1.5 GSPS	8-bit	0		PLL or external		16	8	Double rate sampling at 3 GSPS for a single channel.
X5-G12	Virtex 5 SX95T	1.3 GB/s	2	512MB DRAM 8 MB SRAM	1 GSPS	12-bit	0		PLL or external		16	8	Double rate sampling at 2 GSPS for a single channel, 8K to 256K FFTs in hardware
X5-RX	Virtex 5 SX95T	1.3 GB/s	4	512MB DRAM 8 MB SRAM	200 MSPS	16-bit	0		PLL or external		16	8	Integrated DDC cores for IF processing
X5-COM	Virtex 5 SX95T	1.3 GB/s	0	512MB DRAM 8 MB SRAM			0		Prog. oscillator or external		16	8	4 front panel SFP ports at 3.125 Gbps using fiber or copper
X3-2M	Spartan3A DSP -1.8M	220 MB/s	12	4MB SRAM	10 MSPS	16-bit	0		PLL, external		44	0	
X3-10M	Spartan3A DSP -1.8M	180 MB/s	8	4MB SRAM	25 MSPS	16-bit	0		PLL, external		44	0	Simultaneous sampling, pre-triggering mode
X3-25M	Spartan3A DSP -1.8M	180 MB/s	2	4MB SRAM	105 MSPS	16-bit	2	50 MSPS	PLL, external		44	0	Noise floor <95 dB
X3-Servo	Spartan3A DSP -1.8M	180 MB/s	12	4MB SRAM	250 ksp/s	16-bit	12	1 MSPS	PLL, external	16-bit	44	0	Low latency for servo controls
X3-SDF	Spartan3 -1/2M	180 MB/s	4	4MB SRAM	20 MSPS	24-bit	0		PLL, external	16-bit	44	0	-130 dB noise floor, programmable filters
X3-SD	Spartan3 -1/2M	180 MB/s	16	4MB SRAM	216 ksp/s	24-bit	0		PLL, external		44	0	>120 dB dynamic range
X3-SD16	Spartan3A DSP -3.4M	180 MB/s	16	4MB SRAM	144 ksp/s	24-bit	16	144 ksp/s	PLL, external	24-bit	44	0	>120 dB dynamic range
X3-A4D4	Spartan3A DSP -1.8M	180 MB/s	4	4MB SRAM	4 MSPS	16-bit	4	50 MSPS	PLL, external	16-bit	64 Frnt Pnl LVDS/ LVC MOS44	0	Low latency for servo controls
X3-DIO	Spartan3A DSP -1.8M	400 MB/s	0	4MB SRAM			0					0	Digital capture, test pattern generation
X3-Timing		180 MB/s	0	0			0		100k to 1GHz sample clock		28		Precision sample clock generation with GPS option



X3 PCI Express XMC Module



X5 PCI Express XMC Module



X6 PCI Express XMC Module



The X6 Product Group

The X6 Module family has a Virtex-6 FPGA and memory at its core for DSP and control. The Virtex-6 FPGA is capable of over 1 Tera MACs (SX315T operating at 500 MHz internally) with over 1300 DSP elements in the SX315T FPGA. In addition to the raw processing power, the FPGA fabric integrates logic, memory and connectivity features that make the FPGA capable of applying this processing power to virtually any algorithm and sustaining performance in real-time. The FPGA has direct access to four banks of 1GB DRAM. These memories allow the FPGA working space for computation, required by DSP functions like FFTs, and bulk data storage needed for system data buffering and algorithms like image processing. A multiple-queue controller component in the FPGA implements multiple data buffers in the DRAM that is used for system data buffering and algorithm support.

The X6 module family uses the Virtex-6 FPGA as a system-on-chip to integrate all the features for highest performance. As such, all IO, memory and host interfaces connect directly to the FPGA – providing direct connection to the data and control for maximum flexibility and performance. Firmware for the FPGA completely defines the data flow, signal processing, controls and host interfaces, allowing complete customization of the X6 module functionality. Logic utilization is typically <20% of the device.

X6 products utilize powerful VITA 49 sub-packets contained within Innovative’s unique Velocia packets, providing up to 3 GB/s data streaming to the host. The payload is flexible and extensible for all types of applications. You can freely mix high rate data streams with control, time-stamps and status making it easy to flow data of different types and rates between the host and the FPGA, while maintaining full data rate capabilities.



The X3 Product Group

The X3 PCI Express modules are industry standard XMCE cards which deliver performance with lower system cost

and less development effort than custom designs. Use the X3 XMCE modules in any PCI Express system or any XMCE compatible carrier card. Eliminate custom hardware by har-

nessing the power of PCI Express and customizable FPGA.

X3 modules have a PCI Express host interface delivering 180 - 350 MB/s data transfer rates, along with the flexibility of user-customizable FPGA signal processing. Board specific analog or digital I/O allows directly into the user-configurable Spartan 3 logic device. The supplied stock logic functionality allows the board to be used out-of-the-box as high-speed I/O board in which the large onboard RAM is configured as a virtual FIFO, to increase the instantaneous load-carrying capacity of the board to eliminate data overruns/underruns during real-time streaming.

Using the VHDL source code or MatLab board support package contained within the optional Framework Logic software package, you can readily customize the functionality of the FPGA to include real-time processing such as FIR and IIR filters on each channel, real-time FFT processing, ultra-fast feedback and control loops and much more. Use of MatLab/Simulink with the MatLab board support package opens an entirely new range of real-resolution possibilities. Importantly, this capability can be effectively used by anyone you need not be an FPGA or logic design maven to effectively develop custom logic solutions!



The X5 Product Group

The X5 module family integrates high performance I/O with a Xilinx Virtex-5 FPGA computing core on 75x150 mm module

(IEEE1386) with a PCI Express interface. The Virtex-5 SXT FPGA provides up to 640 DSP48 elements combined with memory blocks and logic that support a complete DSP system on a chip. QDR SRAM and DDR2 DRAM memory pools provide the FPGA with deep, fast memory that is critical to implementing efficient signal processing algorithms and data acquisition.

Innovative’s unique Velocia architecture provides up to 1 GB/s data streaming to the host that is flexible and extensible for all types of applications. It’s fast and easy to use – allowing you to concentrate on your application work because it handles all the data flow and routing. You can freely mix high rate data streams with control and status making it easy to adapt to your application, yet still achieve the full GB/s data rate capabilities of the PCIe interface.

All X5 modules are architected to deliver high data throughput to the Host, along with

PCI Express XMC Modules

the flexibility of user-customizable FPGA signal processing. Board specific analog or digital I/O flows directly into the user-configurable Xilinx 5 logic device. The supplied stock logic functionality allows the board to be used out-of-the-box as a high-speed I/O board in which the large onboard DDR2 DRAM is configured as an enormous virtual FIFO data buffer. The QDR SRAM interface is a very high-speed local cache for custom algorithms running within the FPGA.

Eight PCI lanes equate to nearly unlimited 1200 MB/s sustained, real-world throughput. And due to the autonomy of the PCIe architecture, this bandwidth is not diluted by activity of other PCI or PCIe devices within the system each PCIe slot operates independently and at full speed. But should it be necessary, the P16 interface can be used to provide another independent data path between FPGAs on multiple boards or carriers, further extending the communications capability of the module.

COTS Solutions for High Performance IO

X5 and X6 modules enable new levels of performance in COTS systems and adds custom signal processing, data analysis and system features. It is easier than ever to achieve high performance because PCI Express architecture supports not only much higher data transfer rates, but also eliminates bottlenecks in the system using dedicated point-to-point links. And you'll be replacing custom hardware with an industry-standard PCI Express solution that gets you to market sooner with less cost.



Customize COTS X5 and X6 Modules for Your Application

No other DSP solution can match the level of processing power and flexibility that the Virtex-5 and Virtex-6 FPGA core modules provide. MATLAB and RTL tools in the FrameWork Logic Board Support Packages enable you to customize the X5 & X6 modules for your application requirements and process real-time data at the IO, making system design more efficient and less complex. The MATLAB tools provide a powerful model-based design approach that allows you to go directly from MATLAB to the hardware, radically reducing the time to implement complex signal processing functions. Or if you prefer, use the RTL tools when you need the power and flexibility of working in a high level language like VHDL or Verilog. The right tools for the job mean you get to market quicker.

Software

Firmware and software are provided at no additional charge with each card which permit the board to be used immediately for the acquisition or generation of waveforms using all channels at full bandwidth, so that you can use the cards immediately, without programming, to characterize your analog signals or stimulate devices under test.

Turnkey data acquisition applications are provided for each module support data acquisition and logging. Tools are provided for data analysis, display and connection to MATLAB and Excel.

Innovative's Malibu Software Tools provide comprehensive and powerful software support C++ developers using Windows and Linux. In addition to the basic device drivers, the Malibu Tools have high performance data buffer management, signal processing and host application integration features that make application development and system integration straightforward and rapid.

X6 Module Features	Benefit
XMC Mezzanine Card	Compact IEEE 1386 card format (75x150mm)
XMC.3 PCI Express Module	Integrate into any VITA 42.3 PCI Express system
Virtex6 FPGA - SX315T/SX475T or LX240T	>300 GMACs/s (SX31595T) integrated with memory blocks and logic
4 GB LPDDR2	Real-time memory performance to 8 GB/s for FPGA data buffering and computation
PCI Express, 8 lane, gen2 interface	>3GB/s transfer rates to host eliminates custom hardware requirements
Analog and Digital IO integrated with FPGA	Real-time signal processing integrated with the IO
>4 GB/s dedicated secondary host interface	Tight, real-time host card integration with Serial RIO, Aurora and custom protocols



X6 rx

X6-RX PCI Express XMC Module

Wireless Receiver, WLAN, WCDMA, WiMAX front end, RADAR, Medical Imaging, High Speed Data Recording and Playback, High Speed Servo Controls, IP Development

Features

- Xilinx Virtex-6 SX315T/475T or LX240T
- 4 Banks of 1GB DRAM (4 GB total)
- Ultra-low jitter programmable clock
- Power Management features
- XMC Module (75x150 mm)

A/D

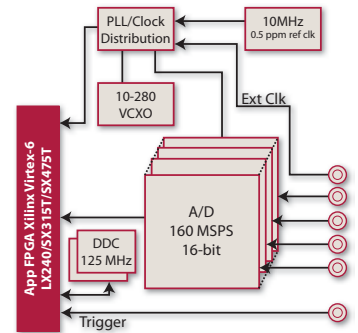
Four 160 MSPS 16-bit A/D channels
Down-Converter ASIC supporting up to 24 Narrowband or 8 Wideband Channels

Digital IO

32-bits (J16)

IP Cores for SDR

16-4096 DDC channels • PSK, FSK demodulation, OFDM receiver



X6 400m

X6-400M PCI Express XMC Module

Ideal for Wireless Receiver and Transmitter, LTE, WiMAX Physical Layer, RADAR, Medical Imaging, High Speed Data Recording and Playback, IP development

Features

- Two 400 MSPS, 14-bit A/D channels or Two 500 MSPS, 12-bit A/D channels
- Two 500 MSPS, 16-bit D/A channels
- Virtex-6 SX315T/SX475T or LX240T
- 4 Banks of 1GB DRAM (4 GB total)
- Ultra-low jitter programmable clock
- Gen2 x8 PCIe 3 GB/s sustained transfer
- XMC Module (75x150 mm)
- 18-25W typical
- Conduction Cooling per VITA 20

A/D

2 channels • 14-bit • 400 MSPS • >68 dB S/N @ 350MHz • +/-1V, 50 ohm, SMA

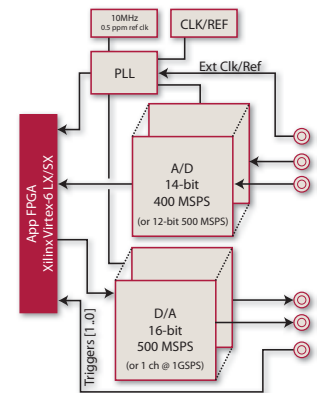
D/A

2 ch • 16-bit • 500 MSPS • 80 dB @ 400MHz or 1 ch • 16-bit • 1 GSPS

Digital IO: 33-bits (J16)

IP Cores for SDR

16-4096 DDC channels • PSK, FSK mod/demod FFT 64K to 1M • OFDM receive and transmitter



X6 GSPS

X6-GSPS PCI Express XMC Module

Wireless Receiver, WLAN, WCDMA, WiMAX front end, RADAR, Medical Imaging, High Speed Data Recording, IP development

Features

- Single channel interleaved @ 3.6GHz
- Virtex-6 SX315T/SX475T or LX240T
- 4 Banks of 1GB DRAM (4 GB total)
- Ultra-low jitter programmable clock
- Gen2 x8 PCIe 3 GB/s sustained transfer
- XMC Module (75x150 mm)
- 26W typical
- Conduction Cooling per VITA 20
- Ruggedization Levels for Wide Temperature Operation

A/D

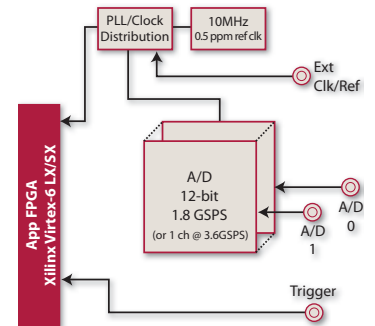
Two 1.8 GSPS, 12-bit A/D channels or One 3.6 GSPS, 12-bit A/D channel +/-1V AC-Coupled 50 ohm SMA inputs

Digital IO

Front panel 64 single-ended or 32-bit LVDS 44 bits (J16)

IP Cores for SDR

DDC for wideband channels



X6 1000m

X6-1000 PCI Express XMC Module

Wireless Receiver, WLAN, WCDMA, WiMAX front end, RADAR, Medical Imaging, High Speed Data Recording and Playback, IP Development

Features

- Virtex-6 SX315T/SX475T or LX240T
- 4 Banks of 1GB DRAM (4 GB total)
- Ultra-low jitter programmable clock
- Arbitrary Waveform Gen Memory Controller for DACs
- Gen2 x8 PCIe 3 GB/s sustained transfer
- XMC Module (75x150 mm)
- 28W typical
- Conduction Cooling per VITA 20

A/D

Two 1 GSPS, 12-bit A/D channels or Four 500 MSPS, 12-bit A/D channels +/-1V, AC or DC -Coupled, 50 ohm, SMA

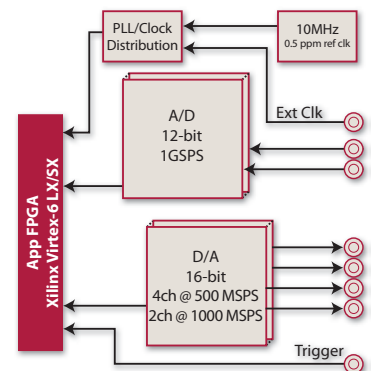
D/A

Two 1 GSPS, 16-bit DAC channels or Four 500 MSPS channels

Digital IO: 32-bits (J16)

IP Cores for SDR

DDC, OFDM Rx/Tx, large FFTs



PCI Express XMC Modules



X6 250m

X6-250M PCI Express XMC Module

Wireless Receiver, WLAN, WCDMA, WiMAX front end, RADAR, Medical Imaging, High Speed Data Recording and Playback, IP Development

Features

- Virtex-6 SX315T/SX475T or LX240T
- 4 Banks of 1GB DRAM (4 GB total)
- Ultra-low jitter programmable clock
- Gen2 x8 PCIe option - 3 GB/s sustained
- XMC Module (75x150 mm)
- 18-22W typical
- Conduction Cooling per VITA 20
- Ruggedization Levels for Wide Temp

A/D

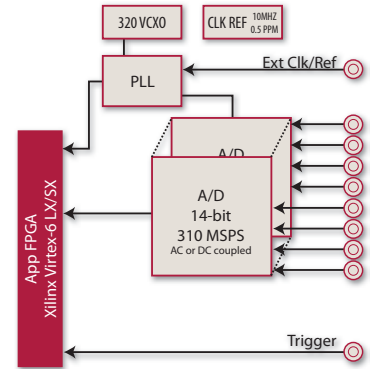
Eight 310 MSPS, 14-bit A/D channels
+/-1V, AC-Coupled, 50 ohm, SMC inputs

D/A

none

Digital IO

16 bits (J16)



X5 210m

X5-210M PCI Express XMC Module

Ideal for Wireless Receiver WLAN, WCDMA, WiMAX front end, RADAR, ECM, Electronic Warfare, High Speed Data Recording, Spectral Analysis, IP development

Features

- Xilinx Virtex-5, SX95T
- 512 MB DDR2 DRAM
- 4 MB QDR-II SRAM
- 8 RocketIO private links, 2.5 Gbps/ea
- >1 GB/s, 8-lane PCIe Host Interface
- Power Management features
- XMC Module (75x150 mm)
- PCI Express (VITA 42.3)

A/D

4 channels • 14-bit • 250 MSPS • +/-1V, 50 ohm, SMA inputs

D/A

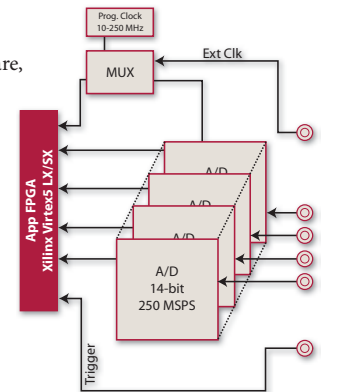
none

Digital IO

16-bits (J16)

IP Cores for SDR

16-4096 DDC channels
PSK, FSK demodulation, FFT 64K-1M



X5 400m

X5-400M PCI Express XMC Module

Ideal for Wireless Receiver/Transmitter, WLAN, WCDMA, WiMAX front end, RADAR, ECM, Electronic Warfare, High Speed Data Recording and Playback, High Speed Servo Controls, Spectral Analysis, IP development

Features

- Xilinx Virtex-5, SX95T FPGA
- 512 MB DDR2 DRAM
- 4 MB QDR-II SRAM
- 8 RocketIO private links 2.5Gbps/ea
- >1GB/s, 8-lane PCIe Host Interface
- Power Management features
- XMC Module (75x150 mm)
- PCI Express (VITA 42.3)

A/D

2 channels • 14-bit • 400 MSPS • >68 dB S/N @ 350MHz • +/-1V, 50 ohm, SMA in & out

D/A

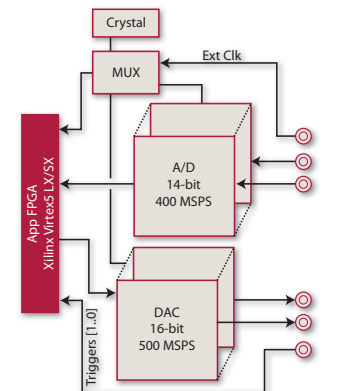
2 ch • 16-bit • 500 MSPS • 80 dB @ 400MHz

Digital IO

33-bits (J16)

IP Cores for SDR

16-4096 DDC channels • PSK, FSK demodulation
FFT 64K to 1M



X5 com

X5-COM PCI Express XMC Module

Front end signal processing ideal node for remote IO and distributed processing systems such Remote Radio Head (RRH) applications

Features

- Xilinx Virtex-5, SX95T/FX100T
- SX95T: 640 DSP48E elements
- FX100T: dual PowerPC processors
- 512 MB DDR2 DRAM
- 4 MB QDR-II SRAM
- 8 RocketIO private links, 2.5
- Power Management Features
- XMC Module (75x150 mm)
- PCI Express (VITA 42.3)

Front Panel IO

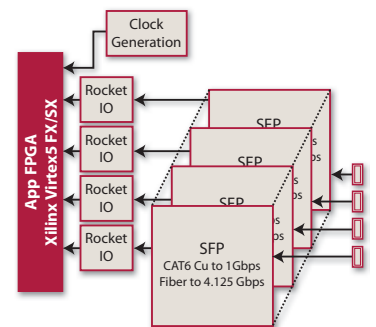
4 SFP ports • Fiber Optic or Copper Interface
Up to 3.125 Gbps

D/A

none

Digital IO

16-bits (J16)





X5 G12

X5-G12 PCI Express XMC Module

Ideal for Wireless Receiver, WLAN, WCDMA, WiMAX front end, RADAR, Medical Imaging, High Speed Data Recording, IP development

Features

- Xilinx Virtex-5, SX95T or LX155T
- 512MB DDR2 DRAM
- 4MB QDR-II SRAM
- 8 Rocket IO private links, 2.5 Gbps each
- >1 GB/s, 8-lane PCIe Host Interface
- Power Management features
- XMC Module (75x150 mm)
- PCI Express (VITA 42.3)
- Integrated FFT for up to 256K FFTs

A/D

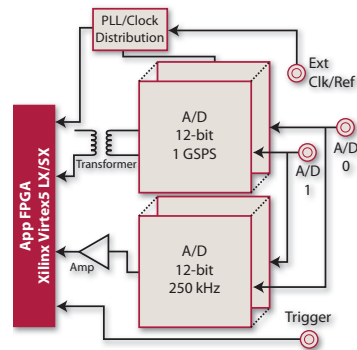
Two 1 GSPS, 12-bit A/D channels or
One 2 GSPS, 12-bit A/D single channel mode
+/-1V, 50 ohm, DC or AC coupled inputs

D/A

none

Digital IO

Front panel 64 single-ended or 32-bit LVDS
33 bits (J16)



X5 GSPS

X5-GSPS PCI Express XMC Module

Ideal for Wireless Receiver, WLAN, WCDMA, WiMAX front end, RADAR, Electronic Counter Measures (ECM), Electronic Warfare, High Speed Data Recording, Spectral Analysis, IP developments

Features

- Xilinx Virtex-5, SX95T FPGA
- 512 MB DDR2 DRAM
- 4MB QDR-II SRAM
- 8 Rocket IO private links, 2.5 Gbps/ea
- >1 GB/s, 8-lane PCIe Host Interface
- Power Management features
- XMC Module (75x150 mm)
- PCI Express (VITA 42.3)

A/D

2 channels • 8-bit • to 1500 MSPS
1 channel • 8-bit • to 3000 MSPS
(National ADC08D1520) +/-1V, 50 ohm, SMA

D/A

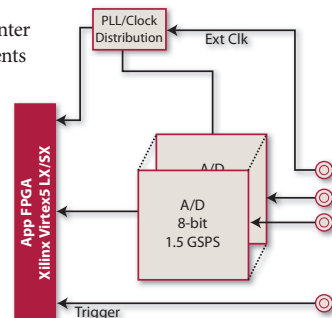
none

Digital IO

16-bits (J16)

IP Cores for SDR

16-4096 channels



X5 rx

X5-RX PCI Express XMC Module

Ideal for Wireless IF Receiver and Processor, Multi-channel RADAR

Features

- Xilinx Virtex-5 SX95T
- 640 DSP48E elements
- 512 MB DDR2 DRAM
- 4 MB QDR-II SRAM
- 8 RocketIO private links, 2.5 Gbps/ea
- >1 GB/s, 8-lane PCIe Host Interface
- Power Management features
- XMC Module (75x150 mm)
- PCI Express (VITA 42.3)

A/D

4 channels • 200MSPS • 16-bit
+/-1V input range

D/A

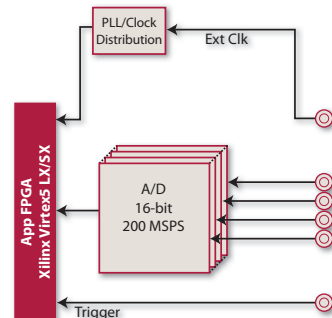
none

Digital IO

16-bits (J16)

IP Cores for SDR

16-4096 channels
FFT 64K-1M



X5 tx

X5-TX PCI Express XMC Module

Ideal for Wireless Transmitter, High Speed Arbitrary Waveform Generation, Exact channel alignment MIMO transmit applications

Features

- Xilinx Virtex-5 SX95T
- 640 DSP48E elements
- 512 MB DDR2 DRAM
- 4 MB QDR-II SRAM
- 8 RocketIO private links, 2.5 Gbps/ea
- >1 GB/s, 8-lane PCIe Host Interface
- Power Management features
- XMC Module (75x150 mm)
- PCI Express (VITA 42.3)

A/D

none

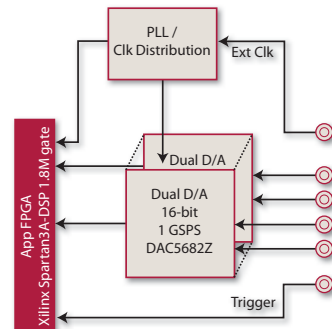
D/A

2 ch • 1 GSPS • 16-bit
4 ch • 500 MSPS • 16-bit
+/-1V output range

Digital IO: 16-bits (J16)

IP Cores

OFDM Tx



PCI Express XMC Modules



X3 2m

X3-2M PCI Express XMC Module

Ideal for Multichannel sensor interface, Neuro-physical instrumentation, High speed motion recording, Spectral Analysis, RADAR

Features

- Xilinx Spartan3A DSP, 1.8M gate FPGA
- 50 ohm, differential inputs
- Continuously acquire 12 simultaneous channels at 10 MSPS to module memory
- Stream to system mem at up to 220MB/s
- 4MB SRAM
- Sample clock is external or programmable, low jitter PLL
- Framed, software or external triggering

A/D

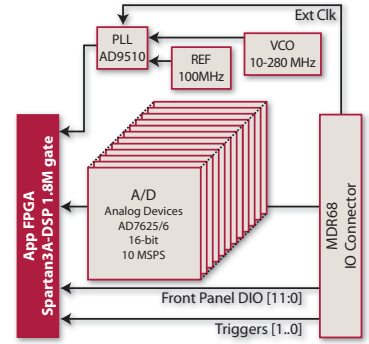
12 channels of 10 MSPS, 16-bit simultaneously sampling A/D
-110 dB noise floor, 91 dB SFDR
Low latency SAR converters

D/A

none

Digital IO

44-bits (J16)



X3 10m

X3-10M PCI Express XMC Module

Ideal for Multichannel sensor interface, Neuro-physical instrumentation, High speed motion recording, Spectral Analysis, RADAR

Features

- Spartan 3A, DSP 1.8Mgate FPGA
- 4MB SRAM
- Programmable PLL timebase
- Framed, software/external triggering
- Log acquisition timing and events
- Power Management features
- XMC Module (75x150 mm)
- PCI Express (VITA 42.3)

A/D

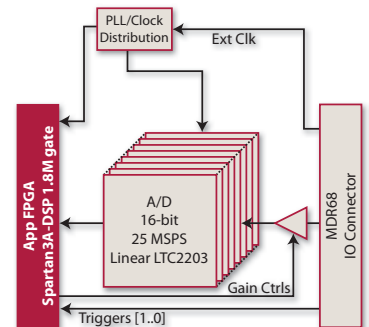
8 channels • 16-bit • 25 MSPS (simultaneous)
+/-2V, +/-1V, +/-0.4V, +/-0.2V input ranges
differential, high impedance inputs

D/A

none

Digital IO

44-bits (J16)



X3 25m

X3-25M PCI Express XMC Module

Ideal for Wireless Receiver/Transmitter, Stimulus-response, Electronic Counter Measures (ECM), High Speed Servo Controls, Arbitrary Waveform Generation, Spectral Analysis, RADAR

Features

- Spartan 3A, DSP 1.8Mgate FPGA
- 4MB SRAM
- External/Programmable PLL timebase
- Framed, software/external triggering
- Log acquisition timing and events
- 16-bit front panel DIO LVDS/TTL
- Power Management features
- XMC Module (75x150 mm)
- PCI Express (VITA 42.3)

A/D

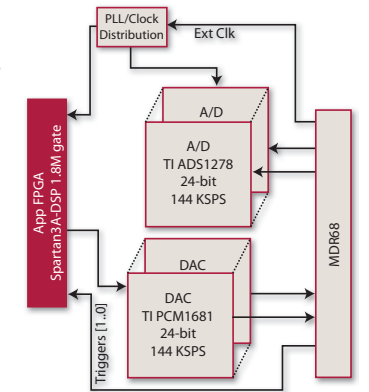
2 channels • 16-bit • 105 MSPS
+/-2V, +/-1V, +/-0.2V input ranges

D/A

2 channels • 16-bit • 50 MSPS
+/-2V output range

Digital IO

44-bits (J16)
16-bits front panel



X3 A4D4

X3-A4D4 PCI Express XMC Module

Ideal for Servo Controls, Stimulus-response measurements, Arbitrary Waveform Generation

Features

- Low Latency I/O for Servo Apps
- Spartan3A DSP, 1.8M gate FPGA
- 4MB SRAM
- External/programmable PLL clocking
- -115 dB noise floor
- Framed, software/external triggering
- Log acquisition timing and events
- 16 bits front panel IO
- Power Management features

A/D

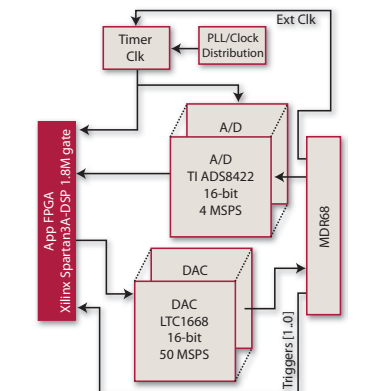
4 channels • 16-bit • 4 MSPS
+/-10V, +/-5V, +/-2.5V, +/-1.25V input
differential, high-impedance inputs

D/A

4 channels • 16-bit • 50 MSPS
+/-10V output range

Digital IO

44-bits (J16)
16-bits front panel





X3 dio

X3-DIO PCI Express XMC Module

Ideal for Pattern Generation, Custom Digital Interfaces for Remote IO, Digital Controls

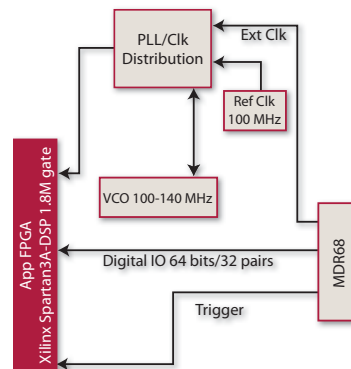
Features

- 100 MHz signal to FPGA using LVDS
- 50 MHz LVCMOS signal rates
- 400 MB/s LVDS capture/play to SRAM
- Optional on-card termination
- Spartan3A DSP, 1.8M gate FPGA
- External clocking and triggering
- External/Programmable PLL timebase
- Framed, software/external triggering
- Log acquisition timing and events

A/D
none

D/A
none

Digital IO
Front panel 64 single-ended or 32-bit LVDS
44 bits (J16)



X3 SD

X3-SD PCI Express XMC Module

Ideal for Vibration Measurement, Audio and Acoustic Testing, Data acquisition

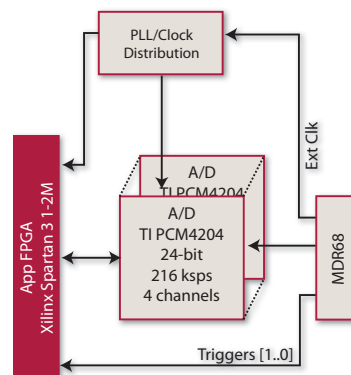
Features

- >110 dB SFDR • >105 dB S/N
- -135 dB noise floor
- Sample rates up to 216 ksps
- Programmable oversampling modes
- Xilinx Spartan3, 1M gate FPGA
- 4MB SRAM
- External/Programmable PLL timebase
- Framed, software/external triggering
- Log acquisition timing and events
- Power Management features

A/D
16 channels • 24-bit • 216 kHz
+/-10V differential inputs

D/A
none

Digital IO
44-bits (J16)



X3 SD16

X3-SD16 PCI Express XMC Module

Ideal for Wide Dynamic Range Acoustic and Vibration Measurements, Spectral Analysis, Audio Waveform Generation

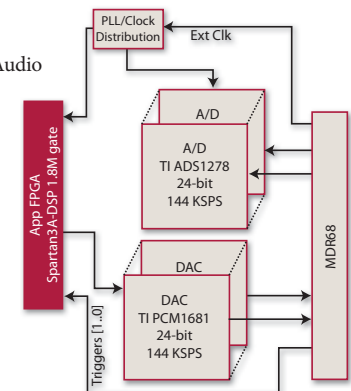
Features

- Spartan 3A, DSP 1.8Mgate FPGA
- 4MB SRAM
- External/Programmable PLL timebase
- Framed, software/external triggering
- Log acquisition timing and events
- 16-bit front panel DIO LVDS/TTL
- Power Management features
- XMC Module (75x150 mm)
- PCI Express (VITA 42.3)

A/D
16 channels • 16-bit • 144 KSPS
2/10/20V input ranges

D/A
16 channels • 24-bit • 144 KSPS
+/-2V output range

Digital IO
44-bits (J16)
16-bits front panel



X3 SDF

X3-SDF PCI Express XMC Module

Ideal for Vibration Measurement, Audio and Acoustic Testing, Data acquisition

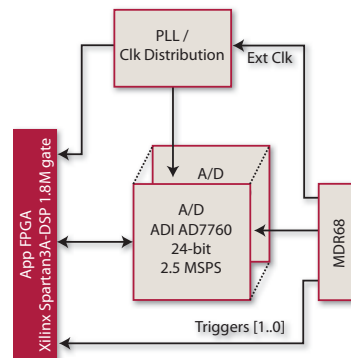
Features

- >110 dB SFDR @ 625 ksps
- >105 dB S/N @ 2.5 MSPS
- -130 dB noise floor
- Programmable output resolution and sample rates up to 20 MSPS
- Programmable filters
- Xilinx Spartan3, 1M gate FPGA
- 4MB SRAM
- External/Programmable PLL timebase
- Framed, software/external triggering
- Log acquisition timing and events

A/D
4 channels • 24-bit • Fast Sigma-Delta
(simultaneous up to 20 MSPS)
+/-5V differential inputs

D/A
none

Digital IO
44-bits (J16)



PCI Express XMC Modules



X3 servo

X3-Servo PCI Express XMC Module

Ideal for Servo Controls, Stimulus-response measurements, Data Acquisition

Features

- Low Latency I/O
- Spartan3A DSP, 1.8M gate FPGA
- 4MB SRAM
- Programmable PLL timebase
- Framed, software/external triggering
- Log acquisition timing and events
- Power Management features
- XMC Module (75x150 mm)
- PCI Express (VITA 42.3)

A/D

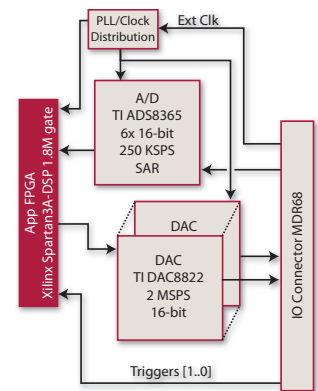
12 channels • 16-bit • 250 KSPS
 +/-10V, +/-5V, +/-2V, +/-1V input ranges
 Differential, high-impedance inputs

D/A

12 channels • 16-bit • 2 MSPS
 +/-10V output range

Digital IO

44-bits (J16)
 12-bits front panel



X3 timing

X3-Timing PCI Express XMC Module

Ideal for Sample Clock Generation for High Speed Data Acq. & Multi-channel Applications, Synchronization for Distributed Systems, GPS-coordinated Systems, Timing Generation

Features

- Clock gen & distribution w/sync triggers
- -115dB phase noise @ 10kHz (fc = 491MHz)
- 0.3 ps jitter RMS
- Synchronize to GPS or local clocks
- 1M to 1 GHz Output Range
- Clock ref is GPS, ext. or on-card 10 MHz
- 10MHz, 280 PPB on-card reference
- Integrated GPS (clock ref & time stamp)
- PXI master clock source with PXI adapter for all sys clocks and triggers
- Supports large channel count systems with multiple card synchronization

Front Panel

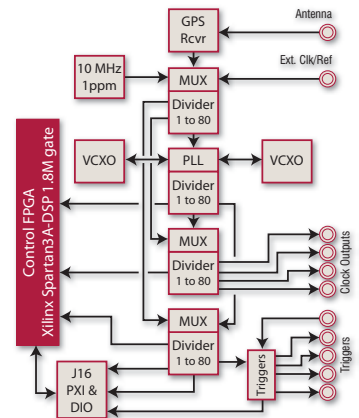
4 clocks, 4 triggers

J16

PXI DSTARA, B, C, 10 MHz reference, 8 triggers

Digital IO

29 bits (J16)





eInstruments

Intelligent Embedded Instrumentation

Windows & Linux Compatible

Rugged Enclosures

Datasheets and online pricing available @ innovative-dsp.com

eInstrument-PC

Miniature Window/Linux embedded PC for standalone or distributed instrumentation using ultimate-performance XMC IO modules. Runs all standard Windows/Linux software just like desktop PC. Intel Penryn i7 Dual core at 2.53 GHz or low power Celeron 1.06 GHz, Up to 4 GB memory, Boot from solid state or hard disk drive. Data logging option: record 800 MB/s sustained up to 2TB.

eInstrument-DAQ Node

A large variety of ultimate-performance XMC modules housed in a rugged enclosure featuring an ultra-fast Cabled-PCIe carrier. Position data acquisition near the unit-under-test without sacrificing high-speed connectivity to a Host PC. Software transparent, full electrical isolation for XMC module. PCI Express 2.5 Gbps (~ 200 MB/s)



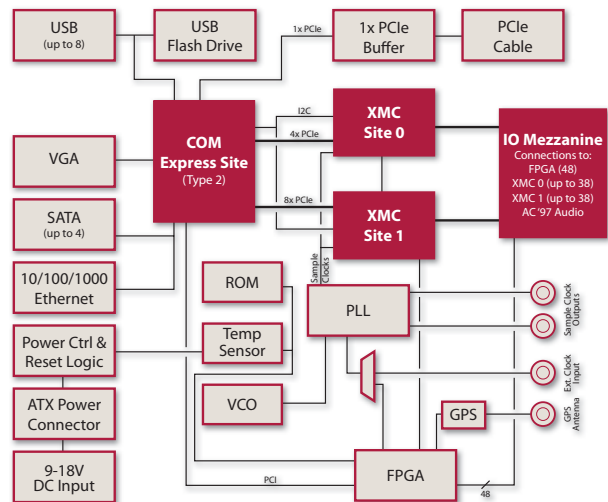
eInstrument-PC

eInstrument-PC

Embedded COM-Express PC, Dual XMC Module Sites, Rugged Enclosure

Features

- Autonomous signal acquisition, processing and logging
- Headless, embedded operation
- Processor Options
 - i7 quad core, 2.1 GHz, up to 16 GB memory
 - Low power Atom at 1.6 GHz, up to 4 GB memory
- Integrated sample clock and triggering for XMC sites
- Precision GPS option for timing reference
- Private Links between XMC modules supporting >1 GB/s transfers
- Customizable rear panel IO includes direct access to XMC modules



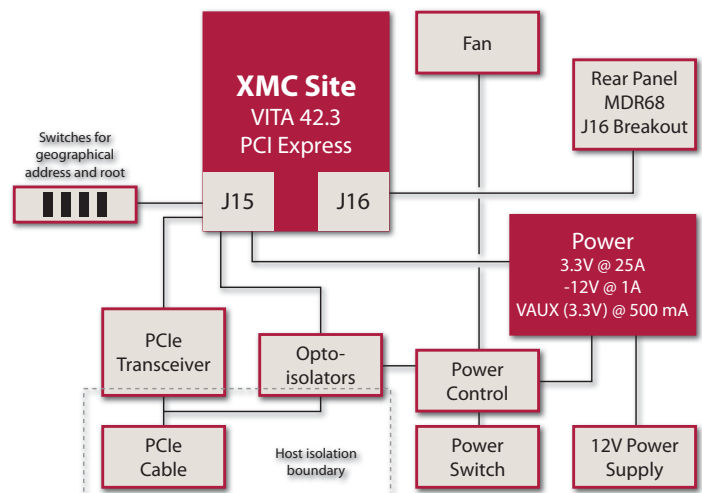
eInstruments

eInstrument-DAQ Node

Cabled PCI Express Carrier in a Rugged Enclosure

Features

- 1U x 1/4 rack width
- Continuous data streaming up to 200 MB/s cabled PCIe LAN
- Quiet environment electrically isolated from host computer
- Tethered operation via PCI Express-over-cable
- Autonomous operation when combined with X5 and X6 series XMC modules
- Use with CPEX hub to provide 1:4 expansion to create large channel-counts



Overview

The wireless marketplace is like our nascent universe. A veritable “big-bang” of new radio frequency (RF) technologies have emerged creating opportunities for solving old problems in innovative, new ways. Flexible high-resolution waveform generation, digitization and analysis subsystems capable of manipulating RF signals in conjunction with down-conversion and tuning multiple “regions of interest” are required. Subsequent, real-time, multi-channel demodulation of these regions using a wide variety of schemes is necessary. Often, such equipment must be portable and operate under harsh environmental conditions creating tremendous challenges in packaging, power consumption and management.

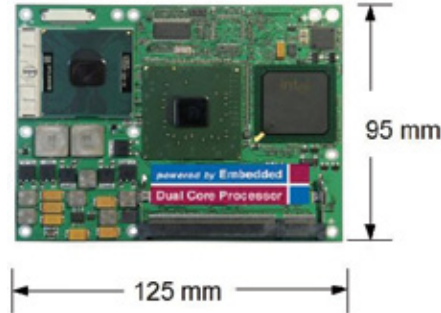
Existing solutions employ arrays of dedicated digital signal processors (DSPs) working in tandem with an RF digitizer to provide the computational bandwidth needed to implement down-conversion and demodulation functions. Though effective, this approach is complicated and expensive since multi-processor programming requires sophisticated process management and load balancing while avoiding race conditions and data bottlenecks. New solutions are emerging as highly-modular devices which leverage the industry-standard, commercial-off-the-shelf (COTS) COM-EXPRESS PC architecture and development tools in conjunction with PCI Express-based XMC mezzanine modules to create cost-effective, customizable RF processing block solutions.

Approach

The performance of mainstream DSP devices has effectively stagnated. The system clock on such devices is currently limited to 1 GHz or less, with bandwidth limited to approximately 800 MB/s throughput from the common 100 MHz, 64-bit external bus. By contrast, the x86 architecture continues to evolve, adding instruction set optimizations, enhanced caches, floating point co-processing and multiple cores-on-a-chip with no abatement in sight. Octal core processors featuring 3 GHz processing cores and 10 GB/s external bus bandwidth are ubiquitous. Moreover, the superb Intel Performance Primitives support native signal processing on a x86 processor an order of magnitude faster than existing DSP devices with the added convenience and accuracy of 80-bit floating-point capabilities. However, a desktop or industrial PC does not meet the portability, packaging or environmental requirements of many embedded applications.

Fortunately, due to the immense popularity of the PC as a development and processing tool, the market has already responded with several small-form-factor PC standards which are well

suiting to creation of embedded, portable instrumentation such as COM-EXPRESS. The COM-EXPRESS format has become a de-facto standard amongst users requiring utmost reliability, scalability, portability and computational performance.



COM-EXPRESS: A rugged PC embedded on a small circuit board

COM-EXPRESS modules are commodity items available from a number of reputable electronics vendors. Pricing ranges from approximately \$300 to \$1300/unit in unit quantities. Pricing is primarily a function of computational capabilities and the required temperature, shock and environmental capabilities required.

COM-EXPRESS modules are small mezzanine modules which are mounted onto a carrier board which is customized to meet specific application requirements.

Innovative Integration has eInstrument-PC to meet the stringent requirements of the embedded RF processing marketplace. Packaged into the company's new eInstrument product, a COM-EXPRESS module, I/O expansion modules and an array of integrated peripherals combine to create a small form-factor, rugged PC which can be embedded within OEM equipment to create intelligent, autonomous instrumentation, servo control or RF processing nodes.

Any mix of the standard peripherals typically found on a PC can be made available in an eInstrument-based system, including Ethernet communications, disk drives, USB and SATA ports. Keyboard and video ports can be provided to aid in field diagnostics. For instance, it is entirely feasible that an eInstrument assembly located in a remote site in a foreign country could be accessed via the Internet using Remote Desktop or VNC by tech support staff at the corporate offices to provide interactive support or software upgrades.

While the cost and computation advantages of a COM-EXPRESS PC compared to traditional chip-level DSP solutions are enormous, a criti-

cal side-benefit of the COM-EXPRESS architecture is the ability to leverage the existing body of excellent development and debugging tools available for the PC. Whereas Texas Instruments or Analog Devices are sole sources for compiler and debugger tools for their DSP devices, the PC marketplace sports thousands of well-established providers offering sophisticated, useful, mature tools featuring superior performance and reduced cost. Moreover, conventional desktop PCs may be used to host such tools further accelerating and simplifying the development of COM-EXPRESS-based products.

Though powerful computationally, a COM-EXPRESS PC does not provide direct support for acquisition or analysis of RF analog signals. Moreover, the multi-core x86 CPUs available now and in the foreseeable future do not offer sufficient bandwidth to process RF signals in real-time. Consequently, some form of I/O and processing expansion is required.

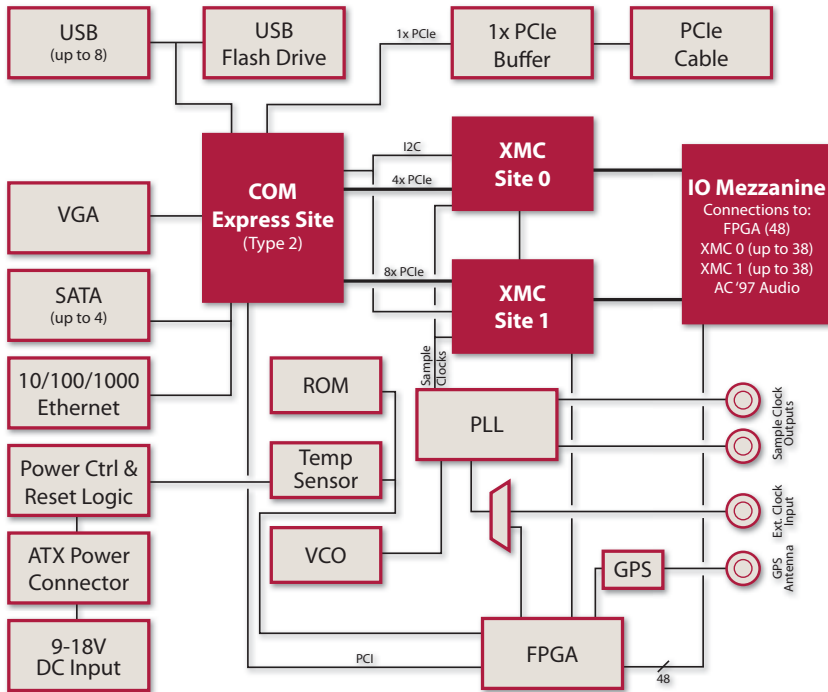
Just as COM-EXPRESS provides a PC repackaged into a mezzanine card format, I/O cards are available in a small, rugged form-factor ideal for use in embedded instrumentation. This format is known as PMC (PCI Mezzanine Card). PMC modules support PCI or PCIe (PCI Express) bus communications, identical to that used in standard desktop PCs, but packaged in a small, rugged format.



Innovative X6-250M PCI Express PMC module with RF digitizing front-end

PCI Express, the successor to the ubiquitous PCI bus, is the ratified standard replacement for I/O expansion in the PC industry. PCIe features software compatibility with dramatically enhanced throughput up to sixty-four times faster than PCI. Additionally, the bus features guaranteed QoS (quality-of-service) and P2P (point-to-point) data flow capabilities, making it an excellent choice for real-time applications.

The eInstrument COM-EXPRESS PC performs initialization, supervisory control, user-interface as well as high-performance computational duties in RF processing applications. PCI Express-based PMC modules provide I/O and digital signal processing expansion, as illustrated in the block diagram on page 12.



Block Diagram of Innovative Integration's COM-EXPRESS-based eInstrument carrier card

User interface devices, such as the keyboard, mouse and display may be exposed as diagnostic ports or omitted entirely. Alternately, access to popular embedded user interface controls such as buttons, graphical OLED displays, etc which are commonplace in embedded instrumentation can be provided. Similarly, the USB and hard disk interfaces may be hidden, omitted in the initial design or presented as optional devices available only on designated systems.

eInstruments-based PCs run standard Windows or Linux variants such as XP, Windows 7 or OpenSuse to fully utilize drivers available for existing PMC modules. These PCs are provided with C++ libraries which exploit high performance signal processing features provided in the optimized Intel Performance Primitives library yielding world-class DSP functionality and performance running on an standard x86 platform.

Two PCI Express XMC module sites are provided for I/O expansion. One is typically used to host the a PMC module which implements the RF front-end analog input and output and FPGA-based digital signal processing capabilities. The second site is uncommitted and available for future expansion. A bevy of PCIe-compliant PMC modules compatible with these sites are available to provide additional capabilities such as fiberchannel ethernet communications, auxiliary voice or ultrasonic-band analog channels or additional FPGA resources.

Each eInstrument site features four or eight 2.5 Gbps PCI Express I/O lanes which is essential to support sustained high speed data transfers. Sustained module-host transfers at 1 GB/s are readily achievable, even under non-real-time operating systems such as Windows XP or Linux. Additionally, the two sites provide eight dedicated communications lanes to allow implementation of algorithms in which large volumes of data are shared between modules. Even accounting for lane inefficiencies, sustained inter-site data rates of 1.8 GB/s are realized.



The eInstrument embedded PC with modular DSP packaged into an 7" x 10" x 3" chassis.

The PCI Express bus provides excellent, high-bandwidth connectivity between the COM-EXPRESS CPU and the PMC module. Given the 1 GB/s sustained throughput, the interface has sufficient bandwidth for low-bandwidth down-converted baseband data plus plenty of additional bandwidth in reserve should it become desirable to capture or log raw IF data in future applications.

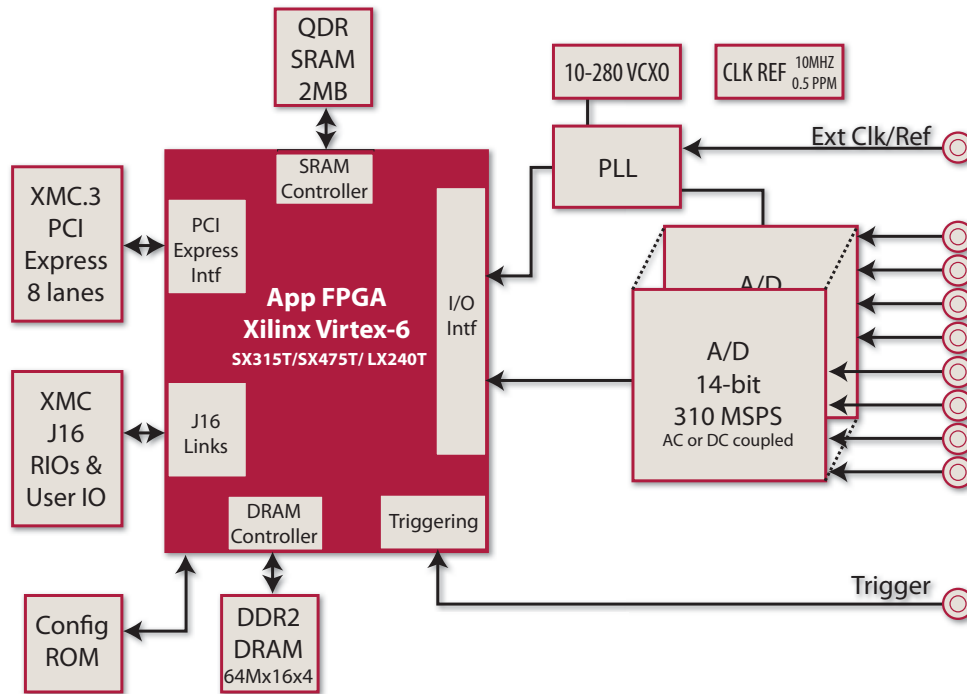
PCIe also supports fast random, asynchronous I/O accesses to peripheral registers on XMC modules, to accommodate operations such as filter coefficient uploads, DDC channel tuning, and the myriad other operations typically required in software radio applications. Typical, individual slave-type accesses will complete in under 1 uS using a modern COM-EXPRESS module.

Innovative's new X6 module product family combines the most powerful FPGA ever offered by Xilinx – the Virtex-6, with a variety of RF-speed, high-resolution analog I/O devices, packaged as industry-standard PMC/XMC modules. These products combine up to 4 channels of high-resolution analog input and/or output plus an FPGA-based signal processing core that is capable of performing the real-time signal digitizing, data buffering and signal processing required for RF processing applications.

These XMC modules support conduction-cooled operation in accordance with the VITA 20 mechanical specification. Additionally, the standard logic includes provisions for continuous temperature monitoring. Software may receive alerts messages whenever the temperature exceeds a programmed warning threshold temperature and the logic is configured to automatically shut down if the temperature exceeds a programmed failure threshold temperature. This combination of advanced thermal management insures excellent real-world, in-field reliability.

Custom firmware for the FPGA, may be built using standard IP cores and fully modeled under MATLAB, which facilitates high performance and accelerated time-to-market for embedded applications. Custom firmware for the Virtex-5 FPGA builds on the Framework Logic, provided by the vendor, to interact with the on-board analog devices, DDR and QDR memory pools and PCI Express bus interface. The firmware works with in conjunction with PC-based software tools and C++ libraries, providing a comprehensive software development system for integration of the PMC with the host application. Data sheets for the Framework Logic and Malibu software libraries may be viewed at <http://www.innovative-dsp.com/products/software.htm>.

In order to provide optimal AC performance, the high-speed RF analog input circuitry must be driven using a stable, low-jitter sample clock. The onboard clock circuit is a derivative of our X3-Timing module product which exhibits < 100 fempto-seconds RMS jitter for 6.25 to 1000 MHz clock range, long-term thermal stability and integrated clock drivers capable of simultaneously sourcing into 50 ohm loads on each of the XMC sites and external devices through the EXT CLK connector.



X6-250M Block Diagram

In some applications it is desirable to synchronize the module sample clock with world time as provided by a GPS circuit. To accommodate these requirements, the eInstrument carrier features an integrated GPS receiver and sample clock time-base circuitry. Control logic embedded into the carrier FPGA servo-locks to the epoch (1 pps) output events produced by the GPS receiver, insuring that eInstrument PCs located in disparate locations across the world start acquisition and sample synchronously to within 1 uS.

Embedded Signal Processing

X6 PMC modules are engineered to support RF signal processing applications with minimal external circuitry and with no modification of the X6 bus interface or PCIe back-end infrastructure. For instance, the diagram above shows the X6-250M functional block diagram.

Significant features of the X6-250M module are its high performance analog front end with 4 channels of 310 MSPS, 14-bit A/D, a high performance processing core built around the state-of-the-art Xilinx Virtex-5 Pro FPGA and memory, sample rate clocking and synchronization, and a high performance packet-protocol PCI Express interface for system integration.

As with all X6 modules, the personality of the 250M FPGA is user programmable using either HDL or MATLAB using Xilinx System Generator. Typically, the FPGA is modified to implement independent down-conversion channels, filters, FFTs and other operations which much be performed at IF frequencies within the FPGA

to form the basis for baseline RF tuning functionality. The eInstrument COM-EXPRESS PC performs initialization, supervisory control, user-interface as well as high-performance computational duties in such RF processing applications.

The MATLAB board support package for the X6-250M allows signal processing to be developed using MATLAB/SimuLink. SimuLink is used to model the signal processing for bit-true, cycle-true design, which may then be directly tested using hardware-in-the-loop features for hardware testing. This allows the signal processing to be developed at a high level, using proven Xilinx IP cores, and tested in the MATLAB environment.

This technique reduces risk and shortens development time by allowing efficient and thorough verification of the signal processing from within the powerful MATLAB/SimuLink environment. The signal processing logic core from MATLAB is then integrated into the Framework HDL for the final logic design.

The Framework Logic package provided with the module provides the hardware interface and support functions such as the A/D interface, memory controllers, host data interface and controls. All standard logic features such as A/D interface, triggering, multi-queue data buffering, DDC control and PCI controller interface are provided as components which must be augmented with custom logic blocks usable in either SimuLink or Xilinx ISE, to form the foundation for the user application firmware.

Ordinarily, the basis for the desired, application-specific signal processing functions can be provided by the module manufacturer or from engineering firms specializing in development of such IP, such as RF Engines, Inc. Such firmware may implement customizable digital down-converters, optimized, high-resolution FFT processing blocks capable of operating at a sustained rate in excess of 100 MHz or other capabilities dictated by the application. This is delivered within an extensive training session in which the developed technology is transferred to the client engineering staff. This is the most cost and time-effective development process. Armed with this infrastructure, engineering teams “hit the ground running” and have little trouble modifying the exiting code to meet application-specific requirements.

Summary

New, ultra-small form-factor PCs allow the creation of a new breed of embedded instrumentation using COTS hardware to lower system cost and improved availability. COM-EXPRESS processor modules provide scalability in host processing power for current and future products. Use of advanced PCI Express PMC modules allows integration of very high-performance FPGA-based computational engines which can be dynamically loaded with customized firmware to address changing RF processing requirements and markets.

O Brave New World, that has such instruments in it!

VPX Products

Rugged, high-bandwidth products in 3U OpenVPX form-factor



Datasheets and online pricing available @ innovative-dsp.com

VPX Products

VPX is an ANSI/VITA standard that provides support for switched fabrics over a new high speed connector. It has been designed specifically with high-reliability and defense applications in mind, with an enhanced module standard that enables applications and platforms with superior performance. VPX is available in 6U and 3U form factor and supports existing PMC and XMC mezzanines.



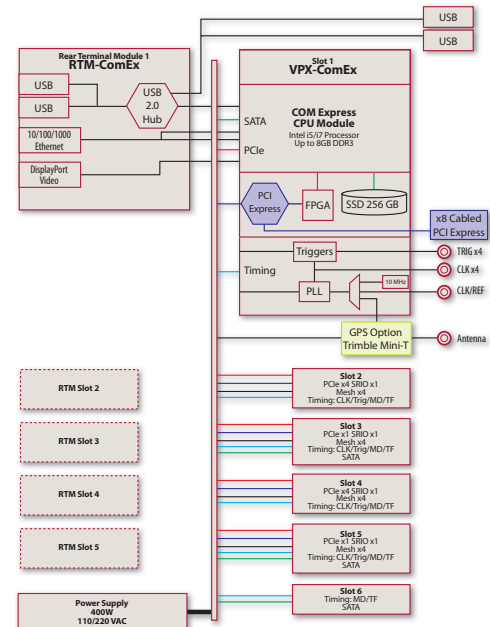
VPXI-ePC

VPXI-ePC

Remote, Autonomous IO, Mobile Instrumentation, Distributed Data Acquisition, Signal Processing Clusters

Features

- 3U OpenVPX embedded computer system
- Integrated timing and triggering
- Advanced multiple plane connectivity
- Rugged with wide-temperature options
- COM Express module with Intel i5/i7
- 8GB RAM max • Windows/Linux/VxWorks
- Gb Ethernet/4x USB/DisplayPort video
- 256GB SSD + up to 3 removable drives
- Half (1/2) rack, 4U system
- 5 slots: CPU • 4 OpenVPX • Storage/IO
- Supports II X3/5/6 modules & VPX-COP
- Multiple Data Plane Support
 - PCI Express and SRIO planes
 - Mesh interconnects all IO cards
 - Front panel x4 optical link for SRIO IO
- Integrated timing and triggering features
- Synchronized, multi-card sampling
- Internal or external clock/references
- Low phase noise sample clocks (0.125-1GHz)
- 10MHz, 0.5 ppm stable clock reference
- Optional GPS-disciplined reference
- Rear Terminal Modules for I/O, CPU slots
- Forced air cooling with upper & lower fans
- Integrated 400W power supply
- Expands to additional VPXI chassis using Cable PCI Express option



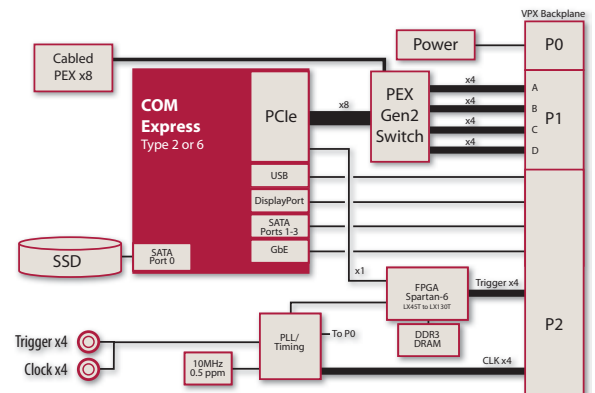
VPXComEx

VPX-ComEx

VPX System CPU, DSP for RADAR, Communications, Signal Intelligence Applications, Medical Imaging, High Speed Data Recording and Playback, Embedded Instrumentation and Control

Features

- 3U OpenVPX VITA65 CPU card
- Runs Windows, Linux, VxWorks
- COM Express Type 6 CPU module
 - Intel i7 - up to Intel i7 Quad-core CPU
- Up to 16GB 1066MHz DDR3 ECC memory
- PCIe Root supports x4/x4/x1/x1 endpoints
- GbE, USB 2.0, 3x SATA300, DisplayPort
- Integrated 1.8 in SATA SSD up to 256 GB
- PCI Express Switch
 - 16 ln to VPX P1 • Front panel x8 PCIe cable
 - Supports system expansion or redundancy
- < 50W typical; conduction or forced-air
- Precision timing/triggering support
 - PLL 125KHz to 1GHz tuning range with -110 dB phase noise @ 10kHz
 - 10MHz, 0.28 PPM clock reference
 - Reference input support for GPS
 - Synchronized triggering outputs
- Xilinx Spartan-6 LX75T-120T FPGA core
 - PCIe interface
 - 128MB memory
- Operating Environment:
 - -40 to 85 °C, 0 to 100% RH
 - 30g shock, 0.04 g2/Hz random vibrate



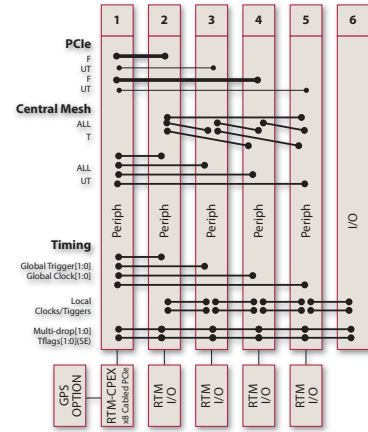


VPXI Expansion Chassis

Five Slot 3U OpenVPX Expansion Chassis with x8 Cable PCI Express Host Connection

Features

- Use w/Cabled PCIe & 3U OpenVPX modules
- 5 slots • 5 OpenVPX Peripheral • IO Slot
- Rear Terminal Modules for peripherals
- Half-rack, 4U enclosure
- Forced air cooling w/upper & lower fans
- Optional high precision GPS option
- Integrated 400W power supply
- Performance architecture supports multi data planes & timing/triggering
- Centralized control IO & data planes
- Ring topology mesh
- Timing/triggering features

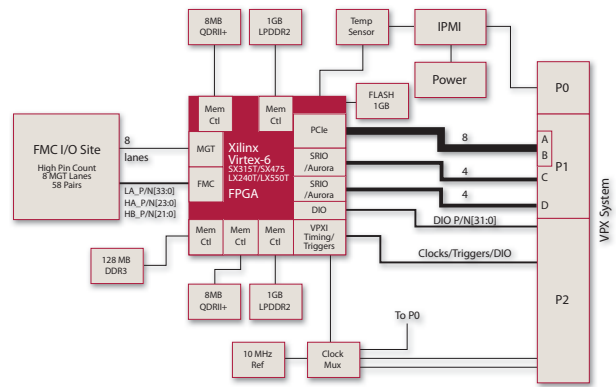


VPX6-COP

Wireless Receivers (LTE, WiMAX, SATCOM), RADAR, Signal Intelligence, Medical Imaging, High Speed Data Recording and Playback, IP Development

Features

- 3U OpenVPX FPGA coprocessor card
- FMC I/O site (VITA 57) with 8x 5 Gbps MGT lanes, 80 LVDS pairs (LA, HA, HB full support)
- FPGA Computing Core
- Xilinx Virtex-6 SX315T/475T LX240T/550T
- 2 Banks of 256 MB DRAM (512 MB total)
- 2 Banks of 9MB QDRII+ SRAM (18MB total)
- 128MB DDR3 DRAM
- Global and local timing and triggering
- Gen2 x8 PCI Express
- 4 GB/s burst • 2 GB/s sustained xfer rates
- 2 Serial RapidIO or Aurora ports- x4 Gen2 (2 GB/s)
- < 15W typical excluding FMC
- Ruggedization Levels up to L4
- Forced air or conduction cooling
- 40g shock • 9g sine • 0.1 g2/Hz random vibs

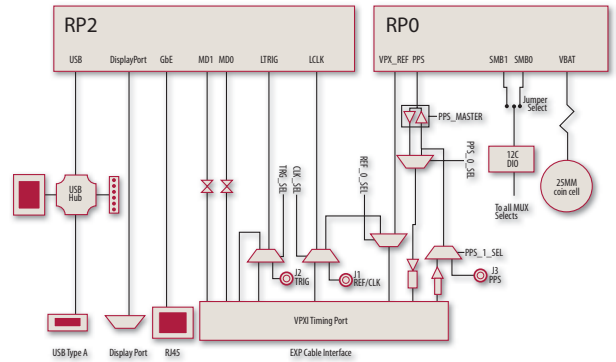


RTM-ComEx

Rear Terminal I/O Module for VPX-COMEX 3U OpenVPX CPU Card for VPXI-ePC signal processing applications, Embedded Instrumentation & Control, System timing expansion for VPXI-ePC

Features

- Rear panel I/O: USB 2.0 • 10/100/1000 Ethernet • DisplayPort • VPXI Timing Port
- Internal I/O (optional rear panel support): 3x USB 2.0 • Sample clock and trigger
- VPXI Timing Expansion Port:
 - Extends VPXI timing signals to second chassis or custom equipment
 - Synchronize multiple chassis sampling
- GPS: Serial port for comm • PPS & 10MHz inputs • Supports Trimble Mini-T GPS & others

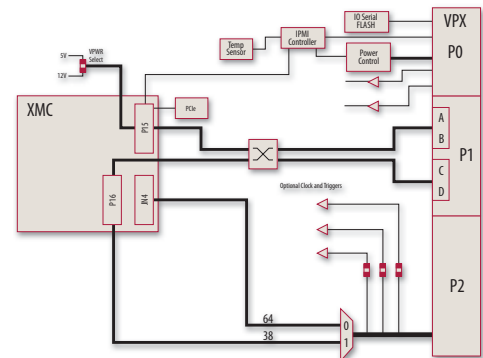


XMC Adapter for 3U OpenVPX

Rugged Conduction or Air Cooled XMC Adapter with IPMI Support

Features

- Adapt one XMC module to a 3U OpenVPX
- Config mapping for VPX to XMC com ports
- Configurable Dig IO w/VITA 46.9 maps
- System management using IPMI
- Dual SMB buses
- Power & temperature monitoring
- -40 to +85 °C operation
- 40g shock • 0.1 g2/Hz random vibration
- Heat-spreading frame w/direct path to host
- VITA20 conduction cooling
- Air Cooling • Flow-through air path



PCI Express Boards

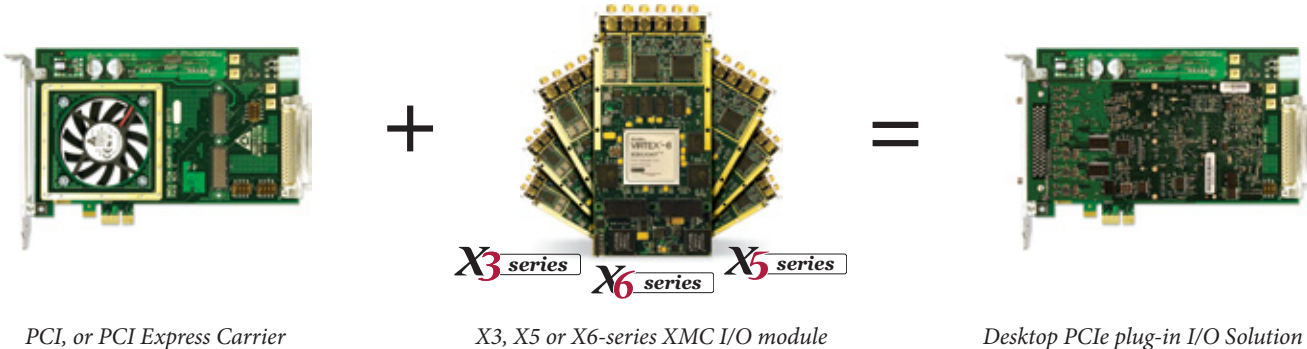
Intelligent, Customizable I/O
High Performance I/O and FPGA Core

Datasheets and online pricing available @ innovative-dsp.com

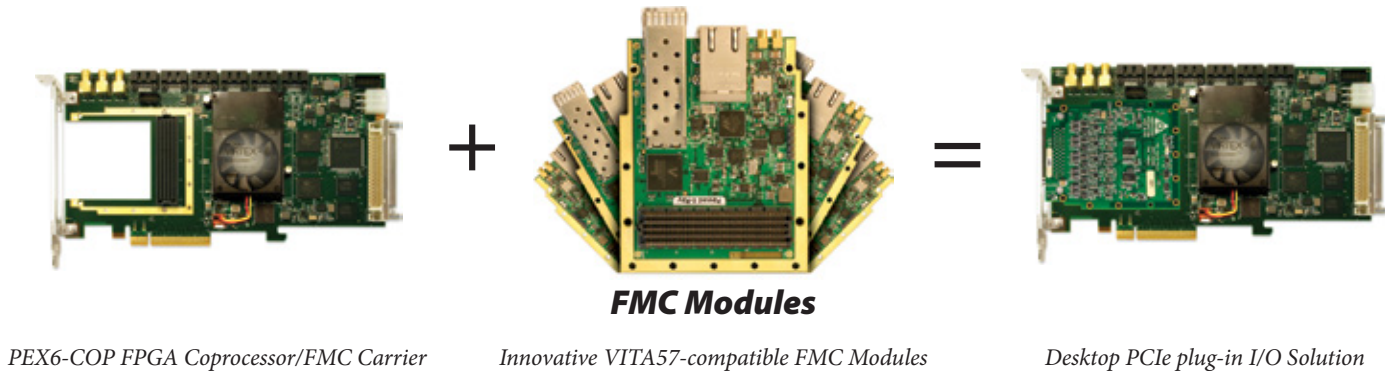
PCI Express Boards

Our X3, X5, and X6 XMC modules are also usable as PCI Express Desktop PC Plug-in boards.

Mounting an XMC module atop our XMC PCIe adapter creates an industry-standard desktop PCI Express plug in card which can deliver performance with lower system cost and less development effort than custom designs. Use in any PCI Express based desktop or industrial PC system. Eliminate custom hardware by harnessing the power of PCI Express and a customizable FPGA. Read more about our wide array of XMC modules on page 4.



Mounting an FMC module atop our PEX6-COP PCIe adapter creates an industry-standard desktop PCI Express plug in card which can deliver performance with lower system cost and less development effort than custom designs. Use in any PCI Express based desktop or industrial PC system. Eliminate custom hardware by harnessing the power of PCI Express and customizable I/O and FPGA. Read more about our wide array of FMC modules on page 24.





PMC Modules

Ultra-fast Reconfigurable I/O PMC/XMC Cards

Advanced Software Radio Modules

Datasheets and online pricing available @ innovative-dsp.com

Speed, Fidelity, Flexibility

The VelociaPMC family integrates ultra-fast signal capture, generation and co-processing on an advanced PMC architecture. Each card combines new generation analog devices with large user-reconfigurable Virtex-II Pro FPGA, ample DDR memory and low jitter clocks/triggers on a 64/66 PCI with a private JN4 64-bit user I/O port and a XMC 4-lane Rocket I/O (per VITA 42) that connects straight to the FPGA of our Velocia cPCI boards or other carriers. This ultimate connectivity allows for rapid deployment of the most advanced systems in SDR, signal intelligence, RADAR, and radio test equipment.

Module	FPGA	Memory	Analog I/O
PMCDR	Xilinx Virtex2 Pro VP40	64MB DRAM 8 MB SRAM	4 channel - 125 MSPS - 14-bit A/D with 16 DDC
PMCUWB	Xilinx Virtex2 Pro VP40	64MB DRAM 8 MB SRAM	2 channel - 250 MSPS - 12-bit A/D
PMCTX	Xilinx Virtex2 Pro VP40	64MB DRAM 8 MB SRAM	4 channel - 500 MSPS or 2 channel - 1 GSPS 16-bit DAC
PMCClockGen	N/A	N/A	PLL and clock generation - 4 channel output



PMC & XMC Carrier Cards

Innovative Integration's convenient PMC and XMC carrier cards allow a single PMC/XMC module to be used in any standard 32 or 64 bit PCI, CompactPCI or PCI-Express slot. Alternately, any of these modules may be remotely located near the unit under test and connected via a cable up to ten meters in length to a PC to create a 200 MB/s local-area data acquisition network. Ideal for production and test environments! See page 22 for more information.



MatLab/Framework VHDL logic system support

A majority of Innovative Integration's PMC/XMC modules are supported by MatLab and/or FrameWork VHDL. See page 29 for more details.

VelociaPMC Features

- High-end A/D & D/A
- VP40 or VP50 Virtex-II Pro
- 64-bit Jn4 to host, 64 pin, 800MB/s
- XMC serial, 8Gbps, J15 connector
- 32MB DRAM/2MB SRAM
- On-board PLL or External Clock
- PMC 64/66 PCI Interface >450MB/s Sustained Transfer Rates

Benefit

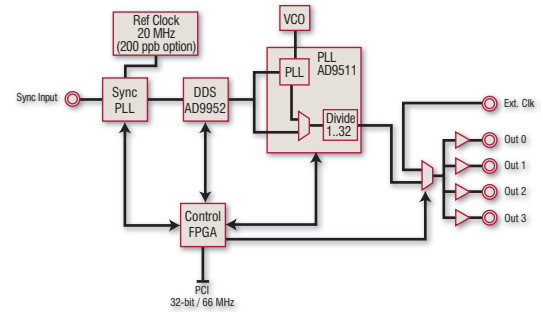
- Best-in-class speed and analog fidelity
- Ample resources for hardware-assisted DSP
- Ultra-fast data stream with low latency
- Ultra-fast serial link to host card
- Fast block-oriented processing and data buffering
- Low-jitter autonomous or ext. sync
- Fast Integration in PCI/cPCI and VME systems



CG - ClockGen PMC Module

Programmable Precision Clock Source Four Clock Outputs

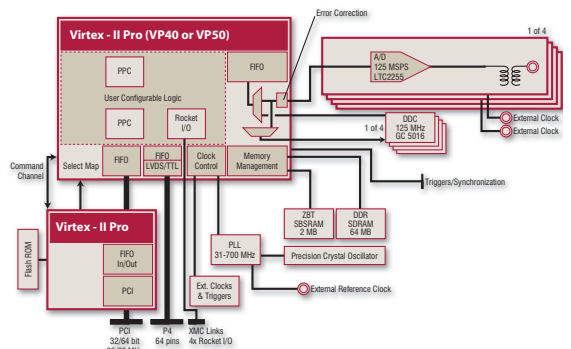
- Up to 450 MHz
- < 1ps RMS jitter
- Locks to reference signals from 5kHz to 300MHz
- 50 Ohm SMA Connectors
- PMC: 32 bit 66 MHz
- Frequency References: 20 MHz or external input
- Optional 0.5ppb, 20MHz reference clock



DR PMC Module

16 Channel Digital Receiver, Four A/D 125MHz

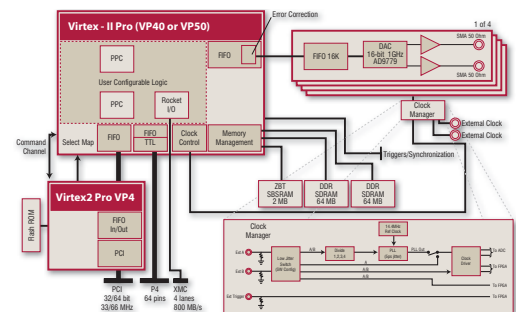
- (4) Input Channels, 125MSPS, 14-bit, using LTC2255 SFDR >80dB, ENOB >11
- (16) Digital Down Channels, from (4) GrayChip GC5016 Converters
- (2) External Clock Inputs
- 250MHz analog input bandwidth
- Any A/D may go to any/all DDC and Output is any A/D or DDC
- 10-200MHz PLL time base
- 64 MB Capture Buffer
- PMC: 64 bit 66 MHz / XMC: 4 lanes, 2.5 Gbps each



TX PMC Module

Digital Transmitter / Arbitrary Waveform Generator, (4) 1GHz DAC

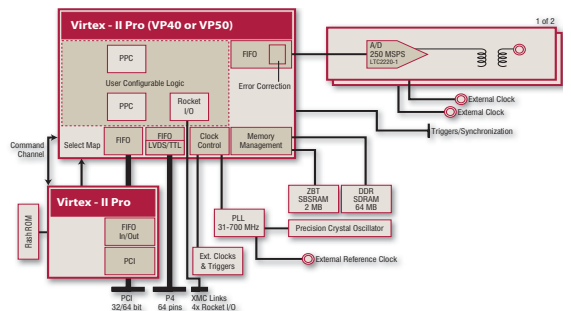
- (4) Output Channels, 1GHz, 16-bit, AD9779, >85dB SFDR
- 1, 2, 4, 8x interpolation output spectra Nyquist band shifting
- Reconstruction filters, 50 Ohm outputs
- 12.5 - 600MHz PLL time base
- Individual external clock input for each channel pair
- Dual 64MB pattern generator/buffer memory banks
- PMC: 64 bit 66 MHz / XMC: 4 lanes, 2.5 Gbps each



UWB PMC Module

Dual channel 250 MSPS with FPGA, 2 A/D 250 MSPS, 12-bit

- (2) Input Channels, 250MSPS, 12-bit, SFDR >75dB, ENOB >10
- 250MHz PLL time base
- Individual external clock input for each channel
- 500 MHz front end bandwidth for undersampling applications
- Application firmware for SDR implementing 20 channels of DDC available
- 64 MB Capture Buffer
- PMC: 64 bit 66 MHz / XMC: 4 lanes, 2.5 Gbps each





Carrier/Adapter Boards

Adapt PMC/XMC/FMC Modules to Desktop, Notebook, Compact PCI, PXI and OpenVPX Systems

Datasheets and online pricing available @ innovative-dsp.com

PMC & XMC Carrier Cards

Innovative Integration's convenient carrier cards allow a single PMC, XMC or FMC module to be used in any standard 32 or 64 bit PCI, CompactPCI, desktop PCI-Express or 3U Open VPX slot. Alternately, one module or more XMC modules may be remotely located near the unit under test and connected via a cable up to ten meters in length to a PC to create a 200 MB/s local-area data acquisition network. Ideal for production and test environments!

Adapters for PCI Express XMC modules (VITA42.3) provide special support for Innovative X3, X5 and X6 module families. Features such as shared clocks and triggers, communications links and access to J16 connector makes the modules easier to integrate into any system.

FMC Adapters

These adapters allow use of standard FMC modules within 3U OpenVPX systems and desktop PCs featuring standard PCI Express expansion slots.



PEX6-COP

PCI Express Desktop/Server Coprocessor with Virtex-6 FPGA computing core and FMC IO site



VPX6-COP OpenVPX

3U OpenVPX Coprocessor with Virtex-6 FPGA computing core and FMC IO site

PMC Adapters

These adapters allow use of standard PMC modules within a desktop PC featuring standard PCI or PCI Express expansion slots.



PMC to PCI Adapter

Fast, Simple PCI Adaptation for PMC and PTMC Modules



PMC to PCI Express Adapter

Fast, Simple PCI Express Adaptation for PMC and PTMC Modules

XMC Adapters

These adapters allow use of standard XMC modules within a desktop PC or expansion chassis, cPCI chassis or 3U VPX system.



XMC Adapter for 3U OpenVPX OpenVPX

Adapter allows a single width XMC module to be used in a 3U OpenVPX slot Rugged Conduction or Air Cooled XMC Adapter with IPMI Support



XMC to PCI Express Adapter (8-lane)

XMC x8 lane to PCI Express x8. Supports private high speed RIO links to other cards J16 breakout connector



XMC to CompactPCI Adapter

XMC x4 lane to CompactPCI-X, 64 bit, up to 133MHz Supports PXI



XMC to PCI Express Adapter

XMC x1 lane to PCI Express x1 J16 breakout connector Trigger and clock inputs



XMC to PCI Adapter

XMC x4 lane to PCI-X, 64-bit 133 MHz J16 breakout connector Trigger and Clock inputs

CPEX Adapters

These adapters allow use of standard XMC modules tethered to a desktop PCI featuring PCI Express expansion slots or to a laptop PC with an ExpressCard slot.



PCI Express X1 Cable Adapter

Transparent PCI Express Cable Adapter Express-Card for notebooks



CPEX4 Hub - 4-lane PCI Express Hub

Use with Innovative PCIe X1 Cable adapters



Instrument-DAQ Node

Turnkey embedded instrumentation! ultra-fast Cabled-PCIe XMC Adapter in a rugged enclosure.



CPEX8-PCI Express X8 Cable Adapter

Transparent PCI Express Cable Adapter



CPEX4-PCI Express X4 Cable Adapter

Transparent PCI Express Cable Adapter



PCI Express X1 Cable Adapter

Transparent PCI Express Cable Adapter



Andale Data Loggers

Turnkey, High-Speed Data Acquisition Up to 48 TB Hard Disk Array

Datasheets and online pricing available @ innovative-dsp.com

High Performance, Turnkey Data Logging

Andale (pronounced on' duh lay) is a powerful data logging system which directly controls an NTFS disk subsystem to support gap-free storage or playback of analog or digital signals acquired using the Innovative X-series XMC modules. The included logging software moves data in real-time between the analog or digital I/O peripherals on any Innovative XMC module to/from dedicated SATA drives with minimal intervention from application software or Windows.

Dedicated PCI Express SATA3 RAID controllers interface to conventional hard/SSD drives supporting data flow rates up to 3200 MB/s, sustained. File

sizes are limited only by the amount of disk storage available. Two terabytes of storage are available in the standard configuration; An optional 48 TB configuration is available and even larger storage is supported via external JBOD enclosures. Call Innovative for details.

A multitude of analog/digital I/O interfaces are available through optional XMC modules. Up to four X-series modules with adapters may be installed and operated simultaneously in the chassis.



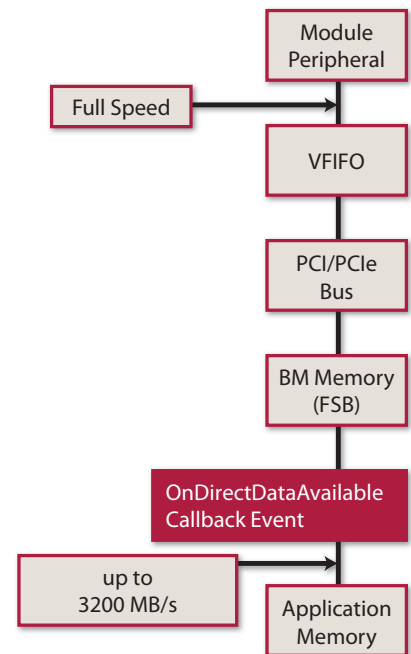
Andale

Andale

Turnkey, High-Speed Data Acquisition with up to 48 TB Hard Disk Array

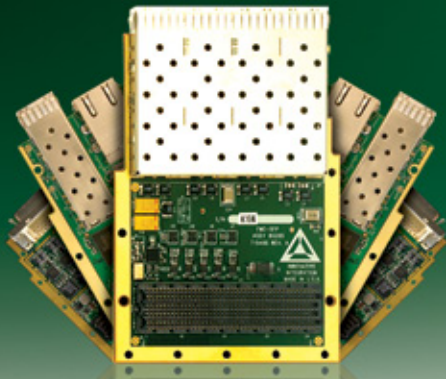
Features

- Turnkey, High-Speed Data Acquisition + Storage
- Runs Windows7/i7 CPU in ATX enclosure with integrated cooling
- Up to 48 TB Hard Disk Array
- Expandable storage via external JBOD
- 3200 MB/s sustained performance from analog or digital I/O module to standard NTFS disk files
- Supports all Innovative X3, X5 & X6 IO module features including triggering and timing features.
- Wideband (1500 MHz) logging/playback
- Autonomous or Network-controlled operation via named pipe



Applications

- High-Speed Recording/Playback
- Laboratory or Factory Instrumentation



FMC Products

Wide range of dense, high-performance I/O solutions in VITA57 form-factor

Datasheets and online pricing available @ innovative-dsp.com

FMC Products

The FMC standard was created to provide a standard mezzanine card form factor, connectors, and modular interface to an FPGA located on a base board (carrier card). Decoupling the I/O interfaces from the FPGA in this manner simplifies I/O interface module design while maximizing carrier card reuse.

The FMC standard requires only the core I/O transceiver circuitry that connects directly to the FPGA on the carrier card. The resulting efficiencies translate to substantial benefits.

Module	A/D	D/A	Other I/O
FMC-500M	2x 500 MSPS, 14b (2x 250 MSPS, 16b)	2x 500 MSPS, 16b (1x 1 GSPS, 16b)	PLL
FMC-1000M	2x 1GSPS, 12b	4x 500 MSPS, 16b	PLL
FMC-250M	4x 250 MSPS, 16b		PLL
FMC-ADC20	20x 125MSPS, 14b AC or DC coupled		PLL
FMC-DAC40		40x 2MSPS, 16b	PLL
FMC-SFP+			4x SFP+ ports

Module	A/D	D/A	Other I/O
FMC-QSFP			2x QSFP port
FMC-DIO			44x DIO (22x LVDS)
FMC-A4D4	4x 4MSPS, 16b	4x 50MSPS, 16b	PLL
FMC-SD16	16x 200KSPS, 24b	16x 144KSPS, 24b	PLL
FMC-RX8	8x 250MSPS, 14b		PLL
FMC-10GE			10GE, 1GE, IRIG, GPS interface

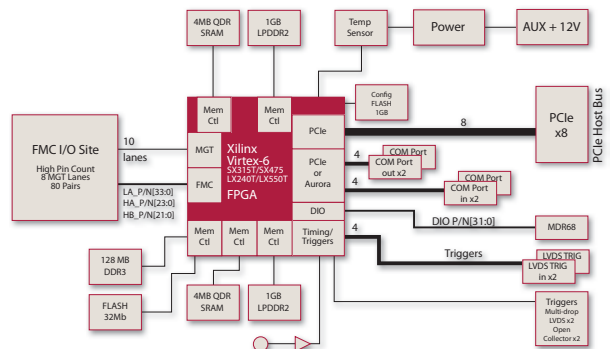


PEX6-COP

PCI Express Desktop/Server Coprocessor with Virtex6 FPGA computing core and FMC IO site for Wireless Receivers (LTE, WiMAX, SATCOM), RADAR, Signal Intelligence, Medical Imaging, High Speed Data Record/Play, IP Development

Features

- FMC I/O site (VITA 57) with x10 5 Gbps MGT lanes, 80 LVDS pairs (LA, HA, HB)
- Virtex-6 SX315T/475T, LX240T/550T
- 2 Banks 1GB DRAM (2GB total)
- 2 Banks 9MB QDRII+ SRAM (18MB total)
- 128MB DDR3 DRAM
- 32Mb FLASH
- Dual sample clock inputs
- High speed trigger inputs support multi-card sync & coordinated sampling
- Gen2 x8 PCI Express providing 4 GB/s burst and 2 GB/s sustained transfer rates
- x4 Secondary Port usable as PCIe or Aurora
- < 15W typical excluding FMC
- Configures from on-card FLASH
- High temp option: 0 to +85 °C

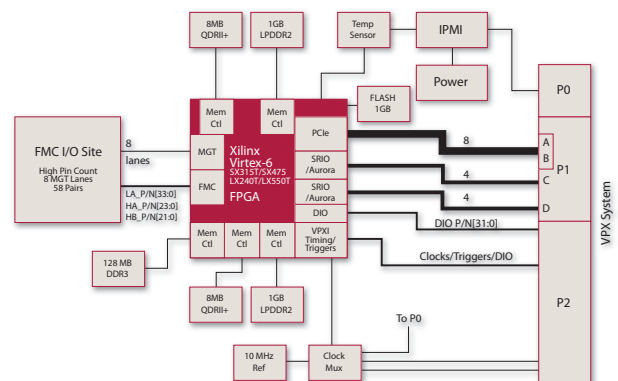


VPX6-COP

Wireless Receivers (LTE, WiMAX, SATCOM), RADAR, Signal Intelligence, Medical Imaging, High Speed Data Recording and Playback, IP Development

Features

- 3U OpenVPX FPGA coprocessor card
- FMC I/O site (VITA 57) with 8x 5 Gbps MGT lanes, 80 LVDS pairs (LA, HA, HB full support)
- FPGA Computing Core
- Xilinx Virtex-6 SX315T/475T LX240T/550T
- 2 Banks of 256 MB DRAM (512 MB total)
- 2 Banks of 9MB QDRII+ SRAM (18MB total)
- 128MB DDR3 DRAM
- Global and local timing and triggering
- Gen2 x8 PCI Express
- 4 GB/s burst • 2 GB/s sustained xfer rates
- 2 Serial RapidIO or Aurora ports
- x4 Gen2 (2 GB/s)
- < 15W typical excluding FMC
- Ruggedization Levels up to L4
- Forced air or conduction cooling
- 40g shock • 9g sine • 0.1 g/Hz random vibration



Innovative Software Toolsets

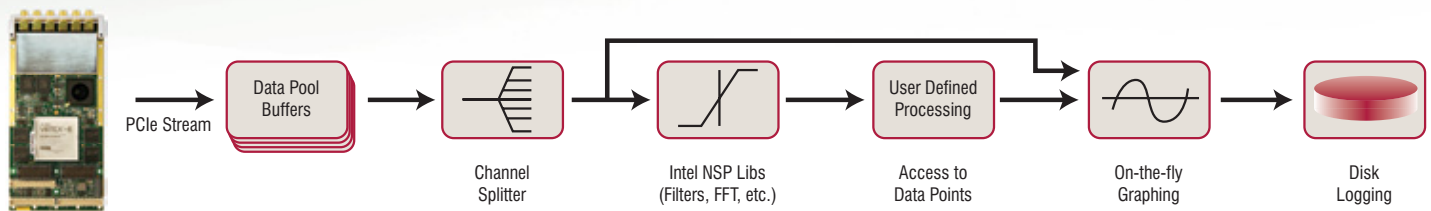
Design Fast - Get to Market Faster!



Datasheets and online pricing available @ innovative-dsp.com

Accelerate System Development with Practical Board-Level Software

With over 25% of our engineering staff working on software, Innovative Integration invests heavily in board-level software support. With every board, we ship a large, complete set of libraries, utilities, and program source code examples that greatly accelerate end-users development. Skip the arduous, low-level hardware and driver programming and jump straight into YOUR application!

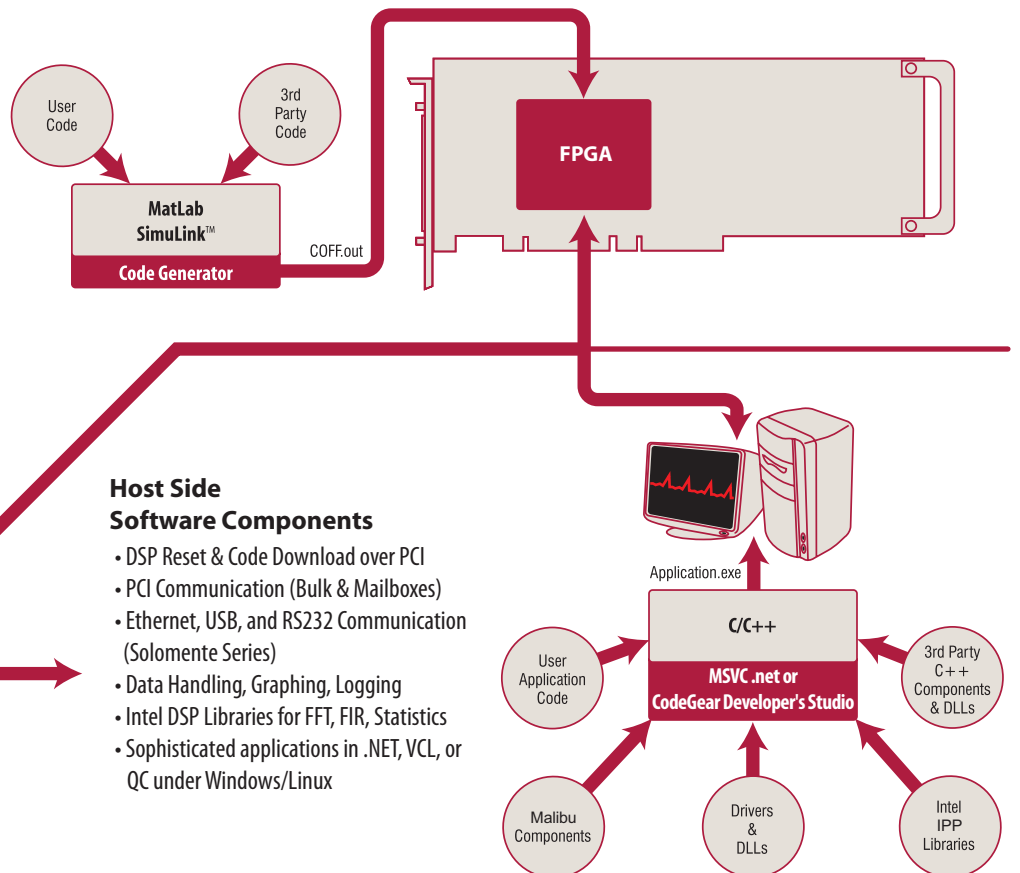


MALIBU – Host-Side Software Tools for Practical Board Config & Com

The host-side software tools, written in C++, allow simple control of and communication with the DSP hardware: boot method, message send/receive, data bi-directional stream control. In addition, a unique, user-friendly and powerful set of components accelerate deployment of data-intensive application: data buffer management, channelization, dynamic viewing/graphing, file logging. It includes Intel's fastest and greatest signal processing libraries, the Intel Performance Primitives.

Target Side Software Tools

- Extensive Libraries
- Example Source Code
- FPGA Peripheral Drivers
- Busmastering and Alerts
- Compatible with MatLab/Simulink



Host Side Software Components

- DSP Reset & Code Download over PCI
- PCI Communication (Bulk & Mailboxes)
- Ethernet, USB, and RS232 Communication (Solomente Series)
- Data Handling, Graphing, Logging
- Intel DSP Libraries for FFT, FIR, Statistics
- Sophisticated applications in .NET, VCL, or QC under Windows/Linux

Malibu Libraries

Ultimate Performance Signal Processing & Data Acquisition Libraries

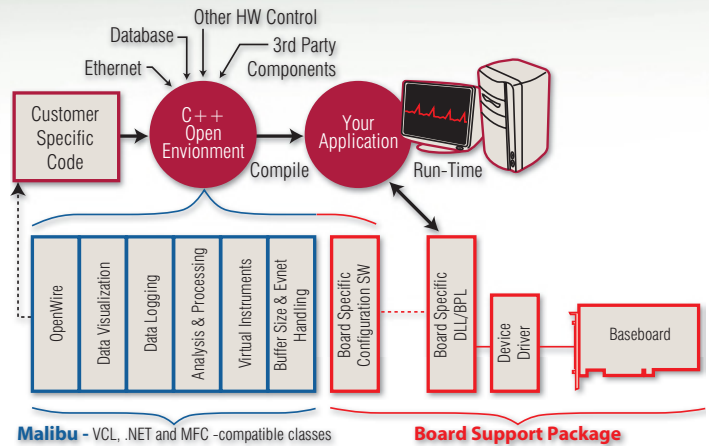
Rapid Application Development

Datasheets and online pricing available @ innovative-dsp.com

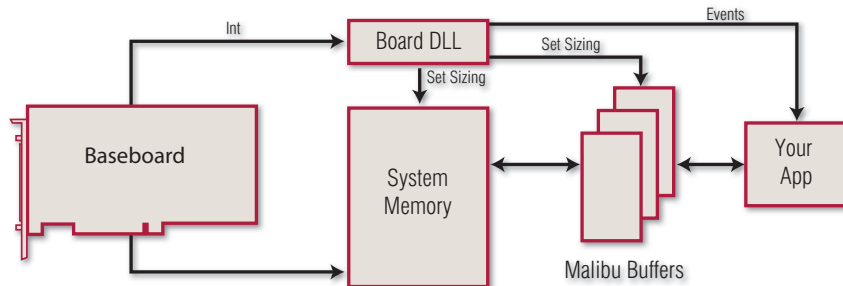


Malibu is a powerful, feature-rich software library designed to meet the challenge of developing software capable of high-speed data flow and real-time signal analysis on the PC. Malibu adds high-performance data acquisition and data processing capabilities to Microsoft Visual C++ .NET or Borland (CodeGear) Developers Studio applications with a complete set of functions that solve data movement, analysis, viewing, logging and fully take advantage of the object-oriented nature of C++. The full data sheet may be downloaded from www.innovative-dsp.com/products/malibu.htm

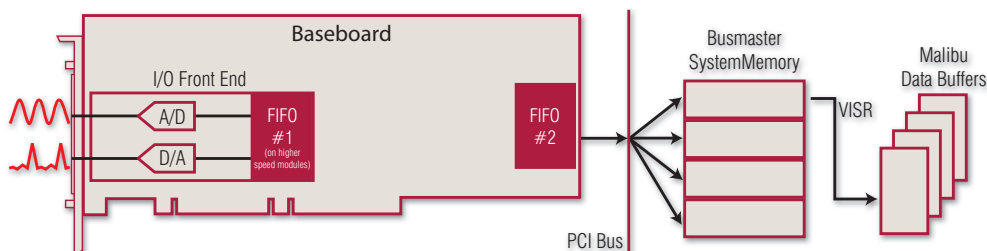
Malibu supports command and control plus data transfer using Innovative's new DSP and data acquisition platforms. It incorporates board support packages comprised of a low-level board device driver (Windows or Linux) and portable libraries which allow full hardware configuration and control from within a C++ application or DLL. The ability to call Malibu functions within a static or dynamic library makes it easy to create custom board interfaces to allow utilization of Innovative Integration DSP or data acquisition products from within third-party graphical environments such as LabView or MatLab.



Malibu automatically manages and dispatches all hardware real-time events and works with the hardware to smoothly flow data and messages between the target and the host application. The library is optimized for low-latency, high-speed data flow and computation at every stage throughout the application.



Hardware data flow uses an advanced data buffering system that allows the PC to achieve high rates while sustaining the overall demands of real-time applications. Where appropriate, multiple stages of data buffering are used to mitigate the rate of interrupt requests. Data flows through driver allocated contiguous physical memory to support sustained real-time demands for data movement, while minimizing data latency normally incurred with large data buffers. This approach is superior to the typical scatter/gather system because it eliminates the overhead associated with managing non-contiguous data buffer pools.



Malibu Libraries - Rapid Application Development

Malibu is a large collection of portable C++ code containing classes organized into the following general categories:

Buffer Classes

The buffer classes provide access to common vector signal processing functions and analysis functions needed in real-time data acquisition and control applications or for post-processing operations. Most of the classes utilize MMX and SIMD-optimized code using the Intel Performance Primitive libraries that offer the highest performance.

The Malibu buffer classes implement copy-on-write to maximize performance. Malibu's internal, proprietary buffer manager has been designed for optimal real-time performance with minimal runtime heap thrashing and superfluous copy operations.

Analysis Classes

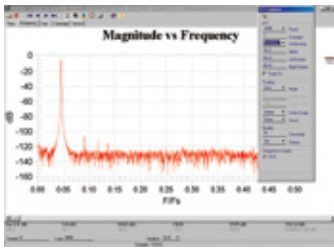
The analysis classes provide access to common DSP algorithms and analysis functions. Most of the components are MMX and SIMD optimized code from the Intel libraries that offer the highest performance.

Digital Signal Processing Classes

In addition to the standard DSP classes listed below, base classes are provided from which you can readily derive to create custom filters and signal generators.

Signal Generation Classes

High-speed generation of Gaussian, Sinusoidal, triangular, square and random signals.



Data Visualization Classes

Develop data graphs. Multiple channels may be simultaneously displayed on a single graph for applications like strip chart recorders and oscilloscopes. Full control of the graph type, scaling and point marking make it easy to develop sophisticated displays. Interactive features allow the user to measure

data during acquisition. Binview is a powerful data graphing and analysis tool that you can directly interface to your application as a post-processing analysis tool. That allows you to view all types of data sets of virtually unlimited size. You can quickly switch viewing between time domain and frequency domain options and see analysis statistics like standard deviation, signal to noise ratio, THD and SINAD. Scrolling and data search features allow you to quickly scan through large data sets.

Data Recording and Playback Classes

Malibu provides built-in support and extensive examples for data logging and playback applications. You can record data to and playback data from Windows file system disks at up to 400 Mb/s with the components supplied with Malibu. You can also record to network drives for system integration.

System Components

A useful set of system components saves development time. Classes and functions are provided for precision profiling and delays, automatically marshal event processing into the foreground thread. A stop watch allows for quick application profiling while other components give direct access to data in RAM, facilitate the numeric display of data arrays and simplify the use of registered Windows messages.

System Functions

File presence and size detection.

Resource Sharing Classes

Most real-time applications involve use of resources which must be cooperatively-shared amongst multiple threads. The classes below facilitate thread creation and thread-safe code and data sections.

Multithreading Support Classes

Abstract base class plus standard derivatives which signal a semaphore or fire an user-controllable event.

Baseboard Classes

These classes provide direct access to each of the Innovative board level products via the supplied device drivers. Methods are provided for COFF file downloading, logic loading, configuration, triggering, real-time bi-directional data flow and manipulation of board-specific features such as DDCs or other embedded signal processing capabilities.

Hardware Support Classes

These classes encapsulate the behavior of common hardware features available on Innovative hardware. For instance, boards featuring analog or digital I/O peripherals employ a precision, user-programmable conversion clock source. Clock objects are provided to allow full control of these timebases in within application programs.

Hardware Register Classes

Many Innovative board-level products employ user-reprogrammable FPGAs, whose behavior may be changed via custom VHDL code. A complete assortment of Register objects are provided to allow convenient bit and field manipulation within user-defined registers.

Information Classes

These classes act as information containers. For instance, boards featuring multiple analog channels allow enabling of individual channels. The ChannelInfo class provides detailed information about the resultant data format flowing from the device.

Communications Classes

In addition to high-rate, block-oriented data flow, messages objects are supplied which are more convenient when passing parametric information or commands between Host and Target.

Timebase Classes

Classes supporting programmatic control of the flexible sample clocks incorporated on Innovative board-level products.

String Classes

Classes for manipulation of lists and vectors of strings, binary and format conversion.

Bit Manipulation Functions

These optimized functions implement commonly-needed bit-manipulation algorithms, such as bit-reversal) in a highly-efficient manner.

Arithmetic Functions

These methods perform commonly-needed arithmetic algorithms in a highly-efficient manner, such as base-2 log, ceiling, floor, ones detection, etc.



Software Support

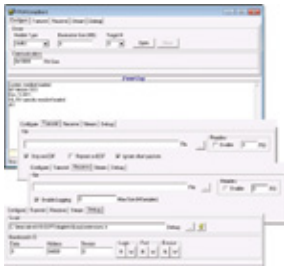
Design Fast - Get to Market Faster!

Utilities & Turnkey Applications

Datasheets and online pricing available @ innovative-dsp.com

Be Productive From Day One!

Every board support toolset includes utilities and turnkey applications that allow end-users to immediately focus all their resources on their application. Enormous resources are delivered free of charge and give our customers the means to get their systems to market faster.



Loop Applet

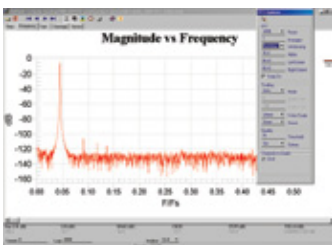
The supplied Loop example supports use of the FPGA as a real-time coprocessor. Test data sets may be streamed to the FPGA at full PCI Express bus rates. Custom firmware within the FPGA processes the incoming stream and sends the resultant data back to the host via PCIe. Transmit and receive test vectors are stored independently for pre/post processing or visualization. Indispensable for acceleration of complex DSP algorithms, such as those produced by Matlab/Simulinks



VSProm Applet

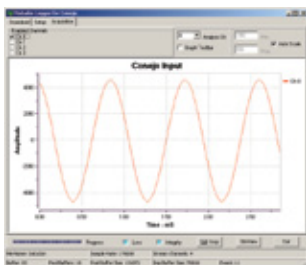
The supplied VsProm utility supports in-field Flash firmware reprogramming on the X5 and X6 -series XMC modules as well as the configuration memory on the PEX6-COP and VPX6-COP coprocessor/carriers.

The flash update operation can be controlled via the graphical user interface below or embedded within custom C++ application code using calls in the supplied Malibu libraries.



BinView – View and Analyze Your Captured Data

- Display and Analyze data graphically
- Zoom, scroll through large files
- Time and Frequency Domain
- Fully portable
- Export and import data with analysis packages



Snap/Wave – Sophisticated Data Acquisition and Playback, out-of-the-box

- Powerful, flexible data acquisition turnkey application
- Includes host and DSP program source code
- Fully exploits A/D & DAC channels, busmastering and mailbox messaging
- A solid foundation serving as reference design

Matlab & Xilinx System Generator

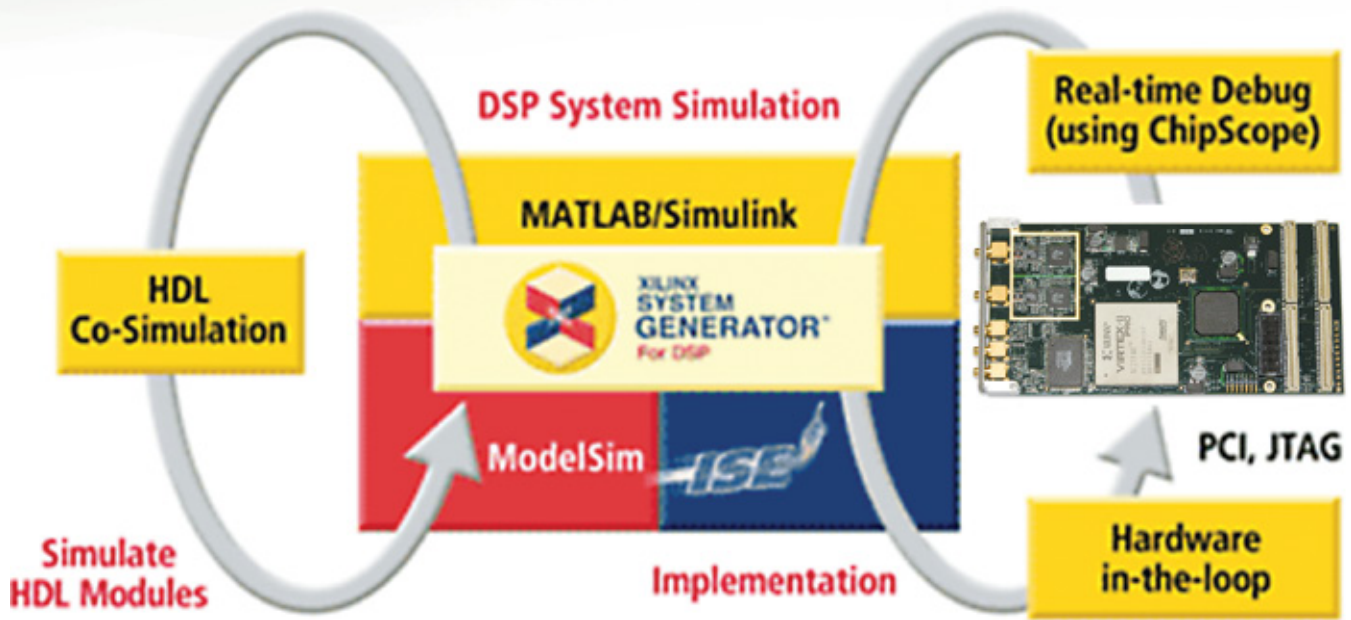
MatLab/FrameWork VHDL Support



Datasheets and online pricing available @ innovative-dsp.com

Develop DSP in MATLAB Simulink ...then go straight to hardware!

Using MATLAB Simulink with Xilinx System Generator, develop DSP systems in the MATLAB environment then run them directly on hardware, all with bit-true, cycle-true results that bring the real world data and hardware into MATLAB. With Innovative Integration's FrameWork Logic and MATLAB board support packages, you can quickly integrate signal processing into the hardware without lengthy, complex coding.



Libraries of signal processing algorithms and hardware functions, written specifically for implementation in logic, allow you to build high-speed signal processing applications and test them under MATLAB. Support for real-time data capture and signal generation gives you the power to use MATLAB to analyze real in-system performance at full rate.

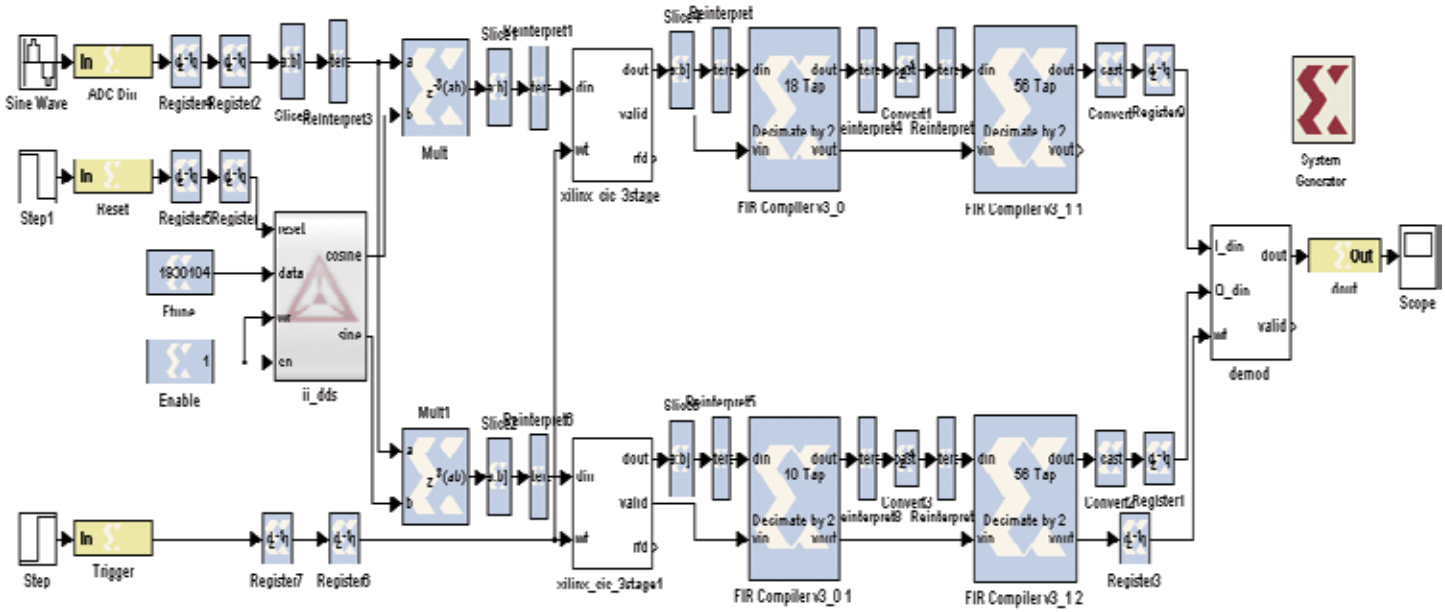
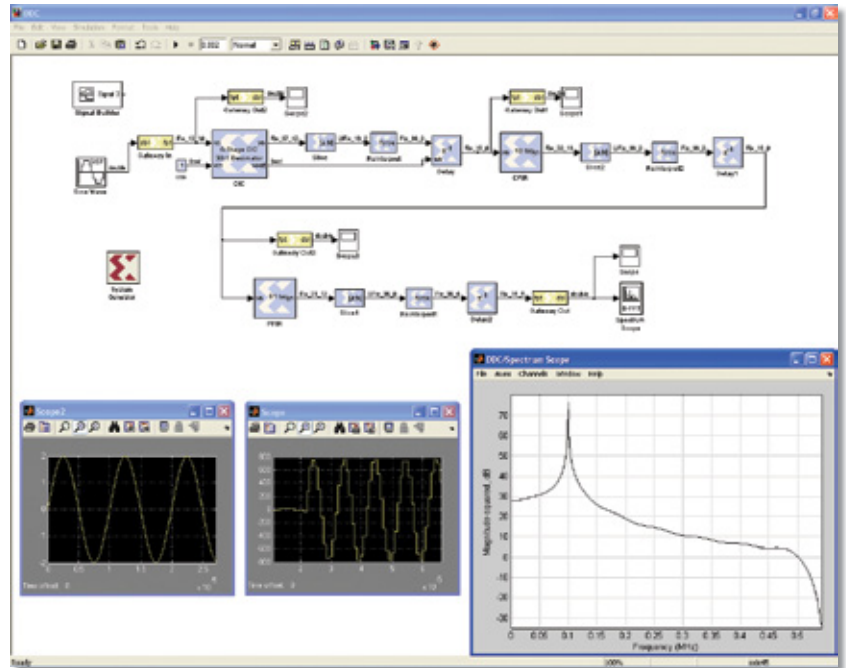
When used with Innovative Integration's FrameWork Logic, you can mix HDL with MATLAB for unique features, or vice versa. Completely flexible, extensible tools give you the power to create your application, with all its unique features without compromise.

Product	FPGA	FrameWork VHDL	MATLAB
X6 Series XMC Modules	Virtex-6 - LX/SX	●	●
PEX6-COP / VPX6-COP	Virtex-6 - LX/SX	●	●
X5 Series XMC Modules	Virtex-5 - LX/SX	●	●
X3 Series XMC Modules	Spartan 3A-DSP, Spartan 3 - 1 & 2M	●	●
UWB PMC Module	Virtex-2 Pro - VP40/50	●	●
TX PMC Module	Virtex-2 Pro - VP40/50	●	●
DR PMC Module	Virtex-2 Pro - VP40/50	●	●

Matlab & Xilinx System Generator

Innovative Board Support Package Features

- Integrates hardware directly into MATLAB Simulink
- Examples demonstrate hardware use under MATLAB
- Framework Logic system in VHDL with example logic
- Function libraries for hardware & signal processing
- IO interfaces – A/D, DAC and digital IO
- Triggers and timers
- Data buffers – very large FIFOs, pattern generation and capture
- System communications – host DSP, PCI, and external



SDR Receiver with 180 MSPS digitizing, DDCs and PSK demodulation implemented in MATLAB on X5-210M

FrameWork Logic

Logic Development for real-time signal processing and control in FPGAs

Datasheets and online pricing available @ innovative-dsp.com

The FrameWork Logic tools provide comprehensive support for customizing FPGA firmware to add signal processing, controls and data analysis to Innovative Integration hardware products. Whenever your application calls for the highest level of real-time performance, adding DSP or custom controls to the FPGA on the card is a great solution.

The FrameWork Logic BSPs support FPGA logic development in MATLAB and RTL for many of Innovative Integration products. FrameWork Logic helps you complete your project sooner by providing pre-written and verified IP cores and logic for hardware interfaces, data buffering and DSP.

Development Process

- Create the application logic IP in MATLAB or VHDL
- Test and Verify the IP using MATLAB hardware-in-the-loop and Innovative Integration support tools
- Build the IP into the FrameWork Logic and compile the project in Xilinx ISE

XIL_DSP Project Status				
Project File:	xl_dsp	Current State:	Programming File Generated:	
Module Name:	xl_dsp	Errors:	No Errors	
Target:	xc3t300 BgT6	Warnings:	223 Warnings	
Product Version:	ISE 9.1i2	Updated:	Mon Jun 25 15:41:04 2007	
XIL_DSP Partition Summary				
No partition information was found.				
Device Utilization Summary				
Logic Utilization	Bandwidth	Available	Utilization	Notes
Number of Slice Flip Flops	1,569	11,360	14%	
Number of 4 Input LUTs	3,710	11,360	33%	
Logic Distribution				
Number of occupied Slices	4,805	7,600	63%	
Number of Slices containing only multiplexers	4,395	4,805	93%	
Number of Slices containing unutilized logic	70	4,805	1%	
Total Number of 4 Input LUTs	4,632	11,360	41%	
Number used as look-up tables	3,710			

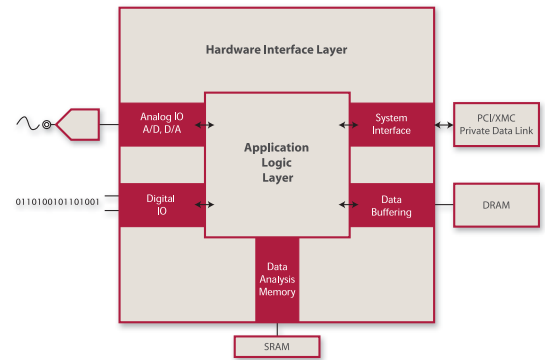
RTL Board Support Packages (BSP)

Shorten your development time by integrating your code into the FrameWork Logic

- Pre-written and tested hardware interface components
- Sensible data-flow design is easy to modify
- Velocia packet data host interface is flexible, extensible, and fast
- Command Channel host interface for status/controls is easy to adapt

Each BSP contains

- FrameWork Logic application example in VHDL
- Library of logic components
- Xilinx ISE projects and ModelSim Testbench
- Open-source code with documentation



Application logic is added to the FrameWork Logic inside a hardware interface layer

	IP Core	Supported Products	Function
Memory Control	ii_ddr_pg	X5, X6	Memory controller for pattern generation using DDR2 DRAM
	ii_sram_intf, ii_sram32_intf	X3	Flexible interface to 16 or 32 bit ZBT SRAM. Supports transfer rates to 250 MB/s
	ii_mq_sram, ii_mq_sram32	X3	Multiple-queue controller for ZBT SRAM
	ii_128mq	X5, X6	Multiple-queue controller for DDR2 DRAM supports up to 4 GB/s transfer rates.
	ii_ddr_fifo_mq	PMC	Multiple-queue controller for DDR DRAM supports up to 1.2 GB/s transfer rates.
VITA-49 Packets	ii_qdr_sram	X5, X6	Flexible interface to 16 or 32 bit QDRII SRAM. Supports transfer rates to 2.5 GB/s
	ii_vita_framer	X6	Creates VITA packets
	ii_vita_deframer	X6	Extracts payload from VITA packets
Bus Interface	ii_vita_router	X6	VITA packets routing
	ii_pcie_intf	X5, X6	PCIe interface for 8 lanes implementing Velocia packet system. 1 GB/s sustained rates
	ii_link	X3	64-bit data link to PCI Express interface controller supporting 250 MB/s.
Velocia Packet System	ii_cmd_channel	X3	Host system command and control data channel.
	ii_packetizer	X3, X5, X6	Creates data packets for PCI Express/PCI system interface and software.
IO	ii_deframer	X3, X5, X6	Parses and routes data packets for PCI Express/PCI system interface and software.
	A/D and DAC interfaces	X3, X5, X6	Design-specific A/D and DAC interfaces for data acquisition and control.
System Monitor	ii_trigger	X3, X5, X6	Data acq controls for software/external triggering (framed capture mode & decimation)
	ii_offgain	X3, X5, X6	Error compensation and correction for analog IO.
	ii_aurora	X5, X6	Communications link using Aurora with subchannels supports 300MB/s.
System Monitor	ii_aurora	X5, X6	Communications link using Aurora with subchannels supports 300MB/s.
	ii_temp_sensor	X3	Monitors system temperature and provides power controls.
	ii_monitor	X5, X6	Monitors system temperature, FPGA voltages and provides power controls.
Data Acquisition	ii_alert	X3, X5, X6	Monitors sys op & provides timestamped packets (overflow, overrange and triggering)
	ii_trigger	X3, X5, X6	Data acq controls for software/external triggering (framed capture mode & decimation)
Communications	ii_offgain	X3, X5, X6	Error compensation and correction for analog IO.
	ii_aurora	X5, X6	Communications link using Aurora with subchannels supports 300MB/s.

Supported Tools

Code Development

- Xilinx ISE using VHDL/Verilog
- Xilinx System Generator

Simulation

- Modelsim

Signal Processing

- MATLAB, Simulink

Debug

- Xilinx ChipScope



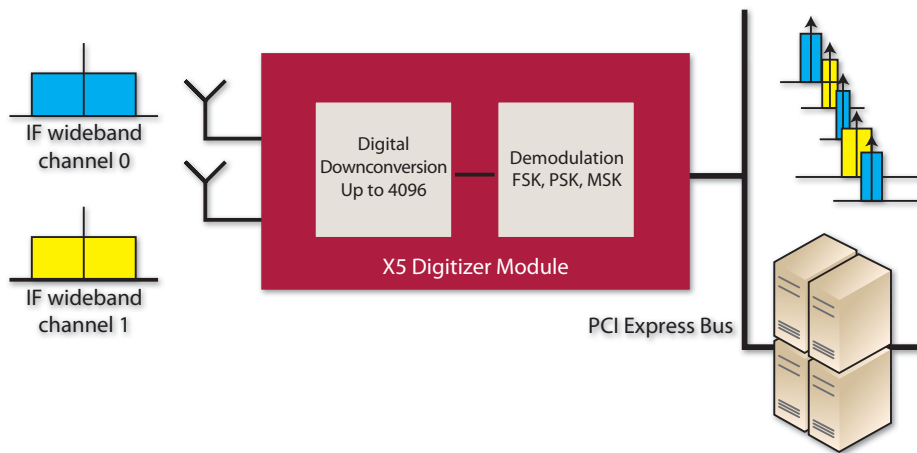
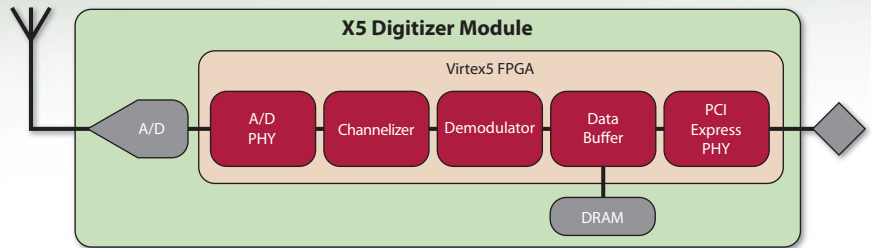
Wireless IP Cores

High performance FPGA cores for channelization, downconversion, and demodulation

Datasheets and online pricing available @ innovative-dsp.com

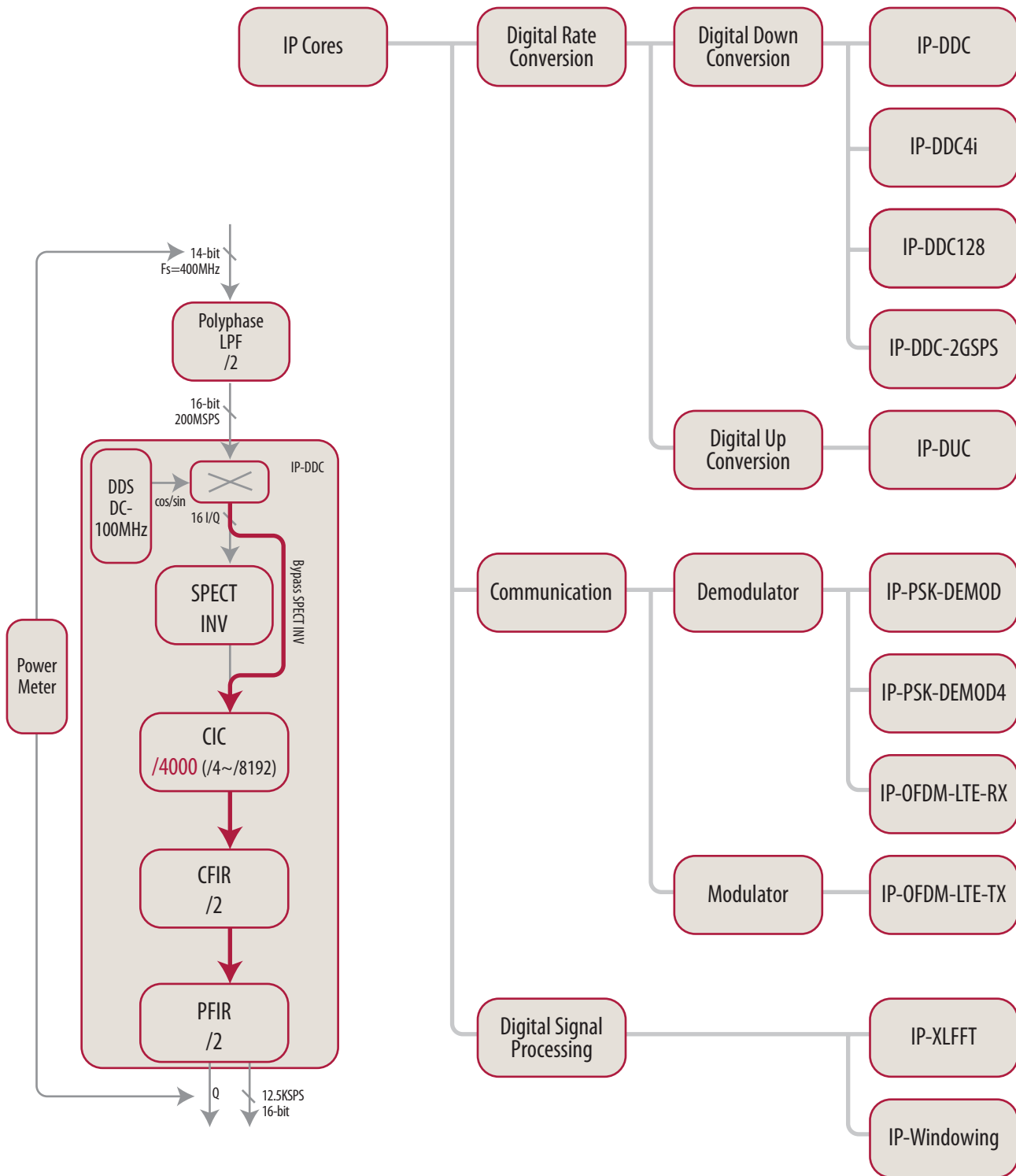
IP Cores for SDR Applications

Innovative has teamed with R-Interface to provide IP focused on Software Digital Radio IP cores. These cores provide essential front-end signal processing for digital down-conversion, channelizing, and demodulation that are the core of any modern SDR application. These cores are also available either integrated into X5 family modules, providing off-the-shelf solutions for wireless, RADAR and instrumentation applications.



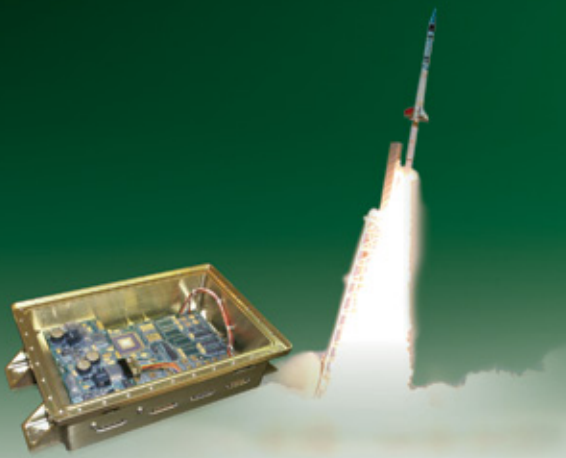
Embedding channelizers and demodulation into FPGAs increases channel density, improves flexibility, and reduces system cost.

Product	Description
IP-DDC4i	Four Independent Channel Digital Downconversion Core for FPGA
IP-DDC8i	Eight Independent Channel Digital Downconversion Core for FPGA
IP-DDC128	128 Channel Digital Downconversion Core for FPGA
IP-FSK DEMOD	Small Footprint Binary FSK Demodulator at rates up to 250MHz
IP-XLFFT	64K TO 1M point FFTs
IP-WINDOWING	Hann, Blackman, and Boxcar Data Windowing Functions
IP-DDC-2GSPS	2GSPS Digital Downconversion Core for FPGA with frequency agile bandpass filter
IP-OFDM-LTE-RX	LTE Downlink Receiver OFDM Component IP core
IP-PSK-DEMOD-1CH	BPSK, QPSK, 8-PSK Demodulator for FPGA
IP-PSK-DEMOD-4CH	BPSK, QPSK, 8-PSK Demodulator for FPGA
IP-DDC4-POLY	Four channel, high-speed DDC core for sample rates up to 2 GSPS
IP-MDUC128	128 channel DUC core for Virtex-5 or Virtex-6
IP-WAVEGEN-1GSPS	2 channel DDC core with 1000 MSPS output rate for Virtex-5 or Virtex-6
IP-PSK MOD	N=2,4,8, pi/4,; Net version
IP-FSK MOD	MSK,FSK,GMSK
IP-QAM MOD	N=16,64



Real World Applications

Innovative Integration Solutions at Work



Whitepapers and datasheets available @ innovative-dsp.com

Our Innovative Architectures at Work

Innovative Integration boards are integrated in a wide array of applications, at the leading edge of most engineering fields, in one-of-a-kind, esoteric systems as well as large volume OEM equipment. Whatever your challenge, we can assist you.

The applications listed below are actual systems developed by our customers using Innovative Integration DSP, data acquisition and embedded control solutions.

Wireless

- Multi-channel Satellite Receiver
- JTRS Test and Verification
- Wideband Surveillance
- Cellular Test

Industrial Control

- Magnetic Bearing Servo-Control
- Ultrasound Material Inspection
- Multi-Axes Motion Control
- Soil Analysis While Oil-Drilling
- Seismic Soil Test

OEM Instruments

- Atomic Force
- Current Tunneling Scanning Microscope
- Wafer Flatness Measurement Tool
- Wafer Surface Inspection Station
- Active Vibration Control Table for Lithography
- In-situ Optical Measurement for Plasma Etching
- Active Noise Cancellation

SONAR Hydrophone Transient Detection

- Rocket Engine Control

Military Hardware

- Flight Data Recorder
- Aircraft Hydraulic Actuator Testing
- Guidance Controls

Medical Imaging

- High-speed MRI and Ultrasound

Telecom/Intelligence

- Software Defined Radio using OFDM Technology
- Joint Tactical Radio System Development
- Military Radio Test Equipment
- Digital Receiver Direction Finder
- Acoustic Direction Finder

Bio-Medical

- Cardiac Assist Pump
- Genetic Slide Generation
- Bionic Ear Development
- Atom Interferometry

Research & Development

- Laser Communication Optics Control
- Laser Telescope Control
- Ultra-High Precision Motion
- Chemical Agent IR Detection
- Ring-Down Cavity Spectroscopy

Test & Measurement

- Jet Engine Vibration Analysis
- Wireless Chip Semiconductor Test
- Disk Drive Testing
- DSL Modem Testing
- Acoustic Wind Tunnel for Aircraft

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